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Mammal
Habitat Assessment

of

MOKOLO – CROCODILE RIVER WATER PIPELINE PHASE 1

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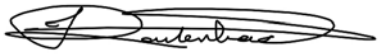
Abstract

From the perspective of mammals, no sensitive areas are defined on the ecologically undiversified site. It is argued that the ecology of the site is deteriorating. Whereas the displacement of the majority of common terrestrial small mammals will be of no consequence, the disappearance of sensitive species is inevitable considering the lack of directed conservation management and is on a global scale of little significance.

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

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of zoology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed Mokolo-Crocodile River Water pipeline route phase 1, described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to the Galago Environmental CC and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2006



I.L. Rautenbach

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1. INTRODUCTION

Galago Environmental CC was appointed to undertake a mammal habitat survey of the proposed route along which the Mokolo – Crocodile River water pipeline is to be constructed, from the Mokolo Dam to near Lephalale and then to Steenbokpan

The objective was to determine which species might still reside on the site. Special attention had to be given to the habitat requirements of all the Red Data species, which may occur in the area. This survey focuses on the current status of threatened mammal species occurring, or which are likely to occur on the proposed development site, and a description of the available and sensitive habitats on the site.

2. OBJECTIVES OF THE HABITAT STUDY

- To assess the current status of the habitat component and current general conservation status of the property;
- To provide lists of mammals which occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the development on the mammals of the study site; and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. SCOPE OF STUDY

This report:

- Is a mammal survey based on sightings and literature, with comments on preferred habitats;
- Comments on ecological sensitive areas;
- Evaluates the conservation importance and significance of the site with special emphasis on the current status of resident threatened species;
- Offers recommendations to reduce or minimise impacts, should the proposed development be approved.

4. STUDY AREA

The Phase 1 pipeline is scheduled for pumping water from the Mokolo Dam in the Mokolo River north of the Marakele National Park to Matimbi Power Station and Grootgeluk Coal Mine at Lephlele (Ellisras), and from there westwards to a future development site north-west of the Village of Steenbokpan. The entire 80km new line will be laid alongside an existing underground waterline serviced by an access road in a servitude.

The route is described in fine detail elsewhere by a land surveyor employed by the planner, complete with an abundance of GPS coordinates. This report will thus not attempt a route description.

Originally the entire Thabazimbi / Lephale (Ellisras) Vaalwater district was devoted to cattle grazing. As such the bio-environment remained relatively undisturbed. However, in recent times there has been a notable shift to game ranching / hunting / eco-tourism activities. This implies that range management have been improved, and that carrying capacity has been increased by maintaining populations of both grazer and browser game species. Aggressive economic conservation management benefited bio-diversity, a conclusion borne out by our observations.

The Phase 1 line traverses through the Waterberg Mountain Bushveld vegetation type (Mucina and Rutherford, 2006), with the northern portion between Lephalele and Steenbokpan falling in the Limpopo Sweet Bushveld vegetation type (Mucina and Rutherford, 2006). Topographically both vegetation types consist of undulating wooded plains, but crosses outliers of the Waterberg between Mokolo Dam and Lephalele.

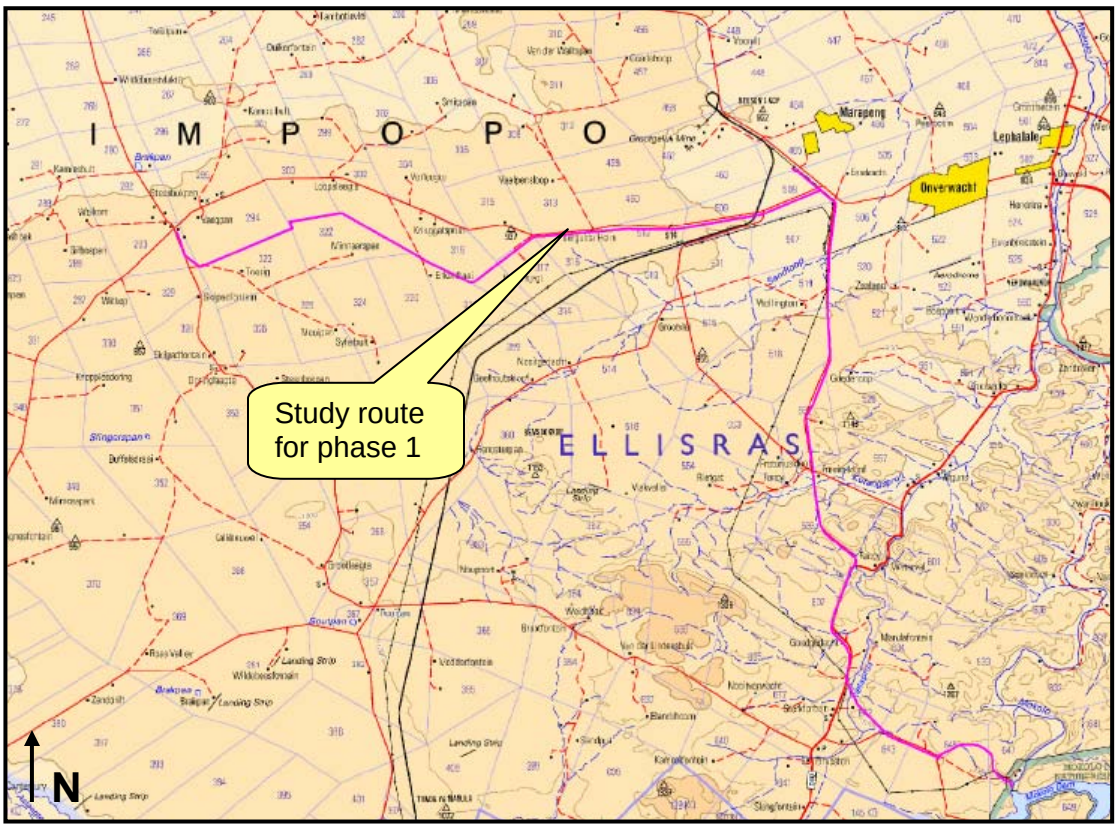

Figure 1: Locality map of the study area

5. METHOD

A five-day site visit was conducted between 23 and 27 March 2009. During the visit the observed and derived presence of fauna associated with the recognised habitat types of the study site, were recorded. This was done with due regard to the known distributions of Southern African fauna.

The adjoining properties were scanned for important fauna habitats.

5.1.1 Field Surveys

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

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

5.1.2 Desktop Surveys

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

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

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

5.1.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data 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*)
- Forest shrew (*Myosorex varius*)
- Short-eared trident bat (*Cloeotis percivali*)
- African clawless otter (*Aonyx capensis*)
- Spotted-necked otter (*Lutra maculicollis*)
- Marsh mongoose (*Atilax paludinosus*)

6. RESULTS

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. Sight records and information from residents or knowledgeable locals audit such deductions.

From a mammal habitat perspective, it should thus be reported that all four major habitats are present on the development route, i.e. terrestrial, arboreal, moisture-dependent and rupiculous. The latter is restricted to the servitude road passing through the Waterberg outlier between the Mokolo dam en Lephalele.

The likelihood of caves in the near vicinity of the lines is deemed minimal. However, cave-dwelling bats are quite likely to find suitable daytime roosts nearby in other structures such as culverts, aardvark burrows and old mines

Figure 2: Southerly view of the servitude for the existing pipe line, which is also the proposed route for the new pipe line. An outlier of the Waterberg complex is visible in the distance, whereas the Waterberg Mountain Bushveld vegetation type is visible in the foreground.

Observed and Expected Mammal Species Richness

A broader perspective was taken in deriving the mammal richness of the pipeline route considering the fact that it traverses a distance of approximately 80km. In many instances the pipeline route borders on game farms, and given the mobility of mammals the entire richness of that property was taken into consideration. In other words, even if a particular species occurs on only one adjoining game farm, it is listed as part of the mammal richness potentially affected by the development.

The mammal richness of the area is inordinately high. This can be ascribed to three reasons, namely the extensive area through which the pipeline will traverse, the ecological complexity of the area, and the aggressive conservation measures applied on game-fenced farms managed for financial gain. As a result of widespread game farming the present-day mammal richness is once again approaching that of historical times. Presently elephants, and as far as is known lion and leopard are still absent, and quite possibly hippopotamus and buffalo. On the other hand, high profit-yielding species such as roan, sable, oryx, eland and red hartebeest are flourishing. Inevitably, blesbok has been introduced outside its distributional range, obviously to extend the variety of a hunting basket on offer to clients. As an add-on to active game conservation it is submitted that naturally-occurring populations of medium and smaller mammals are concomitantly responding positively, viz. leopard, warthog, bush pigs and aardvark.

Mammals typical of the study area and narrowly adapted to especially terrestrial, arboreal and to a lesser extent to wetlands and rupiculous habitats, are all included in the list (Table 1).

Of the 76 mammal species expected to occur on the study site (Table 1), no less than 27 were confirmed during the site visit (Table 2). It should be noted that potential occurrences is interpreted as to be possible over a period of time as result of expansion and contractions of population densities and ranges which stimulate migration, and in this instance re-introductions.

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

Most of the species of the resident diversity (Table 1) are common and widespread, although several Rare and/or Endangered species are recorded (see below).

Mammal Habitat Assessment

The ecological repair of all four major mammal habitat types immediately adjacent to the pipeline route vary from good to pristine. It should be emphasized that the existing pipeline and the proposed 30 meter wide pipeline route is presently ecologically severely disturbed as a result of the past installation of the present pipe line, consisting mostly of the scarred terrain of the line as well as main roads or access roads.

Connectivity: It would appear that the final route will be fenced. In fact, this report suggests a game fence. This implies that smaller species will be able to migrate freely, but understandably that game species will not be able to wander off the properties of owners.

Threatened and Red Listed Mammal Species

Ten “Data Deficient” mammals are listed, which is no more than a precautionary measure to express conservation concern in the face of insufficient field data to express a quantitative opinion. All ten are small mammals who fail to attract attention from researchers.

Eight “Near Threatened”, four “Vulnerable”, two “Rare” and one “Endangered” species are listed (Table 1). Considering the fact that habitat destruction and undue human pressure are the main causes for species to become threatened, it can be argued that thanks to progressive conservation all Red Listed mammals enjoy an above average chance of maintaining healthy breeding populations in the region.

No other Red Data or sensitive species are deemed present along the pipeline route since it falls outside the distributional ranges of some species, or does not offer suitable habitat(s) (viz. golden moles).

Table 1: **The Mammal diversity that were observed or deduced to occupy the study site.**

	SCIENTIFIC NAME	ENGLISH NAME
DD*	*Elephantulus brachyrhynchus*	Short-snouted elephant shrew
DD*	*Elephnatulus intufi*	Bushveld elephant shrew
*	*Elephantulus myurus*	Eastern rock elephant shrew
√	*Orycteropus afer*	Aardvark
*	*Procavia capensis*	Rock dassie
?	*Heterohyrax brucei*	Yellow-spotted dassie
*	*Lepus capensis*	Cape hare
√*	*Lepus saxatilis*	Scrub hare
*	*Pronolagus randensis*	Jameson's red rock rabbit
√	*Cryptomys hottentotus*	African mole rat
√	*Hystrix africaeaustralis*	Cape porcupine
*	*Thryonomys swinderianus*	Greater cane rat
*	*Pedetes capensis*	Springhare
√	*Paraxerus cepapi*	Tree squirrel
DD*	*Graphiurus platyops*	Rock dormouse
*	*Graphiurus murinus*	Woodland dormouse
*	*Acomys spinosissimus*	Spiny mouse
DD*	*Lemniscomys rosalia*	Single-striped grass mouse
√	*Rhabdomys pumilio*	Four-striped grass mouse
√	*Mus indutus*	Desert pygmy mouse
√	*Mastomys natalensis*	Natal multimammate mouse
√	*Mastomys coucha*	Southern multimammate mouse
√	*Thallomys paedulcus*	Acacia rat
√	*Thallomys nigricauda*	Black-tailed tree rat
*	*Aethomys ineptus*	Tete veld rat
*	*Aethomys chrysophilus*	Red veld rat
√	*Aethomys namaquensis*	Namaqua rock mouse
*	*Otomys angoniensis*	Angoni vlei rat
*	*Desmodillus auricularis*	Cape short-tailed gerbil
DD√	*Gerbilliscus leucogaster*	Bushveld gerbil
*	*Gerbillurus paeba*	Hairy-footed gerbil
*	*Saccostomus campestris*	Pouched mouse
*	*Dendromus melanotis*	Grey pygmy climbing mouse
*	*Steatomys pratensis*	Fat mouse
*	*Galago moholi*	South African galago
√	*Papio hamadryas*	Chacma baboon
√	*Cercopithecus pygerythrus*	Vervet monkey
DD?	*Crocidura fuscomurina*	Tiny musk shrew
DD?	*Cricidura maquassiensis*	Maquassie musk shrew
DD*	*Crocidura cyanea*	Reddish-grey musk shrew
DD*	*Crocidura hirta*	Lesser red musk shrew
NT*	*Atelerix frontalis*	Southern African hedgehog
*	*Epomophorus wahlbergi*	Wahlberg's epauletted fruit bat
?	*Rousettus aegyptiacus*	Epytian rousette
*	*Taphozous mauritianus*	Mauritian tomb bat
?	*Sauromys petrophilus*	Flat-headed free-tailed bat
*	*Tadarida aegyptiaca*	Egyptian free-tailed bat
NT?	*Miniopterus schreibersii*	Schreibers' long-fingered bat
NT?	*Pipistrellus rusticus*	Rusty pipistrelle
√	*Neoromicia capensis*	Cape serotine bat

	SCIENTIFIC NAME	ENGLISH NAME
?	*Neoromicia zuluensis*	Aloe serotine bat
?	*Pipistrellus hesperidus*	African (Kuhl's) pipistrelle
√	*Scotophilus dinganii*	African yellow house bat
?	*Nycteris thebaica*	Egyptian slit-faced bat
?	*Rhinolophus hildebrandtii*	Hildebrantd's horsehoe bat
NT*	*Rhinolophus darlingi*	Darling's horseshoe bat
?	*Rhinolophus simulator*	Bushveld horseshoe bat
Vu*	*Manis temminckii*	Ground pangolin
R*	*Proteles cristatus*	Aardwolf
NT*	*Parahyaena brunnea*	Brown hyaena
NT√	*Crocuta crocuta*	Spotted hyaena
Vu?	*Acinonyx jubatus*	Cheetah
R*	*Panthera pardus*	Leopard
*	*Caracal caracal*	Caracal
NT?	*Leptailurus serval*	Serval
√	*Felis silvestris*	African wild cat
*	*Civettictis civetta*	African civet
*	*Genetta genetta*	Small-spotted genet
*	*Genetta tigrina*	SA large-spotted genet
*	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
*	*Atilax paludinosus*	Marsh mongoose
√	*Mungos mungo*	Banded mongoose
√	*Helogale parvula*	Dwarf mongoose
*	*Otocyon megalotis*	Bat-eared fox
√	*Canis mesomelas*	Black-backed jackal
*	*Aonyx capensis*	African clawless otter
NT*	*Mellivora capensis*	Honey badger
DD?	*Poecilogale albinucha*	African weasel
*	*Ictonyx striatus*	Striped polecat
?	*Ceratotherium simum*	White rhinoceros
√	*Equus quagga*	Plains zebra
*	*Potamochoerus larvatus*	Bushpig
√	*Phacochoerus africanus*	Common warthog
?	*Hippopotamus amphibious*	Hippopotamus
√	*Giraffa camelopardalis*	Giraffe
?	*Syncerus caffer*	African buffalo
√	*Tragelaphus strepsiceros*	Kudu
*	*Tragelaphus scriptus*	Bushbuck
√	*Tragelaphus oryx*	Eland
√	*Connochaetes taurinus*	Blue wildebeest
√	*Alcelaphus buselaphus*	Red hartebeest
√	*Damaliscus pygargus phillipsi*	Blesbok
E*	*Damaliscus lunatus*	Tsessebe
Vu*	*Hippotragus equinus*	Roan
Vu*	*Hippotragus niger*	Sable
√	*Oryx gazella*	Gemsbok
√	*Sylvicapra grimmia*	Common duiker
?	*Redunca arundinum*	Southern reedbuck
?	*Redunca fulvorufula*	Mountain reedbuck
√	*Kobus ellipsiprymnus*	Waterbuck
?	*Pelea capreolus*	Grey rhebuck

	SCIENTIFIC NAME	ENGLISH NAME
√	*Raphicerus campestris*	Steenbok
√	*Aepyceros melampus*	Impala
?	*Oreotragus oreotragus*	Klipspringer

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

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

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

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
O. afer	Aardvark	Burrows	Sandy substrate
L. saxatilis	Scrub hare	Fae cal pellets	Wide tolerance
C. hottentotus	African mole rat	Burrow system	Wide tolerance
H. africaeaustralis	Cape porcupine	Quills	Wide tolerance
P. cepapi	Tree squirrel	Sight record	Woodland
G. leucogaster	Bushveld gerbil	Sandveld	Burrow system
P.o hamadryas	Chacma baboon	Sight record	Wide tolerance
C. pygerythrus	Vervet monkey	Sight record	Woodland
C. crocuta	Spotted hyena	Tracks	Wide tolerance
G. sanguinea	Slender mongoose	Sight record	Wide tolerance
M. mungo	Banded mongoose	Sight record	Savannah
H. parvula	Dwarf mongoose	Sight record	Savannah
C. mesomelas	Black-backed jackal	Tracks	Wide tolerance
E. quagga	Plains zebra	Sight record	Grassy plains
P. africanus	Common warthog	Sight record	Wide tolerance
G. camelopardalis	Giraffe	Sight record	Savannah
T. strepsiceros	Kudu	Sight record	Wide tolerance
T. oryx	Eland	Sight record	Wide tolerance
C. taurinus	Blue wildebeest	Sight record	Savannah
A. buselaphus	Red hartebeest	Sight record	Savannah
D. pygargus phillipsi	Blesbok	Sight record	Grassveld
O. gazella	Gemsbok	Sight record	Open plains
S. grimmia	Common duiker	Sight record	Wide tolerance
K. ellipsiprymnus	Waterbuck	Sight record	Riparian woodland
R. campestris	Steenbok	Sight record	Wide tolerance
A. melampus	Impala	Sight record	Savannah

The inordinate number of confirmations is indicative of the intensity and success of conservation endeavours applied in the area. The presence of the spotted hyena is nevertheless a surprise. It is almost inevitable that blesbok was introduced outside its distributional range for commercial interests.

7. FINDINGS AND POTENTIAL IMPLICATIONS

The proposed pipeline route will traverse along an existing pipeline and is not anticipated to directly result in a significant loss of ecological sensitive and important habitat units, ecosystem function (e.g. reduction in water quality, soil pollution), loss of faunal habitat, nor of loss/displacement of threatened or protected fauna. It is most likely that an additional narrow strip of pristine veld will be used for the pipeline route and converted to barren ground eventually supporting pioneer vegetation.

A large ecological concern is the potential deleterious effect that the volume of water to be extracted may have on the welfare of the Mokolo River system downstream of the Dam. The river system provides a unique habitat to a plethora of narrowly specialized species, and furthermore acts as a dispersal corridor. Even a temporary and partial desiccation exacerbated by water extracted for the development during a drought will have far-reaching ecological consequences. The welfare of the river system should therefore supersede that of economic interests.

8. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

None

9. RECOMMENDED MITIGATION MEASURES

Mitigation measures proposed by the specialist:

- The topsoil must be kept separate during excavation, and correctly replaced when filling the ditch.
- Reasonable care must be taken to limit erosion, inter alia by sowing indigenous grass species.
- It is recommended that the developer appoint a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) to advice on the seeding of indigenous grasses.
- No plants not indigenous to the area, or exotic plant species, especially grasses such as Kikuyu and other ground-covering plants, should be introduced in the rehabilitation of the line, as they might spread into the areas of natural vegetation.
- Where possible work should be restricted to one area at a time. This will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
- The contractor must ensure that no fauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- The appropriate agency should implement an ongoing monitoring and eradication program for all invasive and weedy plant species growing within the servitude.*
- Rehabilitation of natural vegetation should proceed in accordance with a rehabilitation plan compiled by a specialist registered in terms of the Natural Scientific Professions Act (No. 27 of 2003) in the field of Ecological Science.*

- Any post-development re-vegetation or landscaping exercise should use species indigenous to South Africa. Plant species locally indigenous to the area are preferred. As far as possible, indigenous plants naturally growing along the route, but would otherwise be destroyed during construction, should be used for re-vegetation / landscaping purposes.*
- Where the pipeline is to traverse a wetland, measures are required to ensure that the pipeline has minimal effect on the flow of water through the wetland, e.g. by using a high level clear span bridge or box culverts rather than pipes.*
- Prior to construction, fences (*game fences*) should be erected in such a manner to prevent access and damage to any sensitive areas identified.*

The mitigation measures marked with an * was developed by the Directorate of Nature Conservation, GDACE, 2009 and are appropriate for this site.

10. CONCLUSION

From a mammalian view there is no compelling reason why the proposed pipeline route should not be developed. Through its entire length it travels along an existing pipeline and service road and for a distance also along existing roads (being farm, tertiary or secondary roads).

The volume of water to be extracted raises a concern for the ecological welfare of the Mokolo River. The river cannot be allowed to even temporary desiccate during drought.

11. LITERATURE SOURCES

Acocks, J.P.H. 1988. Veld types of South Africa, 3rd ed. *Memoirs of the Botanical Survey of South Africa.*

Bronner, G.N., Hoffmann, M., Taylor, P.J., Chimimba, C.T., Best, P.B., Mathee, C.A. & Robinson, T.J. 2003. A revised systematic checklist of the extant mammals of the southern African subregion. Durban Museum Novitates 28:56-103.

Department of Environmental Affairs and Tourism. 2007. National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication of Lists of Critically Endangered, Endangered, Vulnerable and Protected Species. Government Notices.

Directorate of Nature Conservation, GDACE. 2009. GDACE Requirements for Biodiversity Assessments, Version 2. Gauteng Provincial Government.

Friedman, Y. and Daly, B. (editors). 2004. Red Data Book of the Mammals of South Africa: A Conservation Asessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.

Knobel, J. & Bredenkamp, G. 2005. The magnificent natural heritage of South Africa. Roggebaai, Sunbird Publishers.

Low, A.B. & Rebelo, A.G. 1996. 'Vegetation Map of South Africa, Lesotho and Swaziland. Department of Environmental Affairs and Tourism, Pretoria.

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.

Meester, J.A.J., Rautenbach, I.L., Dippenaar, N.J. & Baker, C.M. 1986. Classification of Southern African Mammals. Transvaal Museum Monograph No. 5. Transvaal Museum, Pretoria, RSA.

Mills, G. & Hes, L. 1997. The complete book of Southern African Mammals. Struik Winchester, Cape Town, RSA.

Mucina, L. & Rutherford, M.C. 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

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. 1982. Mammals of the Transvaal. Ecoplan Monograph No. 1. Pretoria, RSA.

Skinner, J.D. & Chimimba, T.C. 2005. The Mammals of the Southern African Subregion. 3rd edition. Cambridge University Press.

Skinner, J.D. & Smithers, R.H.N. 1990. The Mammals of the Southern African Subregion. 2nd edition. Pretoria: University of Pretoria.

Smithers,R.H.N. 1983. The Mammals of the Southern African Subregion. Pretoria: University of Pretoria.

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.

The Conservation of Agricultural Resources Act, 1983 (Act 43 of 1983).

The Environmental Conservation Act, 1989 (Act 73 of 1989)

The National Environment Management Act, 1998 (Act No. 107 of 1998)

The National Forest Act of 1998 (Act 84 0f 1998, amended in 2006)