

WETLAND ASSESSMENT

Tigane, 4 km north of Hartbeesfontein, North West Province



Broken groundwall of small in-channel dam at the northern boundary of the site.
Photo: R.F. Terblanche

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COMPILED BY:

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(M.Sc, *Cum Laude*; Pr.Sci.Nat, Reg. No. 400244/05)

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I) SPECIALIST EXPERTISE

SYNOPTIC CV: REINIER. F. TERBLANCHE

Reinier is an ecologist and in particular a habitat specialist with an exceptional combination of botanical and zoological expertise which he keeps fostering, updating and improving. He is busy with a PhD for which he registered at the Department of Conservation Ecology at the University of Stellenbosch in July 2013. The PhD research focuses on the landscape ecology of selected terrestrial and wetland butterflies in South Africa. Reinier's experience includes being a lecturer in ecology and zoology at the North West University, Potchefstroom Campus (1998-2008). Reinier collaborates with a number of institutes, organizations and universities on animal, plant and habitat research.

Qualifications:

Qualification	Main subject matter	University
M.Sc Cum Laude, 1998: Botany: Ecology	Quantitative study of invertebrate assemblages and plant assemblages of rangelands in grasslands.	North-West University, Potchefstroom
B.Sc Honns Cum Laude, 1992 Botany: Taxonomy	Distinctions in all subjects: Plant Anatomy 75, Taxonomy 84, Modern Systematics 82, System Modelling 75, Plant Ecology 75, Taxonomy Project 77, Statistics Attendance Course.	North-West University, Potchefstroom
B.Sc Botany, Zoology	Main subjects: Botany, Zoology.	North-West University, Potchefstroom
Higher Education Diploma, 1990	Numerous subjects aimed at holistic training of teachers.	North-West University, Potchefstroom

In research Reinier specializes in conservation biology, threatened butterfly species, vegetation dynamics and ant assemblages at terrestrial and wetland butterfly habitats as well as enhancing quantitative studies on butterflies of Africa. He has published extensively in the fields of taxonomy, biogeography and ecology in popular journals, peer-reviewed scientific journals and as co-author and co-editor of books (see 10 examples beneath).

Reinier practices as an ecological consultant and has been registered as a Professional Natural Scientist by SACNASP since 2005: Reg. No. 400244/05. His experience in consultation includes: Flora and fauna habitat surveys, Threatened species assessments, Riparian vegetation index surveys, Compilation of Ecological Management Plans, Biodiversity Action Plans and Status quo of biodiversity for Environmental Management Frameworks, Wetland Assessments, Management of Rare Wetland Species.

Recent activities/ awards: Best Poster Award at Oppenheimer De Beers Group Research Conference 2015, Johannesburg. One of the co-authors of Guidelines for Standardised Global Butterfly Monitoring, 2015, Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany (UNEP-WCMC), GEO BON Technical Series 1. Most recent award: Awarded the prestigious Torben Larsen Memorial Tankard in October 2017; one is awarded annually to the person responsible for the most outstanding written account on Afrotropical Lepidoptera. Lectured as Conservationist-in-Residence in the Wildlife Conservation Programme of the African Leadership University, Kigali, Rwanda, 9-23 February 2019.

EXPERIENCE

Lecturer: Zoology 1998-2008	Main subject matter and level	Organization
Lectured subjects	- 3 rd year level Ecology, Plantparasitology - 2 nd year level Ethology - <i>Master's degree</i> Evolutionary Ethology, Systematics in Practice, Morphology and Taxonomy of Insect Pests, Wetlands.	North-West University, Potchefstroom and University of South Africa
Co-promoter	PhD: Edge, D.A. 2005. Ecological factors that influence the survival of the Brenton Blue butterfly	North-West University, Potchefstroom
Study leader/ assistant study leader	Six MSc students, One BSc Honn student: Various quantitative biodiversity studies (terrestrial and aquatic).	North-West University, Potchefstroom
Teacher 1994-1998	Biology and Science, Secondary School	Afrikaans Hoër Seunskool, Pretoria
Owned Anthene Ecological CC 2008 – present	- Flora and Fauna habitat surveys - Highly specialized ecological surveys - Riparian vegetation index surveys - Ecological Management Plans - Biodiversity Action Plans - Biodiversity section of Environmental Management Frameworks - Wetland assessments	Private Closed Corporation that has been subcontracted by many companies
Herbarium assistant 1988-1991	- Part-time assistant at the A.P. Goossens herbarium, Botany Department, North-West University, 1988, 1989, 1990 and 1991 (as a student).	North-West University, Potchefstroom

10 EXAMPLES OF PUBLICATIONS OF WHICH R.F. TERBLANCHE IS AUTHOR/ CO-AUTHOR

(Three books, two chapters in books and five articles are listed here as examples)

- HENNING, G.A., **TERBLANCHE, R.F.** & BALL, J.B. (eds) **2009**. *South African Red Data Book: butterflies*. SANBI Biodiversity Series 13. South African National Biodiversity Institute, Pretoria. 158p. ISBN 978-1-919976-51-8
- MECENERO, S., BALL, J.B., EDGE, D.A., HAMER, M.L., HENNING, G.A., KRÜGER, M., PRINGLE, E.L., **TERBLANCHE, R.F.** & WILLIAMS, M.C. (eds). 2013. *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and atlas*. Saffronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
- VAN SWAAY, C., REGAN, E., LING, M., BOZHINOVSKA, E., FERNANDEZ, M., MARINI-FILHO, O.J., HUERTAS, B., PHON, C.-K., KÖRÖSI, A., MEERMAN, J., PE'ER, G., UEHARA-PRADO, M., SÁFIÁN, S., SAM, L., SHUEY, J., TARON, D., **TERBLANCHE, R.F.** & UNDERHILL, L. 2015. Guidelines for Standardised Global Butterfly Monitoring. Group on Earth Observations Biodiversity Observation Network, Leipzig, Germany. GEO BON Technical Series 1.
- TERBLANCHE, R.F.** & HENNING, G.A. **2009**. *A framework for conservation management of South African butterflies in practice*. In: Henning, G.A., Terblanche, R.F. & Ball, J.B. (eds). *South African Red Data Book: Butterflies*. SANBI Biodiversity Series 13. South African National Biodiversity Institute, Pretoria. p. 68 – 71.
- EDGE, D.A., **TERBLANCHE, R.F.**, HENNING, G.A., MECENERO, S. & NAVARRO, R.A. 2013. Butterfly conservation in southern Africa: Analysis of the Red List and threats. In: Mecenero, S., Ball, J.B., Edge, D.A., Hamer, M.L., Henning, G.A., Krüger, M., Pringle, E.L., Terblanche, R.F. & Williams, M.C. (eds). *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas*. pp. 13-33. Saffronics (Pty) Ltd., Johannesburg & Animal Demography Unit, Cape Town.
- TERBLANCHE, R.F.**, SMITH, G.F. & THEUNISSEN, J.D. **1993**. Did Scott typify names in *Haworthia* (Asphodelaceae: Alooideae)? *Taxon* **42**(1): 91–95. (International Journal of Plant Taxonomy).
- TERBLANCHE, R.F.**, MORGENTHAL, T.L. & CILLIERS, S.S. **2003**. The vegetation of three localities of the threatened butterfly species *Chrysonotis aureus* (Lepidoptera: Lycaenidae). *Koedoe* **46**(1): 73-90.
- EDGE, D.A., CILLIERS, S.S. & **TERBLANCHE, R.F.** **2008**. Vegetation associated with the occurrence of the Brenton blue butterfly. *South African Journal of Science* **104**: 505 - 510.
- GARDINER, A.J. & **TERBLANCHE, R.F.** **2010**. Taxonomy, biology, biogeography, evolution and conservation of the genus *Erikssonia* Trimen (Lepidoptera: Lycaenidae) *African Entomology* **18**(1): 171-191.
- TERBLANCHE, R.F.** 2016. *Acraea trimeni* Aurivillius, [1899], *Acraea stenobea* Wallengren, 1860 and *Acraea neobule* Doubleday, [1847] on host-plant *Adenia repanda* (Burch.) Engl. at Tswalu Kalahari Reserve, South Africa. *Metamorphosis* **27**: 92-102.

* A detailed CV with more complete publication list is available.

II) SPECIALIST DECLARATION

I, Reinier F. Terblanche, as the appointed independent specialist, in terms of the 2014 EIA Regulations (as amended), hereby declare that I:

- I act as the independent specialist in this application;
- I perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 (as amended) and any specific environmental management Act;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I have no vested interest in the proposed activity proceeding;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Reinier F. Terblanche



Signature of the specialist

Date: 29 November 2019

1 INTRODUCTION

A wetland assessment is required for a site at Tigane, 4 km north of Hartbeesfontein, North West Province, South Africa (elsewhere referred to as the site). If wetlands would be present at the site the assessment further focuses on the hydro-geomorphic setting, an estimate of the properties of the wetlands, an assessment of the functional aspects of wetlands and an impact assessment to wetlands, should the development be approved. If riparian zones would be present an indication of the active channel and riparian zone is given.

1.1 Wetlands in South Africa

Wetlands are defined by the National Water Act (Act 36 of 1998) as:

“land which is transitional between terrestrial and aquatic ecosystems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

According to *A practical field procedure for identification and delineation of wetlands and riparian areas* (DWAF 2005) wetlands must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation
- The presence, at least occasionally, of water loving plants (hydrophytes)
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil

Wetlands, according to the definition of DWAF (2005) are at the interface of aquatic systems and the terrestrial environment. As such the characteristics of the surface water or near surface water in space and time at this interface between the terrestrial and aquatic environment are fundamental to understand the functioning of a particular wetland. At the higher elevations of South Africa surface water at wetlands are characterised by considerable contrasts between seasons and periodic precipitation events. Generally accepted definitions of wetlands which focus on the wetland attributes of soil and vegetation are therefore useful because of its consistency despite seasonal fluctuations.

The Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013) includes wetland ecosystems defined by the National Water Act (Act 36 of 1998) as well as those “wetland systems” defined by the Ramsar Convention. The broader definition of wetlands, according to the Ramsar Convention is that wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water to the depth of which at low

tide does not exceed six metres (cited by Ramsar Convention Secretariat 2011). This Ramsar definition of “wetlands” overlaps broadly with the definition of aquatic systems according to the South African system of classifying wetlands and other aquatic ecosystems. In South Africa an aquatic ecosystem is an ecosystem that is permanently or periodically inundated by flowing or standing water, or which has soils that are permanently or periodically saturated within 0.5 m of the soil surface (Ollis *et al.*, 2013). Therefore an important consideration of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013) is that a wetland (narrow definition according to water act and not Ramsar definition) is taken to be a unique type of aquatic system.

1.2 Importance of wetlands

The importance of wetlands for human well-being and the conservation of biodiversity are recognised world-wide. Ecosystem services which directly or indirectly benefit human well-being are of particular importance when wetlands are considered. Wetlands play a major role to enhance supporting services such as nutrient cycling and primary production, which in turn is the basis for other ecosystem services. Wetlands are very important to regulating services such as maintaining water flow and water quality by processing water and regulating water run-off, provisioning services such as providing freshwater, cultural services such as appreciating the landscape and biodiversity. Overall wetlands play a major role in the sustainability of land use from socio-economic and biodiversity conservation perspectives. The setting and function of wetlands at each site should therefore be evaluated to inform land use management.

Wetland vegetation is of significant importance for wetlands to play a role in valuable ecosystem services. Vegetation plays an important role in natural wetland ecosystems. It holds soil together and slows down the flow of water, reducing the risk of erosion and promoting sediment deposition. Plants are the source of organic material in wetland soils, and form the organic soil in peat wetlands. Vegetation also has an impact on the quality of surface and subsurface water as it (1) provides organic soil matter required by microbes in order to assimilate nutrients and toxicants (2) provides habitat for the microbes in the soil immediately surrounding the roots, and (3) contributes through direct uptake of nutrients and toxicants and incorporation of these into plant tissues (Sieben *et al.* 2009).

1.3 Aims and objectives of the survey

A survey to investigate key elements of habitats on the site, relevant to the conservation of wetlands is conducted. The importance and significance of the site with special emphasis on the current status of biodiversity and

ecological services of the wetland are evaluated. Literature investigations are integrated with field observations to identify potential ecological impacts that could occur as a result of the development and to make recommendations to reduce or minimise impacts, should the development be approved.

The objectives of the wetland habitat assessment are to provide:

- An indication of the existence of wetlands at the site and if so:
- An identification of major aspects of the hydro-geomorphic setting and terrain unit at which the wetland occur;
- An estimate of the size and roughness of the wetland
- An indication of the hydric soils at the site;
- An indication of erodability;
- An indication of the presence or absence of peat at the site;
- An outline of hydrological drivers that support the existence and character of the wetland;
- An assessment of the possible presence or absence of threatened or localised plant species, vertebrates and invertebrates of the region, at the site;
- A description of the functions provided by the wetland at the site;
- An interpretation of the priority of the wetland for local communities in the area;
- An interpretation of the priority of the wetland to biodiversity at the site;

2 STUDY AREA

The study area is at Tigane, 4 km north of Hartbeesfontein, North West Province, South Africa. Site is situated at the Grassland Biome which is represented by the Vaal-Vet Sandy Grassland vegetation type (Mucina & Rutherford, 2006). A brief overview of the vegetation type, which serves as an outline of the ecological context of the site, follows.

Gh 10 Vaal-Vet Sandy Grassland

Distribution: In South Africa the Vaal-Vet Sandy Grassland is present in the North-West Province and Free State Province. Vaal-Vet Sandy Grassland ranges from south of Lichtenburg and Ventersdorp to Klerksdorp, Leeudoringstad, Bothaville and to the Brandfort areas north of Bloemfontein. Altitude ranges from 1 220 – 1560 m for the entire vegetation type (Mucina & Rutherford 2006).

Vegetation and landscape features: Plains-dominated landscape with some scattered, slightly undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element are present. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *Themeda triandra* and the associated increase in *Elionurus muticus*, *Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall. Geology and soils: Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karoo Supergroup (mostly the Ecca group) as well as older Ventersdorp Supergroup and basement gneiss in the north (Mucina & Rutherford 2006).

Climate: Warm-temperate, summer-rainfall climate, with overall mean annual precipitation of 530 mm. High summer temperatures. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford 2006).

Important taxa of the Vaal-Vet Sandy Grassland listed by Mucina & Rutherford (2006): Graminoids: *Antheophora pubescens*, *Aristida congesta*, *Chloris virgata*, *Cymbopogon caesius*, *Cynodon dactylon*, *Digitaria argyrograpta*, *Elionurus muticus*, *Eragrostis chloromelas*, *Eragrostis lehmanniana*, *Eragrostis plana*, *Eragrostis trichophora*, *Heteropogon contortus*, *Panicum gilvum*, *Setaria sphacelata*, *Themeda triandra*, *Tragus berteronianus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Digitaria eriantha*, *Eragrostis curvula*, *Eragrostis obtusa*, *Eragrostis superba*, *Panicum coloratum*, *Pogonarthria squarrosa*, *Trichoneura grandiglumis*, *Triraphis andropogonoides*. Herbs: *Stachys spathulata*, *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespitium*, *Hermannia depressa*, *Hibiscus pusillus*, *Monsonia burkeana*, *Rhynchosia adenodes*, *Selago densiflora*, *Vernonia oligocephala*. Geophytic Herbs: *Bulbine narcissifolia*, *Ledebouria marginata*. Succulent Herb: *Tripteris aghillana* var. *integrifolia*. Low shrubs: *Felicia*

muricata, *Pentzia globosa*, *Anthospermum rigidum* subsp. *pumilum*, *Helichrysum dregeanum*, *Helichrysum paronychioides*, *Ziziphus zeyheriana*.

Note: Not all of the above listed plant species for the vegetation types occur at the site in the study area.

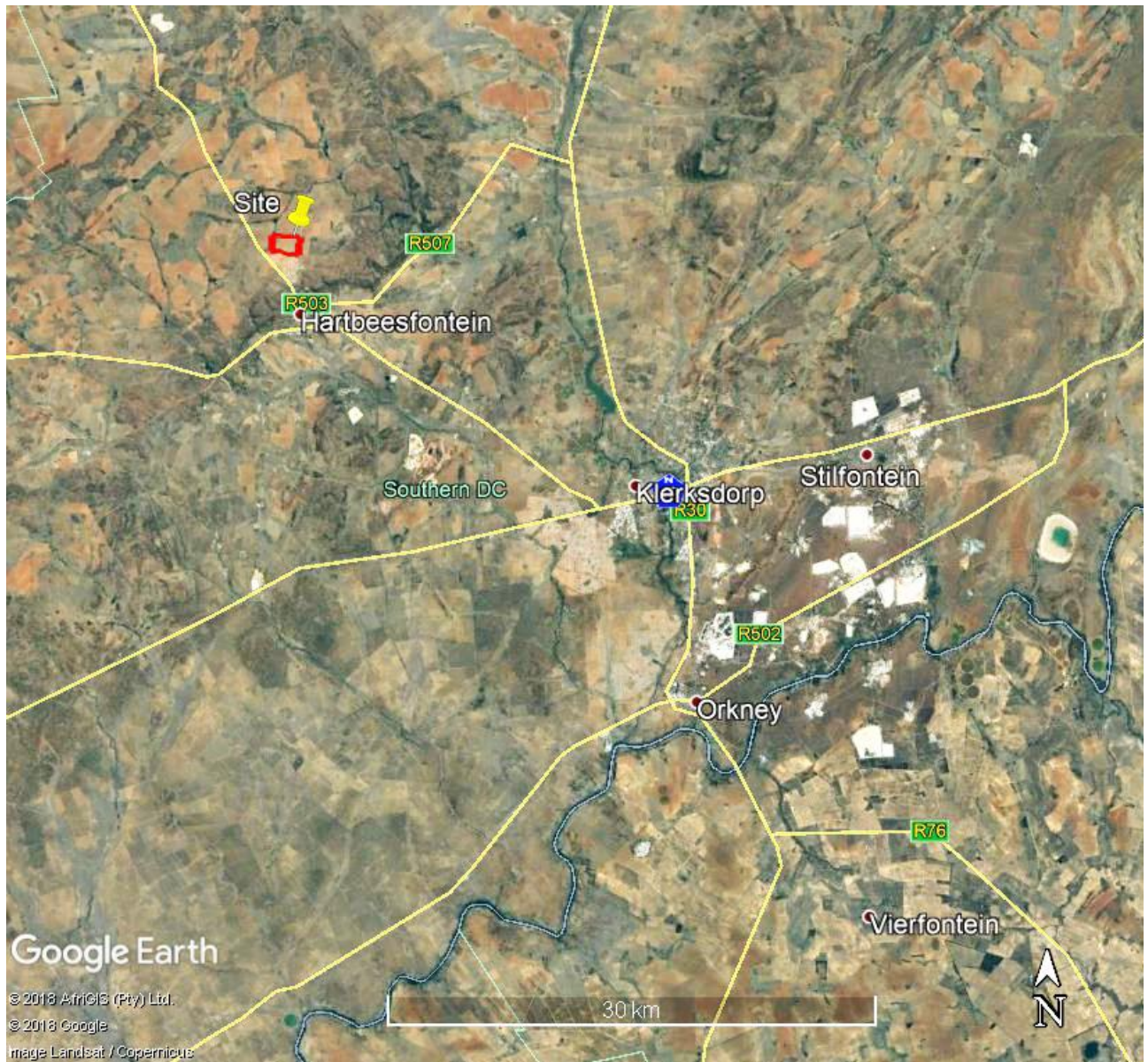


Figure 1 Map with an indication of the location of the site.

Map information were analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2019).

3 METHODS

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

A survey consisted of visits by R.F. Terblanche during August 2019 to note key elements of habitats on the site, relevant to the conservation of wetlands and riparian zones.

Classification of any inland wetland systems that could be present at the site is according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis *et al.*, 2013). One of the major advantages of the Classification System for South Africa (Ollis *et al.*, 2013) is that the functional aspects of wetlands are the focal point of the classification. Wetlands are very dynamic systems and their functionality weighs high against the rapid changes in their appearance, as could be seen from wetland butterfly studies (Terblanche *In prep*). In this document the main guideline for the delineation and identification of wetlands where present is the practical field procedure for identification and delineation of wetlands by DWAF (2005).

The following sections highlight the materials and methods applicable to different aspects that were observed.

3.1 Classification of wetlands (SANBI: Ollis *et al.*, 2013)

3.1.1 System, regional setting and landscape unit (Levels 1, 2 and 3)

Three broad types of Inlands Systems are dealt with in the Classification System namely rivers, open waterbodies and wetlands. These Inland Systems are then classified according to a six-tiered structure that includes six levels.

At the systems level (Level 1) of wetland classification, a distinction is made between Marine, Estuarine and Inland ecosystems using the level of connectivity to the open ocean as discriminator of the biophysical character of each (Ollis *et al.*, 2013). Inland wetland systems are aquatic ecosystems with no no existing connection to the ocean (i.e. characterised by the complete absence of marine exchange and/ or tidal influence (Ollis *et al.*, 2013). In this case if any wetland is present it obviously qualifies as an Inland wetland system.

At Level 2 the regional setting is a spatial framework that is preferred by the investigator to allow for gaining an understanding of the broad ecological context within which an aquatic system occurs (Ollis *et al.*, 2013). A regional setting can be identified according to the DWA ecoregion classification of Kleynhans *et al.* (2005).

A distinction is made between four landscape units at Level 3 of the Classification System for Inland Systems on the basis of the landscape setting (i.e. topographical position) (Ollis *et al.*, 2013). Four landscape units are recognized: slope, valley floor, plain and bench.

3.1.2 *Hydrogeomorphic units (Level 4)*

Seven primary hydrogeomorphic (HGM) units are recognised for Inland Systems at Level 4A of the Classification System for Wetlands and other Aquatic Ecosystems in South Africa, on the basis of hydrology and geomorphology (Ollis *et al.*, 2013). These are a River, Channeled valley-bottom wetland, Unchannelled valley-bottom wetland, Floodplain wetland, Depression, Seep and Wetland flat.

3.1.3 *Hydrological regime (Level 5)*

While the hydrogeomorphic unit (HGM) is influenced by the source of water and how it moves into, through and out of an Inland System, the hydrological regime (as catergorised by the Classification System) describes the behaviour fo the water within the system and, for wetlands, in the underlying soil (Ollis *et al.*, 2013). Together with the hydrogeomorphology the hydrological regime are used to describe the wetland as a functional unit (Ollis *et al.*, 2013). In the case of Inland wetlands which are classified as rivers, perenniality is an important characteristic to describe the hydrological regime. For Inland Systems other than rivers, five categories relating to the frequency and duration of inundation have been provided: Permanently inundated, Seasonally inundated, Intermittently inundated, Never inundated/ rarely inundated and unknown (Ollis *et al.*, 2013). Period of saturation within the upper 0.5 m of the soil is a very important discriminator that also links to the wetland delineation system of DWAF (2005). The following categories for saturation of wetland soils are recognised: Permanently saturated, Seasonally saturated, Intermittently saturated and unknown. These categories of period of saturation correspond to the permanent, seasonal and temporary zones of wetlands respectively.

3.1.4 *Wetland descriptors (Level 6)*

At Level 6 several “descriptors” are included for the structural/ chemical/ biological characterisation of Inland Systems (Ollis *et al.*, 2013). These descriptors are non-hierarchical to one another and can be applied in any order depending on the purpose of a study and the availability of information. Descriptors include natural vs. artificial, salinity, substratum type, pH, geology and vegetation cover (Ollis *et al.*, 2013). Various definitions are given for the descriptors which are likely to increase the consistency and use of the system.

3.2 Delineation of wetland

Together with terrain unit, indirect indicators of prolonged saturation by water: wetland plants (hydrophytes) and wetland (hydromorphic) soils are identified and used to delineate the wetland (DWAF 2005). Three zones, which may not all three be present in all wetlands, namely the permanent zone of wetness, the seasonal zone and the temporary zone are identified. The temporary zone is the outer zone and is saturated for only a short period of the year that is sufficient, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation (DWAF 2005). Hydromorphic soils must display signs of wetness within 50cm of the soil to qualify as wetland soil that can support hydrophytic vegetation. Grid references and altitudes are taken on site with a GPS Garmin E-trex 20 ® instrument. Map information are analysed and depicted on Google images with the aid of Google Earth Pro (US Dept. of State Geographer, MapLink/ Tele Atlas, Google, 2012).

3.3 Vegetation at and near wetland

Though vegetation is a key component of the wetland definition in the Water Act, using vegetation as a primary indicator requires undisturbed conditions and expert knowledge (DWAF 2005). Modern wetland classification systems in South Africa therefore place more emphasis on the soil wetness indicators. It remains however, that plant assemblages undergo distinct changes in species composition from the centre of a wetland to the edge, and into adjacent terrestrial areas (DWAF 2005). This change in species composition of vegetation provides valuable clues for determining the wetland boundary and wetness zones (DWAF 2005).

Apart from botanical aspects which are integrated into the description of a wetland it is imperative to note the existence or not of threatened plant species or other plant species of conservation concern, such as near-threatened, data deficient or declining species at a wetland. Floristic composition is therefore also considered during the wetland assessment. Voucher specimens of plant species are only taken where the taxonomy is in doubt or where the plant specimens are of significant relevance for invertebrate conservation. Field guides such as those by Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (1997) were used to confirm the taxonomy of the species. Works on specific plant groups (often genera) such as those by Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Jaarsveld (2006) and Van Wyk & Smith (2003) were also consulted to confirm the identification of species. An important source of identifications of plant species for the wetland survey is Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011). In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. For the most recent treatise of scientific plant names and broad distributions, Germishuizen, Meyer & Steenkamp (2006) or Raimondo *et al.* (2009) or updated lists on SANBI websites are followed to compile the lists of species.

3.4 Fauna at and near wetland

Species composition of fauna is not used in wetland characterization and assessments. However, it is important to note species that favour wetlands and especially whether threatened animal species are present at a wetland or not.

Mammals are noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) are consulted. Sites are been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces are recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) are consulted for additional information and for the identification of spoor and signs. Trapping is only done if necessary. Habitat characteristics are also surveyed to note potential occurrences of mammals. Many mammals can be identified from field sightings but, with a few exceptions bats, rodents and shrews can only be reliably identified in the hand, and even then some species needs examination of skulls, or even chromosomes (Apps, 2000).

Birds are noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) are consulted. Ringing of birds falls beyond the scope of this survey. Sites are walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests are additionally been recorded. Habitat characteristics are surveyed to note potential occurrences of birds.

Reptiles are noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) are followed. Sites are walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often

collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

Invertebrates of which enough information is available to be integrated into an assessment, such as butterflies, are recorded as sight records, photographic records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such as the *Aloeides*, *Chrysoritis*, *Erikssonia*, *Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deuschländer & Bredenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies are therefore also recorded. Other invertebrate groups such as fruit chafer beetles and mygalomorph spiders are also investigated where relevant.

3.5 Present Ecological Status

Ecological status of wetlands are based on models such as the modified Habitat Integrity approach developed by Kleynhans (1996, 1999). Present ecological status PES methodology is then largely based on criteria for assessing the habitat integrity of floodplain wetlands and notes for allocating a score to attributes and rating the confidence level associated with each score (DWAF 1999). Such criteria are selected on the assumption that anthropogenic modification can generally be regarded as the primary causes of degradation of the ecological integrity of a wetland (see DWAF 1999). This is done by using Table W4-1 given by DWAF (1999):

- Score each attribute according to the guidelines provided in the footnote.
- Calculate a mean score for Table W4-1 using the individual scores for all attributes.
- Provide a confidence rating for each score according to the guidelines provided in the footnote to indicate the areas of uncertainty in the determination.

Table W4-2 provides guidelines for the determination of the Present Ecological Status Class (PESC), based on the mean score determined for Table W4-1. If any of the attributes scores < 2 (i.e., it is considered to be seriously or critically modified) this score and not the mean should be taken into consideration. This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the Present Ecological Status Category (PESC). In any case, the mean on which the assessment of the PESC is based should be regarded as a guideline and should also be tested against the opinion of local experts (DWAF 1999).

Biological integrity is not directly estimated through this approach though in some systems or parts of systems, information on biological integrity is available. In such cases, the information on biological integrity can be used as a

check of the PES Category determination. The mean is used to relate the ecological state of the wetland to a particular PES Category (Table W4-2) (DWAF 1999).

3.6 Ecological Importance and Sensitivity

The assessment of the ecological importance and sensitivity is according to DWAF (1999) which in turn is adapted from Kleynhans (1996) and Kelynhans (1999). "Ecological importance" of a water resource is an expression of its importance to the maintenance of ecological diversity and functioning on local and wider scales. "Ecological sensitivity" refers to the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The Ecological Importance and sensitivity (EIS) provides a guideline for determination of the Ecological Management Class (EMC) DWAF (1999).

In the method outlined here, a series of determinants for EIS according to Table W5-1 of DWAF (1999) are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The method is used as a guideline for the professional judgement of individuals familiar with an area and its wetlands. The assessors must substantiate and document their judgement as far as possible for future reference and revision (DWAF 1999).

3.7 Limitations

Wetlands or riparian zones are very dynamic systems and owing to time constraints a glimpse of conditions at wetlands are taken, even though the hydrogeomorphological setting, soil wetness characteristics and established vegetation constitute some long-term features of a wetland. For each site visited, it should then be emphasized that surveys can by no means result in an exhaustive list of wetland plants and animals present on the site, because of the time constraint. A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

The survey at the site was conducted during August 2019 to note key elements of habitats on the site, relevant to the conservation of wetlands and riparian areas. The focus of the survey remains a habitat survey that concentrates on the hydrogeomorphological, hydrological and additional descriptors to classify and assess wetlands where present and to assess for the likelihood of occurrence or not of any wetland fauna and flora of particular conservation concern.

4 RESULTS AND DISCUSSION

4.1 Assessment of presence of wetlands or rivers at the site

4.1.1 Absence of wetlands

Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site. In conclusion no wetlands are found at the site.

4.1.2 Presence of small non-perennial streambed and small damaged in-channel dam

A small non-perennial streambed, with its active channel and riparian zone, is present at the northwestern parts of the site. A small artificial waterbody which is an in-channel dam (with a broken groundwall) is present in this tributary at the northwestern parts of the site.

Wet areas at the active channel and small dam contains exotic plant species such as the grass *Paspalum dilatatum* and the herb *Oxalis corniculata*. Indigenous plant species such as *Stachys spathulata* and *Helichrysum aureonitens* occur near or at the outer parts of the watercourse at the site. *Persicaria* species (Knotweeds) occur at the permanent zone of the small artificial waterbody (small dam). Megagraminoids (large grasses such as reeds) are absent.

4.1.3 Formation of erosion donga at southern part of the site

The visible erosion which includes the formation of a small donga at the southern part of the site below formal and informal residential areas, is a concern. If the development is approved an opportunity exists to address this problem of erosion with a proper stormwater system.



Photo 1 Most of the site consists of terrestrial and ecologically visibly degraded terrain.
Photo: R.F. Terblanche.



Photo 2 Erosion at the site caused by stormwater and exposed soil.
Photo: R.F. Terblanche



Photo 3 Sediment deposition from eroded areas caused by stormwater from residential area.
Photo: R.F. Terblanche.



Photo 4 Rubble that gathered at eroded area at the site.
Photo: R.F. Terblanche



Photo 5 View towards artificial waterbody which comprises a small dam with a broken groundwall at the site.
Photo: R.F. Terblanche.



Photo 6 Broken groundwall of small in-channel dam at the site.
Photo: R.F. Terblanche



Photo 7 Soil that is seasonally inundated, at the site.
Photo: R.F. Terblanche.



Photo 8 Flower and foliage of alien invasive weed *Oxalis corniculata* (Creeping Sorrel) in between short grass at the riparian zone of inlet of small dam at the site. Though the widespread *Oxalis corniculata* is not exclusive to wetlands and riparian zones it often favours areas where more water is available.
Photo: R.F. Terblanche

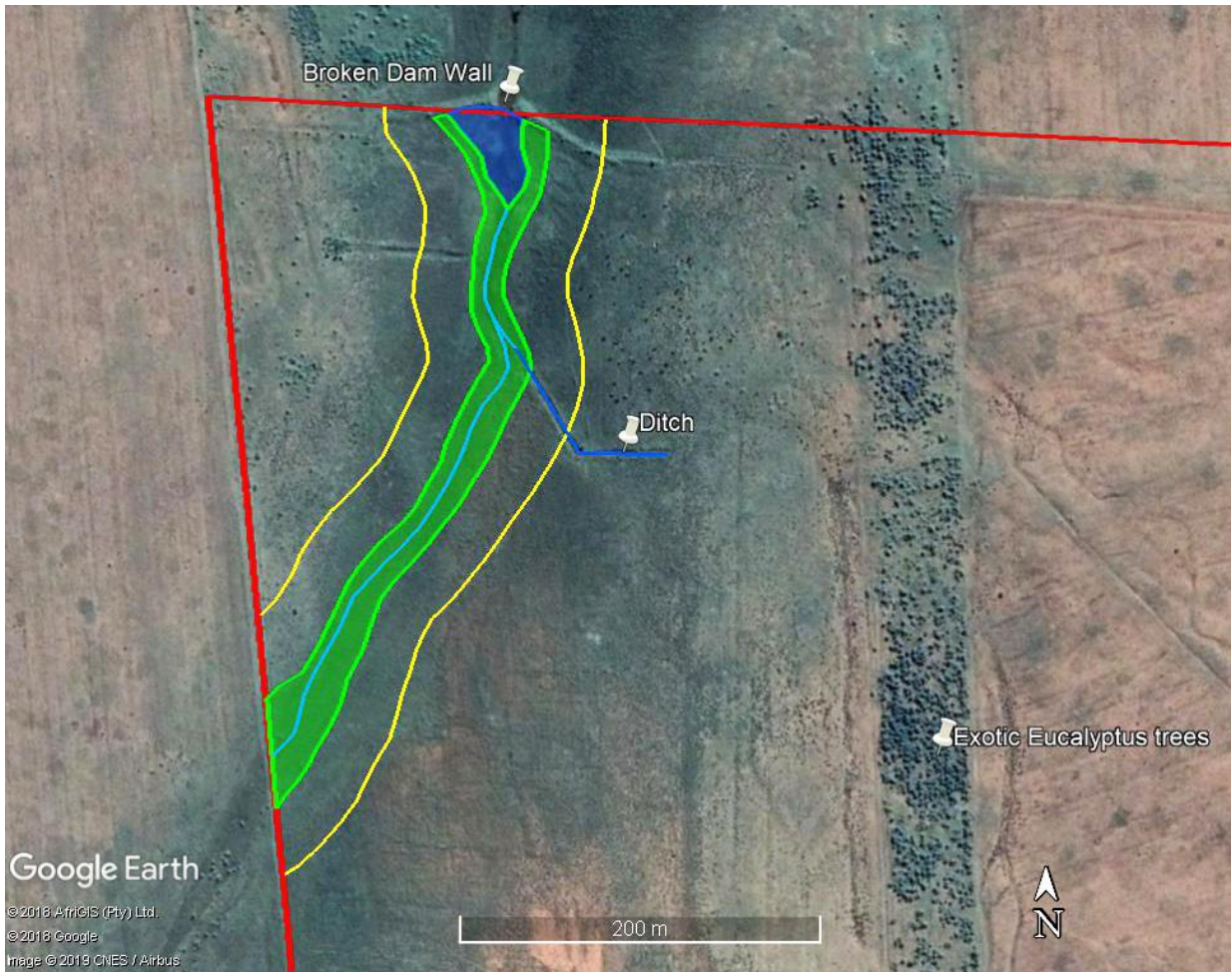






Figure 2 Indications of non-perennial river (active channel, riparian zone, buffer zone) and small artificial in-channel dam of which the groundwater is broken at the site.

- | | | |
|---|-------------------------------|--|
|  | Light blue outline | Route of active channel at the site |
|  | Dark blue outline and shading | Artificial waterbodies (with broken groundwater) |
|  | Green outline and shading | Riparian zone |
|  | Yellow outline | Outer edge of buffer zones |

5 RISKS, IMPACTS AND MITIGATION

No wetlands appear to be present at the footprint proposed for the development. A small non-perennial streambed, with its active channel and riparian zone, is present at the northwestern parts of the site. A small artificial waterbody which is an in-channel dam (with a broken groundwall) is present in this tributary at the northwestern parts of the site.

Wet areas at the active channel and small dam contains exotic plant species such as the grass *Paspalum dilatatum* and the herb *Oxalis corniculata*. Indigenous plant species such as *Stachys spathulata* occur near or at the outer parts of the watercourses at the site. *Persicaria* species (Knotweeds) occur at the permanent zone of the small artificial waterbody (small dam). Megagraminoids (large grasses such as reeds) are absent.

No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern appear to be present at the site.

There is little scope for most of the site to be part of a corridor of particular conservation importance. Non-perennial river at the northwestern part of the site is a corridor of particular conservation concern.

The following potential risks, impacts and mitigation measures apply to the proposed development:

5.1 Identification of potential impacts and risks

The potential impacts identified are:

Construction Phase

- Potential impact 1: Loss of habitat owing to the removal of vegetation at the proposed development.
- Potential impact 2: Loss of sensitive species (Threatened, Near-Threatened, Rare, Declining or Protected species) during the construction phase.
- Potential impact 3: Loss of connectivity and conservation corridor networks in the landscape.
- Potential impact 4: Contamination of soil during construction in particular by hydrocarbon spills.
- Potential impact 5: Killing of vertebrate fauna during the construction phase.

Operational Phase

- Potential impact 6: An increased infestation of exotic or alien invasive plant species owing to disturbance.

5.2 Potential impacts and risks during the construction phase

Classes of impacts for this study: Very High, High, Moderate, Low, Very Low

Aspect/Activity	Clearance of vegetation at part of the site for the development
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Clearing of vegetation at the proposed development. This will entail the partial destruction of habitat of low ecological sensitivity.
Status	Negative
Mitigation Required	Non-perennial active channel and riparian zone with 30 m bufferzone are excluded from the development. Small artificial waterbody and 30 m bufferzone are excluded from the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
RISK	Following the mitigation measures a low risk of impact is expected.

Aspect/Activity	Removal of sensitive species
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Sensitive species: Presence of Threatened or Near Threatened Plants, Mammals, Reptiles, Amphibians and Invertebrates at the site appear to be unlikely. No other plant or animal species of particular conservation concern are anticipated to be resident at the site.
Status	Neutral.
Mitigation Required	No specific mitigation measures for sensitive specie at the site apply at the site.
Impact Significance (Pre-Mitigation)	Low
Impact Significance (Post-Mitigation)	Low
RISK	A low risk of threat to any sensitive species at the site is anticipated.

Aspect/Activity	Fragmentation of corridors of particular conservation concern
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Non-perennial river at the northwestern part of the site is a corridor of particular conservation concern.
Status	Negative
Mitigation Required	Non-perennial active channel and riparian zone with 30 m bufferzone are excluded from the development. Small artificial waterbody and 30 m bufferzone are excluded from the development.
Impact Significance (Pre-Mitigation)	High
Impact Significance (Post-Mitigation)	Low
RISK	Following mitigation, a low impact risk is expected.

Aspect/Activity	Contamination of soil by leaving rubble/ waste or spilling petroleum fuels or any pollutants on soil which could infiltrate the soil
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Rubble or waste could lead to infiltration of unwanted pollutants into the soil. Spilling of petroleum fuels and unwanted chemicals onto the soils that infiltrate these soils could lead to pollution of soils.
Status	Negative
Mitigation Required	Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction. Measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.
Impact Significance (Pre-Mitigation)	Moderate

Impact Significance (Post-Mitigation)	Low
RISKS	A low risk is expected following mitigation.

Aspect/Activity	Possible disturbance, trapping, hunting and killing of vertebrates during construction phase
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	During the construction phase animal species could be disturbed, trapped, hunted or killed.
Status	Negative
Mitigation Required	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation a low risk is anticipated.

5.3 Potential impacts during the operational phase

Aspect/Activity	An increased infestation of exotic or alien invasive plant species owing to clearance or disturbance where the footprint took place.
Type of Impact (i.e. Impact Status)	Direct
Potential Impact	Infestation by alien invasive species could replace indigenous vegetation or potential areas where indigenous vegetation could recover. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) or alien invasive Australian <i>Acacia</i> species (Australian Wattles) that should not be allowed to establish. Once established these combatting these alien invasive plant species may become very expensive in the long term.
Status	Negative
Mitigation Required	Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as <i>Melia azedarach</i> (Syringa) and alien invasive Australian <i>Acacia</i> species (Australian wattles) that should not be allowed to establish.
Impact Significance (Pre-Mitigation)	Moderate
Impact Significance (Post-Mitigation)	Low
RISKS	Following mitigation, a low risk is anticipated.

5.4 Risk and impact assessment summary for the construction phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Clearing of vegetation	Habitat loss, loss of indigenous species	Negative	Part of site	Long-Term	Substantial	Very likely	Low	Low	Keep disturbance to less sensitive area. Avoid watercourse and buffer zone. Non-perennial active channel and riparian zone with 30 m bufferzone are excluded from the development. Small artificial waterbody and 30 m bufferzone are excluded from the development.	High	Moderate	High
Loss of sensitive species	Loss of sensitive species (Note no Threatened species or Near-threatened species)	Neutral	Site	Long-Term	Very low (No species anticipated)	Unlikely	Not applicable	Not applicable	No specific mitigation measures apply to sensitive species at the site.	Moderate	Low	High
Loss of corridors of particular conservation concern	Fragmentation of landscape and loss of connectivity	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Demarcate and avoid watercourse and buffer zone. Non-perennial active channel and riparian zone with 30 m bufferzone are excluded from the development. Small artificial waterbody and 30 m bufferzone are excluded from the development.	High	Low	High
Contamination of soil by spilling pollutants on soil which could infiltrate the soil	Soil contamination	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	Rubble and waste removal. Measures that avoid hydrocarbon (petroleum) spills to get into contact with the soil.	Moderate	Low	High

Disturbance or killing of vertebrates	Disturbance or killing of species	Negative	Site	Long-Term	Moderate	Unlikely	Moderate	Moderate	If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.	Moderate	Low	High
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5.5 Risk/ Impact assessment summary for the operational phase

Aspect/ Impact Pathway	Nature of Potential Impact/ Risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of Impact	Irreplaceability	Potential Mitigation Measures	Significance of Impact and Risk		Confidence Level
										Without Mitigation/ Management	With Mitigation/ Management (Residual Impact/ Risk)	
Increased infestation of exotic or alien invasive plant species	Loss of habitat quality	Negative	Site	Long-Term	Substantial	Likely	Moderate	Moderate	Monitoring and eradication of alien invasive plant species	Moderate	Low	High

5.6 Summary of risks and impacts

No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern appear to be present at the site.

There is little scope for most of the site to be part of a corridor of particular conservation importance, excluding the watercourse and bufferzone at the northwestern part of the site. The non-perennial river at the northwestern part of the site is a corridor of particular conservation concern.

The non-perennial river (with active channel, riparian zone and buffer zone) and the small artificial waterbody (with broken groundwater) are regarded as important conservation corridors in the larger area. Risks and possible impacts to the watercourses if the bufferzone is upheld, are not expected to be significant because excessive surface flow and erosion are not anticipated. There is no distinct indication that interflow plays an important role in the maintenance of the watercourse. The geomorphological setting and flow regime will not be impacted. Loss of any wetland animal or plant species are not expected.

Following the mitigations which will be upheld and planned footprint for development all the impact risks listed above are moderate, low or very low.

6 CONCLUSION

- Wetlands such as floodplain wetlands, channelled valley-bottom wetlands, unchannelled valley-bottom wetlands, depressions, seeps and wetland flats appear to be absent at the site. In conclusion no wetlands are found at the site.
- A small non-perennial streambed, with its active channel and riparian zone, is present at the northwestern parts of the site. A small artificial waterbody which is an in-channel dam (with a broken groundwall) is present in this tributary at the northwestern parts of the site.
- Wet areas at the active channel and small dam contains exotic plant species such as the grass *Paspalum dilatatum*, the alien invasive weed *Oxalis corniculata*. Indigenous plant species such as *Stachys spathulata* and *Helichrysum aureonitens* occur near or at the watercourses at the site. *Persicaria* species (Knotweeds) occur at the permanent zone of the small artificial waterbody (small dam). Terrestrial plant species appear to encroach at the watercourse. Megagraminoids (large grasses such as reeds) are absent.
- No Threatened or Near Threatened plant or animal species appear to be resident at the site. No other plant or animal species of particular conservation concern appear to be present at the site.
- Non-perennial river at the northwestern part of the site is a corridor of particular conservation concern.
- Site is part of the Upper Vaal Water Management Area (WMA 9). The site is not part of a Freshwater Ecosystem Priority Area (FEPA) or wetland cluster (Nel *et al.*, 2011a, 2011b).
- Continued monitoring and eradication of alien invasive plant species are imperative. It is in particular declared alien invasive species such as *Melia azedarach* (Syringa) and alien invasive Australian *Acacia* species (Australian wattles) that should not be allowed to establish.
- Extensive erosion is present at some parts of the site probably owing to stormwater from residential areas further up as well as exposure of soil owing to clearings and ecological disturbances. If the development is approved an opportunity presents itself to address these concerns.

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ANNEXURE 1

List of plant species recorded at the site.

Plant species marked with an asterisk (*) are exotic.

Sources: Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998), Van Wyk & Van Wyk (2013), Crouch, Klopper, Burrows & Burrows (2011), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Ginkel *et al.* (2011), Van Jaarsveld (2006), Van Wyk & Smith (2003).

TAXON	COMMON NAMES	FAMILY
ANGIOSPERMAE: MONOCOTYLEDONS		
<i>Aristida adscensionis</i>		POACEAE
<i>Aristida congesta</i> subsp. <i>congesta</i>	Tassel Three-awn	POACEAE
<i>Aristida stipitata</i>		POACEAE
<i>Asparagus laricinus</i>	Common Wild Asparagus	ASPARAGACEAE
<i>Bulbine narcissifolia</i>		ASPHODELACEAE
<i>Chloris virgata</i>		POACEAE
<i>Cyperus obtusiflorus</i>		CYPERACEAE
<i>Cymbopogon caesius</i>	Broad-leaved Turpentine Grass	POACEAE
<i>Cymbopogon pospischilii</i>	Narrow-leaved Turpentine Grass	POACEAE
<i>Cynodon dactylon</i>	Couch Grass	POACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Elionurus muticus</i>		POACEA
<i>Eragrostis lehmanniana</i>		POACEAE
<i>Eragrostis curvula</i>	Weeping Love Grass	POACEAE
<i>Eragrostis superba</i>	Saw-toothed Love Grass	POACEAE
<i>Heteropogon contortus</i>	Spear Grass	POACEAE
<i>Hyparrhenia hirta</i>	Common Thatching Grass	POACEAE
<i>Melinis repens</i>	Natal Red-top	POACEAE
* <i>Paspalum dilatatum</i>	Dallis Grass	POACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	POACEAE
<i>Setaria sphacelata</i> var. <i>torta</i>	Creeping Bristle Grass	POACEAE
<i>Sporobolus fimbriatus</i>	Dropseed Grass	POACEAE
<i>Themeda triandra</i>	Red Grass	POACEAE
<i>Urochloa mocambicensis</i>	Bushveld Signal Grass	POACEAE
ANGIOSPERMS:		

DICOTYLEDONS		
* <i>Acanthospermum australe</i>		
* <i>Alternanthera pungens</i>	Dubbeltjie	AMARANTHACEAE
* <i>Argemone ochroleuca</i>	White-flowered Mexican poppy	PAPAVARACEAE
<i>Barleria macrosstegia</i>		ACANTHACEAE
<i>Berkheya onopordifolia</i>		ASTERACEAE
* <i>Bidens bipinnata</i>	Spanish Black Jack	ASTERACEAE
* <i>Bidens pilosa</i>	Black Jack	ASTERACEAE
<i>Chamaecrista comosa</i>		FABACEAE
<i>Cleome maculata</i>		CAPPARACEAE
<i>Cleome monophylla</i>	Single-leaved Cleome	CAPPARACEAE
* <i>Chenopodium album</i>	White Goosefoot	CHENOPODIACEAE
<i>Convolvulus sagittatus</i>	Wild Bindweed	CONVOLVULACEAE
<i>Conyza podocephala</i>		ASTERACEAE
* <i>Datura ferox</i>	Thorn Apple	SOLANACEAE
* <i>Datura stramonium</i>		SOLANACEAE
* <i>Eucalyptus camaldulensis</i>	Red Gum	MYRTACEAE
<i>Felicia muricata</i>		ASTERACEAE
* <i>Flaveria bidentis</i>	Smelter's Bush	ASTERACEAE
<i>Gazania krebsiana</i> subsp. <i>krebsiana</i>		ASTERACEAE
* <i>Gleditsia triacanthos</i>	Honey Locust	FABACEAE
<i>Gomphocarpus fruticosus</i>	Cotton Milkbush	APOCYNACEAE
* <i>Gomphrena celosioides</i>	Bachelor's Button	AMARANTHACEAE
<i>Ipomoea crassipes</i>		CONVOLVULACEAE
<i>Helichrysum argyrosphaerum</i>	Wild Everlasting	ASTERACEAE
<i>Helichrysum aureonitens</i>		ASTERACEAE
<i>Helichrysum caespititium</i>		ASTERACEAE
<i>Helichrysum nudifolium</i>	Hottentot's tea	ASTERACEAE
<i>Hibiscus pusillus</i>		MALVACEAE
<i>Hibiscus trionum</i>	Bladder Hibiscus	MALVACEAE
<i>Hilliardiella oligocephala</i>		ASTERACEAE
<i>Lepidium africanum</i>	Pepperweed	BRASSICACEAE
* <i>Lepidium bonariense</i>	Pepperweed	BRASSICACEAE
<i>Lippia scaberrima</i>		VERBENACEAE
* <i>Oxalis corniculata</i>	Creeping Sorrel	OXALIDACEAE
<i>Pentarrhinum inspidum</i>		APOCYNACEAE
<i>Pentzia globosa</i>		ASTERACEAE
<i>Persicaria</i> sp.	Knotweed	POLYGONACEAE
* <i>Physalis viscosa</i>	Sticky Gooseberry	SOLANACEAE
<i>Pollichia campestris</i>	Waxberry	ILLECEBRACEAE
* <i>Schkuhria pinnata</i>	Dwarf Marigold	ASTERACEAE
<i>Seriphium plumosum</i>		ASTERACEAE
* <i>Solanum elaeagnifolium</i>	Silverleaf Bitter Apple	SOLANACEAE

<i>Stachys spathulata</i>		LAMIACEAE
* <i>Tagetes minuta</i>	Khaki Weed	ASTERACEAE
<i>Thesium</i> sp.		SANTALACEAE
<i>Tribulus terrestris</i>	Devil's Thorn	ZYGOPHYLLACEAE
<i>Tripteris aghillana</i>		ASTERACEAE
<i>Vachellia karroo</i>	Sweet Thorn	FABACEAE
* <i>Verbena aristigera</i>	Fine-leaved Verbena	VERBENACEAE
* <i>Verbena bonariensis</i>	Purple Top	VERBENACEAE
<i>Vernonia staehelinoides</i>		ASTERACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	RHAMNACEAE
<i>Ziziphus zeyheriana</i>	Dwarf Buffalo-thorn	RHAMNACEAE