Giant Bullfrog (Pyxcephalus adspersus)
Habitat Assessment and long-term survival plans

(Photo: Steven Bloy 2017/12/17)

at

President Park X6, eMalahleni (Witbank)

November 2020

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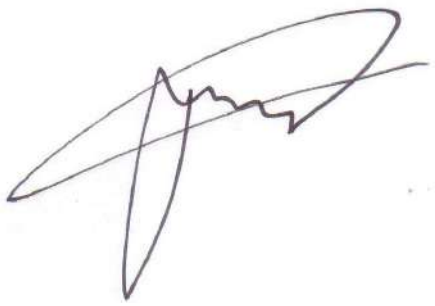
Declaration of Independence:

I, Jacobus Casparus Petrus van Wyk (6808045041084) declare that I:

- hold an MSc in Biological Sciences, which allows registration by SACNASP (SA Council for National Scientific Professions) as a Professional Zoologist (# 400062/09) and sanctions me to function independently as a specialist scientific consultant
- as per prerequisite of the Natural Scientific Professions Act No. 27 of 2003, present this project as my work from inception and reflects exclusively my observations and unbiased scientific interpretations, executed to the best of my ability
- am committed to biodiversity conservation but concomitantly recognise the need for economic development. Even though I appreciate the opportunity to learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the field of Zoology
- am contracted as giant bullfrog specialist consultant for the project "Giant Bullfrog Habitat Assessment on Erven 20,21 and 22 of President Park X6, eMalahleni (Witbank), Mpumalanga Province" described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- have or will not have any vested or conflicting interests in the proposed development
- undertake to disclose to AdiEnvironmental and its client as well as the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations, 2014 (as amended)

- Our intellectual property in this report will only be transferred to the client (the party/ company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, we recognise that written consent of the client will be required for the release of any part of this report to third parties.



J.C.P. van Wyk

1. INTRODUCTION

I, JCP van Wyk, was appointed to undertake a Giant Bullfrog (*Pyxicephalus adspersus*) habitat assessment and long term survival plan on Erven 20, 21 and 22 of President Park X6, eMalahleni (Witbank) or Portion 234 of the farm Zeekoewater 311 JS, Mpumalanga Province (elsewhere referred to as the study site or development site), scheduled for development of a Retail centre and/or Filling Station.

The objective of the study was to determine whether giant bullfrog might still reside on the site and to suggest the best solution for their long-term survival in the area. During the consultation with an Interested and Affected Party (I & AP) for the project, Mr. Steven Bloy, some questions were raised about the giant bullfrog on the study site.

This assignment is in accordance with the 2014 EIA Regulations (as amended) emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

2. SCOPE AND OBJECTIVES OF THE HABITAT STUDY

- The main objective of the study was to confirm whether giant bullfrog still occur on the proposed development site;
- To qualitatively and quantitatively assess the significance of the giant bullfrog on the site and current general conservation status of the property;
- Identify and comment on ecologically sensitive areas;
- To comment on connectivity with natural vegetation and habitats on adjacent sites;
- To highlight potential impacts of the proposed development on the giant bullfrog on the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

The study site is located in the western portion of eMahlahleni (Witbank) in the quarter degree grid cell 2529CD (Middelburg). The study area or development site is about 3 hectares and is spatially more accurately defined by 25°52'59.34"S and 29°15'27.16"E. The site lies on the south-eastern corner of Mandela Drive and Nita Avenue (Figure 1). Nita Avenue is on the western border of the site and Mandela Drive is on the northern border of the site. The site is adjacent to the Portuguese Club and opposite the Nissan dealership. Although some development is present on the site, the southern and northern portions of the site consist of open veld. The site is located to the east of Highveld View and west of Highveld Mall.

The area between the Portuguese Club and Mandela Drive along the northern boundary comprises an old borrow pit, which was backfilled with approximately 25 000m^3 of building rubble and some domestic waste mixed with soil. This section of the site was levelled and grassed over. The only development on the second cut is a hand-basketball court in the central-western corner.

The site is indicated as an Ecological Support Area in the Mpumalanga Biodiversity Sector Plan (MBSP) freshwater database, with Critical Biodiversity Areas located adjacent to the site to the east (Figure 2) inside the 500-metre buffer area (Figure 3). The Critical Biodiversity Areas coincide with the wetland areas indicated in the NFEPA database.

An important topographical feature east of the study site inside the 500-metre buffer area (investigated area) of the study site is a sweep wetland where the watercourses enter a tributary of the Olifants River to the north of the site. In the 500-metre buffer area (investigated area) of the study site north of Mandela Drive, the seep wetland becomes a channelled valley bottom wetland (Figure 3).

The intended development on site falls within the heavily or moderately modified unit of the MBSP terrestrial database, while the remainder of the site is classified as other natural areas (Figure 2).

The study site lies inside the Rand Highveld Grassland (Gm11) vegetation type, which is classified as Endangered (Mucina & Rutherford, 2006). Very few indigenous plants grow on the site, but many exotic plants like different wattle species, bugweed and kikuyu grass grow on or near the study site.

The study site is ecologically disturbed in most parts by infilling and depositing of different material like soil, rocks, etc. as well as by fences, diggings, roads, frequent fire events, invasive plants and general neglect. An overgrown, old Eskom water pipeline trench, less than one metre deep, is located along the eastern boundary of the site. The historical wetland (Venter, 2020) ecosystem east of the site in the 500-metre buffer area (investigated area) is impacted by anthropogenic activities including stormwater release, pollution and impoundment. Based on aerial photographs from 1991 it appears that the size of the wetland to the east of the site (in the 500-metre buffer area or investigated area) has increased in size and extent closer to the edge of the site, likely due to various impacts on site (Venter, 2020). This has resulted in artificial ponding where depressions have formed on the study site (Figures 3 & 4) [see also the accompanying wetland delineation report on the study site]. It is likely that the artificial ponding on the site (development site) is also due to relatively recent anthropogenic influences (post 1991).

The study site is representative of many areas in urban environments in South Africa, where encroaching urbanisation occurs on the remaining fragments of undeveloped habitat (Figure 5).

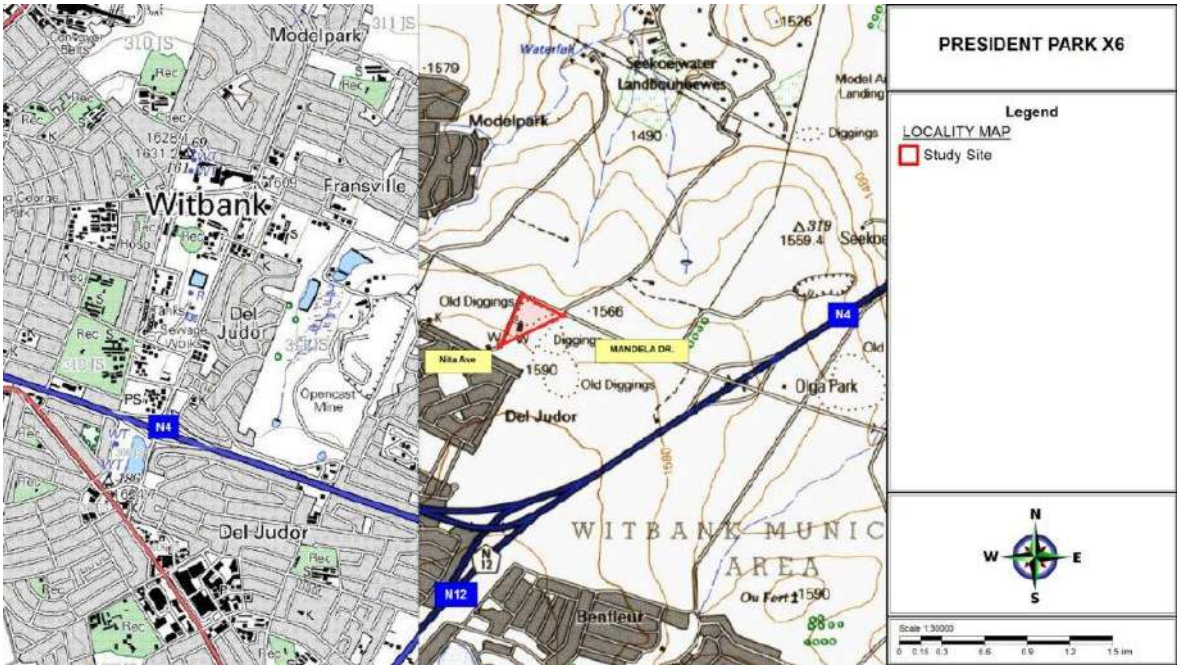


Figure 1: Locality map of the study site

Figure 2: MBSP terrestrial database for the site.

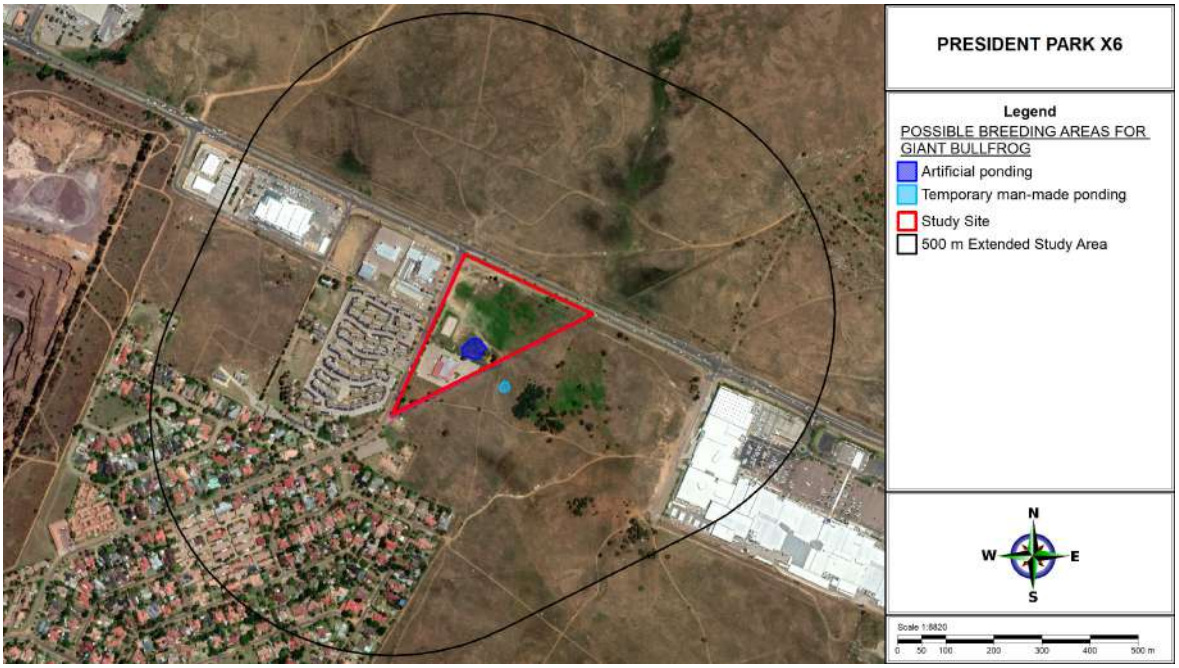


Figure 3: The study site (development site) and its 500-metre buffer area (investigated site).

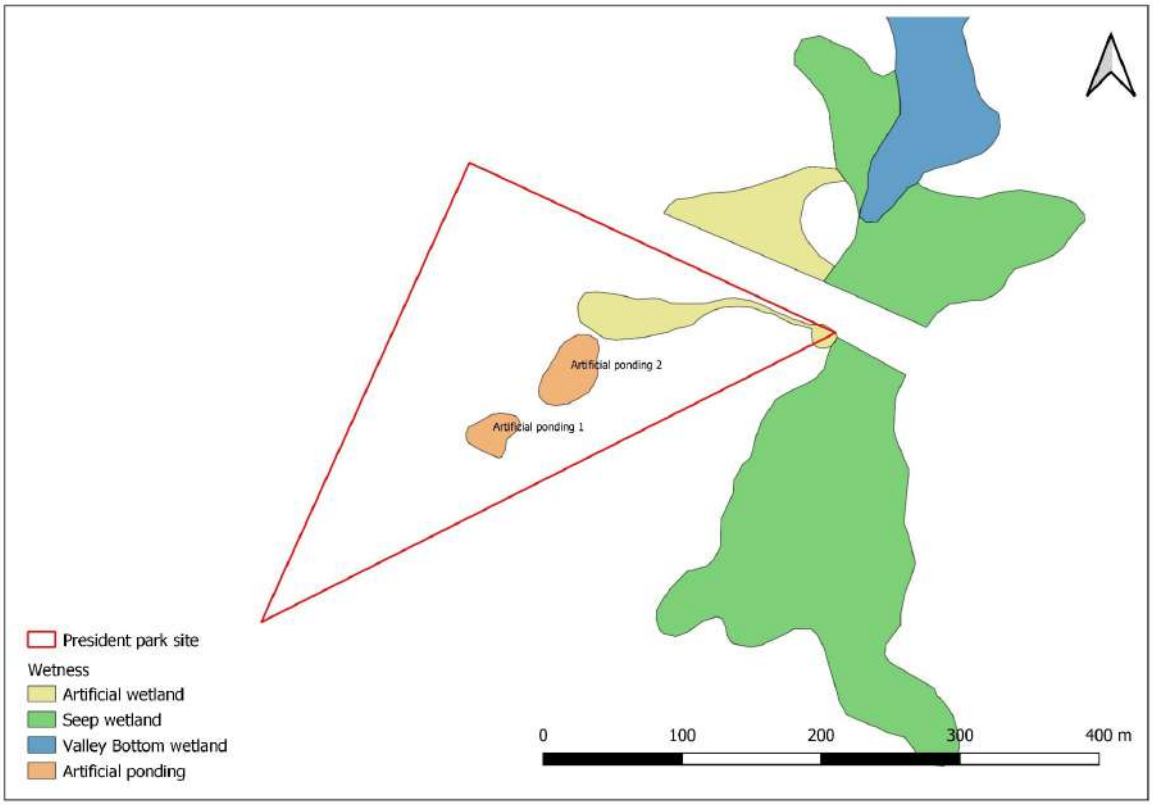


Figure 4: Wetlands on or near the study site (Venter, 2020).

Figure 5: A view towards the proposed filling station stand that is located on the corner of Mandela Drive and Nita Avenue.

4. METHOD

A two-hour site visit was conducted on 5 November 2020. The site visit took place after good rain the previous week and it was raining during the site visit. Normally giant bullfrogs will emerge after good rain (60 mm or more) if they occur on a particular site. September to April is a favourable time for spotting giant bullfrogs because of this species' breeding behaviour during or after good rainfall in the summer rainy season.

At least 500 metres of adjoining undeveloped properties east and north of the site were scanned for important giant bullfrog habitats.

4.1 Field Surveys

During such a site visit, one tries to confirm giant bullfrog presence by looking for suitable habitat and by visual sightings through random transects walks. This includes live adults, tadpole schools, calling males and road kills. No trapping was conducted, as the terms of reference did not require such intensive work.

4.2 Desktop Surveys

Giant bullfrogs are secretive, largely nocturnal, poikilothermic and seasonal. Therefore, the distributional range of this species was consulted to assess whether giant bullfrogs occur in this quarter degree square, based on authoritative tomes, scientific literature, field guides, atlases and databases of the Mpumalanga Tourism and Parks Agency.

Based on the impressions gathered during the site visit, own experience, as well as publications such as Amphibians of Central and Southern Africa (Channing 2001), Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter, et al, 2004) and A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruthers, 2017), certain conclusions were drawn. The latest taxonomic nomenclature was used, and the vegetation type was defined according to the standard handbook by Mucina and Rutherford (eds) (2006).

4.3 Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Giant Bullfrogs (*Pyxicephalus adspersus*) on Erven 20, 21 and 22 of President Park X6, eMalahleni (Witbank), Mpumalanga Province.

4.4 Interviews

Steven Bloy, Dr Mervyn Lotter and Prof Che Weldon were telephonically interviewed or e-mailed (Table 1).

Table 1 Personal Interviews or e-mail regarding the presence of Giant Bullfrog on the site.

NAME	POSITION	Telephone number	E-mail address
Mr Steven Bloy	Interested and Affected Party	(+2782) 447 8679	steven.bloy@gmail.com
Dr Mervyn Lotter	Control Scientist: Biodiversity Planning; Mpumalanga Tourism and Parks Agency	(+27) 13 235 2395 (+27) 83 299 7618	mervyn.lotter@gmail.com
Prof Che Weldon	Associate Professor in Zoology; Program Manager: Biodiversity and Conservation Ecology, Northwest University, Pukke	(+27) 18 299 2375	che.weldon@nwu.ac.za

Mr Steven Bloy was contacted since he is registered as an Interested and Affected Party specifically concerned about the giant bullfrogs on the study site. He requested that the adult bullfrogs be relocated (or at least be investigated to be relocated) to a protected area adjacent, or near to the site.

Mr Steven Bloy's interviews (04/11/2000 & 20/11/2000) were of special interest since he provided important information and good photographic confirmation of the presence of giant bullfrogs on the site (Figures 9, 10 & 11). Steven Bloy has been living in Del Judor Extension 4 since 2009 and he has seen bullfrogs on the proposed site on two occasions, once in December 2017 and again in December 2019. Mr Bloy mentioned that he read about sniffer dogs being used to find giant bullfrogs and asked whether this method could be used to find and then relocate any giant bullfrogs found on the site.

Dr Mervyn Lotter was interviewed by e-mailed since he is the Scientist involved with Red Data species in the Mpumalanga Province.

Dr Mervyn Lotter has provided valuable information on giant bullfrog distribution in the Mpumalanga Province and shed some light on the conservation status of giant bullfrogs in the province.

Prof Che Weldon was consulted after Mr Steven Bloy had asked me to investigate the possibility of using trained dogs to locate giant bullfrogs on the study site after they had burrowed into the soil.

Prof Che Weldon shared information about using trained dogs to find burrowing giant bullfrogs. Apparently the dogs had proven very efficient in finding bullfrogs above ground, even in shallow water, but it was much more challenging to find giant bullfrogs in their burrows with the help of these dogs (Prof C. Weldon, pers.comm). Unfortunately, no such dogs are available to locate giant bullfrogs under the soil. The only two dogs able to detect giant bullfrog are currently being used to locate riverine rabbits. Prof Weldon's former student, Este Mattheus, and these dogs are currently employed by the Endangered Wildlife Trust to find the Critically Endangered riverine rabbit (Prof C. Weldon, pers.comm).

5. RESULTS

5.1 INFORMATION REGARDING GIANT BULLFROGS

Jacobsen (1982) reported that giant bullfrog numbers were declining in Gauteng, North West, Limpopo and Mpumalanga provinces, which, at that time, constituted the Transvaal Province. Giant bullfrogs have been protected by law since 1983 (Anon, 1983). Officially, giant bullfrogs have no Red Data status in the South African Red Data Book – Reptiles and Amphibians in 1988 (Branch (ed), 1988).

The distribution of giant bullfrogs in some areas is estimated to have declined by some 80% between 1980 and 2000 (Harrison et. al 2001, Carruthers, 2007).

Although listed as "least concern globally" (IUCN, 2008), since 2001 *P.adspersus* has been considered "near-threatened" in South Africa (Harrisson et. al., 2001; Minter et al., 2004). Here, the most severe and widespread threat to the species is loss of habitat caused by urban development and agriculture (Harrison et al. 2001, Minter et al., 2004).

The conservation status of giant bullfrogs is controversial. In the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa, but as already mentioned, in places like Gauteng 80% of bullfrog habitat has disappeared between 1980 and 2000 (Carruthers, 2007). This is indicative of the concomitant decline in the specialised habitats used by this species and the loss of important wetland services provided by those habitats (Carruthers, 2009). In Gauteng, South Africa, the decline in numbers has led to the species being regarded as a conservation concern (Du Preez & Carruthers, 2017).

There are only a few localities in Mpumalanga Province where *Pyxicephalus adspersus*, the giant bullfrog, occurs (Du Preez & Cook, 2004). The provincial status for Giant bullfrogs in Mpumalanga Province is Vulnerable A2cd (M. Lotter, pers.comm.) and they have been recorded from the 2529CD (Middelburg) quarter degree grid (M. Lotter, pers.comm.). However, the farm Zeekoewater 311 JS is not part of the Mpumalanga Province data on giant bullfrog distribution in the province.

Contrary to popular belief giant bullfrogs are largely nocturnal and move directly to and from a breeding site. The only exception is during heavy rain when they are active during daytime and also when they breed. A nocturnal lifestyle reduces both their risk of desiccation and predation by diurnally active birds that are major predators of this species (Channing, 2001).

The study site contains a few depressions (Figure 3 & 4) and the 500-metre buffer areas (investigated site) contain a temporary man-made dam (Figure 6), which are potential breeding places for giant bullfrogs. Many of these breeding sites are temporary, which bullfrogs prefer in order to avoid predation from fish. Both the depression and temporary man-made dam have gentle slopes. A gentle slope allows for shallow water (less than 10cm deep), which enables the female bullfrog to stand when she lays her eggs outside the water for the male to fertilise. Giant bullfrogs prefer warm, stagnant water, which giant bullfrog tadpoles need for rapid development (Van Wyk, Kok & Du Preez, 1992).

The majority of the soil on the study site is yellow/grey, imported and compacted (Adi Erasmus, pers.comm.), which is not conducive for burrowing of giant bullfrogs. The area south-east of the study site in the 500-metre buffer area consists of natural, sandy soil and is very suitable as a dispersal area, which combines feeding and aestivation. It is essential that the soil be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods. Giant bullfrogs show strong site fidelity to their nonbreeding habitats with both adult males and females being highly faithful to their long-term burrows over time (Yetman & Furguson, 2011a)

Females move four times further from their breeding sites than males. By remaining close to breeding habitat, males might increase their chances of securing a territory and obtaining mates and rearing offspring where aquatic habitat conditions are most favourable for tadpole development. By moving further from breeding habitat, females might reduce their competition for food with the high numbers of much larger males that are also able to consume larger prey items near the water (Yetman & Ferguson, 2011a).

Giant bullfrogs do occur in the quarter degree grid cell 2529CD (Middelburg) according to M. Lotter (pers.comm), but have not been recorded on this quarter degree square (TVL Museum

Records or Ditsong Museum of Natural History). The occurrence of giant bullfrogs on the study site would depend on whether there is suitable habitat for the frogs.

5.2 GIANT BULLFROG HABITAT ASSESSMENT

The local occurrences of giant bullfrogs are closely dependent on the presence of wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of giant bullfrogs by evaluating the habitat types within the context of global distribution ranges. From a giant bullfrog habitat perspective, it was established that suitable wetland-associated vegetation cover habitat is present in the 500-metre site buffer (investigated site) on a neighbouring property. On the study site there is an artificial depression or ponding 1 site (Figures 3, 4, 6 & 10). According to Steven Bloy (pers.comm) giant bullfrogs have unsuccessfully tried to breed in this depression on the study site (development site).

All water sources, such as the depressions on the study site and a man-made dam near the study site, are temporary. The man-made depression (Figures 6 & 10) occurs on the site near the Portuguese Club. A better breeding place for bullfrogs in the author's opinion is situated off the study site in the 500-metre site buffer on a neighbouring property (Figure 3 & 7). The depression on the site may contain some water after heavy rain but does not hold enough water for long enough to ensure successful metamorphosis for giant bullfrog tadpoles. Giant bullfrogs need 21 – 33 days to complete metamorphosis (Balinsky 1969, Van Wyk et.al 1992). This was confirmed by Steven Bloy, who mentioned that the giant bullfrog tadpoles died before they could complete metamorphosis (pers.comm.), because of the evaporation of all the water in the depression. The author is also of the opinion that the depression on the site (Figure 6) is far from ideal for giant bullfrogs to breed. If the author of this report had not known that giant bullfrogs have tried to breed there, he would have thought that it was remotely possible for these frogs to even try to breed on the study site (development site). The man-made dam (Figure 7) in the 500-metre buffer area (investigated area) of the study site may contain enough water for giant bullfrogs to complete metamorphosis. No natural water sources occur on the actual study site.

Figure 6: A temporary depression on the study site where giant bullfrogs have unsuccessfully attempted to breed in the past (S. Bloy, pers.comm.)

Figure 7: A temporary man-made pond on a neighbouring property which provides potential breeding habitat for giant bullfrogs.

No termitaria were found on the site (development site), but the fairly pristine grassveld on an adjacent property southeast of the site (investigated area), inside the 500-metre buffer, contains many termitaria (Figure 8). Termitaria provide termites, which are a favourite food item for giant bullfrogs, although it is not essential for bullfrogs to have access to termitaria. At the time of the site visit the basal cover was fair due to recent rain and would provide adequate cover for giant bullfrogs. The terrestrial habitat of the study site is ecologically disturbed in

almost all parts by infilling and depositing of different materials like soil, rocks, etc., as well as fences, diggings, roads, frequent fire events, invasive plants and general neglect.

Figure 8: Termitaria and natural grassland adjacent to the study site (investigated area).

There are no logs or dry branches on the study site, which would provide shelter for the prey of giant bullfrogs. However, there were logs in the 500-metre buffer area (investigated site) south-east of the site.

With the exception of the fairly pristine grassveld southeast of the site (investigated area) and a seep wetland (investigated area) where the watercourses enter a tributary of the Olifants River to the north of the site, connectivity is poor, especially to the west and southwest of the site. Mandela Drive and Nita Avenue are also huge barriers for giant bullfrog movement. Steven Bloy has taken a photograph of a giant bullfrog roadkill (Figure 9). The extremely busy N4 double lane National Road cuts off even the open area southeast of the site (Figure 1).

Figure 9: Giant bullfrog roadkill next to the study site (Photo: S. Bloy 2017/12/17)

5.3 GIANT BULLFROG HABITAT REQUIREMENTS

Giant bullfrogs require four types of habitat in order to survive under natural conditions (Carruthers 2009):

(1) Breeding sites, (2) burrowing soils, (3) foraging ground and (4) dispersal corridors. The actual study site (development site) does not provide quality habitat for any of these four requirements. To some extent the areas in the 500-metre buffer south-east of the study site and north of Mandela Drive provide good habitat for all four of these requirements (investigated area) [Figure 3]. Behaviour patterns and the use of these habitats are important in determining appropriate management proposals and each habitat is therefore dealt with in some detail.

5.3.1 BREEDING SITES

The requirements for breeding sites are extremely specialised. Bullfrogs utilise only shallow grassy depressions temporarily filled with rainwater, never fast-flowing streams or deep water. (Du Preez & Carruthers 2017). Suitable sites are often many kilometres apart. Oviposition takes place in water 50 mm to 100mm deep.

Suitable weather conditions are also necessary for breeding. Calling, mating and oviposition usually take place on one single day in the year following good rain of 60 mm or more (Van Wyk et.al 1992). A breeding day may occur twice, or occasionally three times in one year but if weather conditions are unsuitable it may be postponed for an entire year or even up to four years (Carruthers, 1983).

Metamorphosis takes 21 – 33 days (Belinsky 1969, Van Wyk et.al 1992). Tadpoles form tight schools during this period and adult males remain at the breeding site in order to defend tadpoles against predation. They aggressively attack intruders, including humans and, if the water shows signs of drying up, the males may dig a channel of up to ten metres in length to deeper water (Kok, Channing & Du Preez, 1989).

There are two potential breeding sites for giant bullfrogs on or near the site (Figure 3). The depression near the Portuguese Club (development site) is where giant bullfrogs occur during the breeding seasons [December 2017 & December 2019] (Figures 6 & 10), Steven Bloy (pers.comm.). Steven Bloy took photographs (Figure 11 & Title page) to prove that giant bullfrogs do occur on the site. A better breeding site, in the author's opinion, occurs east of the site on a neighbouring property [investigated site] (Figure 7).

Steven Bloy (pers.comm.) has confirmed that giant bullfrogs bred on the site during the 2017 and 2019 seasons. In 2019 he reported to the author that the tadpoles had all died because the water in the man-made depression dried up before metamorphosis could be completed. Follow-up rain is very important for this population to breed successfully. It may happen, at best, once every 10 years, if ever. If the area had been in pristine condition and situated in a conservation area, the depression could have been dug deeper so that there would be enough water to complete metamorphosis. As already mentioned, if the author had not known that giant bullfrog actually tried to breed there, he would have regarded the depression as too shallow for bullfrog to breed there.

5.3.2 BURROWING SOIL

Giant Bullfrogs spend approximately ten months of the year underground. In years when conditions are unsuitable for breeding, they may remain buried for four years (Carruthers, 1983). Burrowing generally takes place some distance away from the breeding site, with females travelling further to burrow. Males and females show strong philopatric tendencies, i.e. they return to the same burrow throughout their lifetime unless they are physically prevented from doing so (Yetman & Ferguson, 2011a). This has important implications for conservation management.

While buried, the frogs are enclosed in an impermeable cocoon of dried keratin that seals in the entire animal except for the nostrils. This reduces water loss. Burrows are usually found in sandy soils. Bullfrogs that are unearthed during winter will generally be encased in their cocoon, which is invariably damaged during handling. Specimens with breached cocoons are vulnerable and should be re-buried in a sterile medium such as Formica (Carruthers 2009).

The infilled soil of most of the study site is not ideal for giant bullfrog burrowing, but it is still possible for giant bullfrogs to dig themselves into this substrate while it is still wet. Giant

bullfrogs cannot burrow into compressed soil. The fairly pristine grassveld southeast of the site in the 500 metre site buffer (investigated area) consists of natural, sandy soil, which is very conducive to burrowing.

5.3.3 FORAGING GROUNDS

Before and after breeding the adult frogs disperse widely to forage before re-burying themselves. In this relatively short period they need to feed sufficiently to sustain themselves during many months of hibernation-aestivation until the following breeding season. For this they require feeding grounds with an abundance of prey in the form of insects, rodents, reptiles, nesting ground birds, other frogs and even their own kind.

The grassland on the site and surrounding properties has been substantially transformed by different anthropogenic factors and prey is probably sparsely distributed, while foraging grounds need to be fairly extensive to support a population.

One way to conserve bullfrogs is to protect their long-term burrows. Significant differences in the temporal and spatial use of aquatic and terrestrial habitat by adult male and female giant bullfrogs have important conservation implications for the species. Males spend significantly more time at breeding sites than females and consequently are more vulnerable to harvesting for human consumption or the pet trade. Increased mortality of males at breeding sites could adversely affect tadpole survival and juvenile recruitment due to paternal care of offspring in giant bullfrogs. In contrast, females spend virtually their entire lives in burrows situated significantly farther from breeding sites than males (Yetman & Ferguson 2011a). Females are consequently more vulnerable to encroaching land transformation (Du Preez & Cook 2004). *Pyxicephalus adspersus* therefore requires effective protection of both aquatic and terrestrial habitat (Yetman & Ferguson 2011b).

A 950-1000m wide buffer around seasonal breeding habitat like temporary dams or depressions has been suggested to protect this species (Yetman & Ferguson, 2011a). Due to the controversial conservation status of giant bullfrogs and the unsuccessful breeding attempts on the study site, this suggestion should not apply on the actual study site.

Importantly, giant bullfrogs will typically return to their exact burrow sites year after year, which is one of the reasons why relocating adults can be difficult. Even if adults are moved to a site far away, they often try to return to their original burrow locations, which can lead to excessively high mortality rates. This is one of the reasons why the relocation of juveniles and/or tadpoles has been recommended (Carruthers, 2014).

The 500-metre site buffer areas south-east and north of the site (investigated areas) provide far better foraging grounds, where there is less influence of anthropogenic factors and a better quality habitat, with many termitaria, more natural soil, fairly pristine grassveld and better breeding site(s).

5.3.4 DISPERSAL CORRIDORS

Giant bullfrogs are distributed throughout the central hinterland of southern Africa. However, because of their specialised breeding site requirements, breeding populations are often widely separated. Members of different breeding colonies, especially juveniles, need to traverse several kilometres between breeding sites to integrate with one another and sustain the generic integrity of the species. Unbroken dispersal corridors are therefore critically important. Bullfrog dispersal often follows drainage lines or seeps.

Giant bullfrog adults are generally philopatric to their breeding sites, whereas immature ones typically disperse, facilitating gene flow between neighbouring populations (Yetman & Ferguson, 2011 a). A population genetics study by Yetman and Ferguson, (unpubl. Data) based on *Pyxicephalus adspersus* sampled from Diepsloot and other localities (mostly in Gauteng Province) revealed significant (historical) gene flow between populations up to 20-100km apart (Yetman & Ferguson, 2011a).

The 500-metre buffer area north-east of the site (investigated area) offers one of the last remaining corridors for genetic exchange in the area. The drainage line in the 500 metre-buffer area, north-east of the site presents distribution opportunities for giant bullfrogs, especially juveniles (if breeding is successful), but the two roads (Mandela Drive and Nita Avenue) and buildings around the study site increasingly inhibit their movement. Cement walls around properties on or near the study site clearly constrain giant bullfrog movement.

Figure 10: The depression on the study site where giant bullfrog attempted to breed (Photo: S. Bloy 2017/12/07)

Figure 11: A giant bullfrog on site (Photo: S. Bloy 2019/12/05).

6. FINDINGS AND POTENTIAL IMPLICATIONS

The 500-metre buffer area (investigated area) east of the study site has important topographical features in the form of wetlands. A shallow man-made depression or artificial ponding 1 (Figure 4) is situated on the study site (development site). The investigated areas, contain both important giant bullfrog habitats, namely terrestrial and wetlands. The terrestrial and wetlands habitats of the study site (development site), however, are sub-optimal for the giant bullfrog's long-term survival.

Species richness: Except for possible giant bullfrogs, other common herpetofauna, bird and mammal species also occur on site. Due to the presence of the two habitat types, especially aquatic habitat on the investigated areas (within 500m of the site), the area should have a fair number of species. It must be emphasised that the species richness is for the general area and NOT for the study site (development site) itself.

Endangered species: Giant bullfrog occur on the study site (Steven Bloy pers.comm). There are potential breeding sites for giant bullfrogs on the development site and especially near the study site (investigated site).

Sensitive species and/or areas (Conservation ranking): The wetlands in the 500-metre buffer areas are sensitive ecological systems. The study site falls in the Rand Highveld Grassland (Gm11), which is considered as an Endangered vegetation type (Mucina and Rutherford, 2006),

however the Rand Highveld Grassland vegetation unit found within the study area (development site) has been significantly degraded. The investigated areas east and north of the site contain fairly pristine Rand Highveld Grassland vegetation units.

Habitat(s) quality and extent: Current land use and the general neglect on the study site is incompatible with giant bullfrog survival in the long term. Neighbouring properties and roads restrict bullfrog foraging, hibernation-aestivation and dispersal. Habitat fragmentation has already taken place and walls, buildings, roads and other structures increasingly inhibit movement.

The study site (development area) is ecologically disturbed in most parts by infilling and depositing of different materials like soil, rocks, etc., as well as fences, diggings, roads, frequent fire events, invasive plants and general neglect. The aquatic ecosystems found on and near the site are impacted by anthropogenic activities including stormwater release and impoundment.

Impact on Herpetofauna richness and giant bullfrog conservation: The proposed development will have a significant and lasting effect on species richness and conservation, because the retail park will destroy most of the study site. This could have a disastrous effect on the long-term survival of giant bullfrog in the area.

The construction of the roads have already had a significant and lasting effect on herpetofauna species richness and conservation in general and giant bullfrogs in particular, due to the increase in traffic. New roads would form an even larger barrier for herpetofauna movement if the retail development is approved and it will result in a further decrease in connectivity.

If the development should go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the water quality of the drainage line due to the surface water runoff from the retail centre and filling station. This could have a negative impact on the survival of giant bullfrogs and other vertebrates in this area.

There are two alternatives for the site:

Alternative one: Site is developed for business purposes only or
Alternative Two: Site is developed for business purposes and includes a filling station.

The author is suggesting a third alternative.
Alternative 3: Site is only developed as a filling station.

Both alternatives one and two would partly affect the giant bullfrogs in and around the depression or artificial ponding 1 (Figure 4) location, because it is a potential breeding area for giant bullfrogs. Alternative three would not have any significant influence on the giant bullfrogs breeding success, due to the location of the planned filling station. Due to an increase in traffic, all three alternatives could however increase the chances for giant bullfrog road kills.

Connectivity: With the exception of the fairly pristine grassveld southeast and north of the site and the storm water drainage line east of the site inside the 500 metre investigated area, connectivity is poor, especially to the west and southwest of the site. Mandela Drive and Nita

Avenue are huge barriers for giant bullfrog movement. The extremely busy N4 double lane National Road cuts off even the open area to the southeast of the site.

Management recommendation: The actual study site itself (development site) is not of high conservation value. Even if the site is left in its current condition of neglect, it is not guaranteed that giant bullfrog would survive there in the long run due to the many anthropogenic factors on and around the site.

There are seven options for the possible long-term survival of the giant bullfrogs and/or the development of the site.

Option 1: No development may take place on the study site. Due to the fact that the status of giant bullfrog in Mpumalanga Province is *Vulnerable A2cd* (M. Lotter pers.comm.) and that this species was observed on the study site (development site), [Steven Bloy photographs on title page and Figure 11] and trying to breed, no further development whatsoever may ever take place on or near the site. The depression pond is not very conducive to the successful breeding of the giant bullfrogs on site. The depression or artificial ponding area 1 should be made deeper, which would improve the chances for giant bullfrog tadpoles to metamorphose into froglets. At least three quarters of the edges of the pond should be gradual around the water body. One way to conserve bullfrogs is to protect their long-term burrows. That means buffers of 800 metres to 1000 metres around a depression or artificial ponding 1. That would imply that no development at all may take place on the study site and its undeveloped buffer areas. It is also imperative that there should be a joint conservation plan for giant bullfrogs in the entire eMahlahleni (Witbank) area. This would be the responsibility of the Mpumalanga Tourism and Parks Agency and the eMahlahleni Municipality.

Option 2: After a relocation plan has been completed, the development may take place. The actual study site (development site) is not of high conservation value. As already mentioned, even if the site is left in its current condition of neglect, it is not guaranteed that the giant bullfrog would survive in the long run due to the many anthropogenic factors in and around the site. The feasibility of relocating this population must be investigated as an alternative to prohibiting this development. The use of sniffer dogs as suggested by Steven Bloy is currently not an option because no such dogs are available and even if they were, it still would be very difficult for the dogs to locate the giant bullfrogs in their burrows. Another possibility is to capture the giant bullfrogs by using passive traps or catching of individuals by hand or in nets. This can only happen when the giant bullfrogs breed. This would mean that one had to wait for the next breeding season (September to April) and even then they may not emerge as a result of low rainfall. No further development on or near the site could happen until the frogs have emerged to breed and are caught to be relocated elsewhere. A relocation plan for giant bullfrogs with all the necessary mitigations should be developed (See 8.RECOMMENDED MITIGATION MEASURES below). The bullfrogs may be moved to either similar habitat elsewhere or to artificial wetlands, which may be engineered to be suitable (Thomas et.al, 2013). The receiver sites must be assessed for suitability as (Thomas et.al, 2013) found that habitat quality is dependent on a variety of parameters. The breeding population of adult bullfrogs and froglets should be relocated to an area where its long-term survival is more secure. After the relocation of the giant bullfrog, further development may take place on the entire study site. This option would allow possible development on neighbouring properties in the future.

Option 3: Development may start, but the depression or artificial ponding area 1 (Figure 4) and a 28-30 metre buffer must be cordoned off. This may help to conserve at least some of the giant bullfrog's habitat and even some of the bullfrogs themselves. Make sure there is an undeveloped corridor to investigated area east of the site (Figure 12). For the possible long-term survival of these giant bullfrogs, no development should take place on the buffer area east of the site.

Option 4: Development may start, but the depression or artificial ponding area 1 (Figure 4) and a 28-30 metre buffer must be cordoned off. This may help to conserve at least some of the giant bullfrog's habitat and even some of the bullfrogs themselves. A relocation plan for giant bullfrogs with all the necessary mitigations must be put in place (See 8.RECOMMENDED MITIGATION MEASURES below). The plan is to capture the giant bullfrogs by using passive traps or catching of individuals by hand or in nets. This can only happen when the giant bullfrogs breed. This would mean that one had to wait for the next breeding season, which may be delayed by low rainfall. The bullfrogs may be moved to either similar habitat elsewhere or to artificial wetlands, which may be engineered to be suitable (Thomas et.al, 2013). The receiver sites must be assessed for suitability as (Thomas et.al, 2013) found that habitat quality is dependent on a variety of parameters. After the relocation of the giant bullfrogs, further development may take place on the depression or artificial ponding area 1. This would be a compromise between the short to medium term survival of the giant bullfrogs in the area and the development on the rest of the site. This option would allow possible development on neighbouring properties in the future.

Option 5: Development may start, but the depression or artificial ponding area 1 (Figure 4) must be cordoned off. The accompanying wetland delineation report of the study site requires no buffers around the depression or artificial ponding areas (Venter, 2020). The depression or artificial ponding area 1 must be protected and the corridor to the open area (investigated area) east of the site (Figure 12). For the optimal long-term survival of these giant bullfrogs, there should also be no development on the undeveloped area east of the site.

Option 6: Development may start, but the depression or artificial ponding area 1 (Figure 4) must be cordoned off. As already mentioned, the accompanying wetland delineation report of the study site requires no buffers around the depression or artificial ponding areas (Venter, 2020). The depression or artificial ponding area 1 and the corridor to the investigated area east of the site must be protected. A relocation plan for giant bullfrogs with all the necessary mitigations must be implemented (See 8.RECOMMENDED MITIGATION MEASURES below). The plan would be to capture the giant bullfrogs by using passive traps or catching of individuals by hand or net. This can only happen when the giant bullfrogs breed. This would mean that one had to wait for the next breeding season and that may be delayed by low rainfall. The bullfrogs may be moved to either similar habitat elsewhere or to artificial wetlands, which may be engineered to be suitable (Thomas et.al, 2013). The receiver sites must be assessed for suitability as (Thomas et.al, 2013) found that habitat quality is dependent on a variety of parameters. After the relocation of the giant bullfrogs, further development on the depression or artificial ponding area 1 may commence. This option would allow possible development on neighbouring properties in the future.

Option 7: The development can go ahead immediately without any concern for giant bullfrogs. The giant bullfrog has no official Red Data status Internationally (IUCN) or Nationally. Its Red Data status is *Least Concern* (Channing & Rödel 2019; Du Preez & Carruthers 2017). A further reason is the fact that the giant bullfrog population is relatively small (S. Bloy, pers.comm.), that their breeding was unsuccessful recently (S. Bloy, pers.comm.) and that their long-term survival in this area, even without further development, is far from secure. The giant bullfrogs in this area would probably die out over time due to sub-optimal breeding, feeding and dispersal habitat on the study site (development site) itself. This is the result of anthropogenic activities and encroaching urbanisation that often occur on the remaining fragments of undeveloped habitat in an urban setting.

The author of this report proposes seven options for the way forward regarding this development and the survival of the giant bullfrogs. His recommendation is option 2, 4 or option 6 as the best chance for at least some of these giant bullfrogs to survive. All three options are a compromise between the relocation of this population of giant bullfrogs and the intended development. Option 2 is his preferred option for the survival and relocation of the giant bullfrogs and option 6 the third best option if the only concern is for the giant bullfrogs. Mpumalanga Tourism and Parks should also be informed of the option that is chosen.

General: Any development on the study site would be detrimental to the long-term survival of giant bullfrogs in the area.

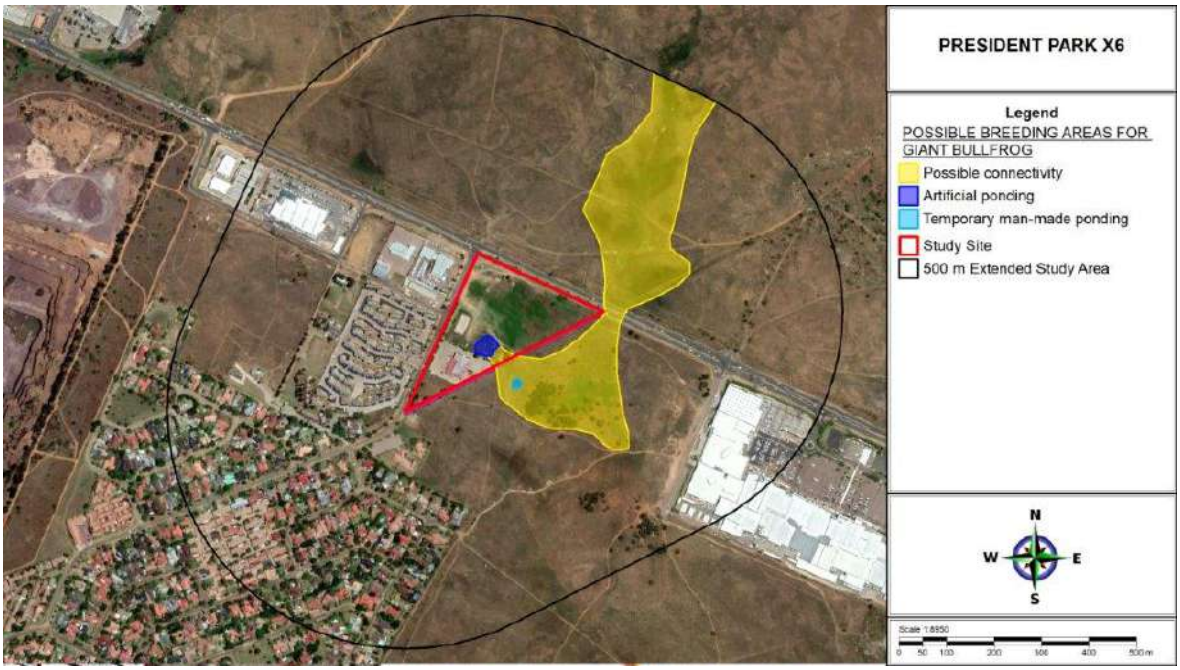


Figure 12: The connectivity of the artificial ponding area on site with a corridor of wetlands in the buffer areas

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

Declaration of Independence: I, JCP van Wyk, am committed to the conservation of biodiversity, but concomitantly recognise the need for economic development. Even though we appreciate the opportunity to learn through the processes of constructive criticism and debate, we reserve the right to form and hold our own opinions and therefore will not submit to the interest of other parties or change statements to appease them.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. To some extent, conclusions are drawn and proposed mitigation measures suggested based on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. I can therefore not accept responsibility for conclusions drawn and mitigation measures suggested in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

8. RECOMMENDED MITIGATION MEASURES

Protection of the depression or artificial ponding 1 (on the development site), seep wetland east of the site and the channelled valley bottom wetland northeast of the site (Investigated areas):

- Every effort should be made to retain the linear integrity, flow dynamics and water quality of these water bodies

Any development on the study site would be detrimental to the long-term survival of giant bullfrogs in the area.

The author of this report has provided seven options for the way forward regarding the intended development and the survival of the giant bullfrogs. His recommendation is option 2, 4 or option 6 as the best chance for at least some of these giant bullfrogs to survive. All three options are a compromise between the relocation of this population of giant bullfrogs and the intended development. Option 2 is his preferred option for the survival and relocation of the giant bullfrogs and option 6 the third best option if the only concern is for the giant bullfrogs. Mpumalanga Tourism and Parks should also be informed of the option that is chosen.

The option of relocation this population must be investigated as an alternative to prohibiting development. It is therefore recommended by the specialist that the breeding population of adult bullfrogs and froglets should be relocated to an area where its long-term survival is more secure.

A Giant Bullfrog Relocation Plan for Erven 20, 21 and 22 of President Park X6, eMalahleni (Witbank), scheduled for a Retail centre and Filling Station, must be drawn up.

No formal or legitimate guidelines currently exist with regard to the relocation of Giant bullfrogs in Mpumalanga Province. Currently best practice guidelines are limited to a small number of previous studies, such as Yetman (2012) and Carruthers (2014). Most studies recommended a phased approach for relocation of *Pyxicephalus adspersus*, and that such relocations be conducted over a number of non-consecutive years. However, due to the planned construction phase commencing soon, only a single season capture-and-relocation plan will be possible. This is a severely limiting factor and as a result, more stringent recommendations and activities are necessary for such a relocation plan to be successful.

- Compilation of a Giant Bullfrog (*Pyxicephalus adspersus*) Relocation Plan includes the identification of possible release sites within a 5 km radius of the study site.
- Detailed description of the relocation process including the capture of individuals.
- Details of the correct authority to approach for permits to move animals.
- Desktop description of the baseline receiving environment specific to the field of expertise (general surrounding as well as site-specific environment), including spatial data analysis and mapping.

It is important to note that translocation is seldom successful as a long-term conservation measure (Yetman, 2007). As mentioned, giant bullfrogs are philopatric and translocated adults may become disorientated or instinctively try to return to their original breeding grounds with high consequent mortality (Yetman, 2007). In order to alleviate this possibility, temporarily fencing off both the capture and release sites is recommended as part of the relocation plan.

Translocation of juveniles and tadpoles has been recommended as another potential relocation or translocation option or as part of the overall strategy to increase the chances of a successful relocation. However, there are inherent risks and concerns over the use of this method. Release sites that have suitable habitat for breeding and burrowing for giant bullfrogs typically already have members of this species present. Introducing translocated tadpoles, juveniles or adults may simply lead to increased competition (among adults especially) and food competition. Moreover, it can lead to the possible transmission of disease, which is a serious concern. All of these considerations must be understood and mitigated as part of this relocation plan.

The following mitigation measures are proposed by the specialist for relocation and/or development:

- The population of breeding bullfrogs must be captured in its entirety and relocated to a pre-determined location in a natural area in the vicinity.
- The depression pond and pan with developing tadpoles must be monitored and cordoned off and if necessary, filled with natural water to enable the tadpoles to complete their metamorphosis. The tadpoles can also be relocated to a suitable pan in a natural area in the vicinity.
- The froglets must then be caught and relocated at a pre-determined location in a natural area in the vicinity.
- The relocation must take place during an evening so that diurnal predators would not kill the froglets.
- After this process has been completed ,the development may commence.

- If any giant bullfrogs are encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity.
- This remediation requires the employment of a herpetologist to oversee the removal of any herpetofauna during the initial ground-clearing phase of construction (i.e. initial ground-breaking by earthmoving equipment). The contractor must ensure that no herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts. The contractor must ensure that no mammal or herpetofauna species are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- If any giant bullfrogs are accidentally killed during the construction phase they should be kept as voucher specimens and donated to the Ditsong Museum for natural History (Former Transvaal Museum)
- Education of construction staff about the value of wildlife and environmental sensitivity is imperative, especially about giant bullfrogs.
- The construction staff should attend a formal lecture by an expert on giant bullfrogs.
- An information notice board must be erected with the necessary information and contact details if any giant bullfrogs are observed in the area.
- The accompanying wetland report is important to indicate the wetland and its buffers.
- Access roads must be kept to a minimum and must lead directly to or from the development.
- Alien and invasive plants must be removed.
- A very important indirect effect would be the likely impact that the proposed development might have on the water quality of the drainage line due to the surface water runoff from the retail centre and filling station. This could have a negative impact on many vertebrate and invertebrate species.
- Measures will have to be taken to prevent the construction of roads or any development near the seep wetland and to monitor water pollution. Measures will have to be taken to stop water pollution during construction and the operational phases of the project.

It is also imperative that there should be a joint conservation plan for giant bullfrogs in the entire eMahlahleni (Witbank) area. This is not the responsibility of the developers; however, but will be a generous gesture for private partners interested in to help with the conservation of giant bullfrogs.

9. CONCLUSION

In South Africa, populations of the explosive-breeding giant bullfrog (*Pyxicephalus adspersus*) are suffering increasing habitat loss due to encroaching urbanisation. Without access to suitable terrestrial habitats, individuals would be unable to complete their life cycles, and populations would eventually fail to persist.

There are only a few localities in Mpumalanga Province where *Pyxicephalus adspersus*, the giant bullfrog, occurs (Du Preez & Cook, 2004). The provincial status for giant bullfrogs in

Mpumalanga Province is *Vulnerable* A2cd (M. Lotter, pers.comm.) and they have been recorded from the 2529CD (Middelburg) quarter degree grid (M. Lotter, pers.comm.). Steven Bloy (pers.comm.) has confirmed that giant bullfrogs have bred unsuccessfully on the study site during the 2017 and 2019 seasons.

Any development on the study site would be detrimental to the long-term survival of giant bullfrogs in the area.

The actual study site itself (development site) is not of high conservation value. Even if the site is left in its current condition of neglect, it is not guaranteed that the giant bullfrog would survive in the long run due to the many anthropogenic factors on and around the site. Neighbouring properties and roads restrict bullfrog foraging, hibernation-aestivation and dispersal. Habitat fragmentation has taken place and walls, buildings, roads and other structures increasingly inhibit movement.

Protection of the depression or artificial ponding 1 area (on the development site), the seep wetland east of the site and the channelled valley bottom wetland northeast of the site (investigated areas) is important.

There are seven options for the possible long-term survival of the giant bullfrogs and/or the development of the site (See 6. FINDINGS AND POTENTIAL IMPLICATIONS Management recommendation).

The author of this report has provided seven options for the way forward regarding the intended development and the survival of the giant bullfrogs. His recommendation is option 2, 4 or option 6 as the best chance for at least some of these giant bullfrogs to survive. All three options are a compromise between the relocation of this population of giant bullfrogs and the intended development. Option 2 is his preferred option for the survival and relocation of the giant bullfrogs and option 6 the third best option if the only concern is for the giant bullfrogs. Mpumalanga Tourism and Parks should also be informed of the option that is chosen.

There are two alternatives for the site:

Alternative one: Site is developed for business purposes only or
Alternative Two: Site is developed for business purposes and includes a filling station.

The author is suggesting a third alternative.
Alternative 3: Site is only developed as a filling station.

Both alternatives one and two would partly affect the giant bullfrogs in and around the depression or artificial ponding 1 (Figure 4) location, because it is a potential breeding area for giant bullfrogs. Alternative three would not have any significant influence on the giant bullfrogs breeding success, due to the location of the planned filling station. Due to an increase in traffic, all three alternatives could however increase the chances for giant bullfrog road kills.

If the proposed development adheres to the preferred options and mitigation measures, any of the three alternatives can be chosen.

If the development go ahead, a very important indirect effect would be the likely impact that the proposed development might have on the surface water runoff and water quality of the seep wetland east of the site and the channelled valley bottom wetland northeast of the site (Investigated areas). This could have a negative impact on the giant bullfrogs and other vertebrates and invertebrates.

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11. CURRICULUM VITAE

JACOBUS CASPARUS PETRUS (JACO) VAN WYK

Identity number	680804 5041 08 4
Gender	Male
Date of birth	4 August 1968
Nationality	South African
Home languages	Afrikaans, fluent in English
Postal address	P.O. Box 25085, Monument Park, Pretoria, 0105. Tel no +27 12 347 6502, Cell +27 82 410 8871 E-mail **jcpvanwyk@absamail.co.za**
Present position	Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof
Consultant	Specialist Environmental Assessments, EIAs, writing, photo-recording
Qualifications	**B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.F.S.), **M.Sc.** (U.F.S.)
Honours	Foundation of Research Development bursary holder Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09

Notable Research Contribution: In-depth field study of the giant bullfrog

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

Employment history

2009 – Present Doing surveys of vertebrate groups and writing Environmental impact assessment reports.

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.

1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.

July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research

1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution

1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State

1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith

Professional Achievement Research: Author and co-author of 52 scientific publications in peer reviewed and popular subject journals, and >350 contractual EIA research reports. Extensive field work and laboratory experience in Africa

Public Recognition: Public speaking *inter alia* radio talks, TV appearances

Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking and bass fishing

MONITORING OF THE PRESIDENT PARK X6 SITE AFTER THE CYCLONE ELOISE RAINS (25 JANUARY – 4 FEBRUARY 2021) BY ADIENVIRONMENTAL cc

Monday, 25 January 2021 (09h00)

Observations:

- After approximately 25mm of rain, some ponding noted in the footpaths/tracks.
- No standing water noted in the Artificial Ponding Area no. 1.
- No bullfrogs or tadpoles noted.

Wednesday, 27 January 2021 (14h00)

Observations:

- No rain.
- Still some ponding noted in the footpaths/tracks.
- No standing water noted in the Artificial Ponding Area no. 1.
- No bullfrogs or tadpoles noted.

Friday, 29 January 2021 (09h00)

Observations:

- After another ±25mm of rain, more ponding noted in the footpaths/tracks.
- Standing water of ±45mm deep noted in the Artificial Ponding Area no. 1.
- A bullfrog was noted amongst grass within the Artificial Ponding Area no. 1.
- No tadpoles noted.

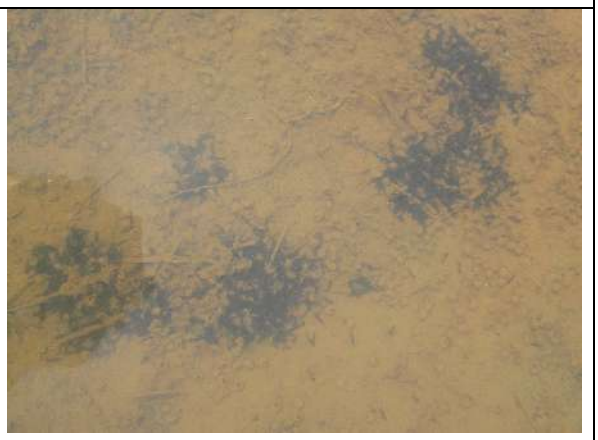
Saturday, 30 January 2021 (11h00)




Observations:

- Ponding noted in the footpaths/tracks.
- Ponding in the Artificial Ponding Area no. 1.
- The bullfrog noted amongst grass within the Artificial Ponding Area no. 1 on Friday, 29 January 2021, no longer present.
- No tadpoles noted.

Sunday, 31 January 2021 (09h00)



Observations:

- Less ponding noted in the footpaths/tracks – water only present in the hollows - approximately 4cm deep.
- Tadpoles (plus eggs – black spots) present in the hollow with water 4cm deep.
- Ponding in the Artificial Ponding Area no. 1 had dried up including amongst the grass where the bullfrog was noted on Friday, 29 January 2021.
- No bullfrogs noted.
- The bullfrog noted amongst grass within the Artificial Ponding Area no. 1 on Friday, 29 January 2021, no longer present.
- Weather – mixture of sunshine and rain (drizzle).
- Not sure how long ponding will last on site.

Monday, 1 February 2021 (09h00)

Observations:

- Rained on Sunday and throughout the night.
- More ponding noted in the footpaths/tracks – deeper approximately 6cm.
- One side of footpaths/tracks teeming with tadpoles.
- Ponding in the Artificial Ponding Area no. 1 again but not as much as on Friday, 29 January 2021.
- No bullfrogs noted.

Tuesday, 2 February 2021 (13h00)




Observations:

- It had rained.
- Water 6cm deep in hollows of footpaths/tracks, becoming shallower towards the edges.
- Noted that water in the footpaths/track had overtopped and spread into the adjacent grassed area with the result that tadpoles were present in a wider area. However, water in this extended area was at most 2cm deep, mostly 1cm and in places less. Water was busy evaporating in these shallow areas.
- Ponding noted where the bullfrog was seen on Friday, 29 January 2021.
- No bullfrogs noted.

3 February 2021 (11h00)




Observations:

- No rain the previous day.
- Ponding in footpaths/tracks much smaller. Some tadpoles were still present.
- Water evaporated in the shallow surrounding areas and the tadpoles had died (black patches in photographs).
- No ponding in the Artificial Ponding Area no. 1.
- No bullfrogs noted.

4 February 2021 (10h00) –
site visit with Dr. Hannes Botha (Mpumalanga Tourism and Parks Agency (MTPA)

Observations:

- No rain the previous day.
- No more ponding on site (including Artificial Ponding Area no. 1).
- Tadpoles dead (black patches in photograph).
- No bullfrogs noted.

27 January 2021 – Off Site Small Dam (14h00)

30 January 2021 – Off Site Small Dam (11h00)

Observations:

- No water was noted in the small dam on both occasions.
- The said dam was also visited on 4 February 2021 with Dr Hannes Botha – no water was noted in the said dam.

Report by:
Adie Erasmus and Riana Janse van Rensburg

Ad Environmental

AdiEnvironmental cc
5 February 2021

Mpumalanga
TOURISM AND PARKS AGENCY

Ref: 13/6/1
Enquiries: Dr Hannes Botha
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Fax: +27 13 262 5269
E-mail: nilecrocs@mweb.co.za

Riana J van Rensburg
AdiEnvironmental cc
PO Box 647
Witbank
1035

Dear Riana

SITE MEETING PRESIDENT PARK X6: GIANT BULLFROG HABITAT ASSESSMENT

A site meeting was attended by representatives of AdiEnvironmental and the MTPA on 3 February 2021 at the President Park X6 site intended for business development.

The proposed development site was identified by an Interested and Affected Party (I & AP) as possible Gaint Bullfrog (*Pyxicephalus adspersus*) habitat. The aim of the site meeting was to discuss the findings of a report regarding habitat assessment and long-term survival plan of the possible Giant Bullfrog population at the development site.

The site intended for development is clearly ecologically disturbed and is characterised by evidence of infilling, depositing of soil, rocks and other materials, fences, diggings, roads, fire events, invasive plants, and general neglect. Artificial ponding is present where depressions formed due to anthropogenic influences. The site intended for development is representative of an urban environment under pressure due to encroaching urbanisation.

After discussion of the Giant Bullfrog (*Pyxicephalus adspersus*) habitat assessment and long-term survival plan report (van Wyk, 2020) and the options recommended by the consultants, the following points was agreed upon:

1. No Giant Bullfrogs were seen in the area intended for development during the site meeting. This was noteworthy because after the high rainfall experienced over the previous weeks one would have expected to see bullfrogs in the area where they were previously reported.

2. Development may start, when authorised by the proper regulating authority, but the depression/artificial pond area (area 1) should be left intact to act as a temporary refuge for bullfrogs that might be present at or may return to the area in following seasons.

3. Due to the physical size of the property, it was agreed that the maintenance of a buffer zone around the depression/artificial pond area would not be needed.

4. Should Gaint Bullfrogs be found during the construction phase, the MTPA must be notified and the bullfrogs must be removed by the appointed ECO and the MTPA Herpetologist to be relocated to the nearest suitable bullfrog habitat.

Kind Regards

Dr HANNES BOTHA
HERPETOFAUNA SCIENTIST
DATE: 11 February 2021

ADDENDUM

JCP van Wyk
jcpvanwyk@absamail.co.ca
082 410 8871

16 February 2021

AdiEnvironmental cc
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GIANT BULLFROG (*PYXICEPHALUS ADSPERSUS*) HABITAT ASSESSMENT AND LONG TERM SURVIVAL PLAN ON ERVEN 20, 21 AND 22 OF PRESIDENT PARK X6, EMALAHLENI (WITBANK) ON PORTION 234 OF THE FARM ZEEKOEWATER 311 JS, MPUMALANGA PROVINCE

The author of the above-mentioned report suggested seven options for the possible long-term survival of the giant bullfrogs and/or the development of the site (Van Wyk, 2020).

The author's recommendation is option 2, 4 or option 6 as the best chance for at least some of these giant bullfrogs to survive. All three options are a compromise between the relocation of this population of giant bullfrogs and the intended development. Option 2 is his preferred option for the survival and relocation of the giant bullfrogs and option 6 the third best option if the only concern is for the giant bullfrogs. Mpumalanga Tourism and Parks should also be informed of the option that is chosen.

SEQUENCE OF EVENTS DURING JANUARY/FEBRUARY 2021

During January 2021 the tropical storm/cyclone, Eloise, resulted in above-average rainfall in the eastern parts of Southern Africa, including the study site.

On Friday, 29 January 2021, the author received a photograph of an adult giant bullfrog on the study site from Steven Bloy (Interested and Affected Party). The author asked Mr Bloy to monitor the site, especially the following day. The author immediately contacted Ina Venter (the wetland specialist of this project). Ms Venter informed the author that Adie Erasmus (AdiEnvironmental cc) also observed a giant bullfrog on the site. The author then contacted Dr Mervyn Lotter (Control Scientist: Biodiversity Planning; Mpumalanga Tourism and Parks Agency) about the situation and possibly obtaining permits for relocation of adult bullfrogs. Dr Lotter gave the author the contact details of Dr Hannes Botha, the herpetologist of Mpumalanga Tourism and Parks Agency.

The next day, 30 January 2021, the author received a photograph of giant bullfrog eggs from Mr Bloy and Mr Bloy reported that he had not observed any more adult giant bullfrogs. The author reported the findings of Mr Bloy to Adie Erasmus. The giant bullfrog must have been breeding during the night, which is unusual because this species normally breeds during the daytime.

From then on Adie Erasmus has given the author a daily update of their monitoring process of the giant bullfrog tadpoles on site. In some populations of giant bullfrogs an adult male stays behind to

protect the tadpoles and to make tunnels to deeper water to enable giant bullfrog tadpoles to survive in dry conditions. Unfortunately, no such behaviour was observed at this population.

On 4 February, Dr Hannes Botha visited the site. Some of the tadpole schools had already died due to the evaporation of water. Dr Botha also gave permission to collect some of the tadpoles. Riana Janse van Rensburg (AdiEnvironmental cc) collected some tadpoles. As soon as they reach metamorphosis, the froglets will be released at the Witbank Nature Reserve.

On 5 February Adie Erasmus reported to the author that unfortunately all tadpole schools on the site had died.

No further giant bullfrog breeding efforts were observed on site.

CONCLUSIONS

- The author's first recommendation was option 2. AdiEnvironmental cc did almost all the requirements for this option during late January and early February 2021.

- Due to the unexpected above-average rainfall during the tropical storm Eloise, there was an attempt at breeding by giant bullfrogs on site. This situation gave the project an opportunity to get more information about the giant bullfrogs on the site and a chance to relocate some of the giant bullfrog.

- Due to an excellent monitoring program run by Adie Erasmus en Riana Janse Van Rensburg (AdiEnvironmental cc), enough information was gleaned to make an informed decision. AdiEnvironmental cc has done a sterling job, which normally would have cost the developer a great deal of time and money.
- As recommended, Dr Hannes Botha from Mpumalanga Tourism and Parks Agency was also informed. As a bonus, Dr Botha also visited the site.

- The recommendations of Dr Hannes Botha should be followed. I agree with Dr Botha that the depression/artificial pond be left intact as long as possible during the construction phase. The intension is not to force the developer to keep the pond intact for ever and a day but rather just to keep the pond going and available for as long as possible in the event that bullfrogs return for some reason.

- According to what the author learned from the available information, the giant bullfrog population on or near the site is very small. It would require an exceptional rainy season for this population to breed successfully.

- If the tadpoles that were collected reach metamorphosis, they must be released at the Witbank Nature Reserve.

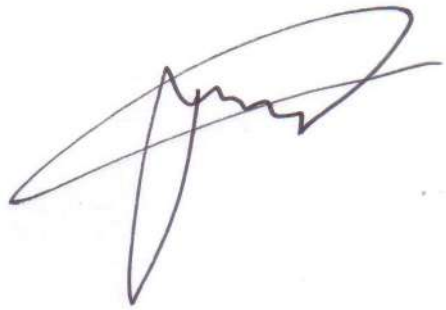
The following mitigation measures are still proposed for the development by the specialist:

- If any giant bullfrogs are encountered or exposed during the construction phase, they should be removed and relocated to natural areas in the vicinity.

- If any giant bullfrogs are accidentally killed during the construction phase they should be kept as voucher specimens and donated to the Ditsong Museum for natural History (Former Transvaal Museum)
- Education of construction staff about the value of wildlife and environmental sensitivity is imperative, especially about giant bullfrogs.

In the light of the above information, there is no further objection against the development from a giant bullfrog perspective.

Kind regards



Jaco van Wyk (Pr. Sci. Nat; M. Sc)
16 February 2021

Riana J. van Rensburg

From: nilecrocs@mweb.co.za
Sent: Friday, 19 February 2021 14:41
To: 'Riana J. van Rensburg'
Cc: adie@adienvironmental.co.za; 'Ina Venter'; jcpvanwyk@absamail.co.ca
Subject: RE: Bullfrog Report - Addendum

Follow Up Flag: Follow up
Flag Status: Completed

Hello Riana, thank you for the addendum to the Bullfrog Report. I agree with the addendum and support the conclusions and recommendations it contains.
Thank you for all your efforts with this.
Best regards,

Dr. Hannes Botha (Pr.Sci.Nat)
Herpetofauna Scientist
Mpumalanga Tourism and Parks Agency

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Mobile: (+27) 82 575 4240
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From: Riana J. van Rensburg <riana@adienvironmental.co.za>
Sent: 19 February 2021 13:02
To: nilecrocs@mweb.co.za
Cc: adie@adienvironmental.co.za; 'Ina Venter' <ina.kalinga@gmail.com>; jcpvanwyk@absamail.co.ca
Subject: Bullfrog Report - Addendum

Good afternoon Dr. Botha

Please find attached the Addendum to the Bullfrog Report as drafted by the specialist Mr. Jaco van Wyk.

Let us know if the letter is in order.

Regards
Riana J. van Rensburg *(Masters in Environmental Management)*
Registered Environmental Assessment Practitioner (EAP): 2019/1341

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