## 4.4 Possible impacts of proposed River Club development on the renosterveld of the SAAO site

Dr Liz Day's report on the wetlands of the River Club (Day, 2015) says the following: "The Flood Report of Krige (2015) (in Day, 2015) suggests that infilling of the entire River Club site to the 1:50 year flood level would not affect flooding in adjacent properties. Subsequent discussions with Mr Krige clarified the fact that infilling of the floodline would have an (as yet) unquantified effect on floodplain capacity, resulting in likely more rapid inundation of areas below a specified floodline, during an event of such a magnitude (as a result of reduced storage capacity). It is assumed that, up to floods of a magnitude at which flows bypass the constricting Salt River bridge, described in Krige (2015), infilling of the floodplain would also result in increased inundation depth in areas that have not been infilled".

There would be no impacts on the dryland renosterveld vegetation at the SAAO site (the water levels would be constant). However, as articulated by Day (2015) there is possibility that certain wetlands would be more quickly inundated, along with an increase in inundation depth. This would likely affect the species composition of localised wetland habitats, where deeper water species such as *Typha capensis* bulrush are likely to invade at the expense of those species with a more ephemeral wetland character. By comparison, the artificial perennial inundation of the Kuils River wetlands has led to the decline and even loss of certain wetland species in the area (Ninham Shand, 1999; Low, 1998).

If inundation of the rare renosterveld wetlands, particularly along the SAAO eastern boundary, becomes more perennial, this would compromise this habitat in a major way and would also impact on efforts to rehabilitate and even augment this habitat.

## 4.5 Conservation

### *10.1.1. 4.5.1 The Observatory Landscape Framework (OLF)*

The OLF (Van der Walt & Strong, 2010) has designated three conservation areas for the SAAO (Figure 3).

Area A[18]:

"Area A is mostly cultivated and includes the southwest area around the main entrance, the McClean Observatory and the old tennis court where different locally indigenous bulbs (e.g. *Sparaxis grandiflora* & *Lachenalia mediana* (Red data listed as Vulnerable), a few annuals (e.g. *Ursinia anthemoides*) and herbaceous herbs ( e.g. *Pelargonium myrrhifolium*) flower in spring under the existing pine and eucalyptus trees. *Moraea aristata* does not occur here, but there are bulbs with speckled petals that Mary Stobie (wife of a previous Director at the SAAO) planted next to the small octagonal garden east of McClean.

[18] taken verbatim from Van der Walt & Strong (2010)


Figure 3. Conservation areas in the SAAO site (from Van der Walt & Strong, 2010). Area B has most of the remnant renosterveld with Area C largely a clay wetland

**Area B:**

"Area B is the most sensitive and important conservation area where the different populations of *Moraea aristata* occur in the unshaded areas. In general the area has a mixture of planted indigenous and exotic plants between the remaining remnants of the original Renosterveld. A variety of bulbs also occur under the pine and English elm (*Ulmus procera*) on the north of the Director's house. These bulbs could have escaped by seeding from the pots grown by Mary Stobie. The area around the bird hide overlooking the Black River wetlands has been altered by landfilling but still supports interesting plants such as *Moraea virgata* not found elsewhere on the property. One Renosterbos (Dicerothamnus (=

Elytropappus) rhinocerotis), the predominant shrub in Renosterveld, is growing just south of the bird hide but it is not clear if this shrub is natural or planted.

The only original *Moraea* population (M4 on their Conservation Areas map) is immediately west of the Director's house and garden. The other areas (M1-M3, M5-M7) have been planted.

**Area C:**

"The eastern boundary is very degraded and mostly covered with kikuyu grass. This low-lying area is flooded during the winter months and is valuable as part of the Black River system, but as no indigenous vegetation remains the area is not deemed conservation worthy at present".

As implied by Van der Walt & Strong (2010) these are not conservation areas in the true sense of the word, and, except for Area B and part* of Area C, do not necessarily relate to natural open (undeveloped) land or even indigenous vegetation, but rather to areas in which different indigenous species happen to occur. Wetlands should form part of Areas B and C, rather than being treated separately (thus Area C would have a combination of seasonally flooded flats and dryland habitat).

Area B has the best remnant of renosterveld thicket and open shrubland (medium height to tall shrubs of 2.5 m+, forming localised dense thicket). This is the most natural site in that there are patches of renosterveld which grade into the wetland in the north (Figure 2). Area B also has the greatest concentration of *Moraea aristata.* I address this Area in more detail when considering an over-arching conservation plan for the combined RC/ SAAO sites below.

### *10.1.2. 4.5.2 Context and possible future conservation action*

Figure 4 shows the relationship of vegetation and landuse between the SAAO and River Club sites, with a summary of extent in Table 4. Unlike the SAAO site, the River Club has no natural vegetation, with only a scattering of indigenous species along the wetland fringe. This is mainly due to the fact that the bulk of the area is fill which has replaced what was likely to have been a wetland habitat.

The original extent of Peninsula Shale Renosterveld is shown in Figure 5. This enables us to establish which parts of the general area might have supported this vegetation type and what linkages there might have been or indeed still exist. Although no wetland vegetation is shown for the area in the SANBI map (Figure 5), there is a clear link along the Black River, stretching from the Mowbray/ Rondebosch Golf Courses, through the Oude Molen grounds as far as the SAAO site. Here the vegetation map is possibly inaccurate (shale and clay as opposed to sand vegetation seems to lie

between the SAAO site and the Black River, and this might well be the case for much of the length of the Black River).

### *10.1.3. Conservation action 1*

Consolidate and revegetate the renosterveld on the SAAO site. Focus should be on the two broad renosterveld habitats here. Firstly, a specific conservation area needs to be identified on the SAAO site and protected as part of the SAAO landscape and management plan. In particular, the open vegetation will need the reintroduction of an emergent shrub layer as a basic minimum intervention, and which would grade into the existing thicket vegetation.

### *10.1.4. Conservation action 2*

Establish and rehabilitate links to the north and south along the Black River, possibly as part of the current TRUP study.

### *10.1.5. Conservation action 3*

I understand that the proposed River Club development, if approved, would require the input of much additional fill. Strategic selection of shale soil and overburden, perhaps from one of the Malmesbury shale aggregate mines in the Tygerberg, could provide potential additional renosterveld substrate on the River Club site and would enable the extension of these habitats along the Black River as well as within the River Club site. A linkage between the two sites should also be considered, even if the two dryland sites (SAAO and River Club) are connected by a wetland/ riverine habitat.

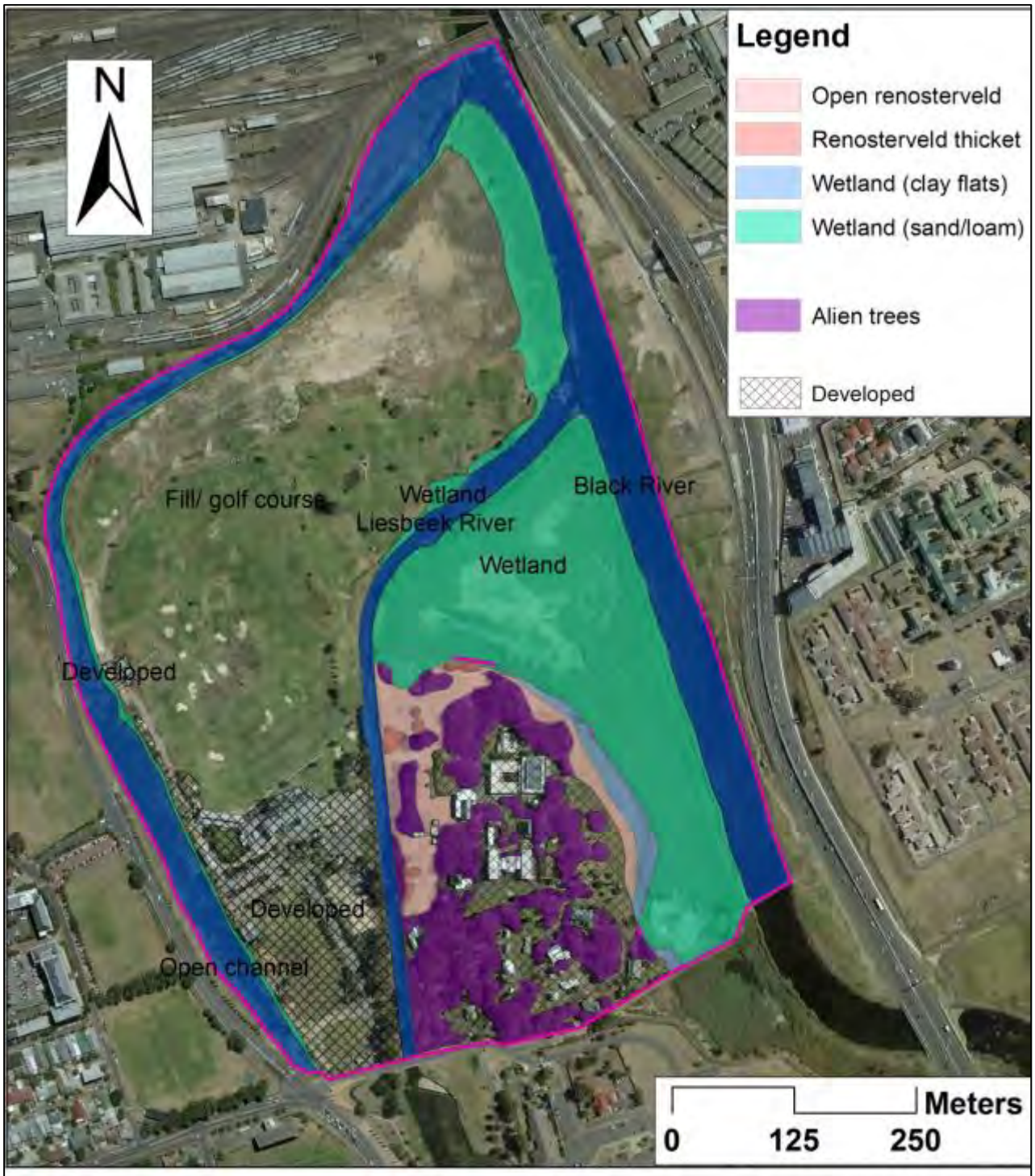


Figure 4. Vegetation and landuse for the River Club and the SAAO site. The former is devoid of any natural vegetation and is dominated by fill and developed areas, notably a golf course and driving range. The channel bordering the River Club in the west and north is completely unnatural and is not fed by either the Black or Liesbeek Rivers

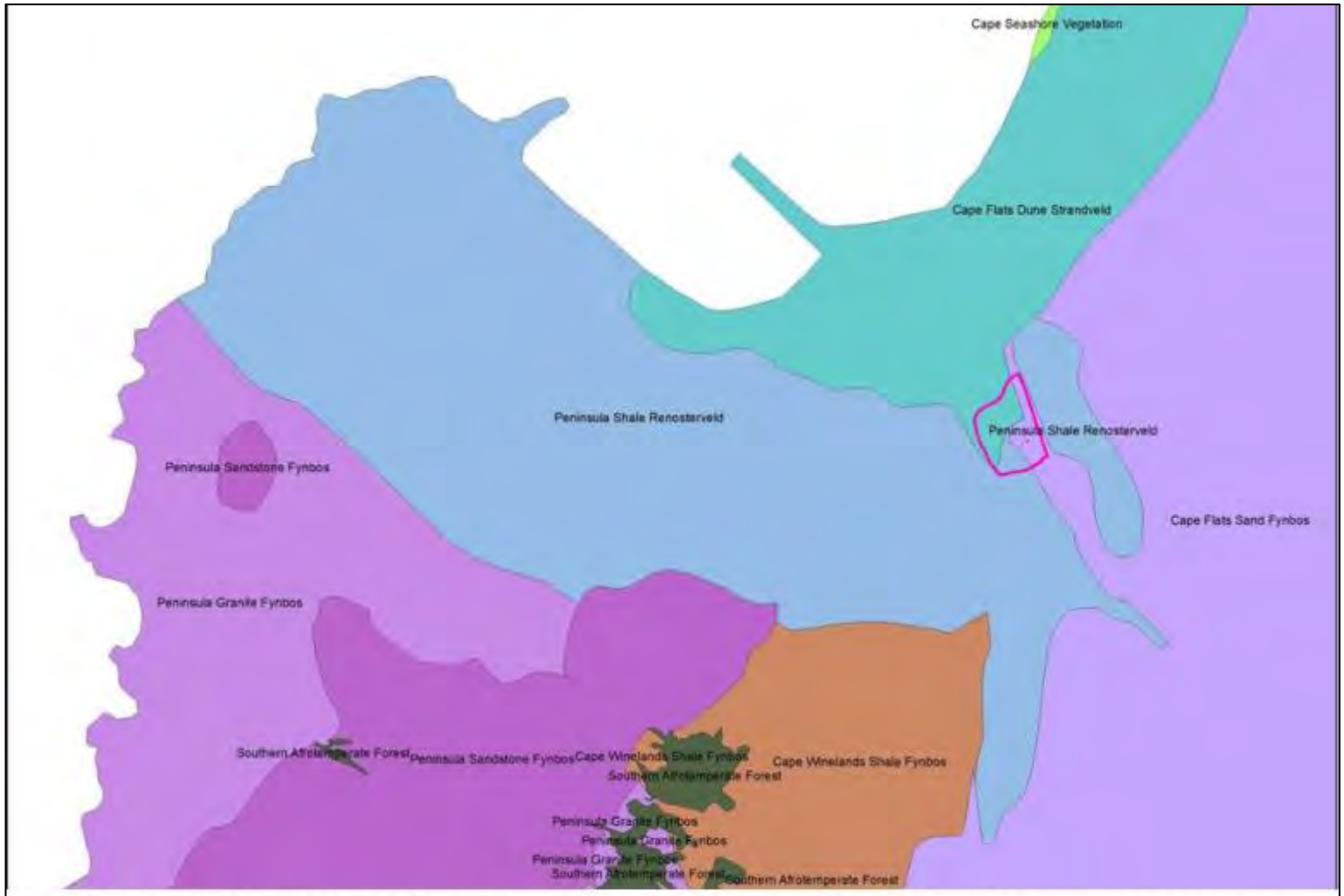


Figure 5. Original extent of Peninsula Shale Renosterveld, showing location of River Club and SAAO sites

| **Table 4. Extent of vegetation and landuse at the River Club and South African Astronomical Observatory (based upon study area shown in Figure 4)** | |
|---|---|
| **Description** | **Area (ha)** |
| Alien trees (SAAO only) | 3.97 |
| Natural dryland vegetation (renosterveld) (SAAO only) | 1.40 |
| | |
| Black & Liesbeek Rivers | 5.31 |
| River Club channel | 3.38 |
| Wetlands | 10.47 |
| | |
| Fill (River Club only) | 16.82 |
| Developed (buildings, roads, landscaped) | 7.53 |
| | |
| **Total** | **48.88** |

## 5. CONCLUSIONS

The proposed development at the River Club is highly unlikely to impact negatively on the dryland renosterveld vegetation at the SAAO site. The security of the Critically Endangered *Moraea aristata* is thus likely assured, provided acceptable conservation measures are introduced on the SAAO site.

However, impacts on the SAAO's renosterveld wetlands might be significant if inundation patterns are altered by the proposed River Club development and present seasonality is compromised.

It is strongly recommended that all three conservation options are followed for the SAAO site and environs, but that efforts at extending the area of dryland renosterveld should be supported by a joint initiative between the River Club and the Observatory.

## 6. REFERENCES

Day, L (2015). Proposed redevelopment of the River Club, Observatory: development opportunities and constraints report from the perspective of freshwater ecosystems. Freshwater Consulting

Joubert, C and Moll, E J (1992). A phytosociological study of Signal Hill, Cape Town, utilizing both perennial and ephemeral species. Bothalia 22(2): 255 - 282.

Low, A B (1998). Kuils River MOSS: plantlife and general ecology. Coastec, Claremont

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

Low, A B & Roberts, R (2016). SaSFlora: Site and species database for the Cape & Karoo floras (1998 – 2016). Coastec, Rondebosch

Ninham Shand (1999). Kuils River Metropolitan Open Spaces System (MOSS). Ninham Shand, Cape Town

Mustart, P (2010). Botanical report for the conservation areas of the South African Astronomical Observatory. Mowbray

Rebelo, A G, Boucher, C, Helme, N, Mucina, L & Rutherford, M (2006). Fynbos biome. In "Mucina, L & Rutherford, M (eds.). The vegetation of South Africa, Lesotho & Swaziland". Strelitzia 19, South African National Botanical Institute, Pretoria. pp 52 – 219

Theron, J N (1984). Cape Town & environs: explanation – sheet maps (1:50 000) 3318CD and DC, 3418AB and BA. Geological Survey, Pretoria

Van der Walt, L & Strong, N (2010). Observatory Landscape Framework. Liesl van der Walt, Landscape Architect

Wood, J & Low, A B (1993). Environmental survey and management guidelines for the Tygerberg and environs. Part 1. Environmental survey. National Botanical Institute, Cape Town

## 7. ACKNOWLEDGEMENTS

Louise Badenhorst kindly took me around the the SAAO site and provided useful discussion on the presence and conservation of renosterveld here; she also facilitated funding for the soil analysis

Jody Aufrichtig was helpful in showing me around the River Club site

Carline Voget provided the image of *Moraea aristata.*

# APPENDIX 1. INDIGENOUS PLANT SPECIES RECORDED FROM THE SOUTH AFRICAN ASTRONOMICAL OBSERVATORY

Report produced by the SaSFLORA database: data (C) Coastec; database design and structures (C) Reuben Roberts 1998-2016

EX = Extinct, EW = Extinct in the wild, CR = Critically Endangered, EN = Endangered, VU = Vulnerable, R = Rare, NT = Near Threatened, DD = Data Deficient, LC = Least Concern, NE = Not Evaluated

**Division** Anthophyta **Class:** Dicotyledones

AIZOACEAE
- Galenia
  - pubescens var. pubescens NE
- Tetragonia
  - herbacea LC

AMARANTHACEAE
- Sarcocornia
  - cf. capensis LC

ANACARDIACEAE
- Searsia
  - crenata LC
  - glauca LC
  - lucida LC
  - tomentosa LC

APIACEAE
- Arctopus
  - echinatus LC

APOCYNACEAE
- Gomphocarpus
  - fruticosus LC

ASTERACEAE
- Arctotheca
  - calendula LC
- Athanasia
  - trifurcata LC
- Cotula
  - coronopifolia LC
  - turbinata LC
- Dimorphotheca
  - pluvialis LC
- Elytropappus
  - rhinocerotis NE
- Eriocephalus
  - africanus LC
- Osteospermum
  - moniliferum LC
  - monstrosum LC
- Senecio
  - burchellii LC
- Stoebe
  - plumosa NE
- Ursinia
  - anthemoides LC

BRASSICACEAE

Heliophila
coronopifolia LC
CARYOPHYLLACEAE
Silene
burchellii var. angustifolia NE

CELASTRACEAE
Gymnosporia
buxifolia LC
EBENACEAE
Euclea
racemosa LC
FABACEAE
Indigofera
incana LC
**psoraloides EN**
Otholobium
hirtum LC
virgatum LC
Podalyria
**sericea NT**
GERANIACEAE
Pelargonium
elongatum LC
myrrhifolium var. myrrhifolium LC
triste LC
KIGGELARIACEAE
Kiggelaria
africana LC
LOBELIACEAE
Cyphia
bulbosa LC
Lobelia
erinus LC
MALVACEAE
Hermannia
hyssopifolia LC
multiflora LC
OLEACEAE
Olea
europaea subsp. africana LC
OXALIDACEAE
Oxalis
caprina LC

compressa LC
hirta LC
obtusa LC
pes-caprae LC
purpurea LC
tomentosa LC
versicolor LC
POLYGALACEAE
Muraltia
demissa LC
Polygala
myrtifolia
SANTALACEAE
Thesium
funale LC
SCROPHULARIACEAE
Hemimeris
racemosa LC
THYMELAEACEAE
Gnidia
laxa LC
Passerina
corymbosa LC

**Division:** Anthophyta **Class:** Monocotyledones
AMARYLLIDACEAE
Amaryllis
belladonna LC
Crossyne
cf. guttata LC
ARACEAE
Zantedeschia
aethiopica LC
ASPARAGACEAE
Asparagus
asparagoides LC
capensis LC
declinatus LC
undulatus LC
ASPHODELACEAE
Bulbine
alooides LC
Trachyandra
ciliata LC
revoluta LC

COLCHICACEAE
- Baeometra
  - uniflora LC
- Colchicum
  - eucomoides LC

CYPERACEAE
- Bolboschoenus
  - maritimus LC

HYACINTHACEAE
- Albuca
  - canadensis LC
- Lachenalia
  - **mediana var. mediana VU**
- Ornithogalum
  - thyrsoides LC

HYPOXIDACEAE
- Empodium
  - plicatum LC

- Pauridia
  - capensis LC

IRIDACEAE
- Babiana
  - **fragrans NT**
- Chasmanthe
  - aethiopica LC
  - floribunda LC
- Geissorhiza
  - aspera LC
  - juncea LC
- Ixia
  - **maculata NT**
- Moraea
  - **aristata CR**
  - flaccida LC
  - gawleri LC
  - miniata LC
  - setifolia LC
  - vegeta LC
  - cf. virgata subsp. virgata LC
- Romulea
  - flava LC
  - hirsuta LC
  - obscura LC

rosea LC
Sparaxis
bulbifera LC
cf. **grandiflora subsp. fimbriata NT**
Watsonia
meriana var. meriana LC
spectabilis LC
POACEAE
Agrostis
lachnantha var. lachnantha LC
Ehrharta
calycina LC
Hyparrhenia
hirta LC
TECOPHILAEACEAE
Cyanella
hyacinthoides LC

**Total named species: 96**
**Total genera: 62**
**Total families: 32**
**Total red list species: 7**

## APPENDIX B

## SPECIALIST FAUNAL REPORT (EXCLUDING BIRDS)

# PROPOSED REDEVELOPMENT OF THE RIVER CLUB, OBSERVATORY: Baseline assessment of mammals, reptiles and amphibians at the confluence of the Liesbeek and Black rivers, with specific focus on the local Western Leopard Toad population

Report compiled for: Commissioned by The Freshwater Consulting Group, for SRK Consulting

Client: Liesbeek Leisure Properties Trust

Report compiled by: Marius Burger, trading as *Sungazer Faunal Surveys*, 6 Putter Street, Lakeside 7945

Phone: 083 231 7452; Email: *sungazer@iafrica.com*

THIRD DRAFT – December 2017

**Figure 1**: Western Leopard Toad (*Sclerophrys pantherina*) from the River Club grounds (Dec. 2016).

**DECLARATION OF INDEPENDENCE**

I hereby declare that I have no conflicts of interest related to the work of this report. Specifically, I declare that I have no personal financial interests in the property and/or development being assessed in this report, and that I have no personal or financial connections to the relevant property owners, developers, planners, financiers or consultants of the development. I declare that the opinions expressed in this report are my own and a true reflection of my professional expertise.

**CV OF SPECIALIST CONSULTANT** (abridged)

Mr **Marius Burger** holds a National Diploma in Nature Conservation with Cape Technicon, and worked as a research assistant with Eastern Cape Nature Conservation (1987-1997). Subsequently he took up employment with the Animal Demography Unit (ADU, University of Cape Town) as National Coordinator of the Southern African Frog Atlas Project (1997-2003) and as Project Herpetologist of the Southern African Reptile Conservation Assessment (2005-2009). Burger's EIA activities as a faunal specialist started in 1996, and since then he has participated in about 85 different projects in collaboration with a variety of EIA consultancies. In 1998, he established a sole-proprietor business *Sungazer Faunal Surveys*. His achievements as a faunal specialist are summarised below:

- Member of IUCN SSC Snake and Lizard Red List Authority 2017-2020: 2017 – present.

- Member of South African Frog Re-assessment Group (SA-FRoG): 2013 – present.
- Extraordinary Lecturer with the Unit for Environmental Sciences and Management, North-West University: 2015 – present.
- Research collaborator with FLORA FAUNA & MAN, Ecological Services Ltd.: 2011 – present.
- Research Collaborator with the Smithsonian Institute: 2002 – 2004.
- Research Collaborator with the South African Museum: 2000 – 2002.
- Country liaison for the journal *Amphibian and Reptile Conservation*: 2000 – 2004.
- Chairman of the Port Elizabeth Herpetological Club: 1992 – 1996.
- Compiled about 100 specialist and EIA reports for various consultancies.
- Published about 105 scientific, semi-scientific and popular articles, and authored/edited three books and 34 chapters/accounts in books.
- Presented 41 papers/posters at national/international symposia.
- Directed/presented in about 100 natural history television documentaries for *National Geographic*, *BBC World*, *SABC, Kyknet* and others.

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faunal surveys

**M. Burger – trading as *Sungazer Faunal Surveys***
**October 2017**

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**Abbreviations**

**ADU** Animal Demography Unit
**CBA** Critical Biodiversity Area
**EN** Endangered
**EIA** Environmental Impact Assessment
**FCG** Freshwater Consulting Group
**FIA** Faunal importance assessment
**IUCN** International Union for Conservation of Nature
**LC** Least Concern
**NT** Near Threatened
**PRASA** Passenger Rail Agency of South Africa
**RBS** Raapenberg Bird Sanctuary
**SA** South Africa, Lesotho and Swaziland
**SAAO** South African Astronomical Observatory
**SANBI** South African Biodiversity Institute
**SCC** Species of conservation concern
**SRK** SRK Consulting
**ToR** Terms of Reference
**TRUP** Two Rivers Urban Park
**VU** Vulnerable
**WC** Western Cape
**WLT** Western Leopard Toad (*Sclerophrys pantherina*)

# 1 SUMMARY

**Introduction**

A baseline study was conducted for the mammal, amphibian and reptile faunas of the River Club study area, in the context of a proposed mixed retail/commercial/residential complex development. The main aims of this faunal study were to assess the area in terms of the local species richness of these various faunal groups, and to highlight environmental issues that may be of special concern in the light of the proposed development of the River Club property. Several site visits were conducted during the period October 2016 through to January 2017. Various data sources and persons were consulted to gain a reasonable impression of these faunal assemblages that are likely to be still present in the general region. In addition to the specific records obtained from the various sources, the local habitats were assessed in order to project the possible/probable species richness of these three faunal groups. A faunal importance assessment (FIA) score was calculated for the site for each of the three faunal groups, to obtain an approximate impression of the site's importance for each respective group at regional (CoCT Metropolitan Area) and national (South African; SA) scales. Various recommendations and mitigation measures were proposed to reduce impacts on the local faunal assemblages.

**Faunal assessment**

MAMMALS: A total of 29 indigenous mammal species may potentially occur on the River Club grounds and immediate surroundings, but the more realistic probable mammal richness here is about 19 or so species (Tale 4). Most of the larger mammal species that used to occur here historically have become locally extinct, leaving only a subset of small species that still manage to maintain meagre populations here. The conservation status of these mammals are almost all listed as being of Least Concern (LC), with only one species (African Clawless Otter) with a global (IUCN) and regional (Child *et al.* 2016) listing of Near Threatened (NT). The presence of otter activity have been confirmed from the general region. The River Club itself is unlikely to have a resident population of otters, but rather a few individuals probably move in and out of this area throughout the year. Although the River Club grounds and adjacent area are generally of MODERATE at regional and LOW to MODERATE at national scales (Table 1; FIA score = 4.5), any developments in this area should nevertheless be considerate about the associated environmental impacts. The most important consideration in respect of the local mammal assemblages would be to maintain or improve the ecological integrity of the Liesbeek and Black rivers, including a buffer region along the banks of these rivers and corridors between them.

REPTILES: A total of 32 indigenous reptile species may potentially occur on the River Club grounds and immediate surroundings, but the more realistic probable reptile richness here is about 20 or so species (Table 5). The conservation status of these reptiles are almost all listed as being of LC, except for the Cape Dwarf Chameleon which currently is listed as Vulnerable (VU). This particular species was recorded on the grounds of the adjacent South African Astronomical Observatory, and it may possibly also occur within the River Club grounds. The FIA score for reptiles (Table 2; score = 5) in the

context of the River Club site is MODERATE at regional and LOW to MODERATE at national scales. However, it is advised to integrate a mosaic of green belts/nodes within the proposed development, in order to maintain a degree of ecological resilience for the remaining faunal groups here. For species like the Cape Dwarf Chameleon for example, the habitats of such ecological nodes could be enhanced to better suite their needs and thus improve the overall conditions for maintaining a long-term population.

AMHIBIANS: A total of eight indigenous amphibian species may potentially occur on the River Club grounds and immediate surroundings, but the more realistic probable amphibian richness here is about six species (Table 6). The conservation status of these amphibians are almost all listed as being of LC, with the notable exception of the Western Leopard Toad (WLT) which is Endangered (EN). Even with the presence of a species of conservation concern (SCC), i.e. the WLT, the FIA score for amphibians (Table 3; score = 6.25) in the context of the River Club site is MODERATE at regional and LOW to MODERATE at national scales. Although this does not trigger a fatal flaw response in respect of the development intentions, the prevalence of WLTs in this area does call for special considerations to adequately accommodate this species here. The WLT represents the most significant faunal concern in respect of the proposed River Club development intentions, and the long-term viability of this species must not be compromised by this development. To achieve this, specific mitigating measures will have to be implemented. The following aspects are relevant in this regard:

WESTERN LEOPARD TOADS (WLT)

- The only known WLT breeding sites in the region of the River Club are wetlands of the Raapenberg Bird Sanctuary (RBS) and about 1.5 km south-east in the Oude Molen area.
- The WLT population of this specific area (Figures 2 and 3), i.e. Observatory and surroundings, appears to be somewhat disjunct and seemingly completely separated from the WLT breeding populations further south (see Figure 4) on the Cape Peninsula.
- Any proposed development of the River Club grounds and immediate surroundings must be mindful of the environmental constraints stemming from this WLT population. The following four components are critical for the viability of any WLT population:

1. Availability of suitable **breeding habitat**: In this case, the conservation and management of the RBS wetlands are thus of outmost importance. Additionally, the creation of supplementary WLT breeding habitat (e.g. along the western reaches of the site) is likely to improve the resilience of the localised Observatory WLT population.
2. Availability of habitat to provide **shelter and food (forage)**: Enough natural or semi-natural habitat must be available within at least a 2 km radius of breeding habitats to sustain WLT individuals for the non-breeding period (i.e. about 10 months of the year). Such sectors must provide the adequate shelter and foraging requirements to sustain the WLTs until the next breeding season. Thus substantial green belts must remain undeveloped, e.g. along the two

rivers and especially in the areas near to the RBS wetlands and the northern sector near the confluence, and also within the east/west dispersal corridors.

3. Availability of **dispersal corridors**: Multiple dispersal options between breeding habitat and year-round occupancy habitat must be maintained, i.e. barriers must be limited. Connectivity must be maintained between the RBS wetlands and the river regions to the west, including the area of the former Liesbeek flow, which must either be rehabilitated as an accessible high quality wetland habitat or converted into high quality terrestrial habitat with some pools/ponds that would retain water into the summer and could be used as WLT breeding grounds. One broad (>70 m wide) east/west belt must be established in the northern reaches of the property, and additional minor (>10m wide) east/west corridors must also be created along the northern and southern site boundaries.
4. Limiting the extent of **hazardous features** and **high-risk areas**: Toad exclusion barriers must be erected to prevent/limit toad access to high-risk zones such as roads, large unvegetated areas and various pitfall structures.

**Main conclusions**

- The importance value of the River Club site in respect of mammals, reptiles and amphibians is MODERATE at regional and LOW to MODERATE at national scales for all three faunal groups.
- From a faunal perspective, the prospects of developing the area is thus not fatally flawed.
- The main faunal consideration of the River Club project is the occurrence of an isolated population of WLTs, an EN species which breeds at the RBS wetlands.
- Significant mitigation is required to limit the impact of the proposed development, and to ensure the long-term viability of this WLT population.
- Mitigation measures implemented for WLTs will by default also serve to mitigate for the other faunal assemblages that are not of significant conservation concern.

**Main recommendations and mitigations**

Several general mitigation measures have been formulated during the course of the freshwater, botanical and faunal assessments (2015 – 217). The mitigation measures most relevant to the faunal considerations are summarised below:

1. **ECOLOGICAL SECTORS**: Several natural or semi-natural ecological sectors must be provided to serve as shelter/forage habitat for WLTs and other faunal species. Some of these ecological sectors may further function as WLT breeding habitat and/or faunal dispersal corridors. The most important ecological sectors are:

- LIESBEEK WEST SECTOR: The historical flow area of the Liesbeek River to the west of the River Club. This sector is earmarked to be converted and landscaped into being more of a vegetated terrestrial landscape, with seasonally flooded wetlands to serve as WLT breeding habitat.
- LIESBEEK EAST SECTOR: The canalised section of the Liesbeek River to the east of River Club. This ecological sector is earmarked to be converted and landscaped into a more natural (not

canalised) watercourse with a substantial buffer area (at least 25m) of semi-natural vegetation including some lawned areas.

- EAST/WEST CORRIDOR: The east/west ecological (or faunal) corridor between the historic and canalised Liesbeek watercourses, as per the current development layout vision. This wide (75-100m) vegetated green belt will serve as the main linkage between the western Liesbeek sector (and landscaped WLT breeding wetland habitat) and the eastern Liesbeek sector (including RBS and Black River). It will also serve as shelter/forage habitat for WLTs and certain other faunal species.
- NORTHERN SECTOR: the northern undeveloped section (owned by the Passenger Rail Agency of South Africa; PRASA) situated between the golf course and the railway line. This area does not form part of the proposed River Club development. It has good potential to serve as shelter/forage habitat and being an east/west faunal corridor. However, the terrain is currently suboptimal for these functions and would require a landscaping initiative to vegetate it adequately according to faunal (and WLT) requirements.

2. **TOAD-FRIENDLY INFRASTRUCTURE**: Toad-friendly structures (examples in Appendix 2) must be integrated with the proposed development, so that the negative impact on the WLT population can be minimise. The most important examples of such features are:

- EXCLUSION BARRIERS: Low barrier walls or fencing can be used to prevent WLTs from gaining access to hazardous terrain or high-risk areas such as parking lots and roads.
- UNDERPASSES: High-risk areas like roads can be made permeable for toads by means of a combination of exclusion barrier walls to keep toads off roads, and underpasses to allow safe movement of toads between different ecological sectors.

3. **WLT MANAGEMENT & MONITORING**: It is recommended that a WLT management and monitoring programme be drawn up for this proposed development. Ideally the monitoring should start at least one WLT breeding season prior to commencing with the construction phase, and continue up until five breeding seasons after construction has been completed. The main aims of this monitoring would be to evaluate the success and efficiency of faunal dispersal corridors, ecological shelter/foraging sectors, new WLT breeding habitat, and the toad-friendly infrastructure. Details to be formulated as part of the final design phase, if approved.

# 2 INTRODUCTION

The *Liesbeek Leisure Properties Trust* (LLPT) proposes to redevelop the River Club property situated within the Two Rivers Urban Park (TRUP) complex near Observatory, Cape Town. The proposal envisages retail, commercial and residential components. The scoping and Environmental Impact Assessment (EIA) studies for this proposed development are being conducted by *SRK Consulting (South Africa) Pty Ltd* (SRK), who in turn commissioned the *Freshwater Consulting Group* (FCG) to undertake the freshwater ecosystem studies. To date the FCG has compiled a preliminary scoping baseline report (Day 2015), which also included an avifaunal component. Additionally, a brief faunal assessment report was compiled by *Nick Helme Botanical Surveys* as part of the botanical assessment report that was prepared for the TRUB study area (Helme 2016). In both the freshwater/avifauna and botanical/faunal reports, the Western Leopard Toad (WLT) was highlighted as a species of conservation concern (SCC) in respect of the proposed developments here, and that a more detailed study was required to gain adequate insight in this regard. As such, a faunal consultant (M. Burger, trading as *Sungazer Faunal Surveys*) was subcontracted by the FCG (for SRK) to conduct a baseline assessment of the mammals and herpetofauna (i.e. reptiles and amphibians) of the TRUP study area.

## 2.1 Terms of Reference (ToR)

- Conduct a series of site visits/habitat assessments (day and night) and gather information and data sets from other resources to:
    1. Identify faunal species at and adjacent to the site;
    2. Estimate the population size of faunal species that utilise the site;
    3. Identify existing breeding locations for faunal species on the site; and
    4. Identify areas on the site used as faunal movement corridors.
- Compile a desktop baseline faunal assessment (informed by habitat assessment) based on known faunal distribution patterns and habitat associations, including:
    1. Identification of fauna that are known to or likely to use the site;
    2. Indication of whether these include red data species or other SCC;
    3. Description of habitat requirements and likely areas of the site that they would utilise;
    4. Identification of important off-site linkages;
    5. Broad comments on the sensitivity of the fauna to development – increased noise, buildings, traffic, construction phase disturbance; and
    6. Comments on appropriate development setbacks and design of corridors and buffer areas to address the habitat requirements of conservation worthy taxa/communities.

In addition to the above ToR, the specialist will comment on the connectivity between the Observatory WLT population and other populations in Cape Town e.g. the Cape Flats.

# 3 STUDY AREA

The TRUP study area is situated in the Observatory region, near the confluence of the Black and Liesbeek rivers (Figure 2). Currently the main land-use nodes are: 1) The River Club venue, with a driving range and 9-hole golf course to the north of the River Club facility, 2) undeveloped terrain owned by Passenger Rail Agency of South Africa (PRASA) in the far north of TRUP, 3) the South African Astronomical Observatory (SAAO) to the east of River Club, 4) the Raapenberg Bird Sanctuary (RBS) to the north and east of the SAAO, and 5) a small area to the south of River Club which is earmarked for an office park and residential development by SKA South Africa. The Black River flows along the eastern limits of the faunal study, whereas the western and northern limits are along the historical flow of the Liesbeek River. The current flow of the Liesbeek River is along a canalised structure that separates the River Club development area from the RBS and SAAO.


**Figure 2**: The location of the TRUP study area, with the approximate boundaries of the faunal study in yellow. The TRUP development footprint will be contained within the area demarcated with red boundaries, including the area currently occupied by the River Club. Two localities to the east of the River Club are noteworthy, i.e. the RBS and the SAAO. The Black River flows along the eastern limits of the faunal study, whereas the western and northern limits are along the historical flow of the Liesbeek River. The current flow of the Liesbeek River is along a canalised structure that separates the River Club and TRUP development area from the RBS and SAAO.

# 4 STUDY APPROACH AND METHODS

The faunal assessment was conducted in the following way:

- Several brief site visits were conducted during night and day during the period October 2016 through to January 2017. The main aim was to assess habitat diversity/quality (with specific attention to WLT habitats), and to search for some representatives of the three faunal groups.
- Some small mammal trapping was conducted in the PRASA and RBS sectors, and tadpole scoops were conducted on the periphery of the RBS wetlands.
- Other sources (e.g. online data sets, literature and persons) were consulted to gain deeper insights of the property. The main sources were:
    - iSpot Nature: https://www.ispotnature.org/
    - Animal Demography Unit (ADU) Virtual Museum: http://vmus.adu.org.za/
    - Dr Tony Rebelo: South African Biodiversity Institute (SANBI).
    - Dr John Measey: Centre for Invasion Biology, Stellenbosch University.
    - Mrs Jean Ramsay: Volunteer, recording annual WLT activities on the SAAO property.
    - Miss Peta Brom: Student of Urban Ecology.
- Faunal importance assessments (FIA) were conducted for the three faunal groups.

## 4.1 Study limitations

The relatively short field surveying period allows mainly to gauge habitat parameters of the study area, with insight on faunal assemblages having to be derived from other sources and inferences made from habitat availability. The extrapolations made from assessing the habitats and the habitat requirements of the species known from the general region, are sufficient for the compilation of reasonably accurate (>80% accurate/complete) faunal checklists. The WLT survey was conducted about one to two months after the 2016 WLT breeding survey, but sufficient information was obtained via other sources to gain an adequate understanding of WLT demographics in this region.

## 4.2 Faunal importance assessments (FIA)

The purpose of assessing the faunal importance of each of the three vertebrate faunal groups, i.e. mammals, reptiles and amphibians, is to obtain an approximate impression of each group's value at a regional (CoCT Metropolitan Area) and national (South African; SA) scale. This assessment incorporates a variety of components, i.e. the presence/absence of threatened species, the levels of conservation status of the threatened species, overall species richness, levels of endemism, ecological functioning potential of the site, the size and habitat quality of the site, habitat heterogeneity or homogeneity, and the site's value as an ecological corridor, a green zone, or source or sink for genetic exchange in respect of peripheral natural areas. The IUCN Red List of threatened species (IUCN 2017), together with the respective SA assessments of the three faunal groups, i.e. mammals (Child *et al*. 2016), reptiles (Bates *et al.* 2014) and amphibians (Minter *et al.* 2004; Measey 2011), served as the sources for the conservation status for fauna of the Observatory region. The following criteria were used to determine the relative importance of the River Club site in respect of

these faunal groups, in the context of the CoCT Metropolitan Area (regional) and SA (national). A score of one point is given for each YES answer, excepting for Red List species where as many as two points can be awarded. A score of 0.5 is awarded if the answer is disputably YES or NO for questions 1 to 5. A score of 0.25, 0.5, 0.75 or 1 may be awarded for questions 6 to 12, depending on the subjective assessments of these questions. Thus a maximum possible score is 12 points.

- Score total 0 - 4 = LOW at regional and national scales.
- Score total 4.25 - 8 = MODERATE at regional and LOW to MODERATE at national scale.
- Score total 8.25 - 12 = HIGH at regional and MODERATE to HIGH at national scale.

Questions:

1. Are any threatened (Red List) species known to occur within the River Club site? Note that for the purpose of this evaluation, threatened species constitute those listed as ***Critically Endangered*** (2 points), ***Endangered*** (1.5 points), ***Vulnerable*** (1 point) and *Near Threatened* (0.5). If several threatened species are present, only the most threatened status of them all is applicable, thus a maximum of 2 points can be scored in this section. Note also that if a score is of YES (1) is made here, then no score can be presented in the next category (i.e. potential occurrence of threatened species). Thus the maximum total possible score for a particular faunal evaluation is 12.
2. If not, are any threatened species likely to occur within the River Club site?
3. Are any localised (CoCT) endemics known or likely to occur within the River Club site?
4. Are any provincial (WC) endemics known or likely to occur within the River Club site?
5. Are any national (SA) endemics known or likely to occur within the River Club site?
6. Is the site likely to support high species richness relative to the CoCT Metropolitan Area?
7. Are the existing faunal communities thought to be of importance in respect of the local ecological functioning of systems within the River Club site?
8. Is the total extent of the River Club site large enough to support the existing faunal communities in the long-term?
9. Is the habitat quality of the River Club site such that it is suitable for the long-term support of faunal communities?
10. Does the River Club site have great habitat heterogeneity that would favour overall high species richness?
11. Is the River Club site important in respect of peripheral natural areas, either as an ecological corridor or a significant suburban green zone?
12. Is the River Club site important in respect of peripheral natural areas as a source or sink for genetic exchange?

# 5 RESULTS

## 5.1 Habitat assessment

Habitat variation, habitat quality and the size of a particular site are significant determining factors in respect of the likely faunal species composition of that site. The assessment of these environmental parameters enables the faunal surveyor to make reasonable predictions concerning the likely presence or absence of specific species at a particular site. These unconfirmed species are incorporated in the respective checklists for the various faunal groups (Tables 4 to 6), together with known/confirmed species records that were obtained from other sources or by means of new faunal surveys and field observations. The relevant habitat parameters of the site are as follow (Figures 3 to 14):

The general terrain is substantially transformed and developed, most notably the SAAO grounds and the River Club property with associated buildings, parking lots and golf course/range fields. The belt of PRASA terrain beyond (north of) the golf course/range is also substantially degraded. The TRUP terrain is generally flat, without any rocky protrusions. A few small artificial ponds are present within the landscaped golf course section. Although also somewhat transformed, the Raapenberg Bird Sanctuary (RBS) wetlands are still of moderate ecological importance and of local conservation value. The Black River has undergone extreme changes from its natural condition (PES Category F according to Day 2015). The original flow of the Liesbeek River was diverted by means of a lined channel that short-cuts to the confluence with the Black River. The natural flow regime of the truncated section of the original Liesbeek along the west and north-west of the study has dwindled to a generally stagnant wetland system.

Vegetation types and quality: Vegetation descriptions of the TRUP study area were prepared in the botanical report (Helme 2016). In summary, the site falls mostly within the original extent of the Cape Flats Dune Strandveld Vegetation type, and a small portion falls within the original extent of the Peninsula Shale Renosterveld vegetation type. The Cape Flats Dune Strandveld Vegetation Type is classified as Endangered, with the Peninsula Shale Renosterveld vegetation being endemic to the CoCT and classified as Critically Endangered (Mucina and Rutherford, 2006). However, these vegetation types are no longer present within the TRUP study area, having been transformed into grassed (lawn) terrain with scattered trees. Essentially, >90% of the TRUP study area can be considered transformed habitats. According to the botanical assessment (Helme 2016), the only remaining terrestrial areas with traces of indigenous vegetation are on the SAAO grounds. However, these small remnants (<1 ha) are heavily transformed and currently support less than 10% of their likely original plant communities.

Geomorphological features: The River Club site is comprised of mostly flat terrain with a few low landscaped mounds incorporated within the golf range section. The area is devoid of any significant

geomorphological features such as hills, rocky outcrops, valleys or major drainage zones. It is thus rather homogenous and consequently it is faunistically conservative. Substrate type is directly correlated with vegetation type. Additionally, substrate type is also a factor for fossorial (burrowing) species, e.g. golden moles, mole-rats, legless skinks, rain frogs, etc. But much of the terrain seems fairly compacted, thus offering only limited scope for varied fossorial faunal assemblages. A summary of substrate types were presented in the botanical report (Helme 2016):

- Alkaline marine sands derived from the Witzand formation (in north-western section).
- Acid sands from the Springfontein formation (east of modern day Alexandra Road, and also along parts of the Black River).
- Clay soils derived from the underlying Malmesbury group shales and ferricretes (in south-western section and a strip between the Black River and modern day Alexandra Road).

Wetland features: The most prominent River Club wetland features were assessed in the freshwater ecology baseline report (Day 2015). Briefly, these are as follow:

- OLD (WEST) LIESBEEK RIVER: The historic unlined reaches of the Liesbeek River, along western and north-western boundary of the TRUP study area (Figure 3). Due to the construction of a canalised shortcut to the confluence of the Black River (Figures 4 and 5), which currently constitutes the main flow of the Liesbeek River along the eastern boundaries of the River Club, the historic Liesbeek has lost most of its flow ability and has become a stagnant system for part of the year. It is not known if WLTs utilise this stretch of wetland (see Figure 17) for breeding, but it appears to be at least partially suited as WLT breeding habitat. For the purpose of this study, it is therefore presumed that WLTs do in fact breed here.
- NEW (EAST) LIESBEEK RIVER: The canalised portion of the Liesbeek River (Figure 4) that flows along the eastern boundary of the River Club property is not suitable as WLT breeding habitat, mostly because it is a flowing river system. WLTs generally prefer standing bodies of open water.
- BLACK RIVER: The Black River that forms the eastern boundary of the TRUP study area (Figure 16) is also a flowing river system that is not suitable as WLT breeding habitat.
- RAAPENBERG BIRD SANCTUARY (RBS) WETLANDS: Several bodies of standing water are present within the RBS (Figures 13 and 17). The RBS is currently the only confirmed WLT breeding site within the River Club study area, although it is not yet clear exactly which of the RBS wetlands are utilised. Another confirmed WLT breeding site is situated close by in the Oude Molen region.
- GOLF COURSE PONDS: Three small artificial wetlands (Figures 6 to 8, and 17) are present in the northern reaches of the golf course. Two of these (Figures 6 and 7) seem ideal as WLT breeding habitat, whereas the third (Figure 8) dries up too soon to allow for successful tadpole metamorphoses.
- SOUTH AFRICAN ASTRONOMICAL OBSERVATORY (SAAO) WETLAND: A small seasonal wetland is present in the north-western corner of the SAAO grounds (Figures 14 and 17). It has moderate to low potential to serve as WLT breeding habitat.

**Figure 3:** The historic unlined reaches of the Liesbeek River, along western and north-western boundary of the study area.

**Figure 4:** A canalised portion of the Liesbeek River that flows along the eastern boundary of the River Club property.

**Figure 5:** The current confluence of the Liesbeek and Black rivers at the north-eastern reaches of the River Club property.

**Figure 6:** Artificial wetland (1 of 3) on the River Club golf range may potentially be suitable breeding habitat for WLTs.

**Figure 7:** Artificial wetland (2 of 3) on the River Club golf range may potentially be suitable breeding habitat for WLTs.

**Figure 8:** Artificial wetland (3 of 3) on the River Club golf range, probably unsuitable as WLT breeding habitat.

**Figure 9:** Degraded terrain of the PRASA sector in the north of the study site.

**Figure 10:** Some low intensity refuse dumping at the PRASA sector.

**Figure 11:** The northern limits of the 9-hole golf course.

**Figure 12:** Transformed habitat within the SAAO grounds.

**Figure 13:** A wetland within the RBS that is utilised as WLT breeding habitat.

**Figure 14:** A small seasonal wetland on the SAAO property. No WLT breeding activities have been noted from this particular wetland.

## 5.2 Mammal FIA

The potential mammal species richness total of the River Club site is 29 (see checklist: Appendix 1, Table 4), but more realistically only about 19 (or less) mammal species are likely to inhabit or occasionally utilise the site. None of these are threatened species, but note that the global (IUCN) and regional (Child *et al.* 2016) status of the African Clawless Otter is NT. As is typical for present-day urban green zones, several mammal species that occurred here historically (e.g. ungulates and medium/large carnivores) have become locally extinct. The current remnant mammal fauna is comprised mostly of small species like rodents, insectivores and small carnivores. Although the rodent and insectivore species may be resident to the River Club site with breeding assemblages, the small carnivores are likely to be occasional visitors only.

The FIA for mammals (Table 1; score = 4.5) in the context of the River Club site is LOW at regional and national scales. The small size of the River Club site, combined with its low habitat heterogeneity and relatively degraded/transformed state, renders this site relatively unimportant in terms of mammal assemblages of the CoCT Metropolitan Area. From a mammal perspective, there are thus no reasonable or compelling grounds for the outright objection to the current development proposal for this site.

**Table 1:** Mammal FIA of the River Club site at regional and national scales.

| Criterion | FIA score |
|---|---|
| Known presence of threatened species | 0.5 |
| Probable presence of threatened species | 0 |
| Presence of CoCT endemics | 0 |
| Presence of WC endemics | 1 |
| Presence of SA endemics | 1 |
| High species richness relative to the CoCT | 0.25 |
| Important ecological functioning | 0.25 |
| Size of the site | 0.25 |
| Habitat quality of the site | 0.25 |
| Extent of habitat heterogeneity | 0.25 |
| Importance as an ecological corridor or an urban green zone | 0.5 |
| Importance for genetic exchange | 0.25 |
| TOTAL | 4.5 |

## 5.3 Reptile FIA

The potential reptile species richness total of the River Club site is 31 (see checklist: Appendix 1, Table 5), but more realistically only about 20 (or less) reptile species are likely to inhabit or occasionally utilise the site. One threatened reptile species occurs within TRUP boundaries, i.e. the Vulnerable (VU) Cape Dwarf Chameleon (*Bradypodion pumilum)*. Note that the conservation status of this chameleon was recently downlisted to NT, but this revised status will only become official in 2018. For the purpose of this FIA, the current listing of VU still applies.

The FIA for reptiles (Table 2; score = 5) in the context of the River Club site is MODERATE at regional and LOW to MODERATE at national scales. The small size of the River Club site, combined with its low habitat heterogeneity and relatively degraded/transformed state, renders this site relatively unimportant in terms of reptile assemblages of the CoCT Metropolitan Area. From a reptile perspective, there are thus no reasonable or compelling grounds for the outright objection to the current development proposal for this site.

**Table 2:** Reptile FIA of the River Club site at regional and national scales.

| Criterion | FIA score |
|---|---|
| Known presence of threatened species | 1 |
| Probable presence of threatened species | 0 |
| Presence of CoCT endemics | 0 |
| Presence of WC endemics | 1 |
| Presence of SA endemics | 1 |
| High species richness relative to the CoCT | 0.25 |
| Important ecological functioning | 0.25 |
| Size of the site | 0.25 |
| Habitat quality of the site | 0.25 |
| Extent of habitat heterogeneity | 0.25 |
| Importance as an ecological corridor or an urban green zone | 0.5 |
| Importance for genetic exchange | 0.25 |
| TOTAL | 5 |

## 5.4 Amphibian FIA

The potential amphibian species richness total of the River Club site is eight frog species (see checklist: Appendix 1, Table 6), with probably only six species actually occurring here. The Endangered WLT is one of the species that utilises the River Club site. The Observatory region is an important strongholds for WLT, with the RBS serving as the nucleus for WLT breeding habitat.

Although the occurrence of this threatened frog and its associated habitats have upped the FIA score to substantially higher than that of the other two faunal groups (i.e. 6.25 vs 4, and 5 respectively), it is nevertheless still below the threshold for being of HIGH importance at a regional scale and MODERATE to HIGH importance at a national scale. This is mostly due to the small size and relatively degraded/transformed state of the River Club site, low habitat heterogeneity, and low species richness relative to the CoCT Metropolitan Area.

The FIA for amphibians (Table 3; score = 6.25) in the context of the River Club site is MODERATE at regional and LOW to MODERATE at national scales. At face value, this FIA score does not trigger a fatal flaw response in respect of the development intentions. However, due to the prevalence of WLTs in this area, special considerations and mitigation measures are nevertheless called for. These are outlined and discussed below in a section dealing specifically with the WLT in the context of the proposed development of the River Club site.

**Table 3:** Amphibian FIA of the River Club site at regional and national scales.

| Criterion | FIA score |
|---|---|
| Known presence of threatened species | 1.5 |
| Probable presence of threatened species | 0 |
| Presence of CoCT endemics | 0 |
| Presence of WC endemics | 1 |
| Presence of SA endemics | 1 |
| High species richness relative to the CoCT | 0.25 |
| Important ecological functioning | 0.25 |
| Size of the site | 0.25 |
| Habitat quality of the site | 0.5 |
| Extent of habitat heterogeneity | 0.25 |
| Importance as an ecological corridor or an urban green zone | 0.75 |
| Importance for genetic exchange | 0.5 |
| TOTAL | 6.25 |

## 5.5 The Observatory Western Leopard Toad population

The demographics of WLTs in the Observatory region is currently not fully understood. The population appears to be centred in the RBS environs, with most observations having been recorded from the SAAO grounds (Figures 15 and 16). WLT specimens were observed on the River Club grounds during the 2016 site visits, generally in the north-eastern reaches of the golf course, and in association with the original Liesbeek River on the west. Some scattered WLT records are known as far as 1.5 km away from the River Club region, to the south-west and south east in Observatory, Mowbray and south-western reaches of Pinelands (aka Oude Molen). Although the M5 must surely serve as a formidable dispersal barrier for WLTs moving between the RBS and south-western Pinelands (Oude Molen), it would appear as though some degree of connectivity still remains. This is presumably at the point where the M5 crosses the Swart River (Figure 17). Alternatively (or additionally), it may be that some of the wetlands just off the Black River are utilised as WLT breeding habitat (Figure 17). This needs to be investigated at some stage. The precise locations of RBS wetlands that serve as WLT breeding habitat are currently in dispute (due to salinity parameters), and should be investigated during forthcoming WLT breeding events. Currently, the only other known (confirmed) WLT breeding site in addition to the RBS is in this area is in the Oude Molen region.


**Figure 15**: The two WLT records in the Oude Molen region are likely associated with a small wetland (black circle) in this area. The wetlands indicated by the stippled blue polygon may potentially serve as WLT breeding habitat (to be confirmed). Although the M5 is a significant dispersal barrier that hampers WLT movements between the River Club region and this western region, the bridge across the Black River (stippled red polygon) may potentially provide some degree of connectivity.

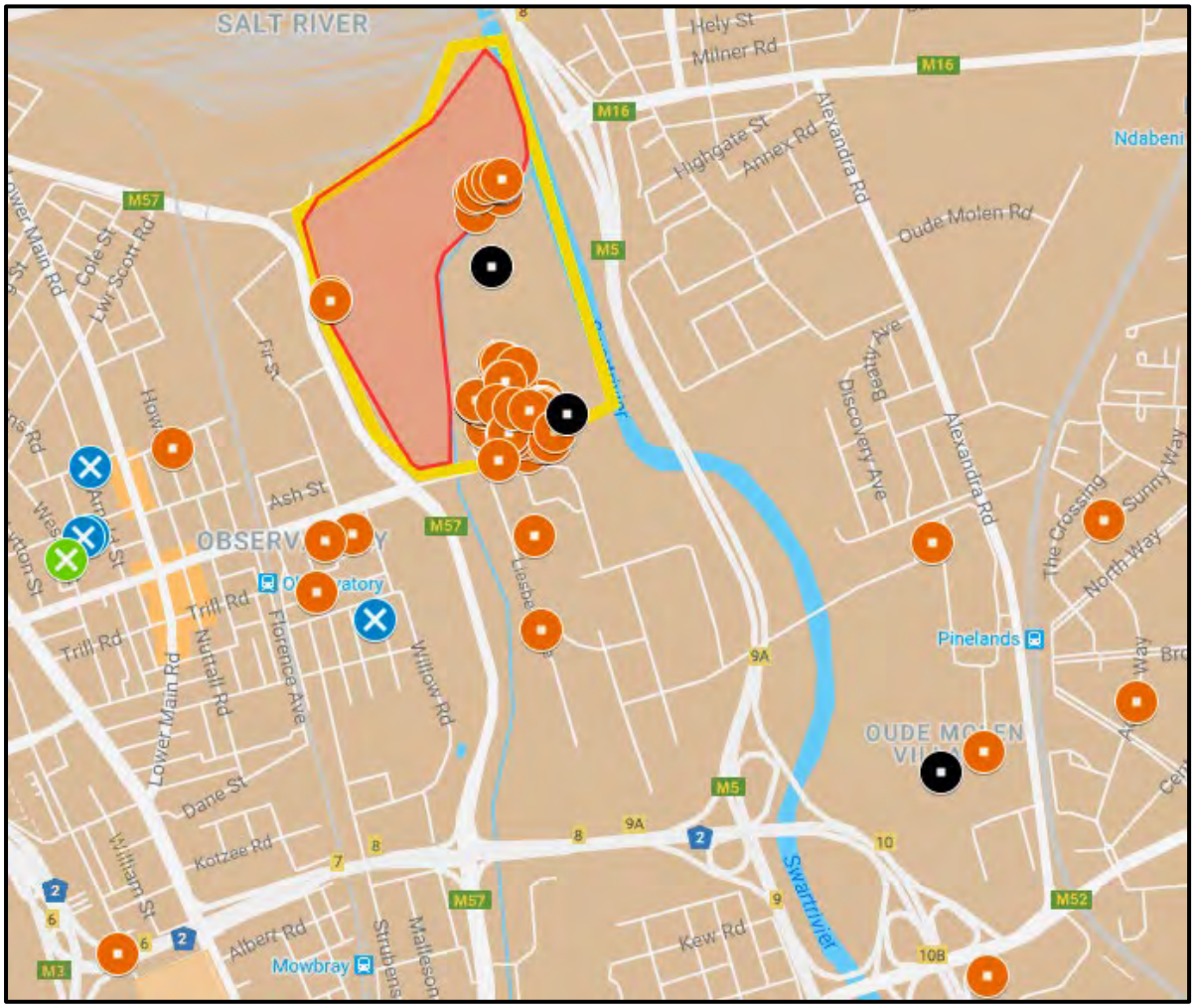


**Figure 16**: Confirmed records of Western Leopard Toads (WLT) in the general region of Observatory and the River Club (orange circles). A few unconfirmed records (blue circles) may either be that of WLTs or the recently established Raucous Toad (*Sclerophrys capensis*; green circle). The black circle denotes the two confirmed WLT breeding sites within the RBS, with a third confirmed WLT breeding site further south-east in the Oude Molen region.


**Figure 17**: Observation records of WLT in the general region of the River Club (small orange circles), and the RBS (red boundaries) which is a known WLT breeding locality (large black circles). The yellow-lined polygons indicate wetlands that additionally may possibly be used as WLT breeding sites.

## 5.6 Connectivity between WLT populations

In the light of the proposed redevelopment plans for the River Club, an issue that was specifically highlighted is that the Observatory WLT population appears to be separated from other CoCT WLT populations. If indeed so, then it would likely be more susceptible to the associated negative development impacts as opposed to being more resilient if it was still functionally connected with other adjacent WLT populations. This issue was included in the faunal ToR, and is addressed here. The WLT is restricted to the south-western Cape region, ranging from the Cape Peninsula eastward to the western-most part of Agulhas National Park. Its total extent of occurrence (EOO) is 3824 km$^2$, with an area of occupancy (AOO) of 405 km$^2$ which is continually being reduced by ongoing development and habitat loss within the CoCT and Overstrand regions (IUCN 2017). The species

breeds at low elevations within 25 km of the sea, but adults have been recorded in the mountains up to 500 m asl. The WLT distribution is disjunct, with two distinct subpopulations separated by about 100 km. These are the CoCT Metropolitan Area and Overberg subpopulations. The eastern Overberg subpopulation is genetically distinct from those in the western CoCT region (Measey and Tolley 2011). For the purpose addressing the question of Observatory WLT population connectivity, the focus will be on the western CoCT WLT subpopulation (Figures 18 to 20). This subpopulation is distributed across four quaternary catchments, roughly according to the following regions:

- **Southern catchment**, including Noordhoek, Fish Hoek and Kommetjie regions. The Noordhoek and Fish Hoek regions is one of the most important strongholds for WLTs. The Kommetjie population was recently re-established, and is separated by about 5 km from the Noordhoek/Fish Hoek stronghold. This is the southern-most population on the Cape Peninsula.
- **Western catchment**, including Hout Bay region. This is also somewhat of an isolated population, separated by about 7.5 km from other CoCT WLT populations.
- **Eastern catchment**, including Lakeside, Kirstenhof, Bergvliet, Constantia, and onto the Cape Flats including Grassy Park, Ottery and Philippi regions. This is an important stronghold for CoCT WLTs.
- **Northern catchment**, including Observatory region. This is the northern-most population for the species, and it is seemingly well separated (9-10 km) from other CoCT WLT populations.

Although the two western and eastern subpopulations were shown to be genetically distinct (Measey and Tolley 2011), this study could not determine any simple patterns of isolation by distance within the populations of the CoCT WLT subpopulation. And although it is generally expected that the influences of different catchments would likely result in significant gene-flow partitioning, again this was not a finding of this study. Instead, distinct genetic group assemblages of haplotypes were found in association with breeding areas, and the influence of mountain barriers also shows grouped genetic structuring. These findings are inconclusive in terms of assessing the degree of connectivity of the Observatory WLT population. For the purpose of this faunal assessment, most of the evidence points to it being a distjunct (unconnected) population, and must thus be treated as being of special conservation significance. It is recommended that a genetic study be conducted to address this particular ambiguity.

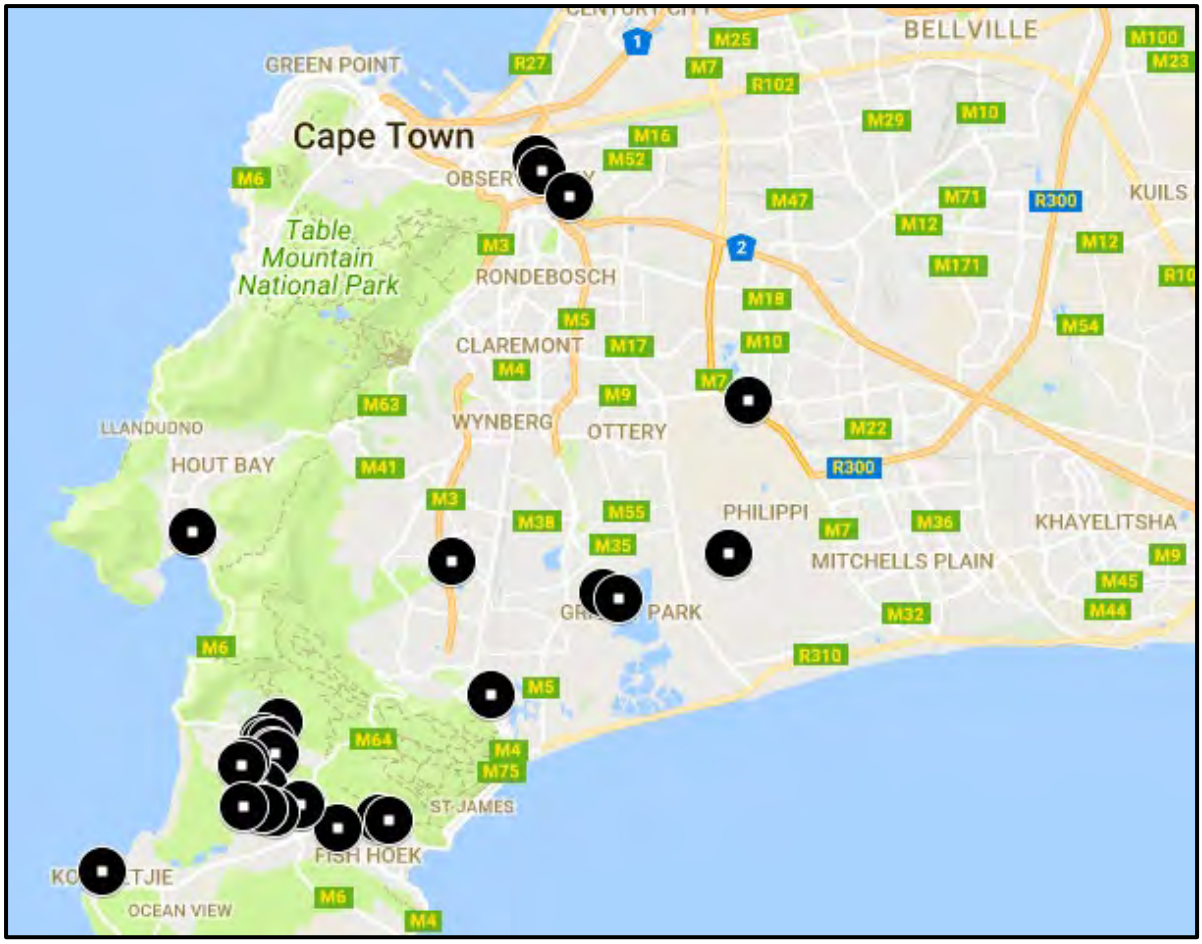


**Figure 18**: Known WLT breeding localities within the jurisdiction of CoCT (not complete). Note the relative isolation of the northern-most breeding population in the Observatory region.

**Figure 19:** Quaternary catchments (4 polygons) with WLT sampling sites (white dots) within the CoCT Metropolitan Area (from Measey and Tolley 2011).

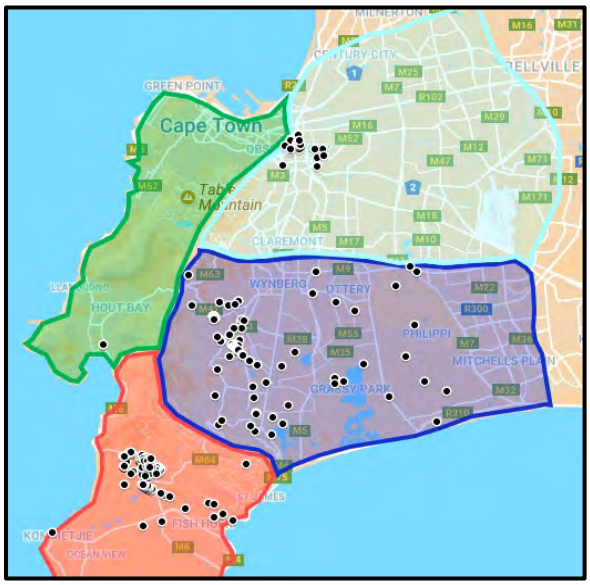


**Figure 20:** An updated schematic representation of the quaternary catchments (4 polygons), based on the study conducted by Measey and Tolley (2011). Black dots represent WLT records.

## 5.7 WLT ecological requirements

The following four components are critical for the viability of any WLT population:

**Breeding habitat:** Availability of suitable breeding wetland habitat is a critical component in the life history of WLTs, and are utilised during the period from approximately late July to middle or late November and sometimes up until early December. Eggs are generally laid during August/September, with the remaining weeks being for the development of tadpoles into metamorphling toadlets. Several WLT breeding habitats within the CoCT Metropolitan Area have been destroyed or degraded in the course of suburban development over the past decades. Conversely, several artificial wetlands constructed here during the past decades have become seemingly suitable as substitute WLT breeding habitats. It is encouraging that the creation of artificial wetland habitats seems to be a viable practical option to increase the breeding potential of WLT populations. In the case of the proposed River Club development project, the RBS wetlands appears to be the primary WLT breeding site. However, the open pans in this area are saline, at least at times (Liz Day pers. comm.) and thus seemingly not suited for WLT breeding. The precise areas at the RBS that are used for WLT breeding need to be determined/investigated during forthcoming WLT breeding seasons. Some of the other existing wetland features (Figure 17) in this area are potential WLT breeding habitat. The proposal to transform the old (western) Liesbeek River into a terrestrial landscape with WLT breeding ponds is a positive development initiative, which may ultimately contribute to the resilience of the Observatory WLT population. However, the presence of breeding habitat alone is not sufficient to safeguard a WLT population.

**Shelter and foraging habitat:** The availability of habitat to provide for WLT shelter and food requirements is another critical component for the viability of any WLT population. Most of the year adult and juvenile WLTs are not specifically associated with the breeding ponds. After breeding and/or metamorphosis have taken place, the toads disperse away from the wetlands and occupy suitable terrain in the general region. Most toads are likely to remain within about a 0.5 to 1 km radius of the breeding ponds, but it is well known that many will move over 2 km away. Much of the TRUP terrain in its current state consists of short-trimmed grass (lawn), most prominently on the driving range, golf course and SAAO grounds. This is generally suboptimal as WLT shelter/forage habitat, although toads will still visit such terrain. Likewise, the PRASA property in the northern reaches of the TRUP study area is also degraded and not well suited as WLT shelter/forage habitat. The proposal to create substantial sections of habitat to specifically improve shelter and foraging conditions for WLTs within the study area is also a positive development initiative that can increase the resilience of the Observatory WLT population. This would entail a substantial increase of low and medium height vegetation cover, with mixed plant species so that invertebrate (= WLT prey) diversity and abundance would be promoted. The more of this type of habitat available in the area, the greater the prospects for maintaining viable breeding stock in perpetuity. Physical shelters for

WLTs can be integrated within the landscaped/gardened area. This can be in the form of natural logs, or artificial structures such as pieces of broken pots or ceramic piping cut lengthwise. The improved moisture retention abilities of such shelters should be advantageous to WLTs, and overall survival rate may be boosted. The rational is that by increase the proportion of WLT metamorphlings that mature to adulthood, the overall resilience of the local WLT population would be increased.

**Dispersal corridors:** With the expansion of urban/suburban communities, it sometimes happens that some faunal communities will become fragmented and isolated. A specific population may end up being split into several smaller subpopulations that can no longer come into contact with each other. This typically happens in species with limiting mobility, and may cause the genetic nonviability of subpopulations. This is certainly of relevance to current day WLT populations too (see for example Measey and Tolley 2011), and thus dispersal corridors are of great importance in maintaining the overall resilience of WLT subpopulations. Any development should also consider the larger scale ecological considerations, instead of only the on-site issues. In the case of the Observatory WLT subpopulation, it appears to be disjunct from other CoCT WLT subpopulations. This in itself is of conservation interest and value, and requires additional studying at the regional scale. In the context of the proposed River Club development, the on-site dispersal corridor needs are primarily to maintain connectivity for east/west migrations (i.e. between RBS and the western Liesbeek region). Details of the shelter/forage sectors and ecological dispersal corridors for this project are presented further below.

**Hazardous features and high-risk areas:** Over and above the need for habitats to cater for breeding, shelter and diet requirements, and dispersal corridors, it is also important to limit the hazardous components that may hinder WLT mobility or cause WLT mortalities. In a suburban setting, the prevalence of brick or concrete walls present WLTs with a maze of barriers which they can often not pass. Toads thus have to expend greater effort during their dispersal endeavours, and also the options for encountering suitable habitats are reduced. High-risk features include pitfall structures from which toads cannot escape (e.g. steep-sided canals, stormwater drains and swimming pools), and roads with vehicular traffic. These threats and high-risk features are discussed in greater detail below.

## 5.8 WLT threats

The hazardous features and high-risk areas that were referred to above, can cause significant WLT mortalities. These hazardous features can usually be grouped into one of the following four categories:

**Roads/vehicles:** WLTs are explosive breeders, which basically mean that they breed for a relatively short period of time each year. During this breeding event, adult toads move from their year-long shelter/food habitats to the breeding ponds. In an urban setting this means that these toads have to cross several roads to get to and fro these habitats. Mortality of the breeding stock caused by

vehicular traffic is one of the most significant impacts on WLT populations, and one of the primary reasons why this species is currently listed as being EN. As such, the network of roads associated with the proposed River Club development will have to incorporate various safeguarding measures to limit or prevent toad mortalities on these roads. Basically, the aim would be to prevent toads from being able to get onto roads, yet at the same time the roads must not restrict the movement of toads between the various ecological sectors. The placement of underpasses in combination with exclusion barrier walls (see Appendix 2) can be employed as an effective mitigation measure to achieve this aim.

**Harsh terrain:** The most hazardous areas in terms of WLTs are busy roads and pitfall features as outlined above. Additionally, large open (unsheltered) areas such as sports fields and parking areas can also cause substantial mortalities. This is usually caused by dehydration and fatigue, for example when thousands of newly metamorphosed toadlets would inadvertently arrive on such terrain. Greater visual exposure to predators such as crows may also be a contributing factor of toad mortalities under these circumstances. As proposed above for roads and pitfall zones, such inhospitable open terrain can be made off-limits by the strategic placement of exclusion barriers.

**Pitfalls:** In the course of adult and juvenile toads moving about in a suburban environment, they may encounter steep-sided features into which they can fall and not escape. The most common of these pitfall traps are swimming pools, steep-sided canals and stormwater drains. Falling into such structures may cause mortalities by means of starvation or dehydration or drowning. Developments should in general always be mindful of such hazards, and not only in cases where threatened frogs occur. Such hazards can be minimised by erecting exclusion barriers to prevent access to such features (see Appendix 2), and escaping devices (e.g. Toadsavers in swimming pools) can be installed in most cases. Even very small pitfalls can cause toad mortalities. For example, during the 2016 site visit it was discovered that the small plastic irrigation boxes that are currently present on the River Club golf course are entrapping and killing toadlets. The proposed River Club development must be mindful about the negative impacts of pitfall structures, and must provide escape options wherever these are installed (e.g. stormwater drains).

**Obstructions:** Solid brick or concrete walls limit the dispersal options of wandering toads. In some instances this may cause large-scale mortalities by dehydration when for example droves of newly metamorphosed toadlings would encounter such a dead-end structure. Where practical, developments should preferably use permeable fencing that does not restrict the movement of small terrestrial animals. Solid walls can also be modified to make it permeable, by providing of a series of pipes/holes through the wall at ground-level. It is of course important to distinguish between barrier walls where permeability is desired (i.e. so as not to hinder toad movements) and barrier walls that are explicitly placed to restrict entry to harsh terrain. The perimeter fencing of the proposed River Club must therefore be permeable at ground level so that WLTs and other small fauna species can move to and fro beyond the TRUP boundaries.

## 5.9 The River Club development in the context of WLTs

Several general mitigation measures have been formulated during the course of the freshwater, botanical and faunal assessments (2015 – 217), and are based on Alternative 1 (this being the preferred alternative for both the biodiversity team and the development team). The mitigation measures most relevant to the faunal considerations are summarised below:

2. **ECOLOGICAL SECTORS**: Several natural or semi-natural ecological sectors must be provided to serve as shelter/forage habitat for WLTs and other faunal species. These sectors will be landscaped and gardened specifically with the aim of optimizing the conditions for WLT habitation. Some of these ecological sectors may further function as WLT breeding habitat and/or faunal dispersal corridors. The most important ecological sectors are:

- LIESBEEK WEST SECTOR: The historical flow area of the Liesbeek River to the west of the River Club. This sector is earmarked to be converted and landscaped into being more of a vegetated terrestrial landscape, with seasonally flooded wetlands to serve as WLT breeding habitat.
- LIESBEEK EAST SECTOR: The canalised section of the Liesbeek River to the east of River Club. This ecological sector is earmarked to be converted and landscaped into a more natural (not canalised) watercourse with a substantial buffer area (the total river corridor to include an area of width at least 25 m) of lawn and semi-natural vegetation.
- EAST/WEST CORRIDOR: The east/west ecological (or faunal) corridor between the historic and canalised Liesbeek watercourses, as per the current development layout vision. This wide (75-100 m) vegetated green belt will serve as the main linkage between the western Liesbeek sector (and landscaped WLT breeding wetland habitat) and the eastern Liesbeek sector (including RBS and Black River). It will also serve as shelter/forage habitat for WLTs and certain other faunal species.
- NORTHERN SECTOR: the northern undeveloped section (owned by the Passenger Rail Agency of South Africa; PRASA) situated between the golf course and the railway line. This area does not form part of the proposed River Club development. It has good potential to serve as shelter/forage habitat and being an east/west faunal corridor. However, the terrain is currently suboptimal for these functions and would require a landscaping initiative to vegetate it adequately according to faunal (and WLT) requirements.

4. **TOAD-FRIENDLY INFRASTRUCTURE**: Toad-friendly structures (examples in Appendix 2) must be integrated with the proposed development, so that the negative impact on the WLT population can be minimise. The most important examples of such features are:

- EXCLUSION BARRIERS: Low barrier walls or fencing can be used to prevent WLTs from gaining access to hazardous terrain or high-risk areas such as parking lots and roads.
- UNDERPASSES: High-risk areas like roads can be made permeable for toads by means of a combination of exclusion barrier walls to keep toads off roads, and underpasses (e.g. culverts) to allow safe movement of toads between different ecological sectors.

5. **WLT MANAGEMENT & MONITORING**: It is recommended that a WLT management and monitoring programme be drawn up for this proposed development. Ideally the monitoring

should start at least one WLT breeding season prior to commencing with the construction phase, and continue up until five breeding seasons after construction has been completed. The main aims of this monitoring would be to evaluate the success and efficiency of faunal dispersal corridors, ecological shelter/foraging sectors, new WLT breeding habitat, and the toad-friendly infrastructure. Details to be formulated as part of the detailed design phase.

# 6 CONCLUSIONS

The general finding of this faunal baseline assessment in respect of the site of the proposed River Club development is that this property is not of particularly high conservation value for all three of the faunal groups that were assessed. However, the occurrence of EN WLTs in this area represents a significant exception to this finding. Thus, other than the presence of WLTs here, the development would not have been significantly constrained by faunal issues. Therefore this faunal baseline assessment focused specifically on the potential negative impacts on the Observatory WLT population. It assessed the environmental issues in respect of the River Club site and it provided general mitigation measures to reduce the overall environmental impact of this proposed development. Provided that proper attention is given to the implementation of WLT mitigation measures, it is deemed plausible to achieve the proposed River Club development intentions whilst at the same time adequately catering for WLT and other faunal ecological needs.

1. The existing WLT breeding habitats within the RBS may not be compromised. The creation of additional WLT breeding habitats within the western Liesbeek sector is likely to be a positive contribution in terms of improving WLT breeding success in this area.
2. Enough natural or semi-natural habitat must be available within a 2 km radius of breeding habitats to sustain WLT individuals for the non-breeding period (i.e. about 10 months of the year). Such sectors must provide the adequate shelter and food requirements to sustain the WLTs until the next breeding season. Thus substantial green belts must remain undeveloped, e.g. along the two rivers and especially in the areas near to the Raapenberg wetlands and the northern sector near the confluence.
3. Multiple dispersal options between breeding habitat and year-round occupancy habitat must be maintained, i.e. barriers must be limited. Connectivity must be maintained between the Raapenberg wetlands and the river regions to the west, including the area of the former Liesbeek flow.
4. One broad (>70 m wide) east/west belt must be established in the northern reaches of the property, and additional minor (>10m wide) east/west corridors must be created along the northern and southern site boundaries as well;
5. High-risk zones such as roads, large unvegetated areas and various pitfall structures must be modified to prevent/limit access by WLTs.
6. It is recommended that a WLT management and monitoring programme be drawn up for this proposed development. Ideally the monitoring should start at least one WLT breeding season prior to commencing with the construction phase, and continue up until five breeding seasons

after construction has been completed. The main aims of this monitoring would be to evaluate the success and efficiency of faunal dispersal corridors, ecological shelter/foraging sectors, new WLT breeding habitat, and the toad-friendly infrastructure. Details to be formulated as part of the detailed design phase, if approved.

# 7 REFERENCES

The following references were consulted in the preparation of this faunal baseline assessment report:


ADU 2017. MammalMAP. http://vmus.adu.org.za/ An online ADU data source.

Anon 2013. Citizen science & the Western Leopard Toad. *Quest* 9(4): 18-21.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J. and De Villiers, M.S. (eds). 2014. *Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland*. Suricata 1. South African National Biodiversity Institute, Pretoria.

Brown, C. and Magoba, R. (eds.) 2009. *Rivers and Wetlands of Cape Town. Caring for our rich aquatic heritage*. Water Research Commission Report No TT 376/08.

Channing, A., Schmitz, A., Burger, M. and Kielgast, J. 2013. A molecular phylogeny of Africain Dainty Frogs, with the description of four new species (Anura: Pyxicephalidae: *Cacosternum*). *Zootaxa* 3701(5): 518–550.

Child, M.F., Roxburgh, L., Do Linh San, E., Raimondo, D. and Davies-Mostert, H.T. 2016. *The Red List of Mammals of South Africa, Swaziland and Lesotho.* South African National Biodiversity Institute and Endangered Wildlife Trust, South Africa.

City of Cape Town 2016. CoCT Biodiversity Network 2016. Available from the Biodiversity GIS website.

Day, L. 2015. Proposed redevelopment of the River Club, Observatory: Preliminary input into the Scoping Phase Baseline Study: Freshwater Ecosystems. *FCG report – July 2015*.

DEA 2011. Threatened Terrestrial Ecosystems in South Africa. *Government Gazette* Vol. 1002: No. 34809. National Printer, Pretoria.

Dodd C.K. and Cade B.S. 1998. Movement patterns and the conservation of amphibians breeding in small, temporary wetlands. *Conservation Biology* 12(2): 331-339.

Ficetola G.F. and De Bernardi, F. 2004. Amphibians in a human-dominated landscape: the community structure is related to habitat features and isolation. *Biological Conservation* 119: 219-230.

Funk, W.C., Greene, A.E., Corn, P.S. and Allendorf, F.W. 2005. High dispersal in a frog species suggests that it is vulnerable to habitat fragmentation. *Biol Lett*. 1: 13–16.

Gibbs J.P. 1993. Importance of small wetlands for the persistence of local populations of wetland-associated animals. *Wetlands* 13(1): 25-31.

Helme, N. 2016. Specialist botanical and ecological scoping phase input: Proposed Two Rivers Urban Park development framework, Cape Town. *NHBS report – July 2016.*

Hels T. and Buchwald E. 2001. The effect of road kills on amphibian populations. *Biological Conservation* 99: 331-340.

IUCN SSC Amphibian Specialist Group & South African Frog Re-assessment Group (SA-FRoG). 2016. *Sclerophrys pantherina*. The IUCN Red List of Threatened Species 2016: e.T54723A77159333. Downloaded on 12 December 2016.

Measey, G.J. (ed.) 2011. *Ensuring a future for South Africa's frogs: a strategy for conservation research.* SANBI Biodiversity Series 19. South African National Biodiversity Institute, Pretoria.

Measey, G.J. and Tolley, K.A. 2011. Investigating the cause of the disjunct distribution of *Amietophrynus pantherinus*, the Endangered South African western leopard toad. *Conservation Genetics* 12: 61–70.

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*. SI/MAB Series #9. Smithsonian Institution, Washington, DC, 360 pp.

Mucina, L. and Rutherford, M.C. (EDS.). 2006. *The vegetation of South Africa, Lesotho and Swaziland.* Strelitizia 19. South African National Biodiversity Institute, Pretoria, South Africa.

Ohler, A., and A. Dubois. 2016. The identity of the South African toad *Sclerophrys capensis* Tschudi, 1838 (Amphibia, Anura). *PeerJ* 4(e1553): 1–13.

SANBI (BGIS) 2012. Vegetation Map of South Africa, Lesotho and Swaziland [vector geospatial dataset URL: http://bgis.sanbi.org].

Schmidt, B.R, and Zumbach, S. 2008. Amphibian Road Mortality and How to Prevent It: A Review. Pp. 157-167. In: Mitchell, J.C., Jung Brown, R.E. and Bartolomew, B. (eds). Urban Herpetology. *Herpetological Conservation* 3: 157-167.

Semlitsch R.D. and Bodie J.R. 1998. Are small, isolated wetlands expendable? *Conservation Biology* 12(5): 1129-1133.

Semlitsch R.D. and Bodie J.R. 2003. Biological criteria for buffer zones around wetlands and riparian habitats for amphibians and reptiles. *Conservation Biology* 17(5): 1219-1228.

Skinner J.D. and Chimimba C.T. (eds) 2005. The Mammals of the Southern African Subregion. Van der Horst D. (Ed.). Third Edition. Cambridge University Press, Cambridge.

# 8 APPENDIX 1: SPECIES CHECKLISTS

**Table 4:** A checklist of mammals that are known from or likely to occur at the River Club grounds and immediate surroundings. Conservation status according to IUCN and local (SA; Child *et al.* 2016) listings include the following: Least Concern (LC) and Near Threatened (NT). Endemism is as follow: Endemic to South Africa, Lesotho and Swaziland (SA), endemic to Western Cape (WC). Scoring for likelihood of occurrence: Possible occurrence (1), probable occurrence (2) and confirmed occurrence (3). Confirmed records were provided by Burger (2017), Helme (2016) and Ramsay (2017).

| Scientific name | English name | IUCN/SA | Endemism | Occur | Notes |
|---|---|---|---|---|---|
| **Chrysochloridae** | **Golden moles** | | | | |
| *Chrysochloris asiatica* | Cape Golden Mole | LC/LC | SA | 3 | Ramsay (2017) |
| **Leporidae** | **Hares & rabbits** | | | | |
| *Lepus capensis* | Cape Hare | LC/LC | 0 | 1 | |
| **Muridae** | **Old World rats, mice & gerbils** | | | | |
| *Otomys irroratus* | Southern African Vlei Rat | LC/LC | SA | 3 | Burger (2017); Helme (2016) |
| *Rhabdomys pumilio* | Xeric Four-striped Mouse | LC/LC | SA | 3 | Burger (2017); Helme (2016); Ramsay (2017) |
| *Mus minutoides* | Pygmy Mouse | LC/LC | 0 | 3 | Burger (2017) |
| *Desmodillus auricularis* | Short-tailed Gerbil | LC/LC | 0 | 1 | |
| *Gerbilliscus afra* | Cape Gerbil | LC/LC | near WC | 3 | Burger (2017); Helme (2016) |
| **Hystricidae** | **Old World porcupines** | | | | |
| *Hystrix africaeaustralis* | Cape Porcupine | LC/LC | 0 | 3 | Burger (2017); Helme (2016); Ramsay (2017) |
| **Bathyergidae** | **African mole-rats** | | | | |
| *Bathyergus suillus* | Cape Dune Mole-rat | LC/LC | WC | 3 | Helme (2016); Ramsay (2017) |
| *Georychus capensis* | Cape Mole-rat | LC/LC | SA | 3 | Helme (2016); Ramsay (2017) |
| *Cryptomys hottentotus* | African Mole-rat | LC/LC | 0 | 2 | |
| **Soricidae** | **Shrews** | | | | |
| *Crocidura cyanea* | Reddish-Grey Musk Shrew | LC/LC | 0 | 2 | |
| *Crocidura flavescens* | Greater Red Musk Shrew | LC/LC | near SA | 3 | Helme (2016) |
| *Myosorex varius* | Forest Shrew | LC/LC | SA | 2 | |
| *Suncus varilla* | Lesser Dwarf Shrew | LC/LC | 0 | 2 | |

**Table 4** (continued)

| Scientific name | English name | IUCN/SA | Endemism | Occur | Notes |
|---|---|---|---|---|---|
| **Pteropodidae** | **Fruit bats** | | | | |
| *Rousettus aegyptiacus* | Egyptian Fruit Bat | LC/LC | 0 | 1 | |
| **Rhinolophidae** | **Old World horseshoe & leaf-nosed bats** | | | | |
| *Rhinolophus capensis* | Cape Horseshoe Bat | LC/LC | near SA | 1 | |
| *Rhinolophus clivosus* | Geoffroy's Horseshoe Bat | LC/LC | 0 | 1 | |
| **Nycteridae** | **Slit-faced bats** | | | | |
| *Nycteris thebaica* | Egyptian Slit-faced Bat | LC/LC | 0 | 1 | |
| **Molossidae** | **Free-tailed bats** | | | | |
| *Tadarida aegyptiaca* | Egyptian Free-Tailed Bat | LC/LC | 0 | 1 | |
| **Miniopteridae** | **Long-fingered bats** | | | | |
| *Miniopterus natalensis* | Natal Long-Fingered Bat | LC/LC | 0 | 1 | |
| **Vespertilionidae** | **Plain-faced bats** | | | | |
| *Eptesicus hottentotus* | Long-Tailed Serotine Bat | LC/LC | 0 | 2 | |
| *Myotis tricolor* | Temmink's Myotis Bat | LC/LC | 0 | 1 | |
| *Neoromicia capensis* | Cape Serotine Bat | LC/LC | 0 | 2 | |
| **Viverridae** | **Genets & civets** | | | | |
| *Genetta genetta* | Small-spotted Genet | LC/LC | 0 | 3 | Helme (2016) |
| **Herpestidae** | **Mongooses** | | | | |
| *Herpestes pulverulentus* | Cape Grey Mongoose | LC/LC | 0 | 3 | Helme (2016); Ramsay (2017) |
| *Atilax paludinosus* | Water Mongoose | LC/LC | 0 | 3 | Burger (2017); Helme (2016); Ramsay (2017) |
| **Mustelidae** | **Weasels, badgers, otters & relatives** | | | | |
| *Ictonyx striatus* | Striped Polecat | LC/LC | 0 | 1 | |
| *Aonyx capensis* | African Clawless Otter | **NT/NT** | 0 | 3 | Helme (2016); Ramsay (2017) |

**Table 5:** A checklist of reptiles that are known from or likely to occur at the River Club grounds and immediate surroundings. Conservation status according to IUCN and local (SA) listings include the following: Not Evaluated (NE), Least Concern (LC), and Vulnerable (VU). Endemism is as follow: Endemic to South Africa, Lesotho and Swaziland (SA), endemic to Western Cape (WC). Scoring for likelihood of occurrence: Possible occurrence (1), probable occurrence (2) and confirmed occurrence (3). Confirmed records were provided by Burger (2017) and Ramsay (2017).

| Scientific name | English name | IUCN/SA | Endemism | Occur | Notes |
|---|---|---|---|---|---|
| **Pelomedusidae** | **Side-necked terrapins** | | | | |
| *Pelomedusa galeata* | South African Helmeted Terrapin | NE/LC | SA | 2 | |
| **Testudinidae** | **Tortoises** | | | | |
| *Chersina angulate* | Angulate Tortoise | LC/LC | near SA | 1 | |
| *Homopus areolatus* | Parrot-beaked Tortoise | LC/LC | SA | 1 | |
| **Gekkonidae** | **Geckos** | | | | |
| *Afrogecko porphyreus* | Marbled Leaf-toed Gecko | LC/LC | SA | 3 | Burger (2017); Ramsay (2017) |
| *Goggia lineata* | Striped Pygmy Gecko | LC/LC | near SA | 1 | |
| *Pachydactylus geitje* | Ocellated Gecko | LC/LC | SA | 2 | |
| **Lacertidae** | **Lacertid lizards** | | | | |
| *Meroles knoxii* | Knox's Desert Lizard | LC/LC | 0 | 2 | |
| **Cordylidae** | **Cordylid lizards** | | | | |
| *Chamaesaura anguina* | Cape Grass Lizard | NE/LC | 0 | 1 | |
| **Gerrhosauridae** | **Plated lizards** | | | | |
| *Tetradactylus seps* | Short-legged Seps | LC/LC | SA | 3 | Ramsay (2017) |
| **Scincidae** | **Skinks** | | | | |
| *Acontias meleagris* | Cape Legless Skink | LC/LC | SA | 3 | Ramsay (2017) |
| *Scelotes bipes* | Silvery Dwarf Burrowing Skink | LC/LC | WC | 1 | |
| *Trachylepis capensis* | Cape Skink | NE/LC | 0 | 3 | Burger (2017); Ramsay (2017) |
| *Trachylepis homalocephala* | Red-Sided Skink | LC/LC | SA | 3 | Ramsay (2017) |

**Table 5** (continued)

| Scientific name | English name | IUCN/SA | Endemism | Occur | Notes |
|---|---|---|---|---|---|
| **Chamaeleonidae** | **Chameleons** | | | | |
| *Bradypodion pumilum* | Cape Dwarf Chameleon | **VU/VU** | WC | 3 | Burger (2017); Ramsay (2017) |
| **Typhlopidae** | **Blind snakes** | | | | |
| *Rhinotyphlops lalandei* | Delalande's Beaked Blind Snake | NE/LC | 0 | 1 | |
| **Leptotyphlopidae** | **Thread snakes** | | | | |
| *Leptotyphlops nigricans* | Black Thread Snake | LC/LC | SA | 2 | |
| **Lamprophiidae** | **Lamprophid snakes** | | | | |
| *Boaedon capensis* | Brown House Snake | NE/LC | 0 | 1 | |
| *Duberria lutrix* | Common Slug Eater | LC/LC | SA | 3 | Ramsay (2017) |
| *Homoroselaps lacteus* | Spotted Harlequin Snake | LC/LC | SA | 1 | |
| *Lamprophis aurora* | Aurora House Snake | LC/LC | SA | 3 | Ramsay (2017) |
| *Lycodonomorphus inornatus* | Olive Ground Snake | LC/LC | SA | 3 | Ramsay (2017) |
| *Lycodonomorphus rufulus* | Brown Water Snake | NE/LC | 0 | 2 | |
| *Psammophylax rhombeatus* | Spotted Skaapsteker | NE/LC | 0 | 2 | |
| *Psammophis crucifer* | Montane Grass Snake | LC/LC | 0 | 2 | |
| *Psammophis notostictus* | Karoo Whip Snake | NE/LC | 0 | 1 | |
| *Pseudaspis cana* | Mole Snake | NE/LC | 0 | 3 | Ramsay (2017) |
| **Colubridae** | **Colubrid snakes** | | | | |
| *Crotaphopeltis hotamboeia* | Herald Snake | NE/LC | 0 | 2 | |
| *Dasypeltis scabra* | Rhombic Egg Eater | LC/LC | 0 | 2 | |
| *Dispholidus typus* | Boomslang | NE/LC | 0 | 1 | |
| **Elapidae** | **Cobras, mambas & allies** | | | | |
| *Naja nivea* | Cape Cobra | NE/LC | 0 | 3 | Ramsay (2017) |
| **Viperidae** | **Adders & vipers** | | | | |
| *Bitis arietans* | Puff Adder | NE/LC | 0 | 1 | |

**Table 6:** A checklist of amphibians that are known from or likely to occur at the River Club grounds and immediate surroundings. Conservation status according to IUCN and local (SA) listings include the following: Least Concern (LC), and Endangered (EN). Endemism is as follow: Endemic to South Africa, Lesotho and Swaziland (SA), endemic to Western Cape (WC). Scoring for likelihood of occurrence: Possible occurrence (1), probable occurrence (2) and confirmed occurrence (3). Confirmed records were provided by Burger (2017) and Ramsay (2017).

| Scientific name | English name | IUCN/SA | Endemism | Occur | Notes |
|---|---|---|---|---|---|
| **Bufonidae** | **Toads** | | | | |
| *Sclerophrys capensis* | Raucous Toad | LC/LC | SA | 1 | Feral population known from Observatory |
| *Sclerophrys pantherina* | Western Leopard Toad | **EN/EN** | WC | 3 | Burger (2017); Ramsay (2017) |
| *Vandijkophrynus angusticeps* | Sand Toad | LC/LC | SA | 3 | Ramsay (2017) |
| **Pyxicephalidae** | **Pyxicephalid frogs** | | | | |
| *Amietia fuscigula* | Cape River Frog | LC/LC | SA | 2 | |
| *Cacosternum platys* | Flat Caco | LC/LC | WC | 1 | |
| *Strongylopus grayii* | Clicking Stream Frog | LC/LC | 0 | 3 | Burger (2017); Ramsay (2017) |
| *Tomopterna delalandii* | Cape Sand Frog | LC/LC | SA | 2 | |
| **Pipidae** | **Pipid frogs** | | | | |
| *Xenopus laevis* | Common Platanna | LC/LC | 0 | 3 | Burger (2017); Ramsay (2017) |

# 9 APPENDIX 2: TOAD-FRIENDLY STRUCTURAL DEVICES

**Underpasses:** Safe-passing options for roads are available in the form of underpasses (Figures 22 to 26). For these to be most effective, roads would have to be somewhat raised to accommodate an underpass of about 30 cm (or more) in height. Additionally, the underpass roof should ideally be open to the surface, i.e. with a gridded top. However, gridded underpasses can be alternated with more simple structures such as under-road piping. Underpasses should be plentiful, preferably not less than at 15 to 20 m intervals. Underpasses should be used in conjunction with exclusion barriers (aka drift-fences) to maximise their functionality (see below).

**Exclusion barriers:** The main aim of exclusion barriers is to prevent access to harsh/hazardous terrain, e.g. roads and parking areas. Additionally, exclusion barriers may also serve as drift-fences to direct animals towards safe-crossing options such as underpasses (Figures 22 to 26). Some example of exclusion barrier designs are presented in Figure 21.

1. Straight wall with horizontal lip on right side, to deter access to the left area.
2. Straight wall with angled lip on right side, to deter access to the left area.
3. Wall angled to right, to deter access to the left area.
4. Straight wall with ramp on right and horizontal lip on right side, to deter access to the left area and allow access to the right area.
5. Fence structure curved to the right, to deter access to the left area.

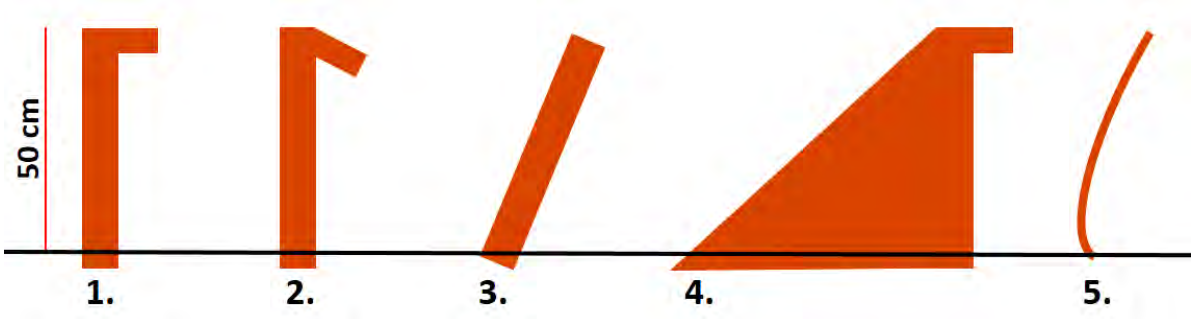


**Figure 21**: Profiles of barrier design options for the control of WLT movements: (1) Straight wall with horizontal lip on right side, to deter access to the left area. (2) Straight wall with angled lip on right side, to deter access to the left area. (3) Wall angled to right, to deter access to the left area. (4) Straight wall with ramp on right and horizontal lip on right side, to deter access to the left area and allow access to the right area. (5) Fence structure curved to the right, to deter access to the left area.

**Cattle-grid structures:** In certain situations (i.e. road entrance to parking areas), cattle-grid structures (Figure 29) can be used to prevent toads from accessing hazardous areas. The grid spaces must be wide enough for toads to drop through into a tunnel that will redirect to and open up in a safe area. These structures probably have greater application on roads for vehicular traffic, and would probably be undesirable (not practical) on paths/pavements with pedestrian traffic.

**Figure 22**: An example of an underpass with a grid roof, designed for toads and other small faunal species. The entrance/exit points are fringed with steep-sided walls to direct faunal movements.

**Figure 23:** Underpass with a grid roof and directing walls.

**Figure 24:** Underpass with a grid roof.

**Figure 25:** Underpass with a grid roof, designed for toads and other small faunal species.

**Figure 26:** Underpass with a grid roof, designed for toads and other small faunal species.

**Figure 27:** An example of permeable toad-friendly fencing in a residential setting.

**Figure 28:** Example of permeable toad-friendly fencing.

**Figure 29**: An example of a cattle-grid structure that can be used strategically to prevent toads from entering specific hazardous areas, and to redirect them by means of tunnels to safe terrain.

## APPENDIX C

## SPECIALIST GEOHYDROLOGICAL REPORT

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08 November 2017
478320- River Club EIA

Mr Matthew Law
SRK Consulting (South Africa) (Pty) Ltd
The Administrative Building
Albion Spring
183 Main Road
Rondebosch
7700

**Attention: Mr Law**

Dear Sir

**Comments on Groundwater at the River Club**

# 1 Introduction

SRK Consulting (South Africa) (Pty) Ltd (SRK) Groundwater Department was requested to comment on the underlying geohydrology at the River Club site, located on the banks of the Liesbeeck River, Cape Town.

The need for specialist comment was to address the following specific issues:

- Based on detailed survey information for the site and adjacent watercourses, as well as publically available desktop information, describe local groundwater hydrology at the site and in adjacent freshwater systems;
- Comment on the degree to which the Raapenburg wetlands are fed by the groundwater table versus floodflows; and
- Comment on potential changes to the groundwater flow regime from developing the River Club (noting that the current elevation of the site will generally be the ground level of a basement of the new proposed development).

# 2 Data

The following data sources were used to assess the groundwater at the River Club:

Geotechnical Report by Kantey and Templer: K&T PROJECT REFERENCE: 14887GG February 2016

**Partners** R Armstrong, AH Bracken, N Brien, JM Brown, CD Dalgliesh, BM Engelsman, R Gardiner, M Hinsch, GC Howell, WC Joughin, DA Kilian, S Kisten, JA Lake, V Maharaj, DJ Mahlangu, I Mahomed, RRW McNeill, HAC Meintjes, MJ Morris, GP Nel, VS Reddy, PE Schmidt, PJ Shepherd, MJ Sim, VM Simposya, HFJ Theart, KM Uderstadt, AT van Zyl, MD Wanless, ML Wertz, A Wood

**Directors** AJ Barrett, GC Howell, WC Joughin, V Maharaj, DJ Mahlangu, VS Reddy, PE Schmidt, PJ Shepherd

**Associate Partners** PJ Aucamp, LSE Coetser, CJ Ford, E Goossens, SG Jones, W Jordaan, AH Kirsten, F Lake, MJ Meiring, L Nedeljkovic, RD O'Brien, T Shepherd, JJ Slabbert, WI Stewart, JS Stiff, M van Huyssteen, D Visser

**Consultants** JAC Cowan, *PrSciNat, BSc(Hons);* JH de Beer, *PrSci Nat, MSc;* JR Dixon, *PrEng;* T Hart, *MA, TTHD;* GA Jones, *PrEng, PhD;* PR Labrum, *PrEng;* PN Rosewarne, *PrSciNat;* AA Smithen, *PrEng;* TR Stacey, *PrEng, DSc;* OKH Steffen, *PrEng, PhD;* PJ Terbrugge, *PrSciNat, MSc,* DJ Venter; *PrTech*

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| Lubumbashi | + 243 (0) 81 999 9775 |

**Group Offices:**
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Asia
Australia
Europe
North America
South America

CESA

The following data were used:

- Borehole and test pit logs; and
- Groundwater level measurements at the boreholes and test pits.

River Channel Survey by Biff Lewis Geomatics dated 23/01/2015.
Data used include:

- Water level heights (mamsl) survey of the Black River; and
- Water level heights (mamsl) survey of the Liesbeeck River.

Raapenburg Wetland Survey (2017).
Data used:

- Water level heights survey of the Black River;
- Water level heights survey of the Liesbeeck River;
- Water level heights survey of surface water in the Raapenburg Wetland; and
- Electrical Conductivity readings of the Black River and wetlands.

# 3 Discussions

### Water Levels

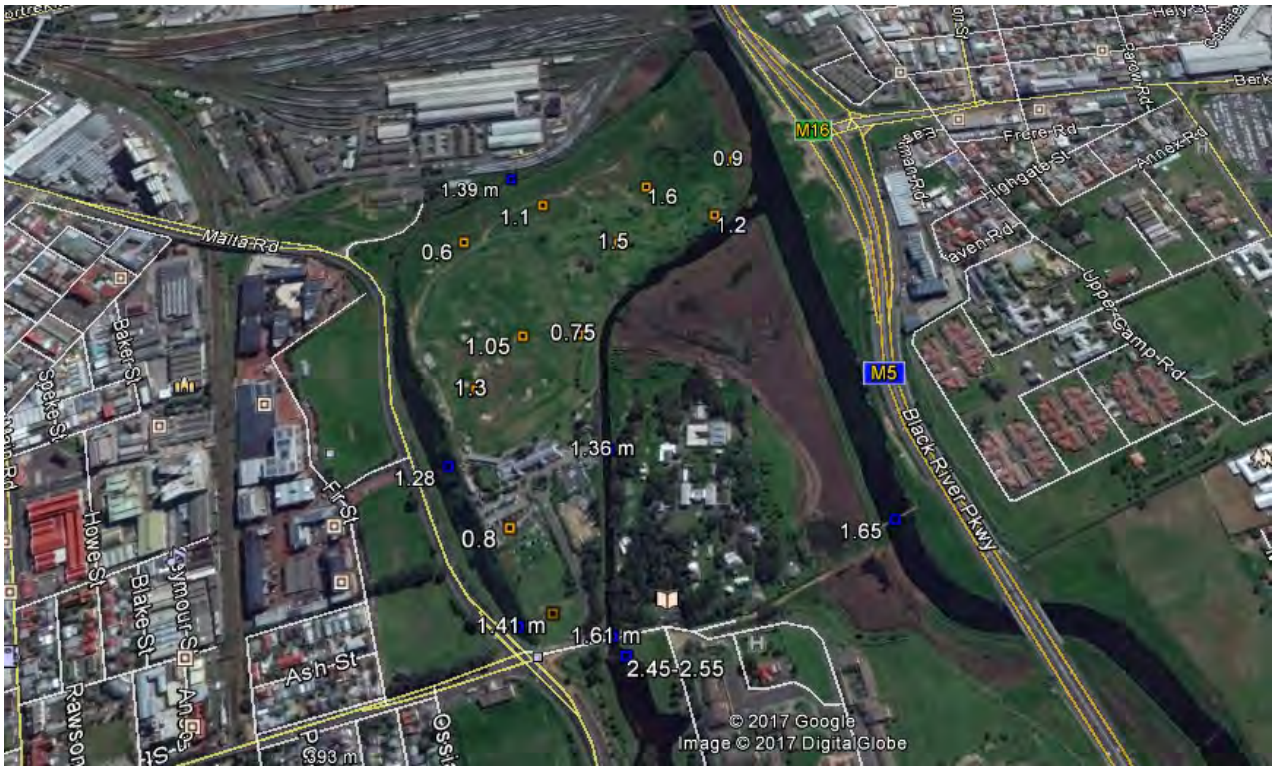
Kantey and Templer drilled four boreholes at the River Club as part of the geotechnical investigation. The depth of the boreholes range between 7.8 m and 16.3 m. **Figure 1** shows the borehole positions (yellow squares), and the measured water levels are shown in MAMSL. The water levels range between 1.62 and 2.02 mamsl. The blue squares are the water level at the Liesbeek and Black Rivers and range between 1.28 and 1.65 mamsl. The groundwater levels at the River Club measured at the deeper boreholes are higher in elevation than the water level in the Rivers, indicating groundwater flow towards the Rivers. It should be noted that these boreholes were drilled into bedrock and could possibly represent some piezometric level influence of a deeper aquifer.


| | | |
|---|---|---|
| srk consulting | **RIVER CLUB EIA**<br>**Position of the deep boreholes with water level (mamsl)** | **Project No.**<br>**478320** |

**Figure 1: Positions and water levels of boreholes**

**Figure 2** shows the positions of test pits where water levels were measured. The water levels range between 0.8 and 1.6 mamsl and are lower than the water levels in the Rivers, again suggesting groundwater flow towards the rivers.

Interesting to note is that the River Club has a fill layer of 1.5 to 2 m thickness, underlain by sediments, which are in turn underlain by bedrock (shale). The water levels measured are mainly at the contact between the fill and sediments. Before the diversion channel was build, the northern part of the River Club was part of the Raapenburg Wetland, which explains why the water table are at the contact with the fill material.




| srk consulting | RIVER CLUB EIA<br>Position of the test pits with water level (mamsl( | Project No.<br>478320 |
|---|---|---|

**Figure 2: Positions of test pits and measured water levels (mamsl)**

**Figure 3** shows the surveyed water levels for the Raapenburg Wetlands and adjacent Rivers. The results indicate that flow is from the Black and Liesbeek Rivers to the Wetlands. It is also noted that the water levels measured in the wetlands are higher than the water levels measured at the test pits and are therefore considered to be upgradient from the River Club.


| srk consulting | RIVER CLUB EIA<br>Water level measurements at the Raapenburg Wetlnads | Project No.<br>478320 |
|---|---|---|

**Figure 3: Water level measurements at the Raapenburg Wetlands**

### Electrical Conductivity

The Electrical Conductivity of the groundwater, wetlands, Liesbeek River and Black River were measured, and the data is presented in **Table 1**. The EC of groundwater and the Wetlands are substantially higher than the EC of the two rivers suggesting the water in the wetlands is mainly groundwater.

**Table 1: Measured EC (mS/m)**

| Water Type | EC (mS/m) |
|---|---|
| BH1 | 2985 |
| BH2 | 4099 |
| BH4 | 851 |
| Black River | 110 |
| Liesbeek River (canal) | 35 |
| Liesbeek (Back Water) | 53-858 |
| Raapenburg Wetland | 2800 |

## 4. Conclusion

The water level and EC data indicate that the water in the Raapenburg Wetlands is mainly groundwater, and that flow from the rivers towards the Wetlands is minor.

In the past, the River Club was part of the Raapenburg Wetlands. The building of the Liesbeek diversion channel changed the hydrology and has created two separate systems. This considered, it is likely that the diversion channel will act as a buffer to activities on the River Club side, and the Wetland is geohydrologically up gradient of the River Club Site. This demonstrates that extensive development at the River Club site will not affect groundwater flow to the Wetlands.

There is insufficient data to comment with confidence on the nature of surface/groundwater interaction, as the river water levels are higher than groundwater levels, but the EC of the rivers is considerably lower than the groundwater. It would therefore be expected that if there was inflow from the rivers to the wetlands that a much lower EC would have been recorded at the wetlands.

**Yours faithfully,**

## SRK Consulting



**Leon Groenewald** Pr. Sci. Nat.
CPM

**Principal Hydrogeologist**

**Bruce Engelsman** Pr Eng Pr

**Partner**

# APPENDIX D

# SPECIALIST AVIFAUNAL (BIRD) REPORT

**Report provided by Dr Tony Williams**

Note:

This report was based on a study area comprising the entire area as defined between Observatory Road, the natural channel of the Liesbeek River from Observatory Road to the Black River confluence and the Liesbeek River Cabal.

Following this input, the study area was redefined as excluding the SKA site and extending only to the Berkley Road road reserve.

Given the low sensitivity of the site from a bird perspective, the specialist was not asked to revise this report.

# BIRD REPORT FOR THE RIVER CLUB

*View towards the junction of the Liesbeek canal and the Black River with the River Club bird hide, roosting trees, and small mudbank*

Prepared by Dr A.J. Williams

Dr Williams Bird Surveys

July 2015

# EXECUTIVE SUMMARY

This report is in two sections. The first deals with the current situation regarding birds in the River Club area (hereafter RCA). The second section considers how provision of habitat for birds can enhance the value of the proposed new development and how such provision can compensate for any potential loss of development opportunity.

**Section 1**: The entire River Club area (hereafter RCA) has been transformed from its original state. About a third of it has been seriously degraded by the dumping of rubble and fill onto former floodplain. Apart from the open water there are now few habitat patches of value for birds. In contrast the immediately adjacent Raapenberg nature reserve, though of a far smaller area, has a higher value for birds. The birds of greatest interest, and conservation significance, are waterbirds. In both inspection visits two species of conservation significance were recorded. Situated at the juncture of the Liesbeek and Black Rivers the RCA has excellent wetland linkages across the centre-north of the Cape Town metropol.

**Section 2**: At present – without better understanding of the proposed commercial intentions – it is difficult to do other than suggest potential features that could enhance the terrestrial area for birds. Two principal approaches are recommended – 1) provision of a peripheral "Apron" with trails; and 2) creation of new managed wetland habitats on the outer part of the in-filled area along the bank of the Black River. The suggested features would primarily provide desirable green amenity features. It is indicated how these could have significant commercial benefits.

**Apron and trails**: It is not considered appropriate to construct buildings right beside the main water channels (rivers and canal) but set-back sufficiently to enable natural landscaping and the provisions of trails between the buildings and the waterbodies. It is recommended that this apron, managed by a property owners association, be broad enough to encompass two separate recreational trails. The "relaxation" trail would wind through naturally landscaped areas nearer the water. It would be suitable for strollers, wheelchairs etc. Offshoots would be provided at intervals to the water's edge where seats would provide seating for visitors or there might be screened viewing of wildlife. Clumps of bushes or trees would provide visual separation of the two trails and of human groups along the relaxation trail. These bush clumps would provide habitat for wildlife. Natural vegetation in the apron will improve outward views from the buildings and enhance property values. Closer to the buildings an "activity" trail would be provided for joggers or cyclists, activities that would otherwise disturb slower travellers and wildlife. These trails would provide circuits around the outer areas of the RCA whilst being routed to minimize disturbance to wildlife.

**Wetland habitats**: Removal of infill from part of the currently uncultivated, river junction, areas beyond the golf course could enable the creation of patches of managed wetland habitats. The fill removed could be used to reduce flood risk on the commercially developed area. Through judicious removal of fill a complex of wetland habitats can be created. This would be attractive to birds and other wildlife (e.g. otters and threatened Leopard Toads). Provision of suitable bird breeding features – e.g. breeding banks for kingfishers, breeding platforms for herons etc. - and of viewing facilities for visitors - e.g. hides and an observation tower - could make this area a considerable attraction for birders, photographers, eco-education purposes, and just for people to relax and enjoy.

These two broad suggestions would benefit the overall development by: 1) easing development approval-through appropriate provision of environmental and social amenities; and 2) increasing the value of properties.

# 1 INTRODUCTION

The controlling company of the River Club Area (hereafter RCA), in the Observatory district of Cape Town, has the intention of undertaking the development of commercial buildings on part of the club area. Apparently the concept is for an office park. At this stage no information has been provided on the proposed layout and the parts of the overall area to be affected.

This bird report has been commissioned to document the current 1) status and importance of birds relative to local and regional contexts: and 2) habitats in the RCA of importance for birds. In addition to 3) indicate opportunities and constraints to guide the future planning of development and provide recommendations for the layout and footprint.

# 2 THE BASIC APPRAISAL

## 2.1. THE AREA

**Riverine situation**: The RCA lies between the channel and canal branches of the Liesbeek River and their conjunction with the Black River. These waterbodies, though peripheral to the RCA property, are the dominant environmental factors that have affected the past, and will have a substantial impact on potential future, development of the RCA, as well as being the key feature for birds in and around the RCA.

The waterbodies which border the RCA are subject to different flow regimes. The Black River results from high lowland ground water levels, now coupled with inflow from urban run-off and the upstream Athlone sewage treatment plant. It is a relatively stable system. The Liesbeek River is more volatile. It originates from mountain streams and now, especially, urban run-off and its flow changes radically in relation to rainfall events. Consequently the Liesbeek is subject to more irregular flows than the Black River. The lower Liesbeek is divided into two waterlines a short distance upstream of the RCA. Most flow is now in the canal which runs along the south-eastern side of the RCA. Flow through the original channel, that forms the north-east boundary of the RCA is now greatly reduced. One result of the reduced flow is shallowing of the channel which has facilitated invasion by, largely alien, aquatic plants that now block parts of the waterbody.

**Flooding**: The RCA lies just inland of regular tidal influence. The RC area must formerly have been a low floodplain about 1 m above normal flow (equivalent to the opposite bank of the Black River). Formerly the terrain and vegetation would have been bio-engineered by hippopotamuses. Downstream there would have been estuarine conditions where during high flow the river could spread over adjoining coastal lowland. The former estuarine environment has been constrained by infilling for the Culemberg rail yard and the industrialized area of Paarden Island. The situation has been exacerbated by the concrete canalization of the river from immediately downstream of the RCA. As a consequence flow backup has likely caused increased flooding in the RCA/M5 area which is the first downstream area where the river has an opportunity to overflow. As a result of continued global warming sea level will rise so there an increasing frequency of flooding can be expected in these lower reaches of the Black/Liesbeek Rivers. Floods particularly occur in September when, after winter rains, the water table is raised and equinoctial spring high tides block river flow into the sea.

To reduce the threat of flooding the RC area has been progressively elevated over the years by infill. This has continued to recent times. Despite the infill the water table remains high across the RCA. Probably it is elevated in part by the clay substrate which underlies the infill. The heightened water table facilitates flooding when flow increases in the adjoining rivers. Consequently flood risk at 1-5 year intervals occurs across much of the RCA. Flood risk has been a major constraint on past development of the RCA hence the lack of former building development and the restriction to its use for a golf course. Alternatively, flooding can be seen as beneficial in that, with the improved economic potential of the site, an open field situation is now available for commercial development.

In ecological terms the Black River, which is broader and more stable offers the greatest potential for birds. The Liesbeek canal is sterilized by walls and is richest where the walls give way to “natural” banks near its confluence with the Black River. Weak flow in the Liesbeek has resulted in shallowing and clogging aquatic plants. These plants inhibit most bird use of the clogged waterbody.

## 2.2. AREA DEMARCATION

For convenience and clarity this report is based on consideration of the RCA in terms of four areas. These areas are: 1) the “Entry” area south of the River Club buildings (Figs. 1 & 2); 2) the “Core” or manicured Golf Course area (Fig. 3) ; 3) the “Rough” the currently un-manicured area of infill between the Golf Course and the junction of the Liesbeek and Black Rivers (Figs. 4 & 5) and 4) the “Periphery” – a belt, approximately 8-10 m broad, beside the open water channels of the Liesbeek, canal, and Black River (Fig. 6) ;. There is overlap between the Peripheral and Rough areas.

*Figs.1 & 2: The Entry area: This is effectively sterile for birds except where there are thickets though these are too small in area to support more than offshoots of birds from the better vegetated observatory area*

*Fig. 3: The manicured Core area is also effectively sterile for most birds as it lacks plant diversity and structure, and is heavily disturbed*

*Fig.4: Part of the Rough area – currently unused, except for occasional dumping.*

*Fig. 5: Another view of the Rough area. The low growth of the alien acacias suggests this area has only been available for plants for a short period i.e. infilling is quite recent*

*Fig. 6: The peripheral area abutting the Liesbeek channel. This area is currently used for maintenance and both banks are visually unappealing*

*Fig. 7. The Liesbeek Canal periphery: sterile edges an ugly corrugated "wall". Birds from the more naturally vegetated Observatory shore probably range into the few patches of appropriate habitat in the RCA*

This report is primarily concerned with the Periphery and Rough areas on the assumption that commercial developments will be wholly or largely confined to the Entry and Core areas. Neither the Entry nor the Core areas are of current importance for birds. Without knowledge of the proposed commercial developments any comment on how these central areas might be made more attractive to birds is superfluous.

## 2.3. BIRD AND PHOTOGRAPHIC SURVEYS

To appreciate the RCA with its constraints and potential the area was visited with Dr Liz Day on 29th June 2015 from 09.30-12.30. A second visit was made from 11.00-12.30 on 8 July to reconsider bird presence and to re-assess concept proposals developed following the initial visit.

During the June visit 32 species of birds were recorded. Most of them were water-related. This total included two red-data (conservation priority) species both rated as near-threatened. These were a Great White Pelican in the Liesbeek channel (Fig. 8) and Greater Flamingos which were seen both in the adjacent Raapenberg reserve and in flight over the River Club. Two less often observed species recorded were Little Bittern and African Black Duck. In the July visit an additional 9 species of birds were recorded, most again were water related. On this visit a flock of 35 Greater Flamingos were near the RCA edge of the Black River just off the bird hide (Fig. 9), and a pelican was again in the Liesbeek channel.

*Fig.8. A Great White Pelican (rated near –threatened in South Africa) seen on the Liesbeek in both June and July*

*Fig. 9. A flock of 35 Greater Flamingos (rated near-threatened in South Africa), ducks, a moorhen and, in the trees, resting cormorants and a heron, seen from the bird hide. This is the most important area of bird habitat*

*in the overall River Club area. Note the floodplain level of the opposite bank. This probably indicates the original level of the RCA. Note also the pipe which conveys urban run-off into the Black River.*

In the Western Cape waterbirds tend to disperse to ephemeral wetlands as soon as winter rains cause temporary local flooding. Consequently the number and diversity of waterbirds seen during the two visits are likely to be lower than would occur in the summer when ephemeral wetlands have dried out and waterbirds are restricted to the use of permanent wetland areas such as the river channels around the RCA.

The current significance of the RCA for birds resides in the attraction of the peripheral waterbodies for waterbirds and their sometime use of the RCA banks for roosting. Waterbird use of the area is heavily influenced by the availability of wetland habitats in the Raapenberg Nature Reserve which is located on the opposite bank of the Liesbeek canal. The major drawback of the area for waterbirds, despite reasonable foraging areas and apparent food availability, is the lack of safe, undisturbed breeding habitat for the larger species. This situation applies along the greater part of the two rivers. The nearest significant breeding populations of larger waterbirds are at Intaka Island in Century City and at Rondevlei, near Grassy Park.

## 2.4. IMPORTANCE

The total area of wetlands remaining in the Western Cape is less than 0.5% of the province. The junction of the Liesbeek and Black River channels is a focal point in the wetland systems of central-north Cape Town. The conjoined Black-Liesbeek River is ecologically linked via Zoar Vlei to the Diep River system that extends northwards to beyond Malmesbury and includes the Rietvlei nature reserve, a registered Internationally Important Bird Area (IIBA). The only other significant wetlands in this centre-north area of Cape Town are at or near Century City: Intaka Island nature reserve wetlands; a large detention “pond”; and, just east of Century City, the pan between the N1 and the railway line. The wetland system of southern Cape Town – based on the False Bay Eco-park (Rondevlei- Seekoevlei-Strandfontein- Sandvlei and associated streams) is within ready flight distance for most waterbirds that use the northern Liesbeek-Black-Diep river wetlands.

The importance of the RCA for birds is in the open water and the abutting waters-edge habitats which together provide a range of micro-habitats for specialist foragers.

The majority, 21 of 33species, of the birds recorded in the two visits were related to wetland habitats, and these included several species of provincial conservation interest in addition to the two nationally rated conservation species.

The Cape Bird Club has an outing to the area planned for 18 August. This indicates established appreciation of birds in the riverine areas of the RCA. Members of the conservation committee of this bird club are likely to represent BirdLife South Africa as an I&AP for any pre- development EIA process.

## 2.5. HABITAT SENSITIVITIES

The greater River Club area has been both transformed and substantially degraded relative to the predicted natural situation prior to European-related regional developments. There is scarcely any habitat in the River Club area, other than the open water bodies, that can be currently considered important from a bird perspective although semi-sensitive habitats abut the area on the outer banks of the two defining water channels i.e. the Raapenberg Nature Reserve and the strip of land between the Culemberg rail-yard fence and the Liesbeek channel. The only patches of habitat currently within the RCA that merit

preservation are the trees on the palm islet opposite the bird hide and the willows along the canal (see Figs. 10 and 113). Other isolated trees along the river bank are also of value as perches.

*Figs. 10 &11: The two groups of trees used by Darters and Cormorants as day roosts. Palm Islet, on the left, is opposite the existing bird- hide. The willows, right hand picture, are a short way along the canal from the bird hide. These are the two habitat patches that most deserve preservation.*

**List of birds identified in the RCA – June 2015**

| Vernacular name | Scientific name |
|---|---|
| Little grebe | *Tachybaptus ruficollis* |
| White-breasted Cormorant | *Phalacrocorax carbo lucidus* |
| Grey Heron | *Ardea cinerea* |
| Purple Heron | *Ardea purpurea* |
| Little Egret | *Egretta garzetta* |
| Greater Flamingo | *Phoenicopterus ruber* |
| Sacred Ibis | *Threskiornis aethiopicus* |
| Hadeda Ibis | *Bostrychia hagedash* |
| Glossy Ibis | *Plegadis falcinellus* |
| Great White Pelican | *Pelecanus onocrotalus* |
| Egyptian Goose | *Alopochen aegyptiaca* |
| Black Duck | *Anas sparsa* |
| Yellow-billed Duck | *Anas undulata* |
| Cape Shoveler | *Anas smithii* |
| Moorhen | *Gallinula chloropus* |
| Red-knobbed Coot | *Fulica atra* |
| Blacksmith Lapwing | *Vanellus armatus* |
| Little Bittern | *Ixobrychus minutus* |
| African Black Duck | *Anas sparsa* |
| Three-banded Plover | *Charadrius tricollaris* |
| Red-eyed Dove | *Streptopelia semitorquata* |
| Laughing Dove | *Streptopelia senegalensis* |
| Speckled Pigeon | *Columba guinea* |
| Malachite Kingfisher | *Alcedo cristata* |
| Pied Kingfisher | *Ceryle rudis* |
| Giant Kingfisher | *Megaceryle maxima* |
| Hartlaub's Gull | *Larus hartlaubii* |
| Kelp Gull | *Larus dominicanus* |

| | |
|---|---|
| Cape Wagtail | *Motacilla capensis* |
| Cape Robin-Chat | *Cossypha caffra* |
| Cape Sparrow | *Passer melanurus* |

## 2.6. OPPORTUNITIES

**Birds focus**: Birds are the most easily appraised surrogate for the assessment of biodiversity. Based on the commissioning of this report it is assumed that the developers have an interest in increasing the attractiveness of the overall RCA for birds. Given the transformed nature of the entire area almost any action to improve the "natural" environment will be beneficial. To improve the area for birds (as a surrogate for the health of natural environments as well as for other wildlife) would, as a sole aim, not be cost effective nor worthwhile for the developer. Habitat for birds and wildlife will only be accommodated it they provide suitable value to the overall development. How birds can benefit from environmental and associated social values is considered in Section 2 of this report.

Habitat benefits for birds usually provide profit for other, less often appreciated, forms of wildlife. This report suggests how, by creating managed "natural" habitats that are attractive to birds the Periphery and Rough areas can be made more attractive as a green amenity.

# 3 COST COMPENSATING ENVIRONMENTAL OPPORTUNITES

## 3.1. THE PLANNING APPROVAL STAGE

**Planning approval:** Application to develop a green area beside wetlands and a nature reserve will require an EIA. Objections are likely from environmental I&APs: city conservation authorities; BirdLife South Africa through the Cape Bird Club conservation committee; and from the NGO Friends of the Liesbeek. Conservation groups tend to be anti-development. The objections relative to environment issues, and this "bird" report, are likely to fall under four categories.

1) The affects the proposed developments may have on the functioning of the existing waterbodies
2) Loss of potentially valuable wetland –associated habitat: through the footprint as well as associated negative impacts – e.g. disturbance, and loss of wildlife use of waters-edge areas
3) Possible negative carry-over effect on birds in the Raapenberg Nature Reserve which may lose foraging areas in or adjacent to the RCA
4) Perception that there will be loss of this urban "green lung", even though, for the non-golfing public. this is largely visual and mental feature.

Pre-emption of these likely objections can hasten planning approval - with accordingly reduced costs. Pre-emption requires pro-active planning to ameliorate or negate the objections. To do so some environmental compensation will have to be offered. Done appropriately such compensation can be potentially of considerable monetary value, to the proposed development, as well as, incidentally benefit birdlife. Hence the following.

**Water functioning:** This topic pertains to freshwater expert(s) & geo-engineers. Here it is assumed that there will be little change to the status quo and that any changes will be positive in terms of wetland

functioning. Increased flow in the Liesbeek channel (not canal) will be beneficial to this outer boundary of the property.

**Wildlife habitats & waterbirds**: Responses strongly urged are for

i) Provision of **an apron of natural habitats** between buildings and riverine waterfronts

ii) Creation of **a mosaic of managed wetland habitats** in part of the existing "rough" area to reciprocate the Raapenberg Nature Reserve and especially to provide needed breeding places for waterbirds at this nodal location.

**Social benefits**: The aprons and wildlife habitats will provide improved aesthetics. Provision can be made within the apron for safe recreation, both active and passive, including for property occupiers as well as through controlled access for the local public, schools, and pensioners.

## 3.2. COST ISSUES

If sections of the RCA are to be set aside for environmental "compensation" the developer will seek legitimate recompense for the loss of potentially developable areas and for costs incurred in providing the indicated environmental and social features.

**How funded**: Compensation will be derived from:

**a)** Readier/ less contested, faster, planning approval which can save litigation, and retain investor interest

**b)** Higher sales/rental values from properties that overlook water and natural habitats (as known from Century City).

**c)** Vegetation masking of uglier external urban vistas – e.g. Culemberg rail-yard - will increase sales /rental values from properties that face such vistas. .

**d)** The positive image from demonstrated environmental and social responsibility will make it easier to market properties and rentals.

**e)** Property levies to a Property Owners Association which will fund management of the non-footprint areas.

**f)** A small entry fee charged for public access (to ensure an acceptable standard of visitor i.e. no undesirables, as well as to cover control/collection costs.

Relative to the multiple millions of rands required to fund re-sculpturing of the terrain to resolve flooding issues, as well as for new infrastructure and buildings, the cost for the proposed environmental/social features is miniscule. The social, environmental and monetary values added should more than compensate for the costs whether direct or through lost opportunity.

These suggestions imply a reversal from the current, central area focused, approach to management of the RCA for which the waterside areas are negative features to a management plan that recognizes the value, with considerable financial rewards, from provision of natural waterside habitats.

Promise an **Environmental Management Plan** – Create an independent advisory committee to pre-empt/ represent broad IAP interests. This should be formed before planning approval is sought.

Experience is that such a committee, if taken into confidence by the developer, tends to act to positively support the developer. The committee need botanist/bird and freshwater specialists, and representatives from the city conservation/ biodiversity section and the Friends of the Liesbeek (how representative of the local concerned public?), with appropriate/suitably senior representatives of the developer. An independent chairperson is needed to give added credibility. The committee should meet at least quarterly but ideally monthly especially through construction phase when short-term changes need to be considered.

**Philosophy**: Research has shown that, in a hospital of which one side faces greenery and the other side buildings, patients facing greenery recover quicker, and with less medication, than those in wards facing buildings. The manager of an office facing onto the Intaka Island nature reserve in Century City has stated that his staff now work longer, and more productively, than they did in their former city centre office, which looked onto adjoining buildings and where a 9.15-4.30 attitude held. Research overseas has demonstrated that the new generation of entrepreneurs has strong appreciation for environmental issues and of their social responsibility and, other things being equal this affects their consideration of where to locate their businesses. The ambience of the locale is an important aspect of this.

**Changes in urban philosophy**: There have been changes in preference from former "straight and sterile" and "concrete or kikuyu" landscapes to a more natural situation with more curves and greater use of indigenous plants. The rivers abutting the RCA have previously been seen as flood source and have been treated negatively. This attitude needs to switch to appreciation of the rivers as major benefactors of the proposed development, not least through provision of a "burglar barrier". This requires a shift in attitude from inward to outward consideration of the RCA. .

**Re-sculpturing & landscaping**: This will be necessary to reduce the flooding risk and to accommodate roads and buildings. In business parks, except for small private areas around the ground floor, most non-footprint ground is under corporate management through a Property Owners Association (POA). Landscaping of communal ground in the RCA must be seen as a continuum, from formal horticulture along roads and immediately around buildings, to "natural" vegetation near waterbodies. Indigenous plants have the benefit of using less fertiliser and water (except for the initial period after planting) and so reduction in maintenance costs.

**Flood avoidance**: The key to structural development on the RCA is reduction of the flood risk. This can be most readily achieved by raising the ground level of the area with buildings and their services to above the 1 in 5 year flood limit. A considerable amount of infill material will be required to achieve this. Transport of fill material from outside the RCA will be very expensive. This cost can be considerably offset by excavation of the infill already used in the "Rough" area and relocating it strategically to raise the area where buildings will be constructed. The resulting excavations can be re-sculptured to create a series of new peripheral wetlands (see suggestions below).

The flood risk is greatest next to the existing water channels. This risk can be reduced by setting buildings etc. some way back from the channels and creating a protective, anti-flood berm between the structures and the water-bodies. The berm and the area between it and the water channel is hereafter referred to as an Apron. The aprons can be most readily developed abutting the Black River and the Liesbeek channel.

**Views**: The water channels and flood avoidance apron will enforce spacing between buildings on the RCA and the neighbouring properties. This will create views of varying character. These views are potentially important selling factors. They offer quite different prospects from those of normal, tightly constrained, urban office developments. The prime views are to the west, towards Table Mountain.

The southerly view will be onto the Observatory. To the east the view is across the Black River to the M5. The least desirable is view is towards the Culemborg railyard.

*Fig. 12. View to southwest across the existing Golf Course. This is likely to be the view – towards Table Mountain - that will determine the orientation of buildings on the site with some adjustment to align along the prevailing southeast-northwest wind directions*.

These views, especially that to the north and east can be considerably enhanced by natural landscaping – through the planting of indigenous bushes and trees.

To further improve views, it would be sensible to negotiate to take-over management of the opposing, non-RCA, banks of the water channels and to also landscape these. Any landscaping must avoid planting trees or bushes in isolation at some distance apart but rather aim for closer planting to create dense masses of foliage. Such dense masses are generally avoided in urban environments as they get used for undesirable practices. However, the river channels around the RCA facilitate exclusion of undesirables on the RCA. Bush development on the away banks would require appropriate fencing (this applies only to the west bank of the Liesbeek as the Culemberg sector is already fenced and the other nearby bank is that of the Raapenberg/Observatory.

*Fig.13. The Raapenberg nature reserve contains varied wetland habitats with a reed screened central open water area highly attractive to waterbirds. Management collaboration with the Observatory administration could lead to improvements in the aesthetics of this view i.e. through replacement of the aging & deteriorating concrete canal wall by more naturally appearing gabions, and the removal of the rusted corrugated iron "wall that divides the Raapenberg wetland from the higher terrestrial area. .*

**Social values**: The proposed peripheral flood protection/ view-enhancing aprons will provide social value to the overall development. To further enhance this value two systems of peripheral trails are proposed. An inner trail, i.e. closer to the buildings, for active recreation – jogging or cycling; and an outer, nearer the water, trail to suit more relaxed recreation – walking, sitting, and enjoyment of the views and nature. Further suggestions for these trails are made below.

**Landscape Management**: By managing the apron as a natural environment, with largely, if not entirely, indigenous plants will cost substantially less in terms of maintenance than if this were "horticulturally" landscaped. Natural vegetation has the benefit of periodic flowering, the provision of nectar, fruit and seeds for wildlife, as well as sheltering habitats for wildlife to breed. Irrigation would only be necessary in the first few years to ensure rapid development to the desired heights and appearance of the vegetation. Bushes and trees mute external traffic noise, and serve to give visual pleasure through greenery, flowers, butterflies, birds and bird song. .

*Fig. 14. What the peripheral area might resemble with appropriate planting – a good, near continuous bushy habitat for birds as well as being aesthetically pleasing to the public. Note the Liberty Life offices backed from, but overlooking, this area in Century City. Contrast this view with that of the current RCA peripheral pictures (Figs. 6 & 7 ). Gaps in the bush cover can be left for sitting, or watching nature.*

*Fig. 15. A public viewing unit – constructed with "plastic wood". Not all viewing areas need be so fancy though decking is important in wet situations where heavy treading would soon result in a muddy mess.*

*Figs. 16 & 17: Examples of a) an inexpensive screen that enables viewing of wildlife with minimal risk of disturbance; and b) a wheelchair suitable walking trail through bush habitat. Note the passing bay and the sense of exploration created by the effect of the trail winding out of sight. Both these sorts of features would be appropriate for the outer, relaxed, trail in the apron.*

**Edutainment values**: The social value of the apron environments would be substantially raised if, at intervals, attractive signage is installed that interprets occasional features of the natural environment. Further interpretation panels would be provided in the bird hides etc. within the new wetland habitats area (see below). An education/interpretation lapa, as well as walkthrough aviary to enable close up viewing of birds, might be considered.

**New wetland habitats**: Excavation of infill from the outer, waterside, part of the Rough area could create a series of new wetland habitats providing water of different depth in each of say three wetlands with water levels controlled by pumping from the Black River and using controlled culverts to manage water levels and seasonal level changes in each. These three habitats should be: one of open deeper water; a shallower reedy water; and a marsh. With peripheral reed/sedge beds these wetlands should provide an ideal group of habitats to attract a diverse range of wetland birds.

Provision should be made to enhance the likelihood of waterbirds breeding i.e. through 1) provision of open vertical embankments in which kingfishers and martins can burrow their nests; 2) a branch islet breeding platform to attract cormorants, darters and ibises; 3) and upright sticks set in the water on which kingfishers can perch. An open dryland area beside the deeper water habitat will attract birds to rest on during the day. Observation hides or screens can be located near these special features so that the public can obtain close looks, and photographs, without unduly disturbing the birds. See Figs. 18-20 for examples from Century City of how the new wetlands might look –all the Century City photos are of artificially created habitats developed mainly in the first five years after the start in 1996. A 4) wooden observation tower beside the Black River would please visitors. It would enable observations into both the new wetlands and Raapenberg nature reserve. This would also facilitate surveys of water bird numbers to demonstrate the degree to which development targets are met. Creation of an area of **reciprocal habitat** on the "point" area of the RCA would greatly increase the wildlife value of this area and simultaneously raise the value of Raapenberg nature reserve as part of a larger total area for wetland birds. These new habitats can be considered an offset against former loss of habitat through infilling of the floodplain. Even small areas of wetland habitat, as well as riparian vegetation have high biodiversity value. Rich aquatic insect life subsidises animals in appropriate immediately adjoining habitat.

*Fig. 18: The sort of relaxing view – from a bird hide or a viewing screen – that could be achieved in a restored, offset, section of the current Rough area*

*Fig. 19. Another view of what might be emulated through restoration of wetland habitats in the Rough area. Note the embankment in which kingfishers and martins excavated breeding burrows. This whole vista has been created artificially. Note the upright dead stick used by kingfishers for observing for fish in the water below.*

*Fig. 20. Branch islets set in permanent waterbodies are keenly valued by waterbirds as safe breeding sites. On such safe sites the birds readily tolerate humans watching from relatively close quarters. Experience has shown that the islets could have been erected considerably closer to the bird hide. This would have provided an even*

*better experience for visitors who lacked binoculars. Note the sandy open loafing area on the left bank much used by birds.*

**Timing and archives**: A natural/ environmental area plan is required from before planning approval. Planting etc. in the apron should commence as soon as approval is granted. The plants can mature whilst construction is taking place so that the visual value is there when the properties are ready for sale or rental. It is important to take photos across the pre-construction phases and at regular intervals across and after development. Regular (ideally monthly) bird surveys are needed to document changes and see to what extent environmental targets, using birds as surrogates, are made.

**Additional ideas for consideration**: Planting thorn trees as these encourage terrestrial birds to breed in safety. The riverine borders constrain terrestrial non-volant predators but attention would have to be paid to aquatic predators, notably water mongooses. One aim should be to foster populations of wetlands species known to be under severe stress in and around Cape Town – Greater Painted Snipe, Leopard Toad etc.

**Conclusion**: Appropriate development of the RCA for an office park of 21st century environmentally conscious standards will cost multi-millions of rands. The costs of developing the proposed natural apron, new wetland habitats, and suggested recreational/ educational features would probably cost less than 1 million. This cost, and the cost of lost developable area, can be more than compensated from the: reduced flooding risk; raised ambience; and so value of the overall site for property sales or rentals; as well by pre-empting most, if not all, environmentally based objections that may be raised at the planning application phase. The suggested environmental developments will greatly enhance the RCA for birds and water-related wildlife in general.

# 4 DR WILLIAMS' WATERBIRD AND WETLAND RELATED CV

After research into seabirds in the UK and Norway and qualifying as a Master of Science (Ornithology) from the University of Sheffield I joined the FitzPatrick Institute for African Ornithology at the University of Cape Town. Over nine years I was senior researcher responsible for the seabird programme at subantarctic Marion Island. I spent 2.5 years on the island during two visits. This led to publication of 21 per-reviewed scientific papers and the award of my Doctorate from the University of Cape Town. As the programme funding ceased in 1982 I transferred to the State Museum in Windhoek as curator of birds. Following the death of the former ornithologist for the then South West Africa (now Namibia) Department of Nature Conservation I took up that position which I held until in 1988.

In 1987 the (old and larger) Cape Province Department of Nature Conservation took over management of most of the former guano islands. Based on my seabird experience I was recruited and, though in charge of research at 16 islands spread from Algoa Bay to the Namib coast, I was stationed at Walvis Bay. In 1994 Walvis Bay and the Namib islands were transferred to Namibia and I was relocated to Stellenbosch as the senior ornithologist for the nature conservation department (now Cape Nature) of the newly created Western Cape Province.

My first task was to appraise the status of birds in the new province. It was immediately apparent that seabirds and water-related birds were those most at risk as coast and wetlands together form less than 1% of the total area of the province. Not only were these environments "rare" but they were also subject to greater human pressures than other provincial environments.

I focused largely on the wetlands and waterbirds. Accordingly I became Cape Nature's representative and on the management advisory committees for the: Paarl Bird Sanctuary (sewage works) from 1994-2004; Rietvlei Nature Reserve 1994-2014; and Intaka Island in Century City (from its initiation in 1995 to present). In addition I worked on surveys of waterbirds at Theewaterskloof, Bot River Lagoon, De Hoop Vlei, Rocher and Wadrif pans, and Paardevlei. This all in addition to my seabird , SANCCOB, and wider ornithological commitments.

In a pre-retirement period of secondment to the Avian Demography Unit (ADU) at UCT I used data from the Co-ordinated Waterbird Count (CWAC) data base at the ADU to assess the overall population and conservation status of the waterfowl, waders, shorebirds and see-birds in the entire province as well as using ecological knowledge to assess the global population status of four species of waterfowl endemic to southern Africa – Cape Teal, Karoo Shelduck, Cape Shoveler, and the southern African race of the Black-necked Grebe.

I considered it vital for the conservation of provincial waterbirds that public appreciation of the wetland habitats be raised. Hence I was a prime instigator of a proposed R 20 million wetland education eco-centre for Rietvlei. I motivated this with the (then) Blaauwberg Municipality. The municipality instigated a R 250,000 EIA report and also sent me on a fact-finding mission to the UK where over a three- week period. There I visited 13 major wetland eco-education centres collecting ideas for features that could be applied in Africa. Unfortunately, although most of the findings of the EIA were positive, it was decided that the project would not be not financially viable, and it lapsed. Subsequently, during attendance at international symposia, I was able to visit, and get ideas from, wetland eco-centres in north-eastern, south-eastern, and western USA as well as in Australia, New Zealand, and Malaysia.

Based on these international experiences I have provided information, advice, and development ideas for a number of proposed wetland developments or wetland impaction situations: the Matzikama Eco-park, Vredendal; developments at Somerset East; Paardevlei in Somerset West; Paarl Bird Sanctuary; Paarl Golf Estate; Drakenstein and Eden municipality landfill extensions; Safari-land near Franschoek; Vredenberg Golf Course; eco-estate residential proposals east and west of the Uilenkraal River; and within Cape Town - Intaka Island in Century City; Grand West Casino; and the Atlantic Hills development. I have also been consulted on the effect of proposed road developments at Wadrif Pan, and to provide information panels for the Rocher Pan nature reserve.

# APPENDIX E
# ENVIRONMENTAL IMPORTANCE AND SENSITIVITY (EIS) PROTOCOL FOR WETLANDS AND RIVERS

# Appendix E Environmental Importance and Sensitivity (EIS) protocol for wetlands and rivers

The method used to assess the EIS of wetlands is a refinement of the DWAF Resource Directed Measures for Water Resources: Wetland Ecosystems method (DWAF, 1999b) and Rivers method (DWAF 199c). It includes an assessment of ecological (e.g. presence of rare and endangered fauna / flora), functional (e.g. groundwater storage / recharge) and socio-economic criteria (e.g. human use of the wetland).

Scoring of these criteria then places the wetland or river in an Importance Class (A-D) (see Tables E1 and E2).

Table E1
Wetland Importance Class integrating Ecological Importance and Sensitivity, and functional and socio-cultural importance modifiers.

| Importance class (one or more attributes may apply) | Range of Median | Wetland Importance Class |
|---|---|---|
| Very high<br>Representative of wetlands that:<br>• support key populations of rare or endangered species;<br>• have a high level of habitat and species richness;<br>• have a high degree of taxonomic uniqueness and/or intolerant taxa;<br>• provide unique habitat (e.g. salt marsh or ephemeral pan; physiognomic features, spawning or nursery environments);<br>• is a crucial avifaunal migratory node (e.g. RAMSAR wetlands);<br>• may provide hydraulic buffering and sediment retention for large to major rivers that originate largely outside of urban conurbations;<br>• have groundwater recharge/discharge comprising a major component of the hydrological regime of the wetland;<br>• are highly sensitive to changes in hydrology, patterns of inundation, discharge rates, water quality and/or disturbance; and<br>• are of extreme importance for conservation, research or education. | >3 <=4 | A |
| High<br>Representative of wetlands that:<br>• support populations of rare or endangered species, or fragments of such populations that are present in other similar and geographically-adjacent wetlands;<br>• contain areas of habitat and species richness;<br>• contain elements of taxonomic uniqueness and/or intolerant taxa;<br>• contain habitat suitable for specific species (e.g. physiognomic features);<br>• provide unique habitat (e.g. salt marsh or ephemeral pan; spawning or nursery environments, heronries);<br>• may provide hydraulic buffering and sediment retention for rivers that originate largely outside of urban conurbations, or within residential fringes of urban areas;<br>• have groundwater recharge/discharge comprising a component of the hydrological regime of the wetland;<br>• may be sensitive to changes in hydrology, patterns of | > 2 <= 3 | B |

| | | |
|---|---|---|
| inundation, discharge rates, water quality and/or human disturbance; and<br>• are important for conservation, research, education or eco-tourism. | | |
| Moderate<br>Representative of wetlands that:<br>• contain small areas of habitat and species richness;<br>• provide limited elements of habitat that has become fragmented by development (e.g. salt marsh, ephemeral pan; roosting sites and heronries);<br>• provide hydraulic buffering for rivers that originate in urban areas;<br>• are moderately sensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance;<br>• perform a moderate degree of water quality enhancement, but are insensitive to sustained eutrophication and/or pollution; and<br>• are of importance for active and passive recreational activities. | >1 <= 2 | C |
| Low/marginal<br>Representative of wetlands that:<br>• contain large areas of coarse (reeds) wetland vegetation with minimal floral and faunal diversity;<br>• have a high urban watershed:wetland area ratio;<br>• are important for active and passive recreation;<br>• provide moderate to high levels of hydraulic buffering;<br>• may be eutrophic and generally insensitive to further nutrient loading;<br>• are generally insensitive to changes in hydrology, patterns of inundation, discharge rates and/or human disturbance;<br>• have regulated water; and<br>• contain large quantities of accumulated organic and inorganic sediments. | >0 <= 1 | D |

Table E2
Wetland Importance Class integrating Ecological Importance and Sensitivity, and functional and socio-cultural importance modifiers.

| Determinant* | Guidelines And Description | Scoring Guidelines |
|---|---|---|
| Rare and@ endangered biota | Biota can be rare or endangered on a local, Provincial and National scale. Useful sources for this information include the South African Red Data Books that are suitable for assessment on a National scale. However, species (or taxa in the case of invertebrates) can be rare or endangered on a Provincial or local scale but not on a National scale. Professional judgement needs to be utilised in such cases. | Very High - rating=4; One or more species/taxon judged as rare or endangered on a National scale (i.e. SA Red Data Books).<br>High - rating=3; One or more species/taxon judged to be rare or endangered on a Provincial/regional scale.<br>Moderate - rating=2; More than one species/taxon judged to be rare or endangered on a local scale.<br>Marginal - rating=1; One species/taxon judged as rare or endangered at a local scale.<br>None - rating=0; No rare or endangered species/taxon at any scale |
| Unique biota@ | Endemic or uniquely isolated species populations (or taxa, i.e. in the case of invertebrates) that are not rare or endangered should be included here. This | Very High - rating=4; One or more population (or taxon) unique on a National scale. For the Western Cape - rated on a biome scale.<br>High - rating=3; One or more population (or taxon) |

| Determinant* | Guidelines And Description | Scoring Guidelines |
|---|---|---|
| | assessment should also consider local, Provincial and National scales and should be treated separately from rare and endangered species (i.e. the same species should not be considered).<br>The assessment should be based on professional knowledge.<br>Fynbos biome: Within this biome all the biota would be unique. The rivers were therefore assessed within the context of the biome for the Western Cape (Luger 1999a). | judged to be unique on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid).<br>Moderate - rating=2; More than one population (or taxon) judged to be unique on a local scale.<br>Marginal - rating=1; One population (or taxon) judged to be unique at a local scale.<br>None - rating=0; No population (or taxon) judged to be unique at any scale. |
| Intolerant biota | Intolerant biota includes those species (or taxa in the case of invertebrates) that are known (or derived or suspected) to be intolerant to decreased or increased flow conditions as well as changed physical habitat and altered water quality conditions related to decreased or increased flows. As little experimental information is available on the intolerance of indigenous biota, assessment should be based on professional judgement.<br><br>Kwazulu/Natal: There is no quaternary without flow and everywhere that there is flow an invertebrate community dependent on flow develops. This would mean that every quaternary should be rated highly with respect to this criterion. The solution to the problem was to use only fish (Chutter 1999). | Very High - rating=4; A very high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle.<br>High - rating=3; A high proportion of the biota is expected to be dependent on permanently flowing water during all phases of their life cycle.<br>Moderate - rating=2; A small proportion of the biota is expected to be dependent on permanently flowing water during some phases of their life cycle.<br>Marginal - rating=1; A very low proportion of the biota is expected to be only temporarily dependent on flowing water for the completion of their life cycle. Sporadic and seasonal flow events expected to be sufficient.<br>None - rating=0; Rarely if any biota expected with any dependence on flowing water. |
| Species/taxon richness | Species/taxon richness can be assessed on a comparative basis according to a local, Provincial or National scale. Strictly, this kind of assessment should be based on the grouping of ecologically similar rivers. However, such a system is still under development and assessment will again to have to be based on professional judgement. | Very High - rating=4; Rated on a National scale. For the Western Cape - rated on a biome scale.<br>High - rating=3; Rated on a Provincial/regional scale. For the Western Cape - rated on a sub-regional scale (i.e. northern, western, southern and karroid).<br>Moderate - rating=2; Rated on a local scale.<br>Marginal/low - rating=1; Not significant at any scale. (a rating of none is not appropriate in this context) |

# APPENDIX F

# SPECIALIST IMPACT ASSESSMENT METHODOLOGY

**Methodology as provided by SRK Consulting**

# IMPACT ASSESSMENT METHODOLOGY FOR EIAS

The significance of all potential impacts that would result from the proposed Project is determined in order to assist decision-makers. The significance rating of impacts is considered by decision-makers, as shown below.

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity.
- **HIGH**: the potential impact **will** affect a decision regarding the proposed activity.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact[19] must be rated according to the methodology set out below:

**Step 1 –** Determine the **consequence** rating for the impact by determining the score for each of the three criteria (A-C) listed below and then **adding** them[20]. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

| Rating | Definition of Rating | Score |
|---|---|---|
| **A. *Extent*** *– the area over which the impact will be experienced* | | |
| Local | Confined to project or study area or part thereof (e.g. site) | 1 |
| Regional | The region, which may be defined in various ways, e.g. cadastral, catchment, topographic | 2 |
| (Inter) national | Nationally or beyond | 3 |
| **B**. ***Intensity*** *– the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources* | | |
| Low | Site-specific and wider natural and/or social functions and processes are negligibly altered | 1 |
| Medium | Site-specific and wider natural and/or social functions and processes continue albeit in a modified way | 2 |
| High | Site-specific and wider natural and/or social functions or processes are severely altered | 3 |
| **C**. ***Duration*** *– the timeframe over which the impact will be experienced and its reversibility* | | |
| Short-term | Up to 2 years (i.e. reversible impact) | 1 |
| Medium-term | 2 to 15 years (i.e. reversible impact) | 2 |
| Long-term | More than 15 years (state whether impact is irreversible) | 3 |

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

| **Combined Score (A+B+C)** | 3 – 4 | 5 | 6 | 7 | 8 – 9 |
|---|---|---|---|---|---|
| **Consequence Rating** | Very low | Low | Medium | High | Very high |

[19] This does not apply to minor impacts which can be logically grouped into a single assessment.

[20] Please note that specialists are welcome to discuss the rating definitions as they apply to their study with the EIA team.

**Example 1:**

| Extent | Intensity | Duration | **Consequence** |
|---|---|---|---|
| Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 |

**Step 2 –** Assess the **probability** of the impact occurring according to the following definitions:

| **Probability**– the likelihood of the impact occurring | |
|---|---|
| Improbable | < 40% chance of occurring |
| Possible | 40% - 70% chance of occurring |
| Probable | > 70% - 90% chance of occurring |
| Definite | > 90% chance of occurring |

**Example 2:**

| Extent | Intensity | Duration | **Consequence** | **Probability** |
|---|---|---|---|---|
| Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 | Probable |

**Step 3 –** Determine the overall **significance** of the impact as a combination of the **consequence** and **probability** ratings, as set out below:

| | | **Probability** | | | |
|---|---|---|---|---|---|
| | | Improbable | Possible | Probable | Definite |
| **Consequence** | Very Low | **INSIGNIFICANT** | **INSIGNIFICANT** | **VERY LOW** | **VERY LOW** |
| | Low | **VERY LOW** | **VERY LOW** | **LOW** | **LOW** |
| | Medium | **LOW** | **LOW** | **MEDIUM** | **MEDIUM** |
| | High | **MEDIUM** | **MEDIUM** | **HIGH** | **HIGH** |
| | Very High | **HIGH** | **HIGH** | **VERY HIGH** | **VERY HIGH** |

**Example 3:**

| *Extent* | *Intensity* | *Duration* | ***Consequence*** | ***Probability*** | ***Significance*** |
|---|---|---|---|---|---|
| Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 | Probable | **HIGH** |

**Step 4 –** Note the **status** of the impact (i.e. will the effect of the impact be negative or positive?)

**Example 4:**

| *Extent* | *Intensity* | *Duration* | ***Consequence*** | ***Probability*** | ***Significance*** | ***Status*** |
|---|---|---|---|---|---|---|
| Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 | Probable | **HIGH** | **– ve** |

**Step 5 –** State level of **confidence** in the assessment of the impact (high, medium or low).

Depending on the data available, you may feel more confident in the assessment of some impact than others. For example, if you are basing your assessment on extrapolated data, you may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

**Example 5:**

| *Extent* | *Intensity* | *Duration* | ***Consequence*** | ***Probability*** | ***Significance*** | ***Status*** | ***Confidence*** |
|---|---|---|---|---|---|---|---|
| Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 | Probable | **HIGH** | **– ve** | High |

**Step 6 –** Identify and describe practical **mitigation** and **optimisation** measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

- **Essential**: best practice measures which must be implemented and are non-negotiable; and.
- **Best Practice**: recommended to comply with best practice, with adoption dependent on the proponent's risk profile and commitment to adhere to best practice, and which must be shown to have been considered and sound reasons provided by the proponent if not implemented.

*Essential* mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures. *Best practice* measures must also be inserted into the impact assessment table, but not considered in the "with mitigation" impact significance rating.

**Example 6: A completed impact assessment table**

| | ***Extent*** | ***Intensity*** | ***Duration*** | ***Conseq.*** | ***Prob.*** | ***Signif*** | ***Status*** | ***Confid*** |
|---|---|---|---|---|---|---|---|---|
| Without mitigation | Regional<br>2 | Medium<br>2 | Long-term<br>3 | **High**<br>7 | Probable | **HIGH** | **– ve** | High |
| **Essential mitigation measures:**<br>• Xxx1<br>• Xxx2<br>• Xxx3<br>**Best practice mitigation measures:**<br>• Yyy1<br>• Yyy2 | | | | | | | | |
| With mitigation | Local<br>1 | Low<br>1 | Long-term<br>3 | **Low**<br>**5** | Improbable | **VERY LOW** | **– ve** | High |

**Step 7 –** Summarise all impact significance ratings as follows in executive summary:

| Impact | ***Consequence*** | ***Probability*** | ***Significance*** | ***Status*** | ***Confidence*** |
|---|---|---|---|---|---|
| Impact 1: XXXX | Medium | Improbable | **LOW** | –ve | High |
| With Mitigation | Low | Improbable | **VERY LOW** | | High |
| Impact 2: XXXX | Very Low | Definite | **VERY LOW** | –ve | Medium |
| With Mitigation: | *Not applicable* | | | | |