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**HERPETOFAUNA AND INVERTEBRATE REMEDIATION  
ACTION PLAN FOR THE MOKOLO AND CROCODILE RIVER  
(WEST) WATER AUGMENTATION PROJECT (PHASE 2A)  
(MCWAP-2A), LIMPOPO PROVINCE**

**Prepared for**

**GIBB Consulting**

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## TABLE OF CONTENTS

<b>LIST OF FIGURES</b> .....	<b>i</b>
<b>LIST OF TABLES</b> .....	<b>i</b>
Acronyms .....	ii
Glossary of Terms .....	ii
<b>1 INTRODUCTION</b> .....	<b>1</b>
<b>2 SPECIES OF CONSERVATION CONCERN DESCRIPTION</b> .....	<b>3</b>
<b>3 REMEDIATION ACTION PLAN</b> .....	<b>12</b>
3.1 General Herpetofauna and Invertebrate Species .....	13
3.2 SCC Rescue and Relocation Plan .....	15
<b>4 CONCLUSION</b> .....	<b>21</b>
<b>5 REFERENCES</b> .....	<b>22</b>
<b>APPENDIX A: Daily Record Sheet to be used</b> .....	<b>23</b>
<b>APPENDIX B: Details, Expertise and Curriculum Vitae of specialists</b> .....	<b>24</b>

## LIST OF FIGURES

Figure 1: Example of how drift fences must encompass the active construction segment of the pipeline. ....	13
Figure 2: Common herpetofauna found during the site assessment (top left to right); Kalahari Dwarf Worm Lizard ( <i>Zygaspis quadrifrons</i> ), Bubbling Kassina ( <i>Kassina senegalensis</i> ) and Raucous Toad ( <i>Amietophrynus rangeri</i> ); (middle), Bushveld Sand Lizard ( <i>Heliobolus lugubris</i> ); (Bottom left to right) Leopard tortoise ( <i>Stigmochelys pardalis</i> ) and Spekes Hinge-back Tortoise ( <i>Kinixys spekii</i> ). ....	14

## LIST OF TABLES

Table 1: Description of SCC within the class Amphibia .....	3
Table 2: Description of SCC within the class Reptilia .....	7
Table 3: Specifications related to the installation, maintenance and movement of the required drift fence. ....	16
Table 4: Actions for the rescue and relocation of the Giant and lesser Bullfrog .....	17
Table 5: Actions for the rescue and relocation of the African Rock Python (and other snake species that may be encountered within the construction area. ....	18
Table 6: Actions for the rescue and relocation of the Lobatse Hinge-back tortoise (and other tortoise species found during the site walkdown). ....	19



## Acronyms

CITES	Convention of International Trade in Endangered Species
CR	Critically Endangered
DD	Data Deficient
ECO	Environmental Control Officer
EN	Endangered
EX	Extinct
EW	Extinct in the Wild
IUCN	The International Union for Conservation of Nature
LC	Least Concern
NE	Not Evaluated
NT	Near Threatened
STS	Scientific Terrestrial Services
SCC	Species of Conservation Concern
TOPS	Threatened and Protected Species
VU	Vulnerable
%	Percentage

## Glossary of Terms

Brumation	A state or condition of sluggishness, inactivity, or torpor exhibited by reptiles (such as snakes or lizards) during winter or extended periods of low temperature
Carapace	the hard upper shell of a turtle, crustacean, or arachnid.
Dorso-ventrally flattened	When an animal or plant / its organ is compressed along its dorsal (upper) and ventral (lower) side
Herpetofauna	The reptiles and amphibians of a particular region, habitat, or geological period.
Invertebrates	An animal lacking a backbone, such as an arthropod, mollusk, annelid, coelenterate, etc. The invertebrates constitute an artificial division of the animal kingdom, comprising 95 percent of animal species and about 30 different phyla.
Tympanum	A membrane covering the hearing organ
Vertebrates	An animal of a large group distinguished by the possession of a backbone or spinal column, including mammals, birds, reptiles, amphibians, and fishes.










# 1 INTRODUCTION

This report provides details pertaining to the Herpetofauna (reptiles and amphibians) and Invertebrates (Baboon spiders and Scorpions) found within the study area during the site visits and provides a remediation action plan for the construction and operational phases to minimise fatality of species, with specific mention to Species of Conservation Concern (SCC).

The International Union for Conservation of Nature (IUCN) Red List which has various species classifications (nine classes) that considered various criteria such as population rate of decline, geographic distribution, population disturbance and fragmentation and potential future threats. The classes all consider the risk of extinction of a species. Table 1 below provides a summary of the nine classifications.

**Table 1: Classifications used in the IUCN red list.**

<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;"> <p>Extinct</p> <p> </p>  </div> <div style="text-align: center;"> <p>Threatened</p> <p>┌───────────┐</p>     </div> <div style="text-align: center;"> <p>Least Concern</p> <p> </p>   </div> </div>	
Extinct (EX)	Species is no longer extant.
Extinct in the Wild (EW)	Species survives only in captivity, cultivation and/or outside native range.
Critically Endangered (CR)	Extremely critical risk of extinction in the wild in the immediate future.
Endangered (EN)	Very high risk of extinction in the wild in the near future.
Vulnerable (VU)	High risk of extinction in the wild in the medium-term future.
Near threatened (NT)	Close to being threatened with extinction in the near future.
Least Concern (LC)	Unlikely to become extinct in the near future.
Data Deficient (DD)	Insufficient data available to determine risk.
Not Evaluated (NE)	Species has not been evaluated and therefore the risk is unknown.

Herpetofauna and invertebrates are considered important for the health and functioning of an ecosystem, several species or genera are of specific importance within South Africa due to their conservation status and their protection status in accordance with the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) and the associated Threatened and Protected Species (TOPS) regulations compiled for South Africa. The SCC for this report are as follows:

- a. African Bullfrog (*Pyxicephalus adspersus*) (Near Threatened);
- b. Lesser Bullfrog (*Pyxicephalus edulis*) (Least Concern);
- c. Southern African Rock Python (*Python natalensis*) (Protected - TOPS);



- 
- d. Lobatse Hingeback Tortoise (*Kinixys lobatsiana*) (Vulnerable);
  - e. Rear-horned Baboon Spider (*Ceratogyrus darlingi*) (Protected - TOPS);
  - f. Common Baboon Spiders (*Harpactira* sp.) (Protected - TOPS);
  - g. Rough Burrower (*Opisthacanthus glabrifrons*) (Protected - TOPS);
  - h. Tree Creeper (*Opisthacanthus asper*) (Protected - TOPS); and
  - i. Giant Rock Scorpion (*Hadogenes troglodyte*) (Protected - TOPS).

Furthermore, the Convention of International Trade in Endangered Species of wild fauna and flora (CITES) provides three categories (within appendices) for the restriction of trade on various SCC. This categories are as follows:

- Ø **Appendix I** includes species threatened with extinction. Trade in specimens of these species is permitted only in exceptional circumstances.
- Ø **Appendix II** includes species not necessarily threatened with extinction, but in which trade must be controlled in order to avoid utilization incompatible with their survival.
- Ø **Appendix III** contains species that are protected in at least one country, which has asked other CITES Parties for assistance in controlling the trade.

The following sections provide in depth details of the above listed SCC as well as the requirements associated with the rescue and relocation of individuals that may be found during the construction of the pipeline. It must be noted that this report should be read in conjunction with the faunal assessment undertaken by STS (2020)<sup>1</sup> for additional information pertaining to identification, methodology and site visit specifications.

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<sup>1</sup> Scientific Terrestrial Services (2021). Biodiversity and invertebrate specialist detailed site sensitivity analyses and design guidance as part of the Mokolo and Crocodile River (West) Water Augmentation project (Phase 2 A) (MCWAP E 2A), Limpopo Project. Reference Number STS 200032.



## 2 SPECIES OF CONSERVATION CONCERN DESCRIPTION

The following tables provides a summary of the available literature review of the herpetofauna SCC(as listed in Section 1 above) for which this remediation action plan, as defined in Section 3 below has been compiled.

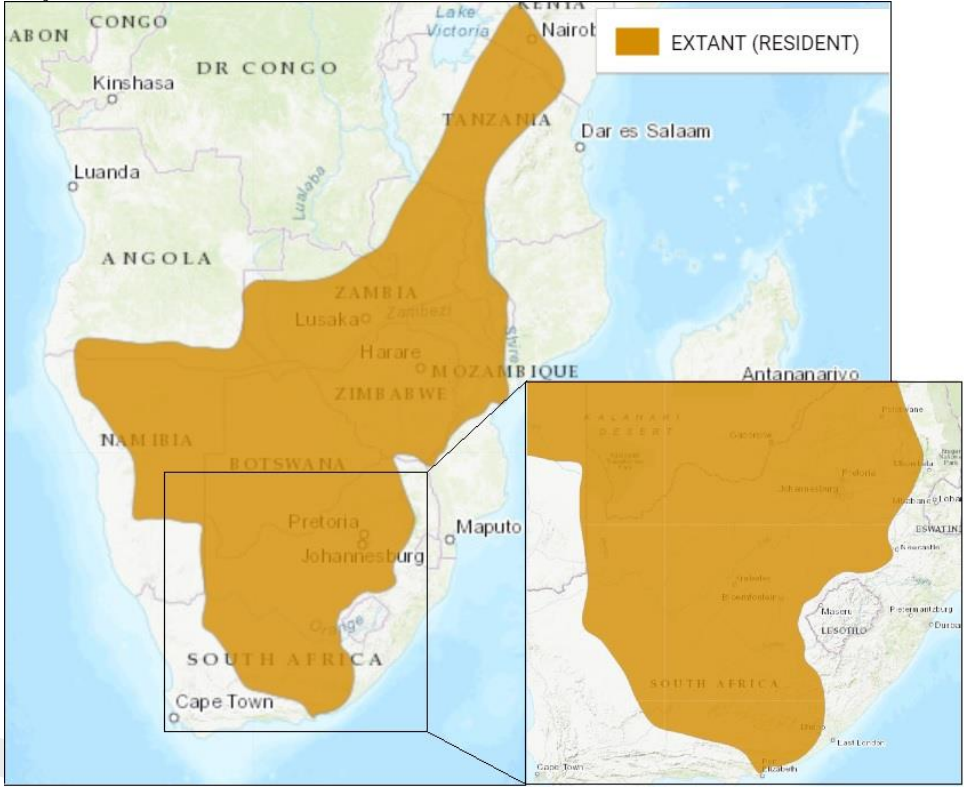
**Table 2: Description of SCC within the class Amphibia.**

Giant Bullfrog ( <i>Pyxicephalus adspersus</i> )		
Photographs from site:		
		
Other Common Names	Highveld Bullfrog African Bullfrog Giant Bullfrog	
Conservation status <sup>2</sup>	IUCN Red List	Least Concern. Population is considered to be declining
	CITES	Not Listed
	National Status	Listed as Near Threatened within South Africa. Listed as a protected species under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Description <sup>3</sup>	<p><i>Pyxicephalus adspersus</i> is one of the largest amphibian species, with males weighing up to 10 x more than females. The head of this species very broad, with a number of uninterrupted skin ridges present along the back. In adults, the dorsum is dark olive-green, but may vary from brown to grey and even blue while short sections of the longitudinal skin ridges may be white or cream. It has been recorded that a snout length exceeding 140 mm may be assigned to <i>P. adspersus</i> and not <i>P. edulis</i>, however, juveniles cannot easily be distinguished.</p> <p>In juveniles, a pale vertebral stripe is often present, contrasting sharply with the bright green brown colour. The abdomen is white to creamy-yellow, except in the region of the forelimbs, where it is bright yellow in breeding males. Dark mottling may be present in the gular region of males (Du Preez 1996).</p>	
Ecology and habitat <sup>2 and 3</sup>	<p><b>Ecology</b> <i>Pyxicephalus adspersus</i>, considered a fossorial species, and remains in a dormant state, buried underground and emerges at the start of the rains (at least 30 mm downpour is noted to be a trigger over continual light rain). Breeding takes place at night after heavy rainfall and within temporary pans or pools of water (where water needs to be retained for at least 30 days). Species is known to be an explosive breeder, finding a mate and laying upwards of 4,000 eggs within 48 hours. Territorial males are larger than non-territorial males and they have been known to battle aggressively for territory and females. Food source includes a variety of invertebrates and small vertebrates, including small rodents, birds, other frog species and even small snakes. This species exhibits cannibalism in the adult, juvenile and even tadpole stages.</p>	

<sup>2</sup> Information compiled from IUCN (2020)


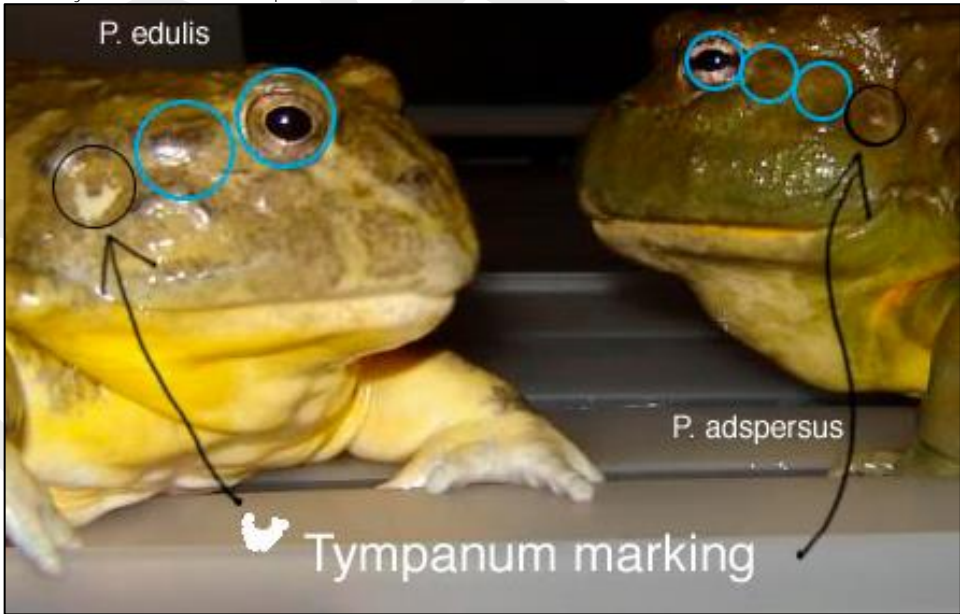
<sup>3</sup> FrogMAP. 2021. *Pyxicephalus adspersus* Tschudi, 1838. Animal Demography Unit. Accessed from <http://frogmap.adu.org.za/?sp=850>; on 2021-03-24 10:03:50



	<p><u>Habitat</u></p> <p>This species is considered one of the most adaptable amphibians on earth as it can tolerate some of the harshest environments in Africa. Certain areas of their range are dry for years at a time, reaching temperatures of 40 °C and drop below freezing during winter months. The African Bullfrog (<i>Pyxicephalus adespersus</i>) is fossorial, staying underground within an estivation chamber, or (cocoon) i b h AY f U b n season. The (w c b i) is developed through shedding of various layers of skin that insulates it from the external environment. Burrowing has been documented between 0.5 m to 1 m in depth depending on the type of soils and humidity of soil (more humid soils will allow individuals to bur deeper and avoid desiccation).</p>
<p>Distribution and range<sup>2</sup></p>	<p>Mostly sub-saharan habitat. Occurs widely in South Africa, Swaziland, Namibia, Botswana, and Zimbabwe, extending north to southern Angola, Zambia, Malawi, Mozambique, Tanzania, and Kenya.</p>  <p>A smaller species, <i>Pyxicephalus edulis</i> occupies a smaller range in southern Africa, from Zimbabwe and northern south Africa to Botswana, Mozambique and Zambia.</p>
<p>Threats<sup>4</sup></p>	<ul style="list-style-type: none"> <li>• Breeding habitat is lost as a result of agricultural development and urbanisation.</li> <li>• Habitat fragmentation.</li> <li>• Linear infrastructure (roads) are a movement barrier and result in mass fatalities due to collisions.</li> <li>• Impoundments, changing flooding patterns thus reducing seasonal wetting.</li> <li>• Pesticides and pollution of water, causing mortality of tadpoles.</li> <li>• Collection for the international pet trade.</li> <li>• Harvesting individuals for consumption (considered a delicacy in some countries).</li> </ul>

<sup>4</sup> Minter, L.R., Burger, M., Harrison, J.A., Braack, H.H., Bishop, P.J., and Kloepfer, D. (eds.) (2004). *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. Volume 9 SI/MAB Series*. Smithsonian, Washington D.C

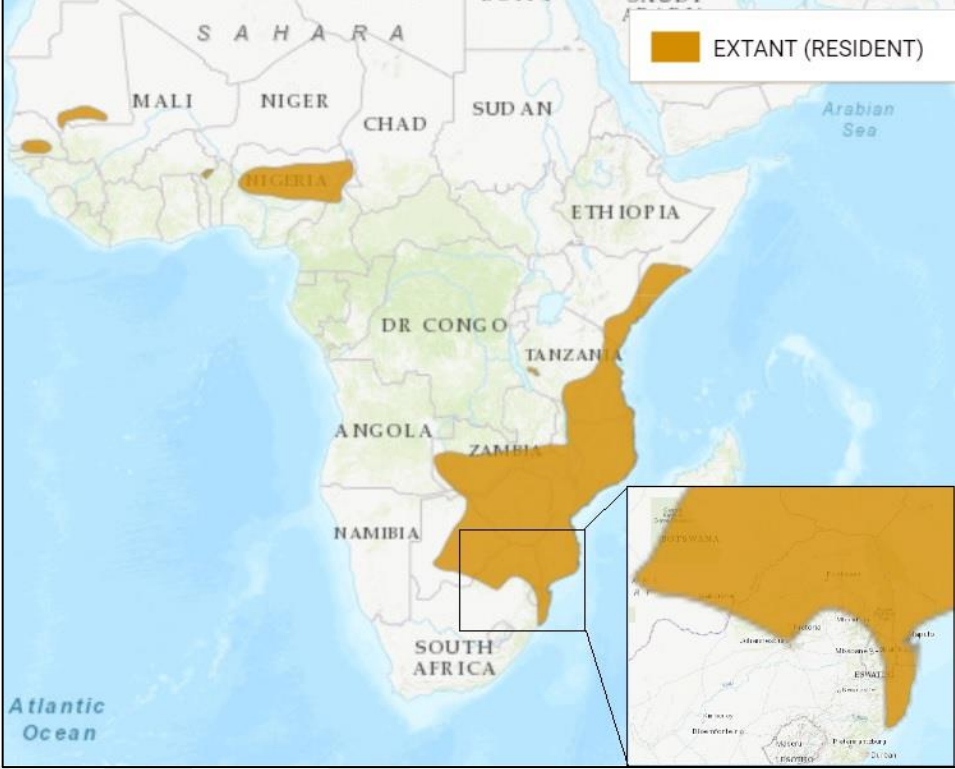


African Bullfrog ( <i>Pyxicephalus edulis</i> )	
Photographs from site	
	
Other Common Names	Lesser Bullfrog Edible Bullfrog Bushveld Bullfrog
Conservation status <sup>2</sup>	IUCN Red List    Least Concern. Population is considered to be declining
	CITES                Not listed
	National Status    No National status listing. Listed as a protected species under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Description <sup>5</sup>	<p>This species was formally synonymised with <i>P. adspersus</i> but was recognised as a separate species by Channing I (1994) on the clear basis of the difference in breeding behavior and call. Adults are also slightly smaller than <i>P. adspersus</i>. There is no reliable, diagnostic or morphological characteristics that make for easy differentiation, specifically in smaller specimens and juveniles although main differential between the 2 species is the tympanum markings, which is located closer to the eye and has a white spot in <i>P. edulis</i>.</p>  <p style="text-align: center;">Tympanum marking</p>
Ecology and habitat <sup>2 and 3</sup>	<p><u>Ecology</u> Like <i>Pyxicephalus adspersus</i>, <i>P. edulis</i> is considered a fossorial species, spending up to 10 months at the start of the rains. Breeding takes place at night after heavy rainfall and within temporary pans or pools of water. Egg and tadpole guarding was observed within this species as well as channel construction by males</p>

<sup>5</sup> Information compiled from FrogMAP (2021)







	<p>within a population in the Kruger National Park. Food source includes a variety of invertebrates and small vertebrates, including small rodents, birds and other frog species.</p> <p><u>Habitat</u>  <i>Pyxicephalus edulis</i> inhabits several bushveld vegetation types within the Savanna biome including flat, low-lying areas in open, grassy woodlands that become flooded during heavy rainfall resulting in ponding within shallow, seasonal pans. These seasonal pans are considered prime breeding habitat for this species and can support large populations within the surrounding landscape. Roadside furrows, agricultural dams and garden ponds are also known to house this species.</p>
<p>Distribution and range<sup>3 and 5</sup></p>	<p>The distribution of this species varies slightly from that of <i>P. aderspersus</i>, with a smaller distribution within South Africa, largely restricted to the Limpopo Province. with the distribution pulling down the eastern border of South Africa into Swaziland and eastern KwaZulu-Natal.</p>  <p>A smaller species, <i>Pyxicephalus edulis</i> occupies a smaller range in southern Africa, from Zimbabwe and northern south Africa to Botswana, Mozambique and Zambia.</p>
<p>Knowledge Gap</p>	<p>Fairly recent separation between <i>Pyxicephalus aderspersus</i> and <i>Pyxicephalus edulis</i> has been identified (1994), however, some literature still refers to this species as <i>P. aderspersus</i>.</p>
<p>Threats</p>	<ul style="list-style-type: none"> <li>Same as listed for <i>P. aderspersus</i> in table above.</li> </ul>




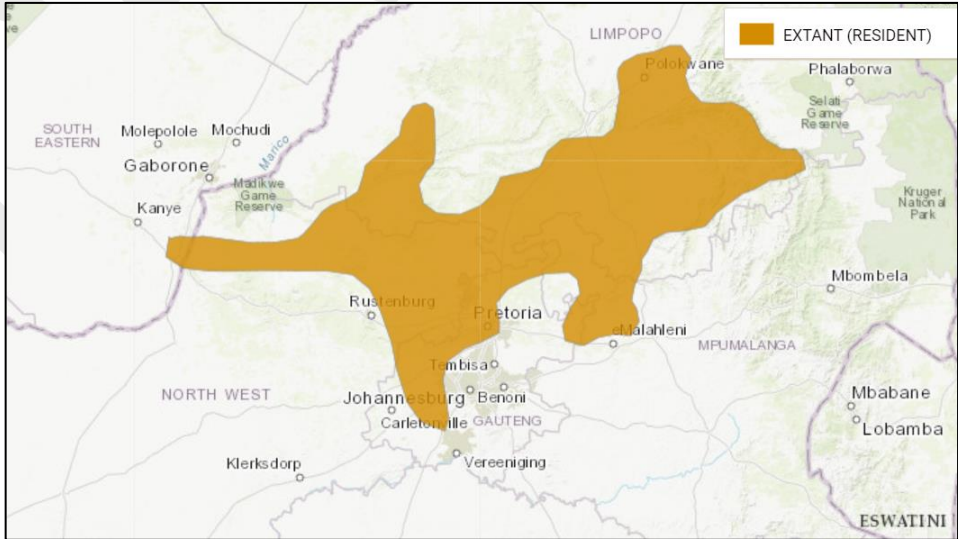
**Table 3: Description of SCC within the class Reptilia**

Southern African Python ( <i>Python natalensis</i> )		
Representative Photographs		
		
Other Common Names	African Rock Python	
Conservation status <sup>2</sup>	IUCN Red List	Not evaluated
	CITES	Appendix II
	National Status	Listed as a protected species under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Description <sup>6</sup>	<p><i>Python natalensis</i> is the largest native snake in Africa, averaging 3- 5m in length. It has a relatively small, triangular head (when compared to its body size) that has irregular scales that are typically black to brownish-grey in colour. The head also has two light-coloured bands that form a spearhead shape from the snout to the back of the head just above the eyes. The body is yellowish, grey-brown, or grey-green, with dark blotches that form a staircase-like pattern on the back. Belly scales are a white colour with black specks producing a salt-and-peppery pattern. On the tip of the tail, there are two dark bands that are separated by a lighter band. Juveniles are more brightly marked than adults.</p> <p>It has been noted that individuals found in the central and western parts of Africa are somewhat more brightly marked than their northern, eastern and southern counterparts.</p>	
Ecology and habitat <sup>6</sup>	<p><u>Ecology</u></p> <p><i>Python natalensis</i> are fairly solitary, seeking their own kind only during the breeding season. Although primarily nocturnal as adults, rock pythons may be active during the day to bask in the sun for thermoregulation. Juveniles, however, are mostly active at dawn and dusk, preferring to retreat to the safety of a rock formation or hollow tree during the day and night. Reproduction usually occurs in Spring, where the female will lay between 20 and 100 eggs (frequently documented within burrows, termite mounds or caves). Female provides maternal care to the eggs until hatching (approximately 90 days later) through incubation and protection of the eggs from predators.</p> <p><i>P. Natalensis</i> primary food source is a variety of large rodents, monkeys, small antelope, birds and other reptile species. Some documented records include them eating cubs of large carnivorous wildlife such as lions, leopards, hyena and wild dog. In instances where the species interacts with humans, it has been known to eat small livestock, poultry as well as domestic pets.</p> <p><u>Habitat</u></p> <p>Species stays on the ground (given their large body size) but have been known to climb if the need arises. This species prefers open savannahs where they often frequent rocky outcrops, although</p>	

<sup>6</sup> Information compiled from Animal Diversity Web (2021)

	<p>association with watercourses is strongly recorded. Also utilise mammal burrows in less rocky areas. This species has been known to easily adapt to disturbed habitats so are often found around human habitation, where food sourced may be high.</p>
<p>Distribution and range<sup>3 and 4</sup></p>	<p>African rock pythons occur throughout sub-Saharan Africa, although they avoid the driest deserts and the coolest mountain elevations. Two subspecies are recognised:</p> <ol style="list-style-type: none"> <li>1. <b><i>Python sebae sebae</i></b>, northern African rock python - found from south of the Sahara to northern Angola, and from Senegal to Ethiopia and Somalia (distribution indicated in green below).</li> <li>2. <b><i>Python natalensis</i></b>, southern African rock python - found from Kenya and Zambia southwards to South Africa, predominantly within the eastern extent of the country (distribution indicated in red below).</li> </ol> 
<p>Knowledge Gap</p>	<p>Home ranges of these species are largely unknown.</p>
<p>Threats</p>	<ul style="list-style-type: none"> <li>• Habitat loss, resulting in most frequent engagement with humans which result in fatalities due to human fear or due to posing a threat to livestock.</li> <li>• Hunted for medicinal purposes, bushmeat as well as their leather.</li> <li>• Collected for the pet trade.</li> </ul>




Lobatse Hinge-back Tortoise ( <i>Kinixys lobatsiana</i> )		
Photographs from site		
		
Other Common Names	Lobatse Hinged Tortoise	
Conservation status	IUCN Red List	Vulnerable. Population is considered to be declining
	CITES	Appendix II (as Testudinidae spp)
	National Status	None.
Description <sup>7</sup>	<i>Kinixys lobatsiana</i> has an elongated shell is dorso-ventrally flattened and the carapace has a broken rayed pattern (often absent in males) on a buff to brown background.	
Ecology and habitat <sup>7</sup>	<p><u>Ecology</u> Activity is highest during the summer rainfall season and it appears to brumate in abandoned animal burrows or rock crevices in winter. This species is sexually dimorphic, with females being larger and heavier than male counterparts. with females laying up to 6 eggs per clutch (based on record from captive kept individuals).</p> <p><u>Habitat</u> <i>Kinixys lobatsiana</i> is a savanna species that inhabits rocky hillsides in habitats of mixed <i>Acacia</i> and <i>Combretum</i> woodland, tropical Bushveld and Thornveld, where vegetation ranges from dense, short shrubland to open tree savanna. This Species is omnivorous and apart from feeding on herbaceous plants, fruits and mushrooms, its diet includes beetles, snails, and millipedes.</p>	
Distribution and range	<p><i>Kinixys lobatsiana</i> is near-endemic to South Africa to southern africa with the distribution within South africa, through the Gautemng, Mpumalanga, North West and Limpopo Provinces, and a small area of Botswana into the Lobatse District.</p>  <p>The total estimate extent of occurrence is 93 017 km<sup>2</sup> with a recorded continual decline in population size.</p>	

<sup>7</sup> Information compiled from Animal Diversity Web (2021)



Knowledge Gap <sup>9</sup>	To date there is no direct population information available to quantify population numbers. Population decline is thus extrapolated based on documented loss and degradation of available habitat.
Threats <sup>8</sup>	<ul style="list-style-type: none"> <li>Distribution falls mainly within Limpopo, for which 15% of the land cover is considered developed or degraded. The remaining 85% of its natural habitat includes the Kruger National Park, where it does not occur. Thus, the species is under threat by any additional habitat changes as a result of urbanisation, agriculture and mining activities. The following summary is relevant: <ul style="list-style-type: none"> <li>20 % of the species habitat has been destroyed or degraded over the past 35-40 years.</li> <li>This is estimated to reach 30 % over the next 30 years.</li> </ul> </li> <li>Use of fire for livestock and biodiversity management may kill large numbers of tortoises.</li> <li>Population isolation due to preference of rocky hillsides and outcrops when movement corridors are degraded and destroyed.</li> <li>Collected as food, for medicinal and cultural purposes and in the pet trade resulting in local extinctions.</li> <li>Slow population growth as females only reach sexual maturity around 9 years of age (based on available research found for <i>K. speki</i>)<sup>9</sup>.</li> </ul>

**Table 4: Description of SCC within the class Arachnida.**

<i>Ceratogyrus darlingi</i> and <i>Harpactira</i> sp.	
Representative Photographs <sup>10</sup> : <i>Ceratogyrus darlingi</i> (a) (Left), <i>Harpactira curator</i> (b) (Middle), and <i>Harpactira gigas</i> (c) (Right).	
	
Other Common Names	A: Rear-horned Baboon Spider B: Malvern Starburst Baboon Spider C: Common Baboon Spider
Conservation status <sup>2</sup>	IUCN Red List   Not yet evaluated.
	CITES   Not Listed.
	National Status   Listed as Near Threatened within South Africa. Listed as a protected species under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).
Description <sup>11</sup>	<p>a: This species reaches a body length of about 13 cm and can be ashy grey, mud brown or black. The peltidium features a black foveal horn.</p> <p>b: Females of this species reach about 14 cm, while males may be up to 11 cm. They display a starburst pattern radiating in light brown lines on a dark brown carapace.</p> <p>c: Females reach 5.5 cm and are slightly larger than the males. This species has the typical starburst pattern radiating in light brown lines on a dark brown carapace.</p>
Ecology and habitat	<b>Ecology and Habitat</b> These species inhabit silk-lined burrows from which they hunt invertebrates and small vertebrates in semi-arid areas, seldomly leaving their burrows. Species inhabits grassland, Bushveld and Lowveld habitat.
Distribution and range <sup>12</sup>	a: Records from Kruger National Park, Klaserie and Sabi Sands Private Nature reserves within Limpopo Province (De Wet and Schoonbee, 1991).

<sup>8</sup> Hofmeyr, M.D & Boycott, R.C (2018)

<sup>9</sup> Coulson, I.M., A. Hailey. 1997

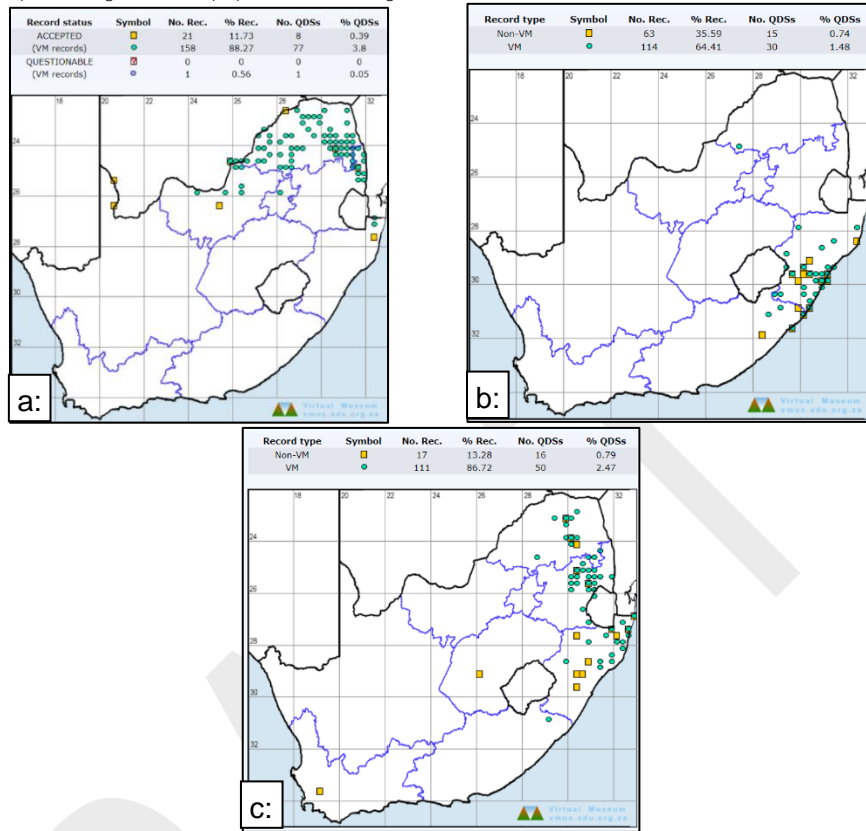
<sup>10</sup> Pictures taken from <https://www.tarantupedia.com/harpactirinae/ceratogyrus/ceratogyrus-darlingi>

<sup>11</sup> Information gleaned from <https://www.inaturalist.org/taxa/548218-Ceratogyrus-darlingi>

<sup>12</sup> Map taken from [http://vmus.edu.org.za/vm\\_sp\\_summary.php](http://vmus.edu.org.za/vm_sp_summary.php)



b: This species has a single record near Thabazimbi while the major distribution range lies within Kwa-Zulu Natal and northern Eastern Cape.  
 c: This species has a large range which encompasses northern Eastern Cape, Kwa-Zulu Natal, Mpumalanga and Limpopo within the region.



**Knowledge Gap** No direct population information available to quantify population numbers. Limited studies have further been undertaken on these species life history and ecology.

**Threats**

- Collection for the international pet trade (De Wet and Schoonbee, 1991).
- Habitat loss through human land use transformation is also surely another primary threat to these species.

***Opisthophthalmus glabrifrons*, *Opisthacanthus asper* and *Hadogenes troglodytes***

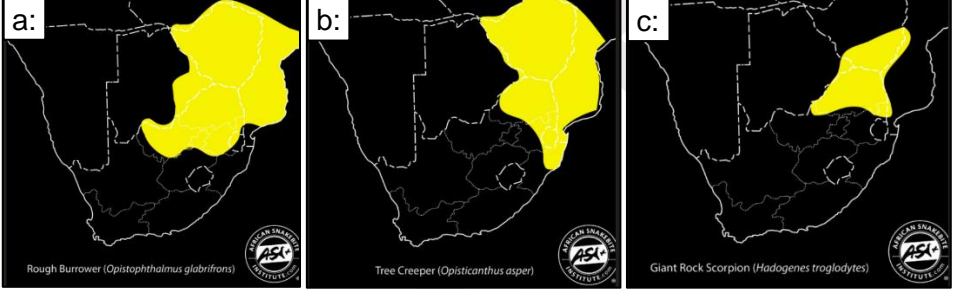
Photographs<sup>13</sup> Left to Right: *Opisthophthalmus glabrifrons* (a), *Opisthacanthus asper* (b) and *Hadogenes troglodytes* (c).



Other Common Names	a: Rough Burrower b: Tree Creeper c: Giant Rock Scorpion	
Conservation status <sup>2</sup>	IUCN Red List	None of the species have been assessed by the IUCN
	CITES	Not listed
	National Status	No National status listing. Listed as a protected species under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004).

<sup>13</sup> Pictures taken from <https://www.africansnakebiteinstitute.com/>



Description <sup>14</sup>	<p>a: Large scorpion of about 12 cm in length. Can be dark to light brown or even dark orange/yellow with light yellow legs. The head is normally light brown in colour. Pincers are pale brown with dark tips.</p> <p>b: A large scorpion of reaching around 10 cm with the tail extended. The pincers are black with orange or yellow legs and stinger. The species has large black pincers.</p> <p>c: This is the largest species of scorpion in Africa. It is usually black or dark brown and occasionally has yellow legs.</p>
Ecology and habitat <sup>15</sup>	<p><u>Ecology and Habitat</u></p> <p>a: This is a burrowing species that will excavate under rocks or within open grassland. It is active on warm nights. Normally found in grassland or bushveld habitat in rocky areas.</p> <p>b: This species can be found under the bark of trees or in locations around trees at night. The species hunts from the crevices under the bark of trees.</p> <p>c: This species occurs in rocky areas where it inhabits cracks between rocks. Normally on hills and in mountain ranges.</p>
Distribution and range <sup>3 and 4</sup>	
Knowledge Gap <sup>1</sup>	<p>Few species specific studies on life history or ecology have been undertaken on the species. Most literature involving scorpions in southern Africa revolves around their biogeography, taxonomy and their venom</p>
Threats	<p>Threats are likely land-use change, collecting for the pet trade and improper fire regimes.</p>

### 3 REMEDIATION ACTION PLAN

In order to minimise impacts on individual species as a result of the construction of the proposed pipeline, rescue and relocation actions must be implemented during the construction phase to ensure all measures are implemented to ensure maximum survivability of individuals. Although the focus is predominantly on SCC, other common species that have a low mobility (tortoises, chameleons, baboon spiders and scorpions) should also be moved out of the construction area. It is further important that fire NOT be used as a tool to clear vegetation as this will increase mortality of less mobile species and further risk surrounding landscapes.

The following sections consider the requirements that must be undertaken for general herpetofauna while section 3.2 provides a detailed list of requirements for the four SCC.

<sup>14</sup> Pictures taken from <https://www.africansnakebiteinstitute.com/>

<sup>15</sup> Pictures taken from <https://www.africansnakebiteinstitute.com/>



### 3.1 General Herpetofauna and Invertebrate Species

Various herpetofauna and invertebrate species were observed during the site visit undertaken and must also be considered as part of this remediation action plan. During active searching (as per the details indicated in Section 3.2 below for SCC), which must be undertaken prior to commencement of construction (the day before and the same day), other common species should also be flushed out of the construction zone.

A drift fence with intermittent pitfall traps and 20 m intervals (refer to Table 3 in Section 3.2 for the exact specifications associated with the installation, maintenance and movement of the drift fence) must encompass the entire segment associated with active construction (i.e. if the pipeline trench will be excavated for 500 m, then the drift fence must encompass the trench length and provide sufficient space on either side for the construction equipment).



**Figure 1: Example off how drift fences must encompass the active construction segment of the pipeline.**

Venomous snake, scorpion and spider species are highly likely and as such it is recommended that a suitably qualified Environmental Control Officer (ECO) be appointed to oversee all rescue and relocation works. A suitable snake handling course must be undertaken by all individuals involved in search and rescue as snake species may also be present during the construction works (most snakes are largely mobile and move large distances in search of food). No herpetofauna or invertebrate species may be killed or collected during this project.

Smaller, less mobile species such as tortoises and chameleons must be actively collected and moved out of the construction zone (as per the methods recommended in Table 5 for the Lobatse Hinge-backed tortoise). Special attention as indicated within Table 7 should be paid to *Ceratogyrus darlingi* (Rear horned Baboon Spider). Other scorpions and Baboon-spiders should be safely collected with the use of suitable gloves and released in similar habitat nearby. Some common species identified during the site visit are illustrated in Figure 2 below.







Figure 2: Common herpetofauna and invertebrates found during the site assessment (top left to right); Kalahari Dwarf Worm Lizard (*Zygaspis quadrifrons*), Bubbling Kassina (*Kassina senegalensis*) and Raucous Toad (*Amietophrynus rangeri*); (2<sup>nd</sup> row), Bushveld Sand Lizard (*Heliobolus lugubris*); (3<sup>rd</sup> row left to right) Leopard tortoise (*Stigmochelys pardalis*) and Spekes Hinge-back Tortoise (*Kinixys spekii*); and (bottom left to right) Transvaal Thickettail Scorpion (*Parabuthus transvaalensis*) and lesser baboon spider (*Harpactirella* sp).



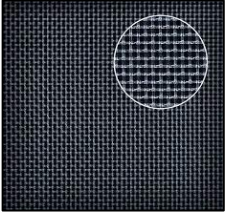
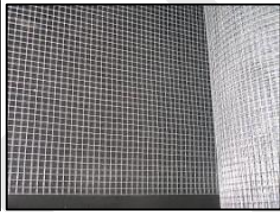

### **3.2 SCC Rescue and Relocation Plan**

The following dashboards provide all relevant information pertaining to the rescue and relocation of the SCC. Other snake species or tortoise species can be relocated using the same methodology as provided for the African Rock Python and the Lobatse Hinge-backed Tortoise respectively. For arachnids only *Ceratogyrus darlingi* (Rear horned Baboon Spider) requires specific methods as stated in Table 8 with regard to its relocation. The same methods may be applied to other baboon spiders, yet, these and scorpions may simply be relocated beyond the drift fence in similar habitat.

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**Table 5: Specifications related to the installation, maintenance and movement of the required drift fence.**

Erection of drift fencing	
Need and Desirability	<ul style="list-style-type: none"> <li>Drift fences are necessary to prevent individuals SCC from accessing the construction site as well as to prevent individuals already removed from the construction area from re-entering the construction area.</li> <li>Prevent the need for any relocation permits as SCC will remain within the general area, only being displaced temporarily until the trenches have been backfilled.</li> <li>Prevent herpetofauna and arachnids from getting trapped within the open trench and collision with construction equipment which would result in individual fatalities.</li> </ul>
Barrier fence design	
Equipment requirements	<p>i. Fencing should be impervious and can be done using plastic meshing, shade cloth, nylon netting (holes may not exceed 2 cm) or hardware cloth (whatever is easily available) which can be reused and moved according to the construction progress.</p> <div style="display: flex; justify-content: space-around;">    </div> <p><i>Examples of fencing material suitable (left) plastic meshing; (middle) nylon meshing (right) hardware cloth.</i></p> <ul style="list-style-type: none"> <li>ii. Wooden stacks or steel droppers (as per fence design details). 500 droppers/stakes will be required per kilometre.</li> <li>iii. Cable ties or wire to attach fencing to the stakes.</li> <li>iv. 50 Buckets (20cm in height)</li> </ul>
Required Actions (responsibility of the ECO who should delegate as appropriate)	
<ul style="list-style-type: none"> <li>i. Drift fences with pitfall traps (20m intervals) must be erected on either side of the construction area (this does not have to be the entire servitude, only the area wherein trenching will occur plus the construction buffer (estimated at 40 m in total width) PRIOR to the commencement of construction and can only be removed once the excavations have been backfilled and suitably compacted, and all large construction equipment has been removed from the area.</li> <li>ii. The drift fence MUST be erected around the entire active construction area (for whatever distance the trenching will be done). This includes behind and in front of the active works to stop species entering into the construction zone and not being able to move.</li> <li>iii. Wooden stakes or steel droppers must be erected at 2 m intervals and must be hammered into the ground to be stable. Suitable fencing material (see equipment section) must be attached to the stakes and material must be weighed down on the ground using cobbles or logs (whatever is accessible) to ensure no species can easily pass below the fence. Pitfall traps (buckets) must be dug into the soil at 20 m intervals and the soil should lie even with the edges of the buckets once in place.</li> <li>iv. Drift fences must remain until trench backfilling has been undertaken and suitable compaction of earth. Only once works are completed and the construction equipment has moved out of the area may the drift fences be removed.</li> <li>v. Drift fences must remain in good working order. Fencing materials that have large holes in them must be replaced and stakes that are broken/bent or any damage as a result of the construction activities must also be replaced. The drift fence must remain impermeable at all times to ensure maximum success of preventing species from entering the active construction area. Pitfall traps and the drift fence must be checked daily for the presence of herpetofauna and arachnids.</li> <li>vi. Construction equipment must remain in the construction area and may not damage or drive over any drift fencing.</li> </ul>	
Examples of drift fences used in the field	
<p>(left) plastic sheeting drift fence and (right) shade cloth drift fences to ensure construction area is cordoned off from the remaining landscape.</p>	





**Table 6: Actions for the rescue and relocation of the Giant and lesser Bullfrog.**

Rescue and Relocation of <i>Pyxicephalus adspersus</i> and <i>P. edulis</i>	
	<p><u>Key Information relevant to the species</u> Will be above ground between October and March (most active between November and January) during or after heavy rainfall. Be aware of mature adults moving to breeding sites.</p>
	<p><u>Breeding sites:</u> Seasonally wet areas associated with wetlands. Pay special attention to areas near wetlands. Can forage up to 1 km from breeding site.</p> <p>Aestivate between April and September. Unlikely to find many species above ground. Be on the look out for Cocoon during excavation works.</p> <p><u>Burrowing sites:</u> Usually in sandy alluvial soils between 0,1- 1 m in depth. Pay special attention to areas where soils are sandy.</p>
<p>Timeframes &amp; specifications</p>	<ul style="list-style-type: none"> <li>Barrier fences must be erected prior to rescue and relocation activities.</li> <li>Active searching and relocation of individuals must be undertaken ON THE DAY PRIOR TO AND ON THE DAY OF CONSTRUCTION COMMENCEMENT.</li> <li>All staff undertaking the works must be on-hand and available.</li> <li>Relocation of individuals during excavation works. Staff must be on hand during active construction to collect and move any specimens</li> </ul>
<p style="text-align: center;"><u>Identification of "hotspot areas"</u></p>	
<p>Specific attention must be paid to areas within a 1 km radius of any depression wetlands as these are used during breeding season for foraging and in search of mates. Hotspot zones should be demarcated along the length of the servitude and mapped prior to commencement of construction. All personnel must be made aware when entering these hot-spot zones to be on the look out for individuals.</p>	
<p>Equipment &amp; requirements</p>	<ol style="list-style-type: none"> <li>Gloves and spades to catch and move individuals.</li> <li>Clean buckets with River sand and a damp cloth to temporarily house individuals. Buckets should have a lid and have breathing holes.</li> <li>Log all findings in a daily record sheet (see Appendix A).</li> <li>Include findings into a monthly ECO report.</li> </ol>
<p style="text-align: center;"><u>Required Actions (responsibility of the ECO who should delegate as appropriate)</u></p>	
<ol style="list-style-type: none"> <li>A walkdown should be undertaken within the active segment once all barrier fences have been erected, for the section of servitude that will be excavated. Walkdowns should be done in a zigzag pattern to maximise transects sizes and likelihood of finding individuals.</li> <li>Any individuals found during walking the transects must be carefully picked up with both hands (gloves can be used as individuals may bite). Hold individuals around the middle letting the limbs hand free to prevent the frog from pushing itself out. Injured frogs must also be rescued.</li> </ol>	
<ol style="list-style-type: none"> <li>Place individuals in the bucket and close the lid. Bucket should have a damp cloth in (not wet) if individuals are to be housed for an extended period of time (longer than one hour). Individuals can then be moved and released on the other side of the barrier fence, on the outside of the servitude. Consideration must be given to where the closest wetland is that individuals could have come from/ been moving to and individuals should be placed on that side of the drift fence (i.e. closest pan wetland to the north of construction, thus all individuals must be released north of the drift fence).</li> </ol>	
<ol style="list-style-type: none"> <li>If a bullfrog cocoon is excavated out during the trenching activities, construction works should stop, and the cocoon should be sprayed down with clean water to loosen the ground around it so that the frog can be easily picked up. Do not spray water directly onto the cocoon as this will damage it.</li> <li>Should individuals have been injured as a result of the excavation works, they should be seen to by a suitably qualified wildlife vet and rehabilitated at a suitably qualified rehabilitation facility. GPS locations of where the individual was collected must be taken to ensure individual is re-released in the same location once successfully rehabilitated.</li> <li>Should cocoons be intact and individuals not require medical attention, follow steps ii and iii for relocation.</li> <li>Cocooned individuals will need to be re-buried outside of the servitude. Loosen an area of approximately 2 m<sup>2</sup> and at minimum 500 mm deep (depending on the depth they were dug-up). Place frog gently in the excavated area and then partially cover with soil (approximately 300mm)</li> <li>DO NOT COMPACT OVER THE COCCON and do not disturb once buried. Allow the frog to conceal itself in its own time within the loosened area.</li> </ol>	





**Table 7: Actions for the rescue and relocation of the African Rock Python (and other snake species that may be encountered within the construction area.**

Rescue and Relocation of <i>Python natalensis</i>		Required Actions (responsibility of the ECO who should delegate as appropriate)
	<p><u>Key Information relevant to the species</u></p> <ul style="list-style-type: none"> <li>Individuals can grow up to 5 m in length.</li> <li>Breeding occurs in Spring between September and December. Likely see an increased movement in species. Females likely to be in burrows, rock crevices or caves.</li> <li>Young hatch approximately 90 days later, between December and March and will leave the nest.</li> <li>Brumation of species during winter is likely. Species will likely remain underground, within termite mounds or sometimes within water resources.</li> </ul>	<ul style="list-style-type: none"> <li>A walkdown should be undertaken for the entire length of the pipeline within the construction area (bounded by the drift fence) as well as any laydown areas or borrow pits prior to commencement of construction works. Walkdowns should be done in a zigzag pattern to maximise transects sizes and likelihood of finding individuals.</li> <li>Individuals can be flushed out. Transects must look under any large rock piles or in dense vegetation tufts. A stick can be used to move vegetation.</li> <li>Should a burrow be encountered, every effort should be made to flush out anything that may be within the burrow to prevent burial once excavation works commence. If possible (and feasible) a snake camera can be used to detect if any faunal species are within the burrow. Should a python species be located within, digging out the individual can be undertaken.</li> </ul>
<p>Timeframes &amp; specifications</p>	<ul style="list-style-type: none"> <li>Active searching and relocation of individuals must be undertaken ON THE DAY PRIOR TO AND THE DAY OF CONSTRUCTION COMMENCEMENT. All staff undertaking the works must be on-hand and available.</li> <li>Relocation of individuals during excavation works, especially if termite mounds or burrows will be demolished. Any individuals uncovered during excavations must be relocated out of the servitude.</li> </ul>	<ul style="list-style-type: none"> <li>Any individuals found during walking the transects must be picked up (more than one person may be required for larger individuals) and bagged or placed in a suitably sized container. Hold individuals behind the head with one hand to prevent snake being able to bite. Although non-venomous they can give a nasty bite.</li> <li>Place individuals in the suitably sized container and close the lid. Individuals can then be moved and released on the other side of the barrier fence, although it is recommended they be released away from the construction area as they may move back to the area if released too close.</li> </ul> 
<p>Equipment &amp; requirements</p>	<ul style="list-style-type: none"> <li>ECO to undertake the searching protocol must have undertaken a snake handling course and understand the correct handling techniques and use of all tools.</li> <li>Snake pole to assist in catching individuals.</li> <li>Gloves to handle individuals.</li> <li>Cloth bag or clean container used to temporarily house individuals. Containers should have a lid and have breathing holes.</li> <li>Log all findings in a daily record sheet (see Appendix A).</li> <li>Include findings into a monthly ECO report.</li> </ul> <p><u>If eggs are found:</u></p> <ul style="list-style-type: none"> <li>A small container lined with paper towelling.</li> <li>It is imperative that the eggs be placed into the container in the same orientation that they were in the nest. Do not ever rotate the egg. This can destroy the contents of the egg. Instead, mark the egg with a felt tip marker so to easily determine where the top of the egg is and not twist it or turn it. Move eggs very gently and be sure to keep the part that was on top at the top.</li> </ul>	<ul style="list-style-type: none"> <li>If any individuals are discovered during trenching works, excavations must stop and the handler must collect the snake as per step iii above. Any individuals that have been injured must receive adequate veterinary assistance prior to release. Any eggs uncovered must be collected and should be taken to a reptile facility (along with the female if possible) until eggs hatch.</li> <li>GPS co-ordinates of where any eggs were located should be taken and once eggs have hatched, they should be released at or near the same location.</li> </ul>





**Table 8: Actions for the rescue and relocation of the Lobatse Hinge-back tortoise (and other tortoise species found during the site walkdown).**

Rescue and Relocation of <i>Kinixys lobatsiana</i>		Required Actions (responsibility of the ECO who should delegate as appropriate)
	<p><u>Key Information relevant to the species</u></p> <ul style="list-style-type: none"> <li>• Most active during summer (between December and April).</li> <li>• Eggs are laid within a nest, dug down approximately 10 cm and re-buried by the female.</li> <li>• Incubation takes approximately 145 days (based on average time recorded for captive spp) before hatchlings emerge. Will be approximately 45 mm in size.</li> <li>• Brumates in winter within rock crevices or abandoned burrows.</li> </ul>	<ul style="list-style-type: none"> <li>i. A walkdown should be undertaken for the entire length of the pipeline within the construction area (bounded by the drift fence) as well as any laydown areas or borrow pits prior to commencement of construction works. Walkdowns should be done in a zigzag pattern to maximise transects sizes and likelihood of finding individuals.</li> <li>ii. Any individuals found during walking the transects must be picked up and placed in a suitably sized container. Care must be taken to check under any vegetation (low lying shrubs and grass turfs) where individual might be located (specifically during the hottest time for the day, individuals may take refuge in the shade).</li> <li>iii. Place individuals in the suitably sized container and close the lid. Individuals can then be moved and released on the other side of the barrier fence.</li> <li>iv. Care must be taking when clearing vegetation for the trenching. Vegetation should be stockpiled separately from soil and should not exceed 2m in height to allow any individuals that may have been displaced during clearing the opportunity to move away.</li> <li>v. The ECO must monitor all vegetation stockpiles and collect and relocate any tortoises that may emerge. This is of specific importance for smaller juvenile individuals that may have been easily missed during the active search and rescue.</li> </ul>
<p>Timeframes &amp; specifications</p>	<ul style="list-style-type: none"> <li>• Active searching and relocation of individuals must be undertaken ON THE DAY PRIOR TO AND THE DAY OF CONSTRUCTION COMMENCEMENT. All staff undertaking the works must be on-hand and available.</li> <li>• Relocation of individuals during excavation works, especially if termite mounds or burrows will be demolished. Any individuals uncovered during excavations must be relocated out of the servitude.</li> </ul>	 <p><i>Vegetation cleared at a construction side. Tortoise sp displaced during vegetation removal, leaving the stockpile (circled in red).</i></p> <ul style="list-style-type: none"> <li>vi. Any eggs unearthed must be collected and housed in a container with suitable bedding (and must remain between 25 °C and 30 °C) until they can be taken to a suitable reptile facility that can incubate and hatch the eggs. Once hatched, all hatchlings should be released back to the area where they were collected.</li> </ul>
<p>Equipment &amp; requirements</p>	<ul style="list-style-type: none"> <li>i. Stick to assist in moving vegetation for easy visibility.</li> <li>ii. Gloves to handle individuals.</li> <li>iii. Clean container used to temporarily house individuals. Containers should have a lid and have breathing holes.</li> <li>iv. Log all findings in a daily record sheet (see Appendix A).</li> <li>v. If possible, individuals of <i>K. lobatsiana</i> should be weighed and measured for research purposes as there is limited information available on wild populations.</li> <li>vi. Therefore, a kitchen scale and tape measure should be available.</li> <li>vii. Include findings into a monthly ECO report.</li> </ul> <p><u>If eggs are found:</u></p> <ul style="list-style-type: none"> <li>i. A small container lined with paper towelling to fit all eggs.</li> <li>ii. It is imperative that the eggs be placed into the container in the same orientation that they were in the nest. Do not ever rotate the egg. This can destroy the contents of the egg. Instead, mark the egg with a felt tip marker so to easily determine where the top of the egg is and not twist it or turn it. Move eggs very gently and be sure to keep the part that was on top at the top.</li> </ul>	



**Table 9: Actions for the rescue and relocation of the *Ceratogyrus darlingi* (Rear horned Baboon Spider).**

Rescue and Relocation of <i>Ceratogyrus darlingi</i> and <i>Harpactira</i> sp. (this method may also be utilized for any other baboon spiders).	
	Key information relevant to the species
	 <ul style="list-style-type: none"> <li>This is a fast and defensive species with potent venom.</li> <li>Night searches with Ultraviolet light torches are recommended for scorpion searches.</li> <li>These species seldomly leave their burrows and will not venture far from them.</li> <li>Most active during summer.</li> <li>Eggs laid within the burrow. Upon hatching spiderlings will remain in the burrow for several weeks before leaving. They will then begin the construction of their own burrow or utilize leaf litter to burrow between.</li> </ul>
	Required Actions (responsibility of the ECO who should delegate as appropriate)
Timeframes & specifications	<ul style="list-style-type: none"> <li>Active searching and relocation of individuals must be undertaken within a month of the proposed development construction phase. Only suitably qualified or suitably trained individuals may excavate spiders from their burrows.</li> <li>Relocation of individuals during excavation works should occur beyond the drift net in a location similar in substrate structure and texture; soil moisture; vegetation type and density; food-source availability (invertebrates) and vegetation canopy cover. The individuals should be monitored for three (3) months after they have accepted their new burrows.</li> </ul>
Equipment & requirements	<ul style="list-style-type: none"> <li>Stick to assist in moving vegetation for easy visibility.</li> <li>Gloves to handle individuals.</li> <li>A large and small spade to excavate burrows.</li> <li>Small soil augers of varying diameters from 10 mm to 30 mm.</li> <li>Steel cages (30cm x 30cm x 7cm). Should allow for the movement of small invertebrates, into and out of the cage.</li> <li>Clean container used to temporarily house individuals. Containers should have a lid and have breathing holes.</li> <li>Log all findings in a daily record sheet as provided in Appendix A.</li> <li>Include findings into a monthly ECO report.</li> </ul>
	<ul style="list-style-type: none"> <li>A walkdown should be undertaken for the entire length of the pipeline within the construction area (bounded by the drift fence) as well as any laydown areas or borrow pits prior to commencement of construction works for each relevant section. Transects should be planned within all areas where vegetation will be removed or disturbed and searched for burrows to maximise the likelihood of finding individuals.</li> <li>Any individuals found within the transects must be safely excavated and placed within a temporary storage container. All habitat characteristics information (substrate structure and texture; soil moisture; vegetation type and density; food-source availability (invertebrates) and vegetation canopy cover) must be recorded. A location of similar characters beyond the barrier fence must be selected for relocation and the GPS co-ordinates must be logged.</li> <li>At the chosen relocation site place a steel cage over on the ground (Image right E Yeld, 2013).</li> <li>Auger two holes of appropriate sizes 20 cm into the ground.)</li> <li>Gently place the spider onto the ground within the protective cage.</li> <li>Monitoring of the acceptance and survival rate of the spiders should be recorded by the specialist undertaking the relocation.</li> <li>Monitoring of pitfall traps should occur daily during construction and any specimens besides <i>Ceratogyrus darlingi</i> (Rear horned Baboon Spider) may be released 30 m beyond the barrier fence in similar habitat to what the specimens were found in.</li> </ul> 



## 4 CONCLUSION

This remediation action plan provides detailed methodology for the rescue and relocation of various SCC if encountered within the construction footprint area. The installation, maintenance and movement of the drift fence is an integral factor into the success of this work and ensuring smaller species that are at increased risk of fatality within the construction zone, be prevented from accessing the area. Similarly, the establishment of the drift fence will reduce distances that rescued SCC need to be released (thus saving considerable time) and reduce the need to search out relocation sites. As such, the drift fence must remain in full working order at all times.

It is imperative that a suitably qualified ECO be appointed to oversee all activities as detailed herein and keep a daily log. A short monthly SCC rescue and relocation report should be compiled wherein the details of the SCC found and relocation details are reported (the daily record sheets must be appended). These reports must also provide feedback on the monitoring requirements as stated herein for relocated SCC. All monthly reports should be submitted to the relevant authorities.





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## APPENDIX A: Daily Record Sheet to be used

Species list:

- 1. African Bullfrog (*Pyxicephalus adspersus*) and/or Lesser Bullfrog (*Pyxicephalus edulis*)
- 2. Southern African Rock Python (*Python sebae*)
- 3. Lobatse Hingeback Tortoise (*Kinixys lobatsiana*)
- 4. Rear-horned Baboon Spider (*Ceratogyrus darlingi*)
- 5. Common Baboon Spiders (*Harpactira* sp.)
- 6. Rough Burrower (*Opisththalmus glabrifrons*)
- 7. Tree Creeper (*Opisthacanthus asper*)
- 8. Giant Rock Scorpion (*Hadogenes troglodyte*)
- 9. Other heptofaunal species, not of conservation concern

Table A1: Record sheet to be used during search and rescue to record all heptofaunal that were found within the servitude.

Record Sheet for SCC rescued and relocated				
Date:		Weather condition:		
Location (reference to nearest town):				
Species of Conservation Concern				
Species: (1 - 9as defined above)	Number: e.g. 6 individuals	GPS ordinates: (Deg, Min, Sec)	Co-	Notes: e.g. habitat, healthy adult found aboveground. Located within a burrow. Eggs collected – 6.



## APPENDIX B: Details, Expertise and Curriculum Vitae of specialists

### (i) Details of the specialist who prepared the report

Stephen van Staden	Msc (Environmental Management) (University of Johannesburg)
Christopher Hooton	BTech Nature Conservation (Tshwane University of Technology)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Daryl van der Merwe	MSc. Plant Science (University of Pretoria)

### (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Terrestrial Services		
Name / Contact person:	Stephen van Staden		
Postal address:	PO. Box 751779, Gardenview		
Postal code:	2047	Cell:	084 311 4878
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Accredited River Health practitioner by the South African River Health Program (RHP) Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum		

### . (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

- I act as the **independent specialist** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct

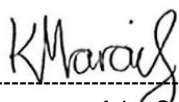


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Signature of the Specialist



I, Kim Marais, declare that -

- I act as the **independent specialist** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



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Signature of the Specialist

I, Christopher Hooton, declare that -

- I act as the **independent specialist (reviewer)** in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct.



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Specialist Signature

I, Daryl van der Merwe, declare that -

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the relevant legislation and any guidelines that have relevance to the proposed activity;
- I will comply with the applicable legislation;
- I have not, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct



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Signature of the Specialist





## SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

### CURRICULUM VITAE OF STEPHEN VAN STADEN

#### PERSONAL DETAILS

Position in Company	Managing Member, Group CEO, Water Resource Discipline Lead, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SEGC	2003 (year of establishment)
Founding Director: Scientific Terrestrial Services	2005
Other Business	Trustee of the Serenity Property Trust

#### MEMBERSHIP IN PROFESSIONAL SOCIETIES

- Ø Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
- Ø Accredited River Health Practitioner by the South African River Health Program (RHP)
- Ø Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
- Ø Member of the Gauteng Wetland Forum;
- Ø Member of International Association of Impact Assessors (IAIA) South Africa;
- Ø Member of the Land Rehabilitation Society of South Africa (LaRSSA)

#### EDUCATION

##### Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

##### Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

#### COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces  
 Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia  
 Eastern Africa – Tanzania, Mauritius  
 West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona  
 Central Africa – Democratic Republic of the Congo

#### DEVELOPMENT SECTOR EXPERIENCE

1	Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2	Linear developments (energy transmission, telecommunication, pipelines, roads)
3	Minerals beneficiation
4	Renewable energy (Hydro, wind and solar)
5	Commercial development
6	Residential development
7	Agriculture
8	Industrial/chemical





## SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

### CURRICULUM VITAE OF KIM MARAIS

#### PERSONAL DETAILS

Position in Company	Senior Scientist Water Resource Manager
Joined SAS Environmental Group of Companies	2015

#### MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP – Reg No. 117137/17)  
Member of the Western Cape Wetland Forum (WCWF)

#### EDUCATION

##### Qualifications

BSc (Hons) Zoology (University of the Witwatersrand)	2012
BSc (Zoology and Conservation) (University of the Witwatersrand)	2011

##### Short Courses

Aquatic and Wetland Plant Identification (Cripsis Environment)	2019
Tools for Wetland Assessment (Rhodes University)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013

#### KEY SPECIALIST DISCIPLINES

##### Biodiversity Assessments

- Biodiversity Action Plans (BAP)
- Alien and Invasive Control Plans (AICP)
- Faunal Eco Scans
- Faunal Impact Assessments

##### Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Watercourse Maintenance and Management Plans
- Freshwater Offset Plan

##### Aquatic Ecological Assessment and Water Quality Studies

- Riparian Vegetation Integrity (VEGRAI)
- Water quality Monitoring
- Riverine Rehabilitation Plans

##### Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions
- Public Participation processes





## SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

### CURRICULUM VITAE OF CHRISTOPHER HOOTON

#### PERSONAL DETAILS

Position in Company	Senior Scientist, Member Biodiversity Specialist
Joined SAS Environmental Group of Companies	2013

#### EDUCATION

##### Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

#### AREAS OF WORK EXPERIENCE

**South Africa** – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Free State

**Africa** - Zimbabwe, Sierra Leone, Zambia

#### KEY SPECIALIST DISCIPLINES

##### Biodiversity Assessments

- Floral Assessments
- Faunal Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Protected Tree and Floral Marking and Reporting
- Biodiversity Offset Plan

##### Freshwater Assessments

- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning





## SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

### CURRICULUM VITAE OF **DARYL VAN DER MERWE**

#### PERSONAL DETAILS

Position in Company	Field Biologist, Member Terrestrial Ecology
Joined SAS Environmental Group of Companies	2019

#### MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Environmental Observation Network (SAEON)

#### EDUCATION

##### Qualifications

MSc (Conservation Biology) (University of Cape Town)	2019
BSc (Hons) Plant Science (Ecology) (University of Pretoria)	2014
BSc Environmental Science (University of Pretoria)	2013

#### AREAS OF WORK EXPERIENCE

**South Africa** – Gauteng, Mpumalanga, North West, Limpopo, Free State, Western Cape and Northern Cape

#### KEY SPECIALIST DISCIPLINES

##### Biodiversity Assessments

- Faunal Assessments
- Invertebrate Assessments
- Invertebrate Monitoring
- Avifaunal Assessments
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Protected Tree and Floral Marking and Reporting

##### Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use Licence Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

