# Assessment of the Herpetofauna of the Rietvlei and Bronberg areas and the Impact of the Proposed Water Pipeline

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## Executive summary

- The Rietvlei Nature Reserve generally has a high conservation value for the herpetofauna due to its large area and relatively pristine habitats, including grasslands, bushveld, rivers and rock outcrops.
- The Bronberg site also has a relatively diverse herpetofauna, but shows higher levels of disturbance and transformation, and habitats have become fragmented and degraded.
- Sixty four species of herpetofauna could potentially occur in the Rietvlei Nature Reserve, but the actual species list is likely to be somewhat lower (range 47-55 species). Sixty one species could potentially occur on the Bronberg site, but the actual list is likely to be between 33 and 42 species.
- Eight species that are of conservation concern occur in the area (potentially 8 at Rietvlei and 6 at Bronberg). These include three species of lizards, two species of snakes, one species of tortoise, one species of crocodile and one species of frog.
- One of the threatened species of snake (*Python natalensis*) and *Crocodylus niloticus* have recently been introduced to Rietvlei Nature Reserve and probably did not occur there historically. These populations are thus of low conservation value.
- Three of the remaining species are officially 'Red Data listed'. These are the Coppery Grass Lizard (*Chamaesaura* aenea), Striped Harlequin Snake (*Homoroselaps dorsalis*) and the Giant Bullfrog (*Pyxicephalus adspersus*). The first of these is provisionally listed as 'Vulnerable' by the Southern Africa Reptile Conservation Assessment (SARCA), while the other two are currently listed as 'Near Threatened' (IUCN 2009). All three of these species will be negatively impacted by the proposed development.
- The remaining three species of conservation concern are not officially 'Red Data listed', but have restricted, patchy distributions, are relatively rare ('Orange listed') and are thus deserving of conservation concern.
- The proposed development will not have a very significant negative impact, provided that the development proceeds with amelioration in mind.
- Of the two alternative routes through Rietvlei Nature Reserve, the eastern route is favoured since this is closely aligned with existing roads and will thus

not act as an additional barrier to the movement of fossorial and terrestrial species of herpetofauna.

- Amelioration should include minimization of disturbance during construction and only the minimum length of access road should be maintain during the operation phase.

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# Background

The proposed development involves the establishment of a water pipeline through the Rietvlei Nature Reserve and part of the Bronberg. Two alternative routes through the Rietvlei Nature Reserve have been proposed (Fig. 1), one of which is restricted to the boundary of the reserve. The route that bisects the reserve largely follows an already established pipeline, and is partly above ground. Only one route is proposed for the Bronberg part of the pipeline.

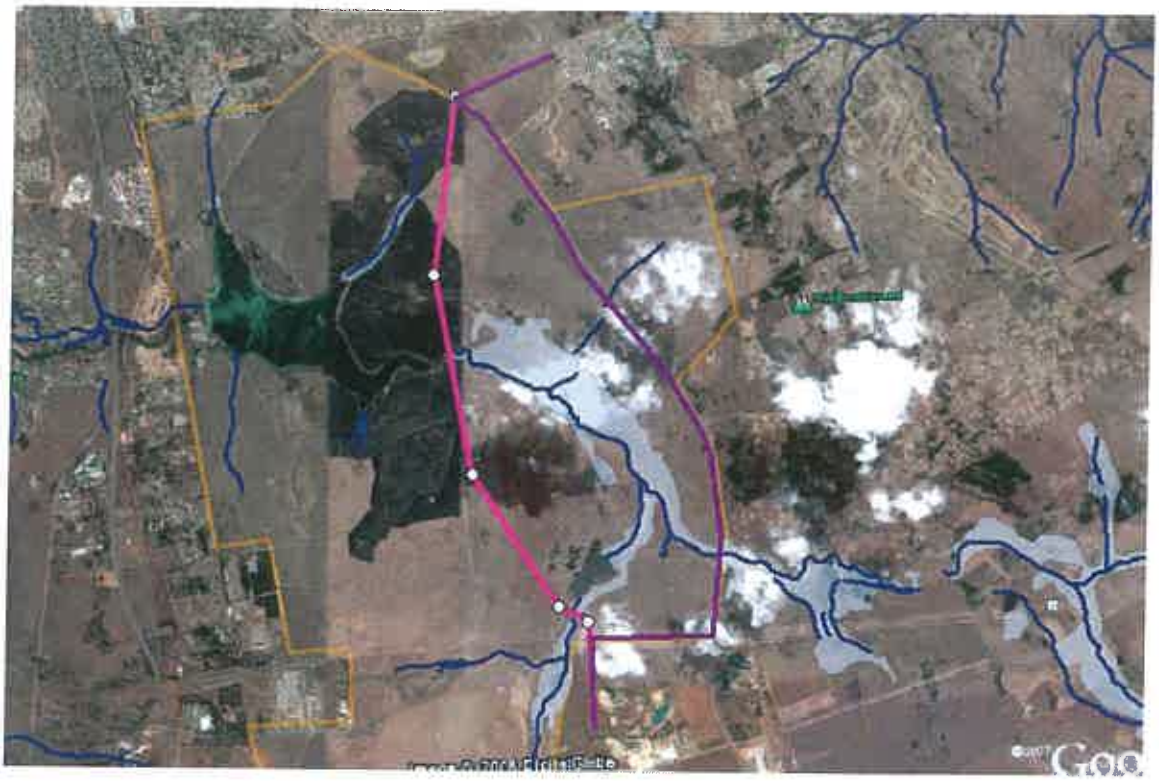

Figure 1. Two proposed routes for the water pipeline through Rietvlei Nature reserve (Pink line indicates route through the reserve, purple line, the route along boundary).

## Methods

Fieldwork was conducted on the 20th November, 2008 and involved only opportunistic sampling and habitat assessment (i.e., no trapping). Unlike some other taxa, the herpetofauna are notoriously difficult to sample comprehensively, and occurrant species can go undetected in an area for years. Thus, the species list (Table 1.) is not only based on specimens records during the limited field work, but also on habitat associations, biogeographic considerations and reference to databases (Jacobsen 1989; Jacobsen 1995; GDACE database).

The limited time spent conducting field work also meant that the "precautionary principle" was applied wherever there was doubt as to whether a particular species occurred in the various habitats, but 'probability of occurrence' is rated for each species in order to make species lists realistic. Total species lists and probability of occurrence are provided in Table 1 for reptiles and Table 2 for amphibians. Summary numbers are provided in Tables 3 and a summary of 'threatened' species is provided in Table 4.

Species were categorized as climate, substrate or habitat limited. This information was utilized in the generation of management proposals in the section dealing with conservation concerns. The conservation status of each species is also reported in Tables 1 and 2. IUCN and RDB official listings are presented. However, the conservation assessment of South African reptiles is largely obsolete, and so I have also used the provisional assessments from the ongoing 'Southern African Reptile Conservation Assessment' which is due to be published during the latter part of 2009.

Interpretations are based on several factors including biogeographic, ecological and life history aspects of each species. These issues are covered in more detail for 'threatened' species on page 14.

## Results and Discussion

Generally, the Rietvlei Nature Reserve has a rich herpetofaunal assemblage, with up to 64 species potentially occurring in the area. This is made up of 21 species of lizards, 25 species of snakes, four species of chelonians, one species of crocodile and 13 species of frogs (Table 3). Many of these were confirmed to occur in the area (31 species) since there was a high level of reptile activity on the day of my survey (e.g., 16 snakes found on the day) and because GDACE had also previously surveyed the area. The actual species list for Rietvlei Nature Reserve is likely to be somewhat lower than the potential list (range 47-55 species; see Table 3).

Sixty one species could potentially occur on the Bronberg site, but the actual list is likely to be between 33 and 42 species. Both sites are associated with the range edge from many of the occurant species and the region should thus be seen as an area of intergrade between biogeographic entities. This biogeographic placement is one of the most important factors responsible for the high diversity of the area.

Typically, populations near range edges tend to be more fragmented and more isolated from other populations of the same species than those near the centre of the range. This, in turn, means that these isolates are more prone to extirpation and are more likely to be sink populations than are those nearer to the centre of the range (Gaston 2003), making corridors natural habitat critically important for the maintenance of biodiversity in the area.

Table 1. (Begins on page 5) Species list of reptiles that occur in the Rietvlei and Bronberg areas. The "Probability of occurrence" for each species is recorded for Rietvlei and Bronberg in the appropriate columns and is categorized as follows:

1) Confirmed – Species recorded in the respective site. (Probability ≈ 1)
2) Likely to occur – Recorded within about 10 kms of the site during previous surveys or considered to occur at the site on the basis of currently measured distribution and habitat requirements. (Probability 0.75 to 1)
3) Probably occurs – Although not confirmed during the field survey and not recorded previously within 10 kms, the species should occur on the site based on the distribution pattern of the species and its habitat requirements. (Probability 0.5 to 0.75)
4) Could occur – Not confirmed during field survey and not recorded previously within 10 kms of the site. The distribution pattern could include the site but the habitat available is not ideal or the site is peripheral to the distribution. (Probability 0.25 to 0.5)
5) Unlikely to occur – Not confirmed during field survey and not recorded previously within 10 kms of the site. The distribution probably does not include the site and the habitat is not ideal for the species, but there is a possibility of occurrence. (Probability 0 to 0.25)
6) Does not occur – In some instances, a species may occur at one site, but is certain to not occur at the other site (e.g., *Crocodylus niloticus*). (Probability ≈ 0)

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| **Lizards** | | | | | |
| *Hemidactylus mabouia* Moreau's Tropical House Gecko | Likely to occur. | Likely to occur. | Peripheral to the north, but likely to extend into the area. Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Lygodactylus c. capensis* Cape Dwarf Gecko | Confirmed. | Likely to occur. | Widespread and common in the area. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Lygodactylus o. ocellatus* Spotted Dwarf Gecko | Unlikely to occur. | Could occur. | Restricted and patched distribution. | Limited to outcrops. | 'Least Concern' (SARCA), Rare, patchy and endemic |
| *Lygodactylus n. nigropunctatus* Black-spotted Dwarf Gecko | Unlikely to occur. | Could occur. | Restricted and patched distribution. | Limited to outcrops. | 'Least Concern' (SARCA) |
| *Pachydactylus capensis* Cape Gecko | Confirmed. | Likely to occur. | Widespread and common in the area. | Substrate limited | 'Least Concern' (SARCA) |
| *Pachydactylus affinis* Transvaal Gecko | Confirmed. | Likely to occur. | Widespread and common. Peripheral. | Substrate limited | 'Least Concern' (SARCA) |
| *Agama atra atra* Rock Agama | Could occur. | Likely to occur. | Widespread and common. | Limited to outcrops | 'Least Concern' (SARCA) |
| *Agama aculeata distant* Ground Agama | Likely to occur. | Confirmed. | Widespread in the area. | Substrate limited | 'Least Concern' (SARCA) |
| *Trachylepis capensis* Cape Skink | Confirmed. | Could occur. | Widespread in the area. | Temperate; climate limited | 'Least Concern' (SARCA) |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| *Trachylepis varia* Variable Skink | Confirmed. | Confirmed. | Widespread in the area. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Trachylepis punctatissima* Montane Speckled Rock Skink | Confirmed. | Likely to occur. | Widespread in the area. | Transitional; climate limited | 'Least Concern' (SARCA) |
| *Panaspis wahlbergii* Wahlberg's Snake-eyed Skink | Likely to occur. | Likely to occur. | Widespread in the area. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Acontias percivali occidentalis* Percival's Legless Skink | Unlikely to occur. | Unlikely to occur. | Widespread but patchy. Study site is peripheral. | Substrate limited | 'Least Concern' (SARCA) |
| *Acontias gracilicauda gracilicauda* Thin-tailed Legless Skink | Unlikely to occur. | Unlikely to occur. | Widespread but patchy. Study site is peripheral. | Substrate limited | 'Least Concern' (SARCA) |
| *Nucras lalandii* Delalande's Sandveld Lizard | Unlikely to occur. | Unlikely to occur. | Widespread buy rare (especially in Gauteng). Peripheral. | Temperate; climate limited | 'Least Concern' (SARCA), Rare, patchy and endemic |
| *Nucras holubi* Holub's Sandveld Lizard | Unlikely to occur. | Unlikely to occur. | Widespread and common. | Substrate limited | 'Least Concern' (SARCA) |
| *Varanus albigularis* Rock Monitor | Unlikely to occur. | Unlikely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (Branch 1988) |
| *Varanus niloticus* Water Monitor | Confirmed. | Unlikely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (Branch 1988) |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| *Gerrhosaurus flavigularis* Yellow-throated Plated Lizard | Likely to occur. | Confirmed. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Cordylus vittifer* Transvaal Girdled Lizard | Likely to occur. | Likely to occur. | Widespread and common. | Substrate limited; (split rocks in grassland) | 'Least Concern' (SARCA) |
| *Chamaesaura anena* Coppery grass Lizard | Confirmed. | Unlikely to occur. | Restricted and patchy. Peripheral. | Grassland specialist. | Vulnerable (SARCA) |
| **Snakes** | | | | | |
| *Typhlops bibronii* Bibron's Blind Snake | Confirmed. | Likely to occur. | Widespread and common. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Rhinotyphlops lalandei* Delalande's Beaked Blind Snake | Likely to occur. | Unlikely to occur. | Widespread and common. Peripheral. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Leptotyphlops scutifrons scutifrons* Peters' Worm Snake | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Leptotyphlops scutifrons conjunctus* The Eastern Cape Worm Snake | Confirmed. | Likely to occur. | Widespread and common. | Transitional; climate limited | 'Least Concern' (SARCA) |
| *Leptotyphlops jacobseni* Jacobsen's Worm Snake | Could occur. | Could occur. | Restricted. Peripheral. | Substrate limited | 'Least Concern' (SARCA) |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| *Python natalensis* Southern African Python | Previously recorded, but probably only translocated specimens. | Does not occur. | Widespread and locally common. Peripheral. | Tropical; climate limited | Vulnerable (Branch 1988), Near Threatened (SARCA) |
| *Lycodonomorphus rufulus* Common Water Snake | Likely to occur. | Likely to occur. | Widespread and common. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Lamprophis aurora* Aurora House Snake | Confirmed. | Confirmed. | Fairly widespread. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Lamprophis capensis* Brown House Snake | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Lycophidion capense* Common Wolf Snake | Likely to occur. | Likely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Duberria lutrix* Common Slug-eater | Unlikely to occur. | Unlikely to occur. | Widespread and common. Peripheral. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Pseudaspis cana* Mole Snake | Confirmed. | Confirmed. | Widespread and common. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Psammophylax rhombeatus rhombeatus* Spotted Skaapsteker | Confirmed. | Unlikely to occur. | Widespread and common. | Temperate; climate limited | 'Least Concern' (SARCA) |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| *Psammophis brevirostris* Short-snouted Sand Snake | Confirmed. | Unlikely to occur. | Widespread and common. Peripheral. | Transitional; climate limited | 'Least Concern' (SARCA) |
| *Psammophis crucifer* Cross-marked Sand Snake | Confirmed. | Unlikely to occur. | Widespread but patchy. Peripheral. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Aparallactus capensis* Black-headed Centipede-eater | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Homoroselaps dorsalis* Striped Harlequin Snake | Could occur. | Could occur. | Patchy and rare. | Transitional; substrate limited | Rare (Branch 1988); NT IUCN; Rare, patchy and endemic |
| *Atractaspis bibronii* Bibron's Stiletto Snake | Confirmed. | Could occur. | Widespread and common, Peripheral. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Philothamnus hoplogaster* Green Water Snake | Could occur. | Unlikely to occur. | Widespread and common, Peripheral. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Crotaphopeltis hotamboeia* Herald Snake | Confirmed. | Confirmed. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Dasypeltis scabra* Rhombic Egg-eater | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Elapsoidea sundevalli media* Highveld Garter Snake | Could occur. | Unlikely to occur. | Patchy, restricted and rare. | Transitional; climate limited | 'Least Concern' (SARCA) |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History and Biogeographic Affinities | Conservation status |
|---|---|---|---|---|---|
| *Hemachatus haemachatus* Rinkhals | Confirmed. | Could occur. | Widespread and common. Peripheral. | Temperate; climate limited | 'Least Concern' (SARCA) |
| *Causus rhombeatus* Rhombic Night Adder | Confirmed. | Could occur. | Widespread and common. Peripheral. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Bitis arietans* Puff Adder | Likely to occur. | Confirmed. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| **Chelonians** | | | | | |
| *Stigmochelys pardalis babcocki* Leopard Tortoise | Confirmed, but probably translocates. | Confirmed, but probably translocates. | Widespread and common. Peripheral. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Kinixys lobatsiana* Lobatse Hinged Tortoise | Could occur, but has not yet been recorded. | Unlikely to occur. | Fairly restricted and patchy. | Transitional; climate limited | 'Least Concern' (SARCA), Endemic, fragmented and declining |
| *Pelomedusa subrufa* Marsh Terrapin | Likely to occur. | Unlikely to occur. | Widespread and common. | Tropical; climate limited | 'Least Concern' (SARCA) |
| *Pelusios sinuatus* Serrated Hinged Terrapin | Unlikely to occur. | Does not occur | Widespread. Peripheral. | Tropical; climate limited | 'Least Concern' (SARCA) |
| **Crocodylia** | | | | | |
| *Crocodylus niloticus* Nile Crocodile | Confirmed, but due to introduction. | Does not occur. | Widespread. Peripheral. | Tropical; climate limited | Vulnerable (Branch 1988) Vulnerable 'Regional (SARA) |

Table 2. Species list of amphibians that occur in Rietvlei and Bronberg areas (Fig. 1). "Probability of occurrence" for each species is recorded for Rietvlei and Bronberg in the appropriate columns and is categorized as defined for Table 1. Additionally, breeding requirements are provided under "Probability of occurrence".

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History | Conservation status |
|---|---|---|---|---|---|
| *Xenopus laevis laevis* Common Platanna | Likely to occur. | Likely to occur. | Widespread and common. | Temperate; climate limited. Requires permanent water. | 'Least Concern' (Minter et al. 2004) |
| *Amietophrynus gutturalis* Guttural Toad | Confirmed. | Confirmed | Widespread and common. | Tropical; climate limited. Requires still water. | 'Least Concern' (Minter et al. 2004) |
| *Amietophrynus rangeri* Raucous Toad | Likely to occur. | Could occur. | Widespread and common. | Temperate; climate limited. Requires still water | 'Least Concern' (Minter et al. 2004) |
| *Schismaderma carens* Red Toad | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited. Requires still deep water. | 'Least Concern' (Minter et al. 2004) |
| *Breviceps adspersus* Bushveld Rainfrog | Could occur. | Confirmed. | Widespread and common. | Tropical; climate limited | 'Least Concern' (Minter et al. 2004) |
| *Kassina senegalensis* Bubbling Kassina | Likely to occur. | Likely to occur. | Widespread and common. | Tropical; climate limited. Requires ephemeral water bodies. | 'Least Concern' (Minter et al. 2004) |
| *Cacosternum boettgeri* Boettger's Caco | Confirmed. | Likely to occur. | Widespread and very common. | Temperate, climate limited. Requires ephemeral still water. | 'Least Concern' (Minter et al. 2004) |
| *Phrynobatrachus natalensis* Snoring Puddle Frog | Likely to occur. | Likely to occur. | Widespread and common. | Tropical; climate limited. Requires perennial streams. | 'Least Concern' (Minter et al. 2004) |
| *Amietia angolensis* | Likely to occur. | Likely to occur. | Widespread and common. | Tropical; climate limited. | 'Least Concern' |

| Species | Rietvlei | Bronberg | Distribution in relation to Study Sites | Life History | Conservation status |
|---|---|---|---|---|---|
| Common River Frog | | | | Requires perennial streams. | (Minter et al. 2004) |
| *Pyxicephalus adspersus* Giant Bullfrog | Confirmed. | Unlikely to occur. | Widespread, but patchy. | Transitional; substrate limited. Requires ephemeral still water. | 'Near Threatened' regionally (Minter et al. 2004) |
| *Strongylopus fasciatus* Striped Stream Frog | Could occur. | Unlikely to occur. | Fairly widespread. Peripheral. | Temperate; climate limited. Requires semi permanent wetlands. | 'Least Concern' (Minter et al. 2004) |
| *Tomopterna cryptotis* Tremolo Sand Frog | Likely to occur. | Likely to occur. | Widespread and common. | Tropical; climate limited. Requires ephemeral still water. | 'Least Concern' (Minter et al. 2004) |
| *Tomopterna natalensis* Natal Sand Frog | Confirmed. | Likely to occur. | Widespread and common. | Tropical; climate limited. Requires ephemeral still water. | 'Least Concern' (Minter et al. 2004) |

Table 3. Summary information for "Probability of occurrence" and Threats for herpetofauna on the Rietvlei (R) and Bronberg (B) sites. '≥ Likely' includes species that have been confirmed and those that are classified as 'Likely to occur'. '≥ Could' include all species that have been confirmed, are classified as 'likely to occur' and those classified as 'could occur'. 'Threatened' species include all species that are classified as 'Threatened' by the IUCN, considered threatened by Branch (1988), Minter et al. (2004), by the SARCA project (currently unpublished) or are considered worthy of special consideration due to population declines ('Orange' species in my opinion).

| Taxon | Total species | | Confirmed | | ≥ Likely | | ≥ Could | | Threatened | |
|---|---|---|---|---|---|---|---|---|---|---|
| | R | B | R | B | R | B | R | B | R | B |
| Lizards | 21 | 21 | 8 | 3 | 13 | 11 | 14 | 14 | 3 | 3 |
| Snakes | 25 | 24 | 16 | 4 | 20 | 11 | 24 | 16 | 2 | 1 |
| Chelonia | 4 | 3 | 1 | 1 | 2 | 1 | 3 | 1 | 1 | 1 |
| Crocodiles | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |
| Frogs | 13 | 13 | 5 | 2 | 11 | 10 | 13 | 11 | 1 | 1 |
| **Totals** | **64** | **61** | **31** | **10** | **47** | **33** | **55** | **42** | **8** | **6** |

Table 4. Summary information for 'Threatened' species. 'Threatened' species include all species that are classified as 'Threatened' by the IUCN, considered threatened by Branch (1988), Minter et al. (2004), by the SARCA project (currently unpublished) or are considered worthy of special consideration due to population declines ('Orange' species in my opinion).

| Species | Threat | Probability of occurrence | |
|---|---|---|---|
| | | Rietvlei | Bronberg |
| *Lygodactylus o. ocellatus* Spotted Dwarf Gecko | Rare, patchy and endemic | Unlikely to occur | Could occur |
| *Nucras lalandii* Delalande's Sandveld Lizard | Rare, patchy and endemic | Unlikely to occur | Unlikely to occur |
| *Chamaesaura anena* | Restricted, patchy. 'Vulnerable' SARCA | Confirmed | Unlikely to occur |
| *Python natalensis* Southern African Python | Vulnerable (Branch 1988) | Confirmed introduction | Does not occur |
| *Homoroselaps dorsalis* Striped Harlequin Snake | Rare (Branch 1988); NT (IUCN); endemic | Could occur | Could occur |
| *Kinixys lobatsiana* Lobatse Hinged Tortoise | Endemic, fragmented and declining | Could occur | Unlikely to occur |
| *Crocodylus niloticus* Nile Crocodile | Vulnerable (SARCA) | Confirmed introduction | Does not occur |
| *Pyxicephalus adspersus* Giant Bullfrog | NT (Minter et al. 2004) | Confirmed | Unlikely to occur |

## Species of Conservation Concern

Species that are either officially classified as 'Threatened' or are considered here in more detail:

***Lygodactylus ocellatus ocellatus*; Spotted Dwarf Gecko** (Rare, patchy and endemic)

This species lives on exposed rocks on rocky outcrops. It is restricted to Mpumalanga, Swaziland and Gauteng and has a very patchy occurrence. Genetically-based studies may show the different isolated populations to be distinct clades, further raising the conservation value of any populations that may occur at the sites. Although it has not yet been recorded at either of the sites, there are records from the west, and it is possible that the species occurs, especially on the rocky outcrops of the Bronberg. This species is not officially rated as 'Threatened', but is currently being reassessed by the Southern Africa Reptile Conservation Assessment initiative.

*Conservation management recommendations*: Since the distribution of the Spotted Dwarf Gecko appears to be limited by occurrence of suitable habitat, rather than by climatic factors, it is less likely that anticipated climatic changes will have a direct impact on its range. Conservation efforts should focus on preservation of suitable habitat. Detailed survey work should also be conducted in areas where the species is likely to occur, in order to confirm its occurrence.

***Nucras lalandei*; Delalande's Sandveld Lizard** (Rare, patchy and endemic)

Although *Nucras lalandei* occurs fairly widely in the more temperate parts of South Africa, populations appear to be very patchy and have a high level of fragmentation, possibly as a result of the species' close association with grassland habitats. Population densities also appear to be low wherever they occur, and those in Gauteng appear to have declined over the last two decades. Jacobsen (1995) has even considered the possibility that the species had become locally extinct in Gauteng, although this has been disproved in some recent surveys. *Nucras lalandei* has been recorded to the south and west of Rietvlei and the presence of suitable habitats in the area means that its occurrence is possible though unlikely. This species is not currently RDB listed and population densities are unknown.

*Conservation management recommendations*: Conservation measures should focus on detecting the presence of the species at Rietvlei and protection of suitable habitat patches, primarily grassland areas. Because of the cryptic nature of this species, detection is best effected by trapping (funnel traps associated with drift fences) of selected sites during the summer months.

***Chamaesaura aenea*; Coppery Grass Lizard** (Vulnerable (SARCA) Rare, patchy and endemic)

This species occurs in only fairly pristine grasslands and does not appear to tolerate any significant disturbance of this habitat. Populations are scattered and the species appears to have experienced very significant population declines over the last decade due to fragmentation of natural grasslands and inappropriate management. Transvaal Grass Lizards are specialized grass-swimmers and struggle to locomote

on hard surfaces such as tarred roads, which thus act as barriers to movement and dispersal. They are also dependent on rocky areas for protection from veld fires, and generally succumb to fires if denied easy access to rocky shelters. Thus, fragmentation of their grassland habitat usually results in population declines or local extinction. *Chamaesaura aenea* has been recorded in the Rietvlei Nature Reserve. Although not officially rated as 'Threatened', it is currently being reassessed by the Southern Africa Reptile Conservation Assessment initiative.

*Conservation management recommendations*: Areas where this species still persists should be protected and management of habitat patches should include the establishment of an appropriate burning regime.

***Python natalensis*; Southern African Python** (Vulnerable (Branch 1988))

The Southern African Python is listed as 'Vulnerable' in the latest Red Data Book on South African reptiles (Branch 1988; listed therein as *Python sebae natalensis*) and in Appendix II of CITES. Concern for the conservation plight of the species has resulted mainly from the apparent decline in its numbers and range in South Africa. Range reduction and population declines have already resulted in an isolated population in the Eastern Cape becoming extinct; the last specimen was captured in Bathurst in the Eastern Cape in 1927 (Broadley 1983). Attempted reintroductions have been of limited (Branch 1986) or unknown success (Branch pers comms). Pythons have also become locally extinct in many other areas as a result of habitat degradation and human development. Alexander (1990) records the local extinction of pythons in municipal Durban. However, more recent research identifies the inability of females to successfully incubate eggs in cold areas as the causal limiting factor to the distribution, and climatic warming is thus expected to cause an expansion of the distribution in South Africa where suitable habitat is available (Alexander 2007).

Records of *Python natalensis* from Rietvlei Nature Reserve appear to be the result of the translocation of individuals from outside of the area. At present both Rietvlei and Bronberg appear to be outside of the natural distribution of the species, and conservation recommendations are thus inappropriate.

***Homoroselaps dorsalis*; Striped Harlequin Snake** (RDB as Rare (Branch 1988); Near Threatened (IUCN 2009); Rare, patchy and endemic)

This South African endemic has been recorded from scattered localities (Branch 1988) and appears to be rare over its entire range. Populations appear to be highly fragmented and localized. In Gauteng, the species is associated exclusively with grasslands, and does not appear to tolerate disturbance of this habitat. Branch (1988) notes that populations appear to have declined as a result of habitat modification through agricultural activity, and it is likely that transformation of Highveld grasslands has already had a negative effect on the conservation status of the species. The majority of recorded specimens have been found in old, moribund termitaria. The populations in Gauteng are isolated and appear to have declined sharply over recent decades, probably as a result of habitat fragmentation and degradation, and the widespread decimation of termitaria. This species has been recorded in the west of Rietvlei Nature Reserve, in areas that have undergo significant transformation since the records were made. Suitable habitat for this species is present on both Rietvlei Nature Reserve and the Bronberg site.

*Conservation management recommendations*: The maintenance of good quality, functional grassland in a relatively pristine state is needed for the conservation of this species.

***Kinixys lobatsiana*; Lobatse Hinged Tortoise** (Endemic, fragmented and declining)

*Kinixys lobatsiana* is restricted to a small portion of southeastern Botswana and adjacent parts of Northwest Province, Limpopo and Gauteng provinces. The relatively limited distribution of this species, the patchy nature of its occurrence and its apparent inability to persist in transformed areas mean that populations have declined. To some extent, it is also under threat from illegal collecting. The species has not been recorded at either of the sites and it is thus not very likely that it does occur (tortoises are usually noticed and recorded in nature reserves).

*Conservation management recommendations*: Existing populations must be detected by a detailed survey of suitable habitats. Areas where this species still persists in numbers should be protected.

***Crocodylus niloticus*; Nile Crocodile** (Vulnerable (Branch 1988) Regionally 'Vulnerable' SARCA)

Historically, this species has undergone major declines in population and range through hunting and human persecution (conventional farming activities and crocodiles appear to be incompatible). However, over recent times, populations have stabilized or even increased in some parts of South Africa, and the recent boom in crocodile ranching has resulted in threat of extinction diminishing greatly.

Records of *Crocodylus niloticus* from Rietvlei Nature Reserve appear to be the result of the translocation of individuals from outside of the area. At present both Rietvlei and Bronberg appear to be outside of the natural distribution of the species, and conservation recommendations are thus inappropriate.

***Pyxicephalus adspersus*; Giant Bullfrog** (Regionally 'Near Threatened' (Minter et al. 2004))

*Pyxicephalus adspersus* is classified as Regionally 'Near Threatened' by Harrison et al. (2001) and Branch & Harrison (2004). It is easily the largest frog in South Africa. Because of its size (SVL > 200 mm in males in the Gauteng area) and life history strategy, time to sexual maturity tends to be long (Channing (2001) estimates life expectancy to be over 45 years). Adults also spend a major portion of their lives in a dormant state underground, emerging only when conditions are suitable for feeding or breeding. The species requires ephemeral pans for breeding and populations are generally centred around suitable breeding sites.

The well-defined life history pattern and specific habitat requirements of *P. adspersus* allows for easy identification of critical environmental requirements necessary to sustain populations. The following are critical habitat components for the species: temporary pans that are large enough to hold water for at least a month; breeding pans must be accessible to frogs; the substrate must be suitable for aestivation and lastly, frogs must have areas in which to forage. In Gauteng, *P. adspersus* is found primarily in areas of low lying grasslands. In this respect, Rietvlei Nature Reserve provide ideal habitat and the species occurs widely within the reserve. It is

unlikely that the Bronberg site provides suitable breeding opportunities for this species.

*Conservation management recommendations*: Habitat patches where the presence of *P. adspersus* is confirmed, which are in an untransformed state and are sufficiently large should be identified and protected (as is the case in Rietvlei Nature Reserve).

## Impacts and Mitigation

The most significant impacts of the pipeline on the herpetofauna are associated with the construction phase, and magnitude of these impacts is dependent, to a large degree, on the size of the footprint of transformed land needed for construction of the proposed water pipeline. Additionally, fossorial species will be most directly impacted as disturbance to the soil horizons that result from construction can be long-lasting, especially if access roads are maintained into the operational phase.

As a guiding principle, the pipeline should, wherever possible, be aligned with previous disturbances, such as the existing pipeline or roads. This will effectively reduce the negative impacts of the proposed pipeline, especially with respect to its impact as a barrier to the movement of fossorial species (i.e., the barrier already exists).

### Construction Phase

**Impact**: Transformation and disturbance of natural habitat for construction – the construction of the pipeline will require the development of an access road, trench for buried pipeline and foundations for above-ground pipeline.

**Amelioration**: Area of disturbance should be kept to a minimum. Disturbance of natural habitat should be minimized by using previously disturbed area where possible.

**Impact**: Wanton killing of wildlife – labourers on the construction site are likely to kill exposed wildlife, especially snakes.

**Amelioration**: Labourers should be educated and made aware that animals should not be harmed.

### Operational Phase

**Impact**: Maintenance of access roads – the soil horizons under the access roads needed to facilitate maintenance of the pipeline become compacted and the road surface remains in an unnatural state. This is especially problematic for fossorial and terrestrial species of herpetofauna which are thus excluded from road areas or are killed by vehicular traffic.

**Amelioration**: Length of access roads should be kept to a minimum. Use of access roads should also be minimized and restricted during times of froglet immergence of *P. adspersus*.

## Choice of Alternative Routes in Rietvlei Nature Reserve

The two alternative routes through Rietvlei Nature Reserve each have advantages and disadvantages: the western route is shorter (positive), but transects the reserve (negative) and is aligned (for the most part) only with another water pipeline (negative). The eastern route is longer (negative), but is aligned with the reserve fence line (for much of its length) and roads (positive).When these factors are considered together, the eastern route appears to be the best option from the perspective of negative impacts on the herpetofauna.

## Recommendations and Conclusions

Generally, the negative impacts to the herpetofauna resulting from the proposed development are probably of an acceptable significance and magnitude if appropriate amelioration is implemented and construction is implemented in a sensitive manner. Although construction is likely to result in the unavoidable death of a certain number of reptiles and amphibians, the footprint is likely to be reasonably small in comparison to the area of natural habitat on the two sites. Thus, provided that that operational phase is relatively benign to the environment, the development is unlikely to have any significant long-term impact on the herpetofauna.

## References


Alexander, G.J. 1990. The reptiles and amphibians of Durban, South Africa. Durban Museum Novitates 15: 1-41.

Alexander, G.J. 2007. Thermal biology of the Southern African Python (*Python natalensis*): Does temperature limit its distribution? Pp 50-75. *In* Biology of the Boas and Pythons (Eds. Henderson, R.W. and R. Powell). Eagle Mountain Publishing. LC.

Branch, W.R. 1986. The African Python – A lost giant of the Eastern Cape? Pelea 5:50–51.Branch, W.R. 1998. Field Guide to Snakes and Other Reptiles of Southern Africa. Struik, Cape Town.

Branch, W.R. (Ed.) 1988. South African red data book – reptiles and amphibians. South African National Scientific Projects Report 151: 1 – 242.

Branch, W.R. & J.A. Harrison. 2004. Conservation status and threats. Pp. 13-29. *In* Minter, L.R., M. Burger, J.A. Harrison, H.H. Braack., P.J. Bishop & D. Kloepfer. (Eds.) Atlas and Red data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, D.C.

Broadley, D.G. 1983. FitzSimons' Snakes of Southern Africa. Delta Books, Cape Town.

Channing, A. 2001. Amphibians of Central and Southern Africa. Protea. Pretoria.

Gaston, K.J. 2003. The Structure and Dynamics of Geographic Ranges. Oxford University Press. New York.

Harrison, J.A., M. Burger, L.R. Minter, A.L. de Villiers, E.H.W. Baard, E. Scott, P.J. Bishop & S. Ellis. 2001. Conservation Assessment and Management Plan for

Southern African Frogs: Final Report. IUCN/SSC Conservation Breeding Specialist Group, Apple Valley, MN.

IUCN. (2009). www.IUCNredlist.org.

Jacobsen, N.G.H. 1995. The Herpetofauna of Gauteng Province – Localities and Distribution Maps. Chief Directorate of Nature and Environmental Conservation.

Jacobsen, N.G.H. 1989. A Herpetological Survey of the Transvaal. Unpub. Ph.D. thesis. University of Natal, Durban.

Minter, L.R., M. Burger, J.A. Harrison, H.H. Braack., P.J. Bishop & D. Kloepfer. (Eds.) 2004. Atlas and Red data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, D.C.