# Proposed construction of new overhead powerline infrastructure to the Reabetswe Substation, Rietkuil, Mpumalanga Province.

## Wetland/Riparian Delineation and Functional Assessment
## December 2017

Drafted by
Limosella Consulting Pty Ltd
Reg No: 2014/023293/07
Email: antoinette@limosella.co.za
Cell: +27 83 4545 454
www.limosella.co.za

Prepared for:
Envirolution Consulting
P.O. Box 1898, Sunninghill 2157.
223 Columbine Avenue, Mondeor, 2091
Tel: 0861 44 44 99
Fax: 0861 626 222
Email: info@envirolution.co.za
www.envirolution.co.za

**Declaration of Independence**

I, **Antoinette Bootsma**, in my capacity as a specialist consultant, hereby declare that I -

- Act as an independent consultant;
- Do not have any financial interest in the undertaking of the activity, other than remuneration for the work performed in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- Undertake to disclose, to the competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the National Environmental Management Act, 1998 (Act 107 of 1998);
- As a registered member of the South African Council for Natural Scientific Professions, will undertake my profession in accordance with the Code of Conduct of the Council, as well as any other societies to which I am a member; and
- Based on information provided to me by the project proponent, and in addition to information obtained during the course of this study, have presented the results and conclusion within the associated document to the best of my professional judgement.

**Antoinette Bootsma (PrSciNat)**
Ecologist/Botanist
SACNASP Reg. No. 400222-09

2017.12.07
Date

**Indemnity**
This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as information available at the time of study. Therefore the author reserves the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.
Although the author exercised due care and diligence in rendering services and preparing documents, she accepts no liability, and the client, by receiving this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the author and by the use of this document.

**Qualification of Specialists**

| | |
|---|---|
| Report writing and review | Antoinette Bootsma<br>Ecologist/Botanist/Wetland specialist<br>SACNASP Reg. No. 400222-09<br><br>Rudi Bezuidenhoudt<br>Wetland specialist / Ecologist<br>SACNASP Reg. No. 500024/13 |
| Field work and data analysis | Antoinette Bootsma<br>Ecologist/Botanist/Wetland specialist<br>SACNASP Reg. No. 400222-09<br><br>Rudi Bezuidenhoudt<br>Wetland specialist / Ecologist<br>SACNASP Reg. No. 500024/13 |

## EXECUTIVE SUMMARY

Limosella Consulting (Pty) Ltd was appointed by Envirolution Consulting to undertake a wetland delineation and functional assessment for the Environmental Authorization for the proposed construction of overhead powerlines to the Reabetswe Substation, near Rietkuil, Mpumalanga Province.

The proposed scope of work includes (Figure 1):

- Establish a Loop In Loop Out line between Speculate and Grootlaagte traction Stations
- Build 2x90m 132kV Chickadee lines from the Loop In Loop Out line to the proposed Rietkuil POS
- Establish a 132kV metering point at the proposed Rietkuil Traction (T) Station (switching station)

The terms of reference for the study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake functional and integrity assessment of wetlands areas within the area assessed as specified in General Notice 267 of 24 March 2017;
- Undertake an impact assessment as specified in the NEMA 2014 regulations,
- Recommend suitable buffer zones, both generic (as required in GDARD, 2014) and scientific as specified in General Notice 267 of 24 March 2017, following Macfarlane *et al* 2015 ; and
- Discuss appropriate mitigation and management procedures relevant to the conserving wetland areas on the site.

Fieldwork was conducted on the 29$^{th}$ of November 2017.

One wetland was recorded on the study site. The wetland is classified as an unchannelled valley bottom wetland. The wetland forms the headwaters of the Bosmanspruit River which drains into the Klein Plifants River to the north. From historical aerial imagery (Google earth timeline function and 1963 photos) it can be seen that no dams or ponding existed south of the railway however, in 2014 (Google earth timeline function) two large areas of standing water can be seen south of the study site as well as large wet areas. It is likely that the railway line and its associated berm has resulted in the interception of water that would naturally have fed into the wetland. The wetland is therefore probably much drier than it would have been. However, clear soil and vegetation indicators still remain on and around the area earmarked for the proposed overhead powerline.

The main impacts that were recorded during the site visits include farming and related impacts, anthropogenic activities such as urbanisation including infrastructure and exotic vegetation. A summary of the results of the wetland functional assessment are presented in the table below:

| Classification (SANBI, 2013) | PES (Macfarlane *et al*, 2007) | EIS (DWAF, 1999) | WetEcoServices (3 most prominent scores) | Generic Buffer (GDARD, 2014) | Scientific Buffer (Macfarlane et al 2015) |
|---|---|---|---|---|---|
| Unchannelled Valley Bottom | 6.1 E | 1.6 C | Phosphate trapping 2,3 Toxicant removal 2,4 Threats 3,0 | 30 m | 29 m (Construction)<br>15 m (Operational) |

The important findings discussed in this report are summarised below:

| | Quaternary Catchment and WMA areas | Important Rivers possibly affected | Buffers |
|---|---|---|---|
| | B12B, 2nd, Olifants WMA | The wetland forms part of the headwaters of the Bosmanspruit River which drains into the Klein-Olifants River | Scientific buffer (Macfarlane *et al*, 2014) is calculated as 15 m during operation and 29 m during construction. |
| **NEMA Impact assessment** | Activities have a medium or low impact score before implementation of mitigation measures and a low score after mitigation | | |
| **Does the specialist support the development?** | Yes. Although the powerline is located on a confirmed wetland, due to the extent of current impacts already associated with the wetland and the small ecological footprint likely to occur from the proposed powerline. | | |
| **Major concerns** | Colonisation of exotic vegetation<br>Compaction of soil<br>Downstream sedimentation | | |
| **Recommendations** | Effective mitigation measures should be implemented throughout the development. Rehabilitation of disturbed areas should follow the construction phase. Activities in the wetland during wet conditions should be avoide.d | | |
| **CBA and other Important areas** | The powerline traverse areas classified as CBA Optimal (Entire Site) | | |

## Table of Contents

## Figures



## Tables

# 1 INTRODUCTION

Limosella Consulting (Pty) Ltd was appointed by Envirolution Consulting to undertake a wetland delineation and functional assessment for the Environmnetal Authorization for the proposed construction of overhead powerlines to the Reabetswe Substation, near Rietkuil, Mpumalanga Province.

The proposed scope of work includes (Figure 1):

- Establish a Loop In Loop Out line between Speculate and Grootlaagte traction Stations
- Build 2x90m 132kV Chickadee lines from the Loop In Loop Out line to the proposed Rietkuil POS
- Establish a 132kV metering point at the proposed Rietkuil Traction (T) Station (switching station)

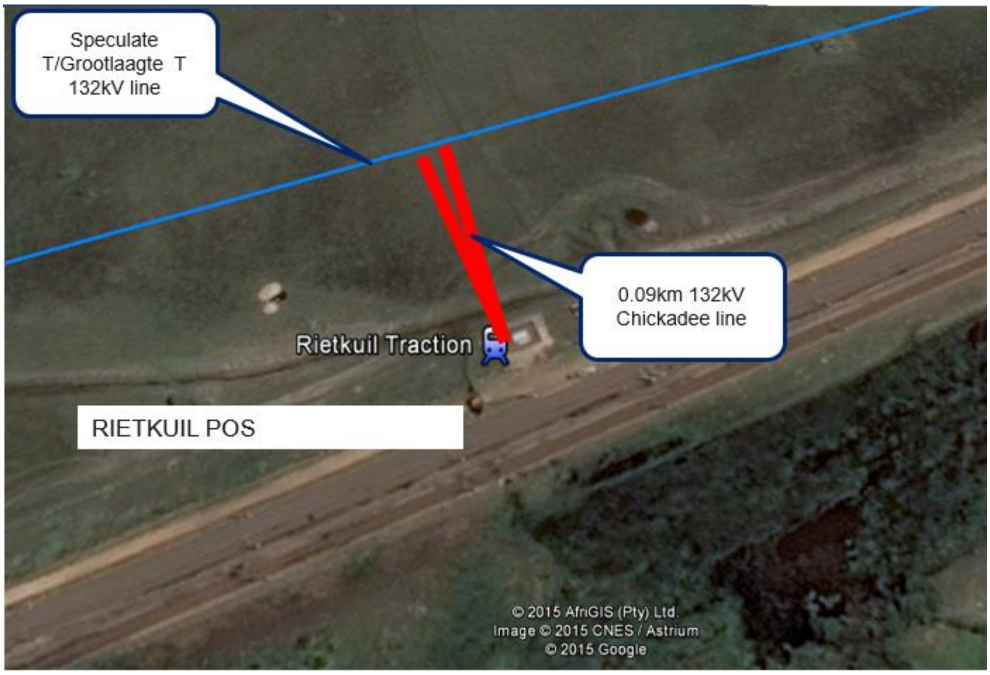



**Figure 1: A representation of the proposed activities for the Reabetswe project as provided by Eskom**

Fieldwork was conducted on the 29th of November 2017.

## 1.1 Terms of Reference

The terms of reference for the study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake an impact assessment as specified in the NEMA 2014 regulations,
- Recommend suitable buffer zones, both generic (as required in GDARD, 2014) and scientific as specified in General Notice 267 of 24 March 2017, following Macfarlane *et al* 2015 ; and
- Discuss appropriate mitigation and management procedures relevant to the conserving wetland areas on the site.

## 1.2 Assumptions and Limitations

- The information provided by the client forms the basis of the planning and layouts discussed.
- All wetlands within 500 m of any developmental activities should be identified as per the DWS Water Use Licence application regulations. In order to meet the timeframes and budget constraints for the project, wetlands within the study sites were delineated on a fine scale based on detailed soil and vegetation sampling. Wetlands that fall outside of the site, but that fall within 500 m of the proposed activities were delineated based on desktop analysis of vegetation gradients visible from aerial imagery.
- The detailed field study was conducted from a once off field trip and thus would not depict any seasonal variation in the wetland plant species composition and richness.
- Sections of the area surrounding the study site was fenced off and access was an issue here, extrapolation was used here.
- Description of the depth of the regional water table and geohydrological and hydropedological processes falls outside the scope of the current assessment
- Floodline calculations fall outside the scope of the current assessment
- A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study
- The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters.
- Wetland delineation plotted digitally may be offset by at least five meters to either side. Furthermore, it is important to note that, during the course of converting spatial data to final drawings, several steps in the process may affect the accuracy of areas delineated in the current report. It is therefore suggested that the no-go areas identified in the current report be pegged in the field in collaboration with the surveyor for precise boundaries. The scale at which maps and drawings are presented in the current report may become distorted should they be reproduced by for example photocopying and printing.

### 1.3 Definitions and Legal Framework

This section outlines the definitions, key legislative requirements and guiding principles of the wetland study and the Water Use Authorisation process.

The National Water Act, 1998 (Act No. 36 of 1998) [NWA] provides for Constitutional water demands including pollution prevention, ecological and resource conservation and sustainable utilisation. In terms of this Act, all water resources are the property of the State and are regulated by the Department of Water and Sanitation (DWS). The NWA sets out a range of water use related principles that are to be applied by DWS when taking decisions that significantly affect a water resource. The NWA defines a water resource as including a watercourse, surface water, estuary or aquifer. A watercourse includes a river or spring; a natural channel in which water flows regularly or intermittently; a wetland, lake, pan or dam, into which or from which water flows; any collection of water that the Minister may declare to be a watercourse; and were relevant its beds and banks.

The NWA defines a wetland as "land which is transitional between terrestrial and aquatic systems 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." In addition to water at or near the surface, other distinguishing indicators of wetlands include hydromorphic soils and vegetation adapted to or tolerant of saturated soils (DWA, 2005).

Riparian habitat often performs important ecological and hydrological functions, some similar to those performed by wetlands (DWA, 2005). Riparian habitat is also the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). It is defined by the NWA as follows: "Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse, which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas".

Water uses for which authorisation must be obtained from DWS are indicated in Section 21 of the NWA. Section 21 (c) and (i) is applicable to any activity related to a wetland:
Section 21(c): Impeding or diverting the flow of water in a watercourse; and
Section 21(i): Altering the bed, banks, course or characteristics of a watercourse.

Authorisations related to wetlands are regulated by Government Notice 509 of 2016 regarding Section 21(c) and (i). This notice grants General Authorisation (GA) for the above water uses on certain conditions. This regulation also stipulates that water uses must the registered with the responsible authority. Any activity that is not related to the rehabilitation of a wetland and which takes place within 500 m of a wetland are excluded from a GA under either of these regulations, unless the impacts score as low in the requires risk assessment matrix (DWS, 2016) Such an activity requires a Water Use Licence (WUL) from the relevant authority.

In addition to the above, the proponent must also comply with the provisions of the following relevant national legislation, conventions and regulations applicable to wetlands and riparian zones:

- Convention on Wetlands of International Importance - the Ramsar Convention and the South African Wetlands Conservation Programme (SAWCP).
- National Environmental Management Act, 1998 (Act No. 107 of 1998) [NEMA].
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- National Environment Management Protected Areas Act, 2003 (Act No. 57 of 2003).
- Regulations GN R.982, R.983, R. 984 and R.985 of 2014, promulgated under NEMA.
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983).
- Regulations and Guidelines on Water Use under the NWA.
- South African Water Quality Guidelines under the NWA.
- Mineral and Petroleum Resources Development Act, 2002 (Act No. 287 of 2002).
- DWS General Notice 267 of 24 March 2017.

## 1.4 Locality of the study site

The site is located approximately 4 km north of Arnot Power Station (Figure 2). The N4 lies approximately 9km to the north of the site. A Transnet railway forms the southern border of the site. The approximate central coordinates of the study site are 25°54'52.69"S and 29°47'3.37"E.

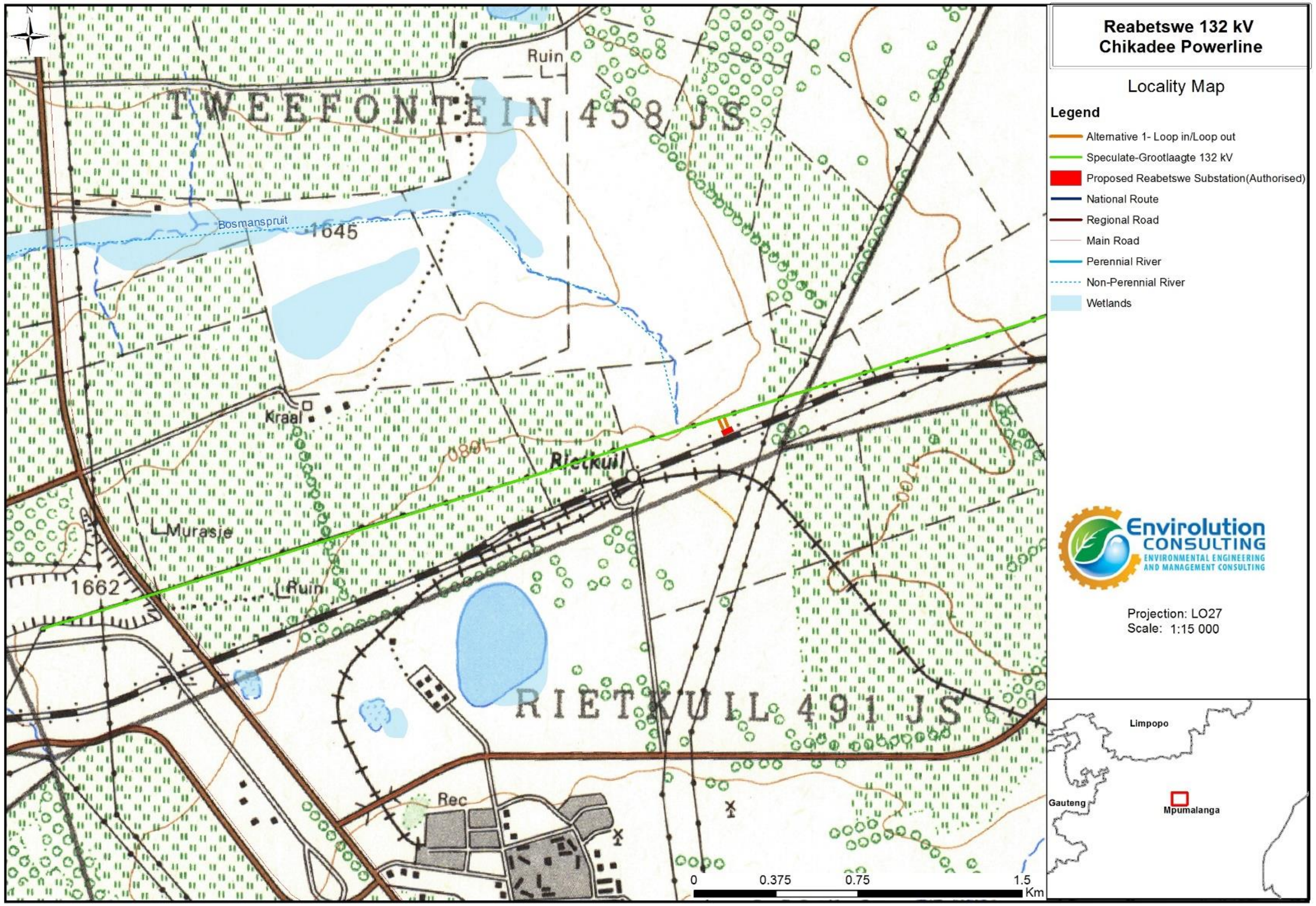



**Figure 2: Locality Map**

## 1.5 Description of the Receiving Environment

A review of available literature and spatial data formed the basis of a characterisation of the biophysical environment in its theoretically undisturbed state and consequently an analysis of the degree of impact to the ecology of the study site in its current state.

Quaternary Catchments and Water Management Area (WMA):

As per Macfarlane *et al*, (2009) one of the most important aspects of climate affecting a wetland's vulnerability to altered water inputs is the ratio of Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) (i.e. the average rainfall compared to the water lost due to the evapotranspiration that would potentially take place if sufficient water was available). The site is situated in the Quaternary Catchment B12B. In this catchment, the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.35. Consequently, wetlands in this area are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

Nine water management areas were established by, and their boundaries defined in Government Notice No. 40279 on 16 September 2016, as follows the Quaternary Catchment B12B falls within the second Water Management Area (WMA), the Olifants WMA. The major rivers that are located within this WMA include the Elands, Wilge, Steelpoort and Olifants and Letaba Rivers. The wetland on the study site forms the headwaters of the Bosmanspruit River, which drains into the Klein-Olifants River which in turn drains into the Olifants River.

Hydrology:

Surface water spatial layers such as the National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Types for South Africa (Ollis *et al*, 2013) were consulted for the presence of wetlands and rivers. This layer reflects a non-perennial river close to the study area (Figure 3).

Regional Vegetation:

The study site is located on a vegetation type known as Eastern Highveld Grassland. Eastern Highveld Grassland comprises short dense grassland and small, scattered rocky outcrops are characterised by wiry, sour grasses and some woody species. This vegetation unit is poorly conserved with much of its area transformed by cultivation, grazing, and mining. Where disturbances occurred, the invasive exotic tree *Acacia mearnsii* (Black Wattle) can become dominant and displace the natural vegetation. Due to the extensive usage of the areas once covered by Eastern Highveld Grassland vegetation types, the remaining portions are of high conservation value and sensitivity and are thus classified as endangered vegetation types (Mucina & Rutherford, 2006).

Geology and soils:

The geology of the study site is Arenite (ENPAT, date unknown) and by the Madzaringwe Formation, Karoo Supergroup. The soil type is Ba19 (AGIS. Date unknown) and the soil class is S17 (ENPAT, date unknown). S17 soils class is characterised by undifferentiated structureless soils with One or more of: low base status, restricted soil depth, excessive or imperfect drainage, high erodibility  The soil type Ba19 is characterised by a Plinthic catena: dystrophic and/or mesotrophic; red soils widespread, upland duplex and margalitic soils rare.

Mpumalanga Critical Biodiversity Areas

Critical Biodiversity Areas (CBA's) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2010). These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision making. CBA's are therefore areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses (Desmet *et al,* 2009).

In addition, the assessment also made provision for Ecological Support Areas (ESA's), which are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas (Desmet *et al,* 2009).

The biodiversity map (Figure 4) indicates where Critical Biodiversity Areas (CBA's) occur. CBA's are Terrestrial (T) and Aquatic (A) features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services (SANBI 2007). The CBA's are ranked as follows:

- CBA 1 (including PA's, T1 and A1) which are natural landscapes with no disturbances and which is irreplaceable in terms of reaching conservation targets within the district
- CBA2 (including T2 and A2) which are near natural landscapes with limited disturbances which has intermediate irreplaceability with regards to reaching conservation targets
- In addition, Ecological Support Areas (ESA's) that support key biodiversity resources (e.g. water) or ecological processes (e.g. movement corridors) in the landscape are also mapped. ESA's are functional landscapes that are moderately disturbed but maintain basic functionality and connect CBA's.

The study site is located on an area known as:

- CBA Optimal (Entire Site)

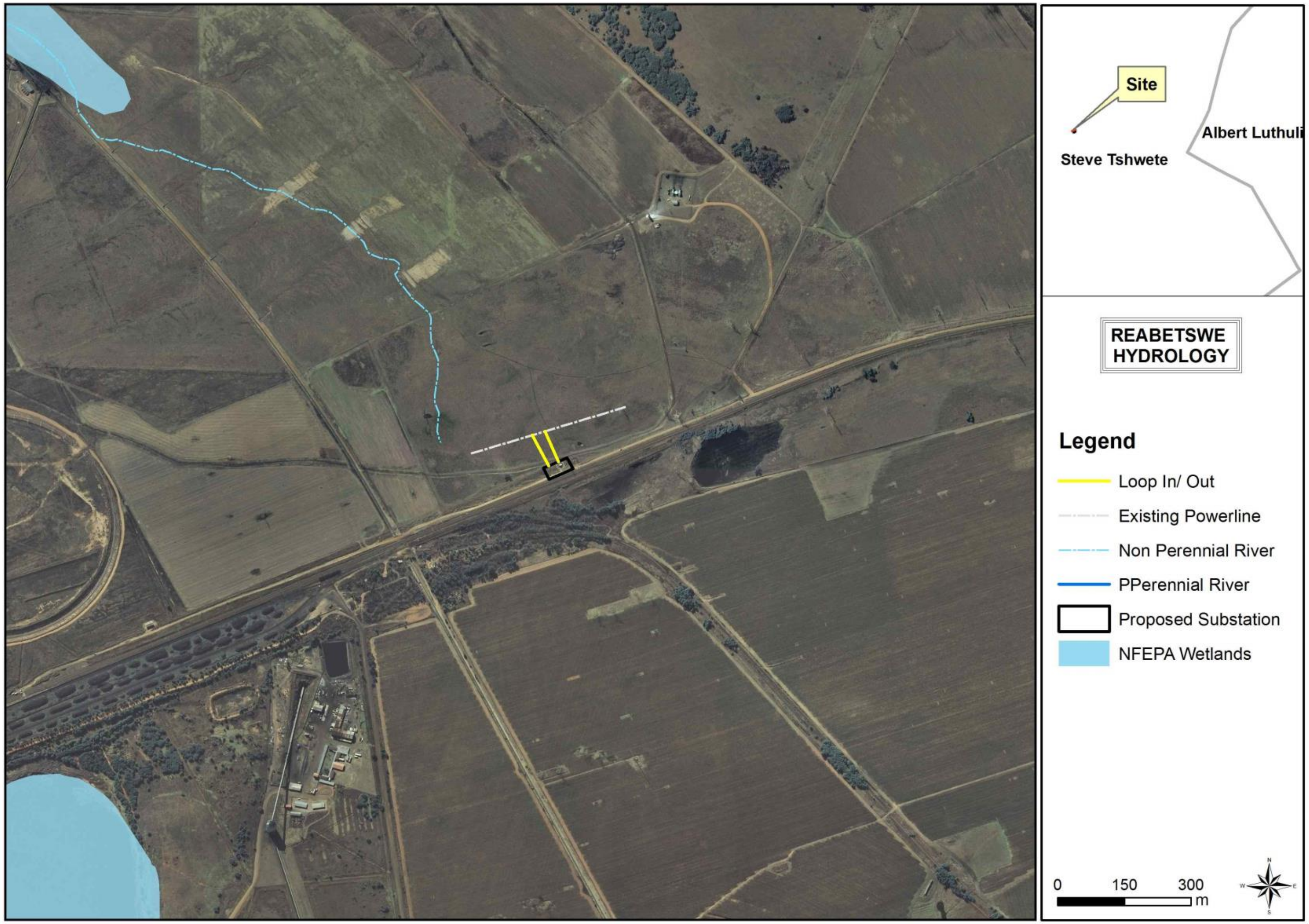



**Figure 3: Hydrology of the study area.**


**Figure 4: Critical biodiversity areas of the study site.**

# 2 METHODOLOGY

The delineation method documented by the Department of Water affairs and Forestry in their document "Updated manual for identification and delineation of wetlands and riparian areas" (DWAF, 2008), and the Minimum Requirements for Biodiversity Assessments (GDACE, 2009) as well as the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al,* 2013) was followed throughout the field survey. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas such as soil and vegetation forms as well as the terrain unit indicator.

A hand held Garmin Montana 650 was used to capture GPS co-ordinates in the field. 1:50 000 cadastral maps and available GIS data were used as reference material for the mapping of the preliminary watercourse boundaries. These were converted to digital image backdrops and delineation lines and boundaries were imposed accordingly after the field survey.

## 2.1 Wetland and Riparian Delineation

Wetlands are identified based on the following characteristic attributes (DWAF, 2005) (Figure 5):

- The presence of plants adapted to or tolerant of saturated soils (hydrophytes);
- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation; and
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing within 50cm of the soil surface.

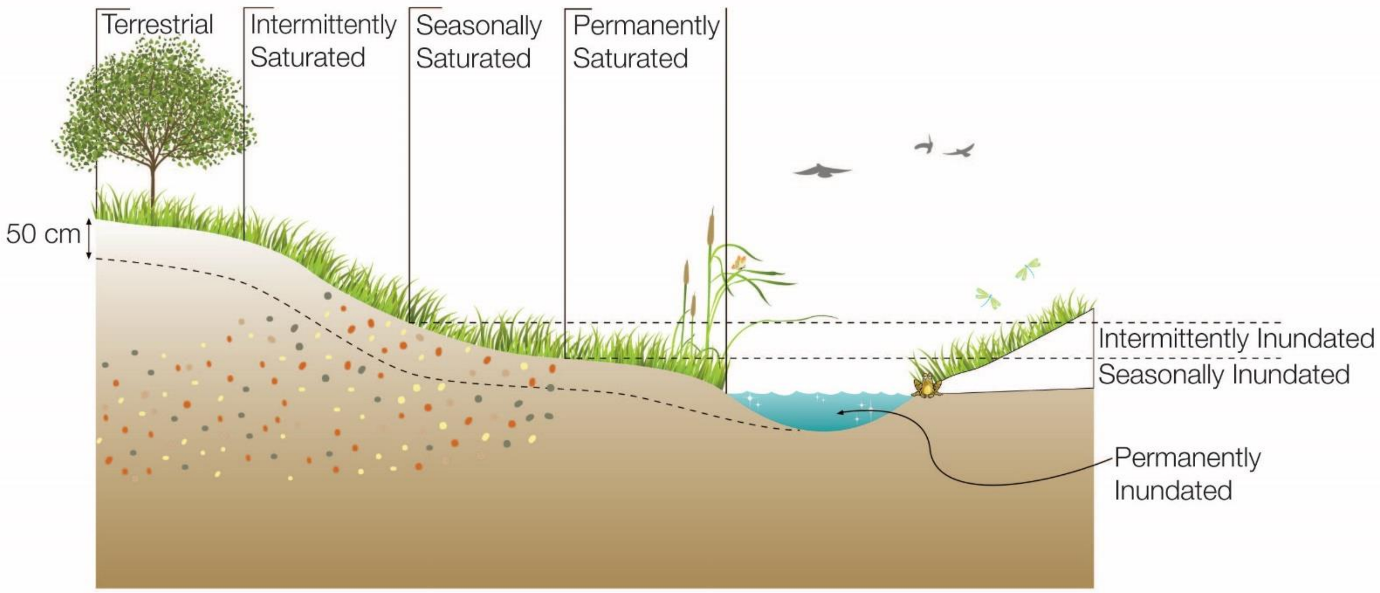



**Figure 5: Typical cross section of a wetland (Ollis, 2013)**

<u>The Terrain Unit Indicator</u>

The terrain unit indicator (Figure 6) is an important guide for identifying the parts of the landscape where wetlands might possibly occur. Some wetlands occur on slopes higher up in the catchment where groundwater discharge is taking place through seeps. An area with soil wetness and/or vegetation indicators, but not displaying any of the topographical indicators should therefore not be excluded from being classified as a wetland. The type of wetland which occurs on a specific topographical area in the landscape is described using the Hydrogeomorphic classification which separates wetlands into 'HGM' units. The classification of Ollis, *et al*. (2013) is used, where wetlands are classified on Level 4 as either Rivers, Floodplain wetlands, Valley-bottom wetlands, Depressions, Seeps, or Flats (Figure 7).

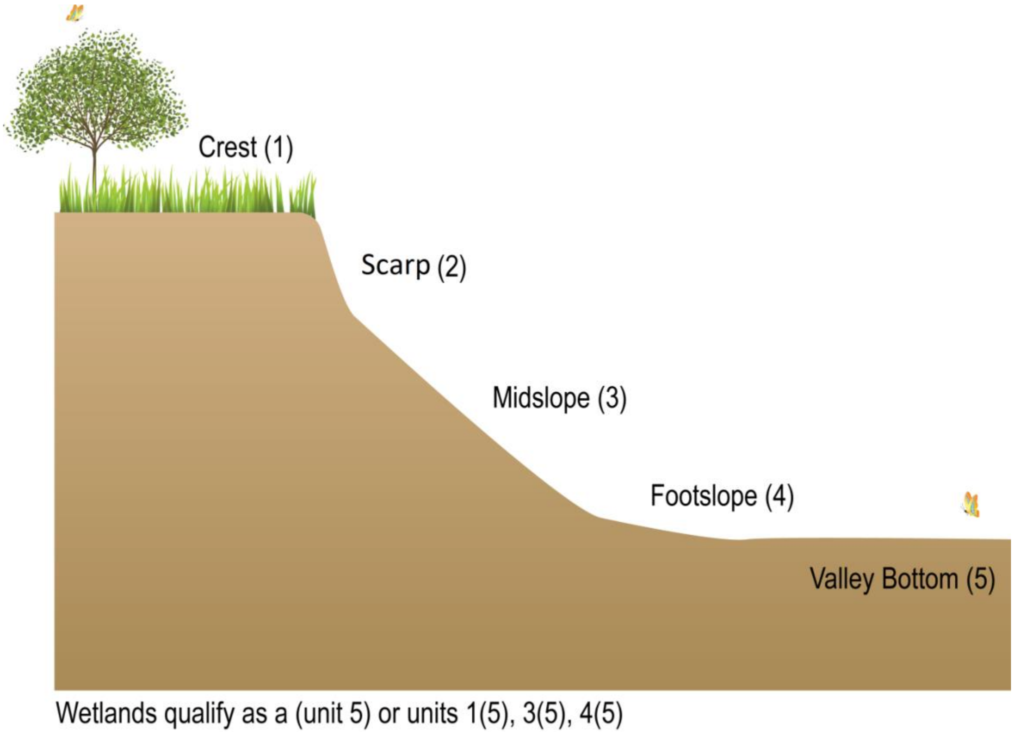



**Figure 6. Terrain units (DWAF, 2005).**

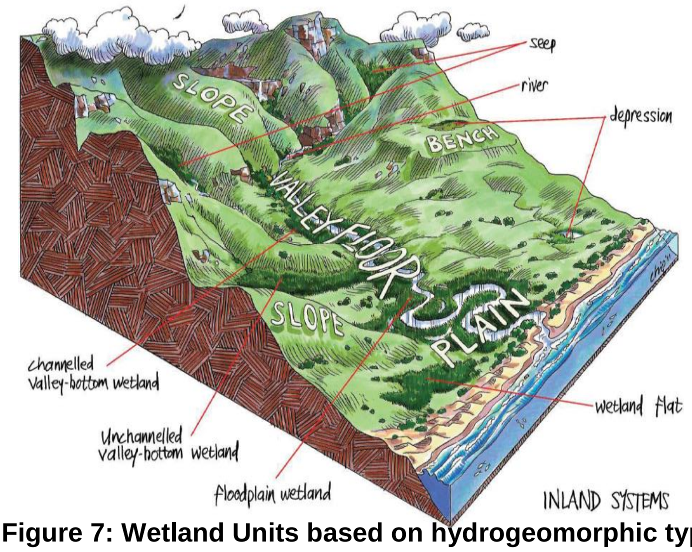



**Figure 7: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)**

<u>Riparian Area:</u>
A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 8) (Kotze, 1999).

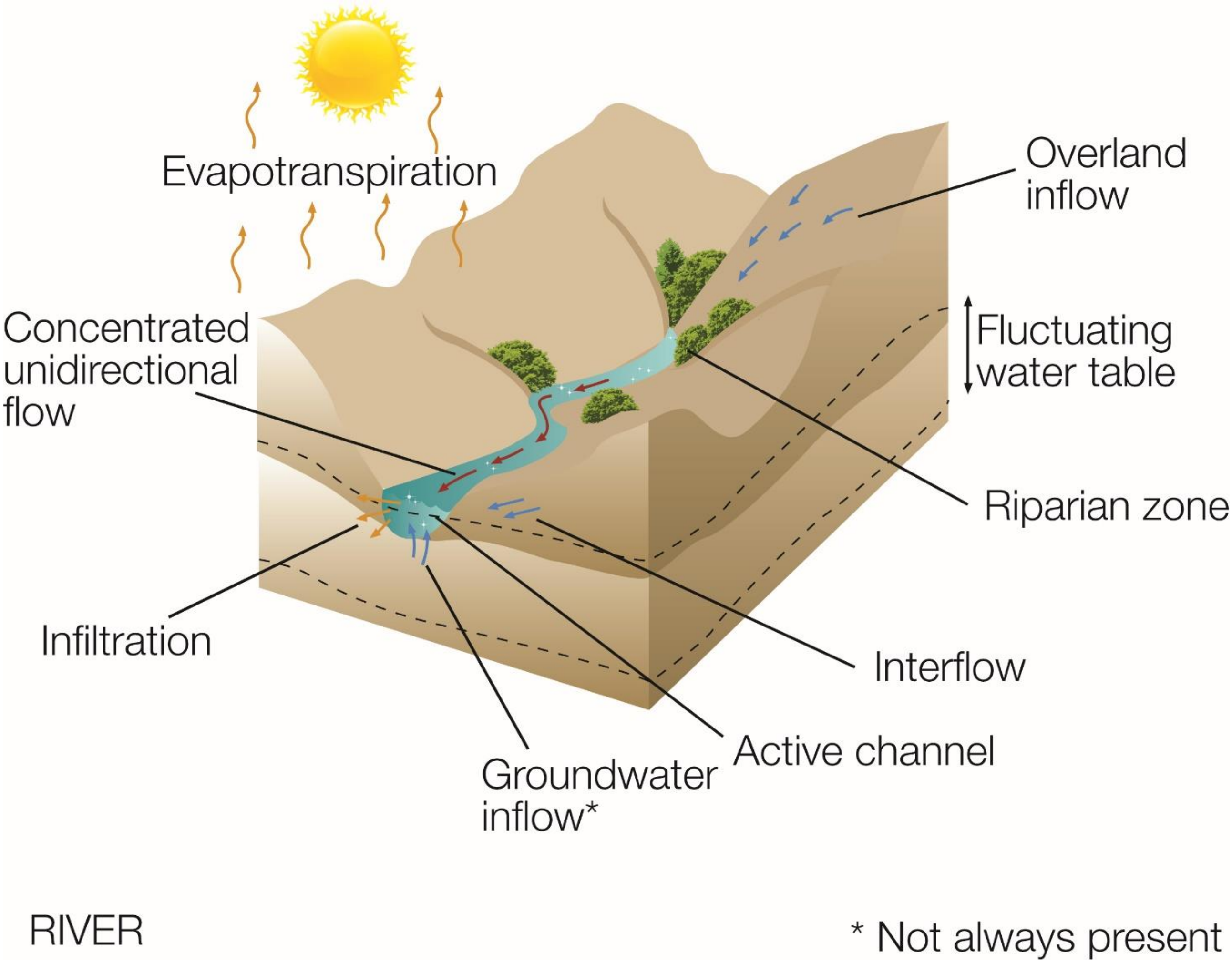



**Figure 8: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).**

Riparian areas can be grouped into different categories based on their inundation period per year. Perennial rivers are rivers with continuous surface water flow, intermittent rivers are rivers where surface flow disappears but some surface flow remains, temporary rivers are rivers where surface flow disappears for most of the channel (Figure 9). Two types of temporary rivers are recognized, namely “ephemeral” rivers that flow for less time than they are dry and support a series of pools in parts of the channel, and “episodic” rivers that only flow in response to extreme rainfall events, usually high in their catchments (Seaman *et al,* 2010). The riparian areas recorded on site are thus classified as episodic streams due to the high elevation of these streams.

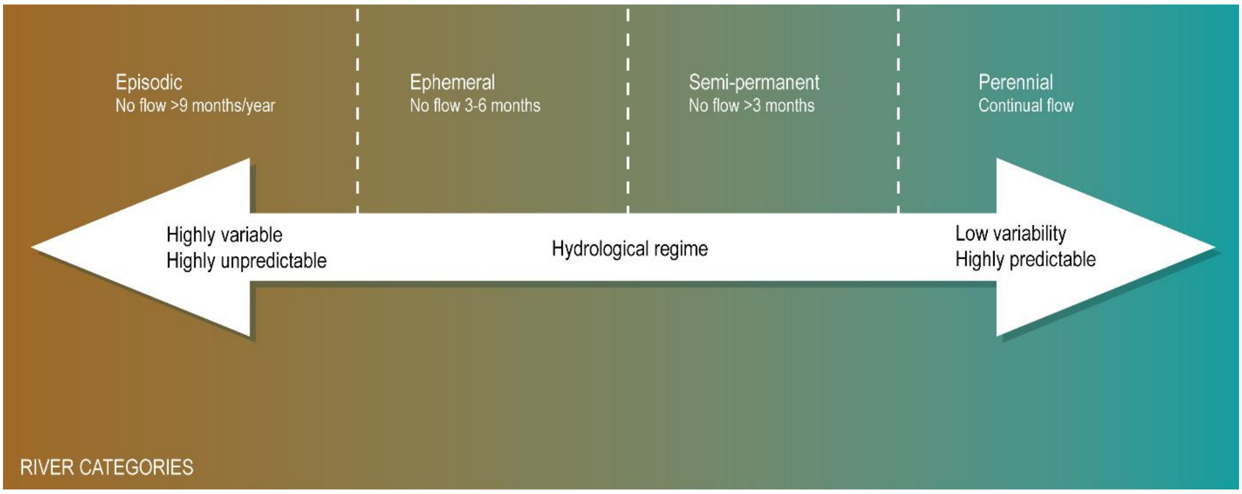



**Figure 9: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).**

## 2.2 Wetland Classification and Delineation

The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ollis *et al*, 2013). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line with a level three category recognised in the classification system proposed in Ollis *et al*, (2013). HGM units take into consideration factors that determine the nature of water movement into, through and out of the wetland system. In general HGM units encompass three key elements (Kotze *et al,* 2005):

- Geomorphic setting - This refers to the landform, its position in the landscape and how it evolved (e.g. through the deposition of river borne sediment);
- Water source - There are usually several sources, although their relative contributions will vary amongst wetlands, including precipitation, groundwater flow, stream flow, etc.; and
- Hydrodynamics - This refers to how water moves through the wetland.

The wetland identified on the study site is an unchannelled valley bottom wetland with a strong seepage component.

<u>Unchanneled valley bottom wetland:</u>

Unchannelled valley bottom wetlands are described as a linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas, or at tributary junctions where the sediment from the tributary smothers the main drainage line (Figure 10) (Kotze, 1999).

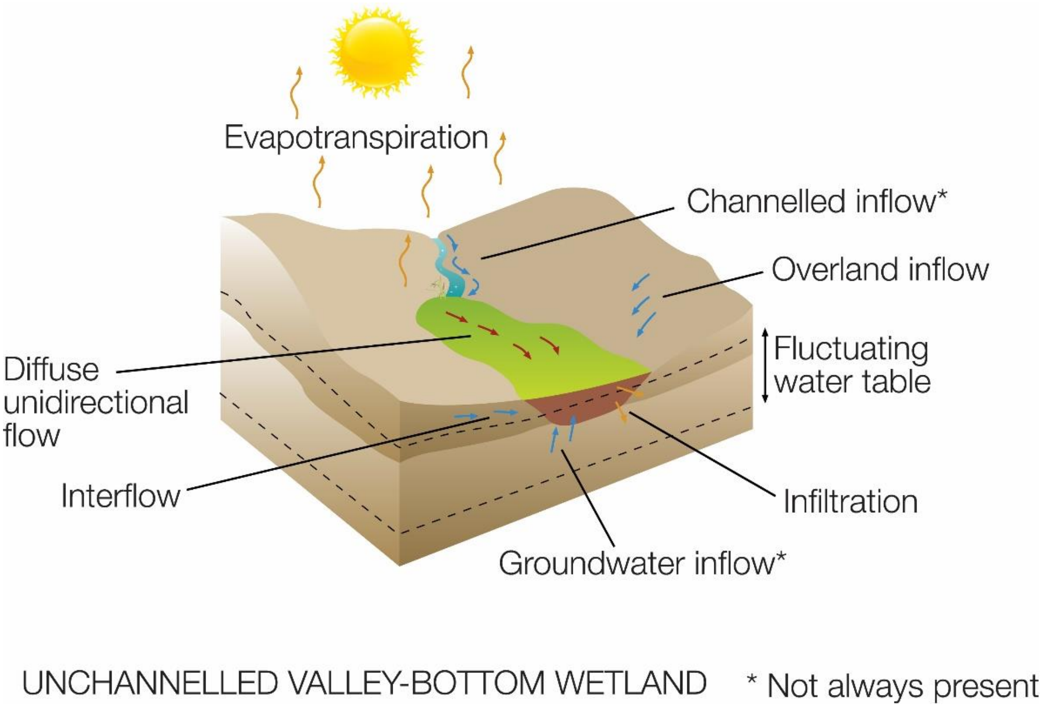



**Figure 10: A schematic representation of the processes characteristic of unchannelled valley bottom wetlands (Ollis *et al*, 2013).**

## 2.3 Buffer Zones

A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development has several impacts on the surrounding environment and on a wetland. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments. The buffer zone identified in this report serves to highlight an ecologically sensitive area in which activities should be conducted with this sensitivity in mind.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. A brief description of each of the functions and associated services is outlined in Table 1 below.

**Table 1: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al*, 2010)**

| Primary Role | Buffer Functions |
|---|---|
| Maintaining basic aquatic processes, services and values. | • Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands. |
| Reducing impacts from upstream activities and adjoining land uses | • Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water |

| Primary Role | Buffer Functions |
|---|---|
| | from adjoining lands thus reducing the sediment load of surface waters.<br>• Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use.<br>• Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing the potential for excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments.<br>• Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements. |

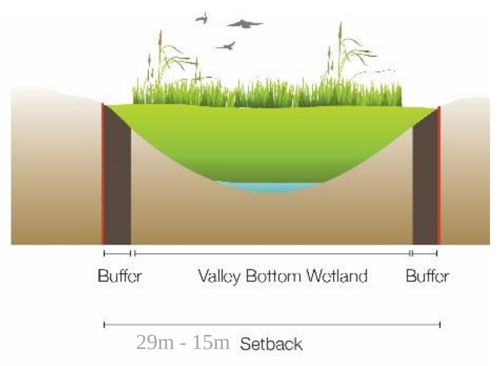
Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are therefore proposed as a standard mitigation measure to reduce impacts of land uses / activities planned adjacent to water resources. These must however be considered in conjunction with other mitigation measures.

Local government policies require that protective buffer zones be calculated from the outer edge of the temporary zone of a wetland (KZN DAEA, 2002; CoCT, 2008; GDARD, 2014).

Various buffer zones are required in different authorisation processes. Authorization from the DWS in for example, the Water Use Licence application process requires the calculation of a buffer using the Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Consolidated Report" by the WRC (Macfarlane *et al* 2015) (GN 267, 2017). The calculations involved in this method take into account various site specific factors, including soil type, slope, vegetation cover and the nature of the development. The calculated buffer zone for the study site using this method comes to 30m for the construction phase and 15m for the operational phase (Macfarlane, *et al* 2015). A representation of the placement of a buffer zone is presented in Figure 11 below.

The calculated buffer for the unchannelled valley bottom is as follows:

- 29 m during the construction phase
- 15 m during the operational phase



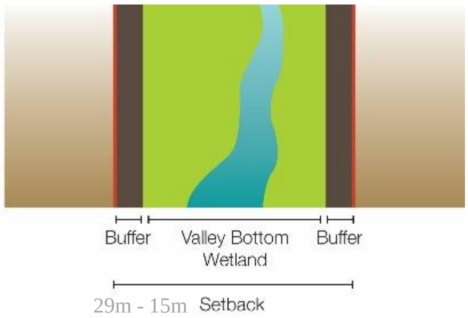



**Figure 11: A represent the buffer zone setback for the wetland types discussed in this report**

## 2.4 Impact Assessments

### 2.4.1 NEMA (2014) Impact Ratings

As required by the 2014 NEMA regulations, impact assessment should provide quantified scores indicating the expected impact, including the cumulative impact of a proposed activity. This assessment follows the format presented below (Table 2).

The impact assessment score below are calculated using the following parameters:

- Direct, indirect and cumulative impacts of the issues identified through the specialist study, as well as all other issues must be assessed in terms of the following criteria:
  - The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
  - The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
  - The **duration**, wherein it will be indicated whether:
    - The lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
    - The lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
    - Medium-term (5–15 years) – assigned a score of 3;
    - Long term (> 15 years) - assigned a score of 4; or
    - Permanent - assigned a score of 5;
  - The consequences (magnitude), quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
  - The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
  - The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
  - The status, which will be described as either positive, negative or neutral.
  - The degree to which the impact can be reversed.
  - The degree to which the impact may cause irreplaceable loss of resources.
  - The degree to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:

- S=(E+D+M)P
- S = Significance weighting
- E = Extent
- D = Duration
- M = Magnitude
- P = Probability

The **significance weightings** for each potential impact will be determined as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

**Table 2: Significance Weightings**

| Points | Significant Weighting | Discussion |
|---|---|---|
| **< 30 points** | Low | This impact would not have a direct influence on the decision to develop in the area. |
| **31-60 points** | Medium | The impact could influence the decision to develop in the area unless it is effectively mitigated. |
| **> 60 points** | High | The impact must have an influence on the decision process to develop in the area. |

## 2.5 Wetland Functionality, Status and Sensitivity

Wetland functionality is defined as a measure of the deviation of wetland structure and function from its natural reference condition. The natural reference condition is based on a theoretical undisturbed state extrapolated from an understanding of undisturbed regional vegetation and hydrological conditions. In the current assessment the hydrological, geomorphological and vegetation integrity was assessed for the wetland unit associated with the study site, to provide a Present Ecological Status (PES) score (Macfarlane *et al*, 2007) and an Environmental Importance and Sensitivity category (EIS) (DWAF, 1999). These impacts are based on evidence observed during the field survey and land-use changes visible on aerial imagery.

The allocations of scores in the functional and integrity assessment are subjective and are thus vulnerable to the interpretation of the specialist. Collection of empirical data is precluded at this level of investigation due to project constraints including time and budget. Water quality values, species richness and abundance indices, surface and groundwater volumes, amongst others, should ideally be used rather than a subjective scoring system such as is presented here.

The functional assessment methodologies presented below take into consideration subjective recorded impacts to determine the scores attributed to each functional Hydrogeomorphic (HGM) wetland unit. The aspect of wetland functionality and integrity that are predominantly addressed include hydrological and geomorphological function (subjective observations) and the integrity of the biodiversity component (mainly based on the theoretical intactness of natural vegetation) as directed by the assessment methodology.

In the current study the wetland was assessed using, WET-Health (Macfarlane *et al*, 2007), EIS (DWAF, 1999) and WetEcoservices (Kotze, 2005).

### 2.5.1 Present Ecological Status (PES) – WET-Health

The Present Ecological Score is based on the ability of the wetland to preform indirect benefits (Table 3).

**Table 3: Indirect Benefits provided by wetland habitats (Macfarlane *et al*, 2007).**

| | | | |
|---|---|---|---|
| **Regulating & supporting benefits** | | **Flood attenuation** | The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream |
| | | **Streamflow regulation** | Sustaining streamflow during low flow periods |
| | **Water Quality Enhancement** | **Sediment trapping** | The trapping and retention in the wetland of sediment carried by runoff waters |
| | | **Phosphate assimilation** | Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality |
| | | **Nitrate assimilation** | Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality |
| | | **Toxicant assimilation** | Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality |
| | | **Erosion control** | Controlling of erosion at the wetland site, principally through the protection provided by vegetation. |
| | | **Carbon storage** | The trapping of carbon by the wetland, principally as soil organic matter |

A summary of the three components of the WET-Health namely Hydrological; Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 4. A Level 1 assessment was used in this report. Level 1 assessment is used in situations where limited time and/or resources are available.

**Table 4: Health categories used by WET-Health for describing the integrity of wetlands (Macfarlane *et al*, 2007)**

| Description | Impact Score Range | PES Score | Summary |
|---|---|---|---|
| Unmodified, natural. | 0.0.9 | A | Very High |
| Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place. | 1-1.9 | B | High |

| Description | Impact Score Range | PES Score | Summary |
|---|---|---|---|
| Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. | 2-3.9 | C | Moderate |
| Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred. | 4-5.9 | D | Moderate |
| The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable. | 6-7.9 | E | Low |
| Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. | 8.10 | F | Very Low |

A summary of the change class, description and symbols used to evaluate wetland health are summarised in Table 5.

**Table 5: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)**

| Change Class | Description | Symbol |
|---|---|---|
| Improve | Condition is likely to improve over the over the next 5 years | (↑) |
| Remain stable | Condition is likely to remain stable over the next 5 years | (→) |
| Slowly deteriorate | Condition is likely to deteriorate slightly over the next 5 years | (↓) |
| Rapidly deteriorate | Substantial deterioration of condition is expected over the next 5 years | (↓↓) |

### 2.5.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) score forms part of a larger assessment called the Wetland Importance and Sensitivity scoring system which also addresses hydrological importance and direct human benefits relevant to a HGM unit. Both PES and EIS form part of a larger reserve determination process documented by the Department of Water and Sanitation.

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use (Table 6).

**Table 6: Direct human benefits associated with wetland habitats (Macfarlane *et al*, 2007).**

| | | |
|---|---|---|
| **Subsistence benefits** | **Water for human use** | The provision of water extracted directly from the wetland for domestic, agriculture or other purposes |
| | **Harvestable resources** | The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc. |
| | **Cultivated foods** | Areas in the wetland used for the cultivation of foods |
| **Cultural benefits** | **Cultural heritage** | Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants |
| | **Tourism and recreation** | Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife |
| | **Education and research** | Sites of value in the wetland for education or research |

The Ecological Importance and Sensitivity of wetlands are represented are described in the results section. Explanations of the scores are given in Table 7.

**Table 7: Environmental Importance and Sensitivity rating scale used for the estimation of EIS scores (DWAF, 1999)**

| **Ecological Importance and Sensitivity Categories** | **Rating** | **Recommended Ecological Management Class** |
|---|---|---|
| Very High<br>Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water in major rivers | >3 and <=4 | A |
| High<br>Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers | >2 and <=3 | B |

| Ecological Importance and Sensitivity Categories | Rating | Recommended Ecological Management Class |
|---|---|---|
| Moderate<br>Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers | >1 and <=2 | C |
| Low/Marginal<br>Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water in major rivers | >0 and <=1 | D |

### 2.5.3 WetEcoServices

The Department of Water and Sanitation authorisations related to wetlands are regulated by Government Notice 267 published in the Government Gazette 40713 of 24 March 2017 regarding Section 21(c) and (i). Page 196 of this notice provides a detailed terms of reference for wetland assessment reports and includes the requirement that the ecological integrity and function of wetlands be addressed.

This wetland assessment method is an excel based tool which is based on the integral function of wetlands in terms of their hydrogeomorphic setting. Each of seven benefits are assessed based on a list of characteristics (e.g. slope of the wetland) that are relevant to the particular benefit. Scores are subjectively awarded to characteristics of the wetland and its catchment relative to the proposed activity.

### 2.5.4 Recommended Ecological Category (REC)

According to Roundtree *et al,* (2013) the REC should be calculated upon completion of the PES and EIS assessments for the wetland. This score is important since the PES score does not adequately reflect the ecological value of a wetland. The EIS score is therefore brought into consideration in an objective way to derive an integrity benchmark value. This value should guide the rehabilitation targets of the project. Proposed development activities should not lead to the degradation of a wetland lower than the REC. Compliance to this target should be included into the Environmental Management Plan and audited by a qualified Ecological Control Officer.

The REC is determined by the Present Ecological State of the water resource and the importance and/or sensitivity of the water resource. Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWA. In such cases the REC must automatically be increased to a D.

Where the PES is in the A, B, C, D or E the EIS components must be checked to determine if any of the aspects of importance and sensitivity (Ecological Importance; Hydrological Functions and Direct Human Benefits) are high or very high. If this is the case, the feasibility of increasing the PES (particularly if the PES is in a low C or D category) should be evaluated. This is recommended to enable important and/or sensitive wetland water resources to maintain their functionality and continue to provide the goods and services for the environment and society.

If:

- PES is in an E or F category:
  The REC should be set at at least a D, since E and F EC's are considered unsustainable.
  - The PES category is in a A, B, C or D category, AND the EIS criteria are low or moderate OR the EIS criteria are high or even very high, but it is not feasible or practicable for the PES to be improved:
- The REC is set at the current PES.
  - The PES category is in a B, C or D category, AND the EIS criteria are high or very high AND it is feasible or practicable for the PES to be improved:
- The REC is set at least one Ecological Category higher than the current PES." (Rountree *et al,* 2013)

# 3 RESULTS

## 3.1 Land Use and Land Cover

The study site is located on open land and is bordered by a railway line and access road. The area surrounding the study site is predominantly farming land and mining areas with a large coal deposit area south west of the study site. A small substation is currently located on the study site. From early historical imagery of 1963 clear wetness indicators can be seen on the study site and surroundings (Figure 12). From then significant impacts can be observed such as various trenches and gullies and various changes in the catchment. The study site and a large section of the wetland has been used for agriculture for a prolonged time and is subsequently significantly altered from its reference state.

The construction of the railway line and its associated embankment is likely to have altered the hydrology of the wetland's catchment, cutting off water that would have entered the headwaters of this wetland. From aerial imagery from 2003 (Google earth timeline function) and from the 1963 aerial imagery it can be seen that no dams existed south of the railway. However, in 2014 (Google earth timeline function), a particularly wet year, two large dams can be seen south of the study site as well as large wet areas (Figure 13). This ponding of water supports the theory that the hydrology has changed and that the railway line and embankment intercept water that would have fed the wetland as is visible in wet years. In conclusion it is likely that the wetland is much drier than it was before construction of the railway line.

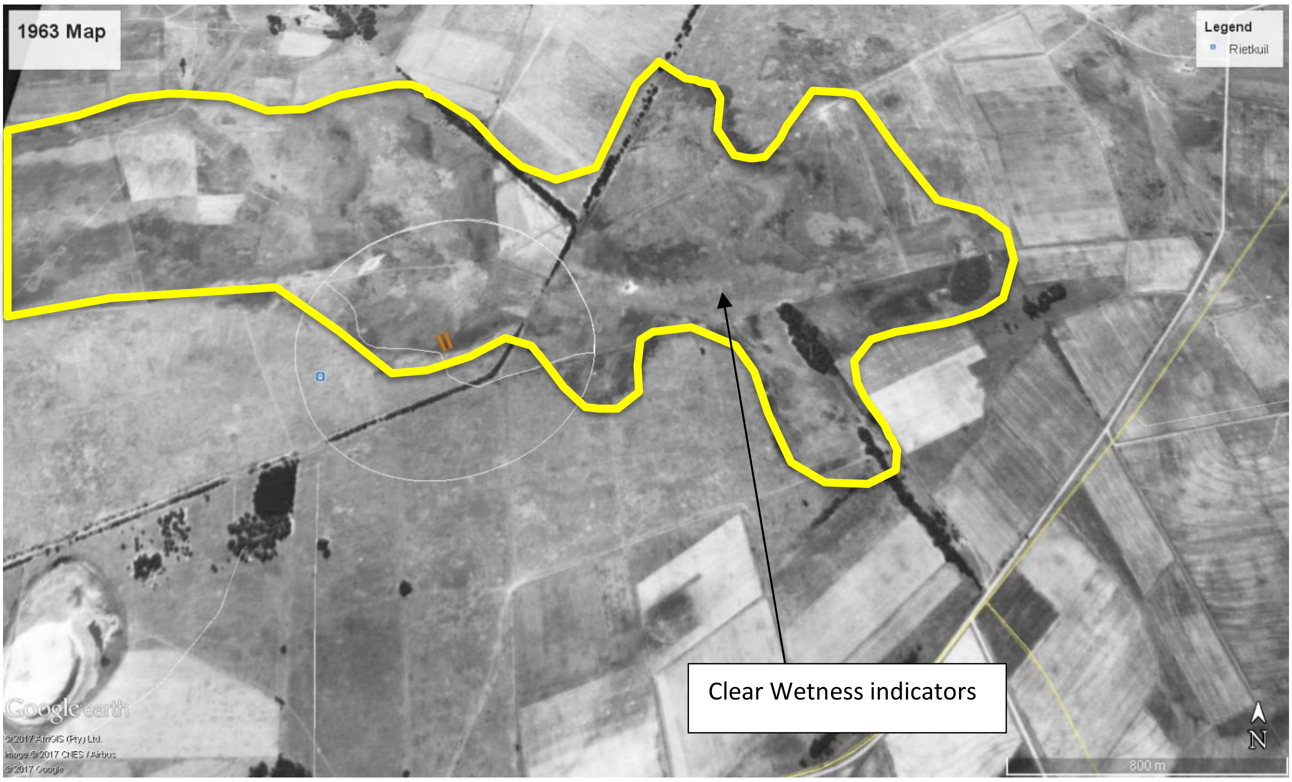



**Figure 12: 1963 aerial imagery indicating the presence of a wetness gradient.**

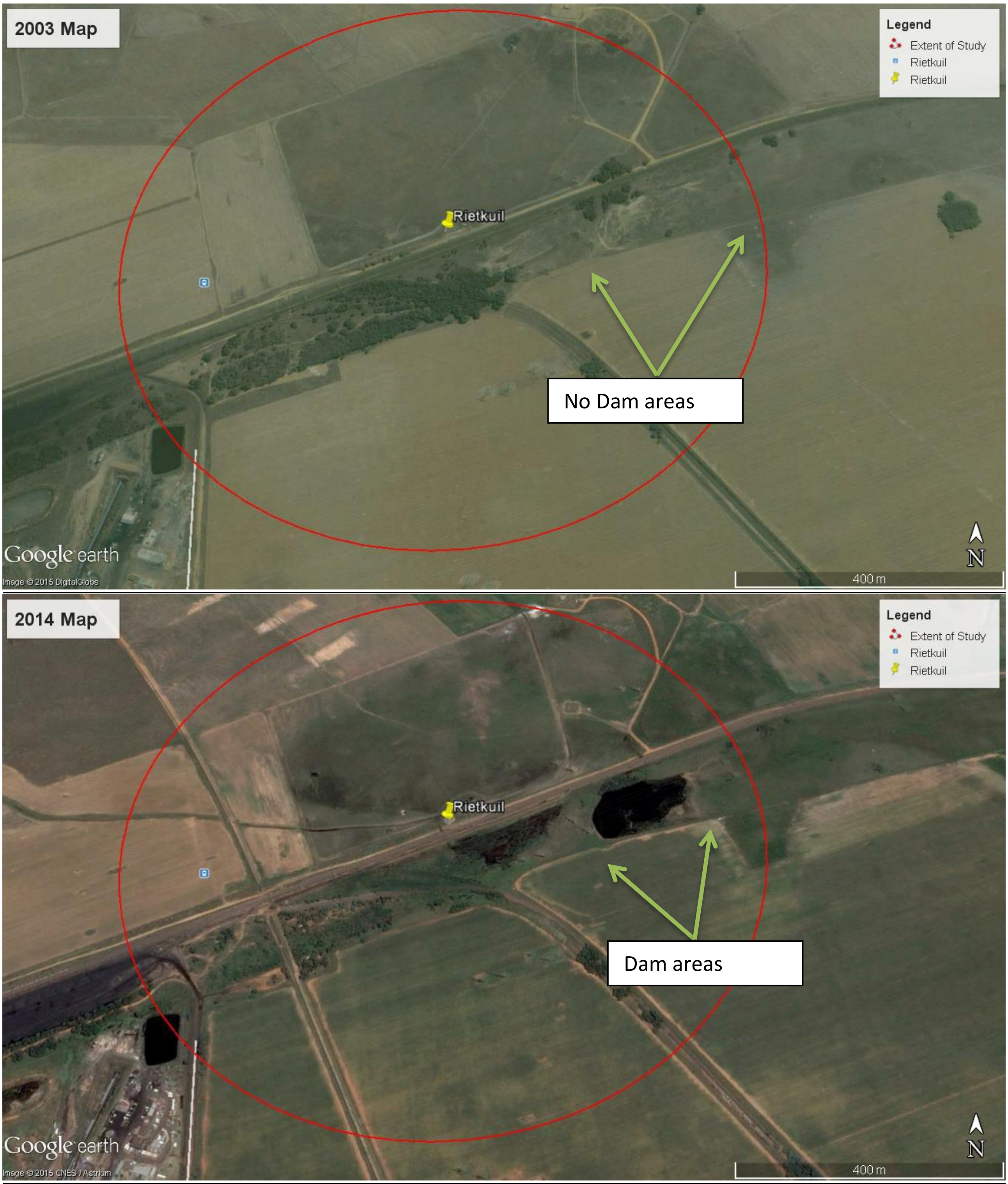



**Figure 13: 2003 with limited wetland characteristics (Top) compared to the 2014 map with numerous wetland evidence as well as the presence of two dams (Bottom).**

## 3.2 Wetland/Riparian Classification and Delineation

One wetland was recorded on the study site. The wetland is classified as an unchannelled valley bottom wetland (Figure 14). The wetland forms the headwaters of the Bosmanspruit River which drains into the Klein-Olifants River to the north. The proposed powerline is located within the wetland area.

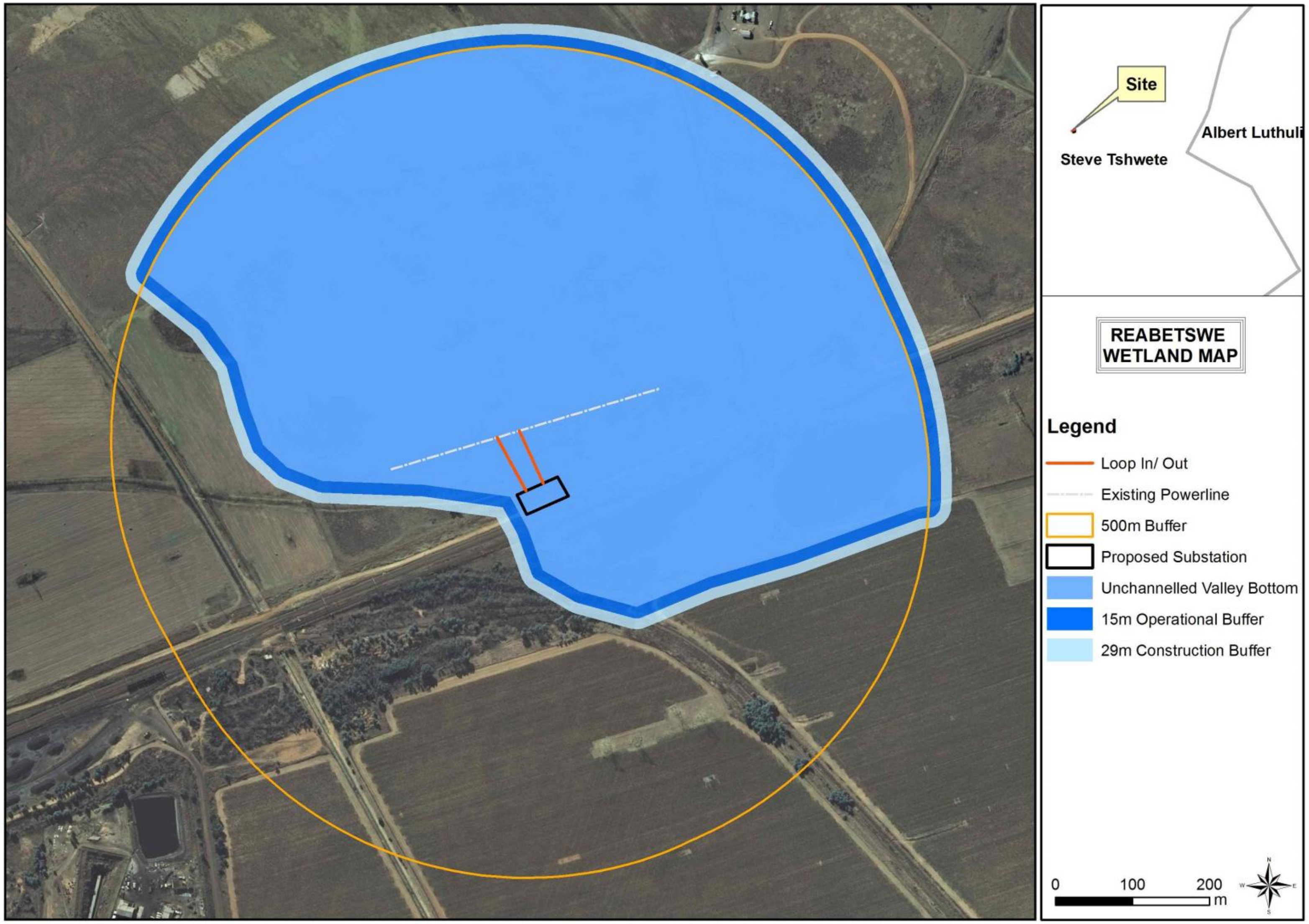



**Figure 14: The delineated wetland together with associated buffer zones.**

### 3.2.1 Soil and Vegetation Indicators

Soil

The soil of the wetland exhibited clear redoximorphic characterisitcs. The soil was characterised by grey sandy soil with distinct mottling and gleying (Figure 15). Small scale erosion was recorded in the valley as well as areas with bare soil where vegetation was removed. A layer of organic material was also recorded in the wetland

**Figure 15: Mottling and gleying present in the soil profile of the study site as well as organic material.**

A summary of the soil characteristics is given in the table below (Table 8):

**Table 8: Summary of wetland conditions on site (Adapted from Job, 2010).**

| | |
|---|---|
| **Site Conditions:** | |
| Do normal circumstances exist on the site? | No |
| Is the site significantly disturbed (difficult site)? | Yes |
| **Indicators of soil wetness within 50 cm of soil surface:** | |
| Sulfidic odour (a slight sulfidic odour was noted in permanent zone) | No |
| Mineral and Texture | Sandy |
| Gley | Yes |
| Mottles or concretions | Yes |
| Organic streaking or oxidised rhizopheres | Limited |
| High organic content in surface layer | No |
| **Setting (In bold):** | |
| crest (1) scarp (2) midslope (3) footslope (4) **valley bottom (5)** | |
| **Additional indicators of wetland presence:** | |
| Concave | No |
| Bedrock | No |
| Dense clay | No |
| Flat | No |
| Associated with a river | Yes |

Vegetation

The dominant species that could be identified included *Imperata cylindrica, Cyperus denudatus, Cyperus longus* var. *tenuiflorus, Andropogon eucomus, Andropogon huilensis, Lobelia flaccida, Pycreus macranthus* and *Juncus oxycarpus.* Other species recorded include *Gomphocarpus fruticosa, Ranunculus multifidus.* Large section of the surrounding areas was under farming and was thus cleared of natural vegetation. Exotic vegetation was present throughout the site and especially adjacent to the railway access road. Large sections were also clear of vegetation (Figure 16). The exotic vegetation located on the study site include *Solanum sisymbriifolium, Acacia mearnsii* and *Stoebe plumosa.*

**Figure 16: Vegetation of the study site and the surroundings.**

## 3.3 Present Ecological Status (PES)

The combined PES scores for the wetland is **E - Low**- The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable. (Macfarlane *et al*, 2007). The scores are summarised in the tables below (Table 9):

**Table 9: Summary of hydrology, geomorphology and vegetation health assessment for the wetlands affected by the proposed powerline (Macfarlane *et al,* 2009).**

| Wetland Unit | Extent (%) | Hydrology | | Geomorphology | | Vegetation | | Overall Health Score | |
|---|---|---|---|---|---|---|---|---|---|
| | | Impact Score | Change Score | Impact Score | Change Score | Impact Score | Change Score | Impact Score | Change Score |
| Unchannelled Valley Bottom | 100 | 6.5 | 0 | 6.1 | 0 | 5.4 | -1 | 6.1 | 0 |
| **PES Category and Projected Trajectory** | | **E** | **→** | **E** | **→** | **D** | **↓** | **E** | **→** |

Ecological Importance and Sensitivity (EIS)

The EIS scores for the wetlands studied during the study site visit are summarised below (Table 10). The unchannelled valley bottom wetland scored a **C (Moderate)** - Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water in major rivers (DWAF, 1999).

**Table 10: Combined EIS scores obtained for the wetlands on the study site (DWAF, 1999).**

| Wetland | WETLAND IMPORTANCE AND SENSITIVITY | Importance | Confidence |
|---|---|---|---|
| **Unchannelled Valley Bottom** | Ecological importance & sensitivity | 1.0 | 3.0 |
| | Hydro-functional importance | 1.6 | 3.0 |
| | Direct human benefits | 0.5 | 3.0 |
| | **EIS Score** | **1.0 C** | |

Details for the components assessed in the WIS assessment are presented in Appendix B.

WetEcoServices

The ecosystem services provided by the wetlands on the study site is summarised in the table below (Table 11). The table is listed from the lowest scores to the highest scores:

**Table 11: Results of the Ecosystem Services provided by unchannelled valley bottom**

| Function | Score | Significance |
|---|---|---|
| Cultural significance | 0,0 | Low |
| Education and research | 0,0 | Low |
| Cultivated foods | 0,4 | Low |
| Tourism and recreation | 0,6 | Low |
| Natural resources | 0,8 | Low |
| Flood attenuation | 1,0 | Moderately Low |
| Opportunities | 1,0 | Moderately Low |
| Maintenance of biodiversity | 1,2 | Moderately Low |
| Carbon storage | 1,3 | Moderately Low |
| Erosion control | 1,6 | Moderately Low |
| Streamflow regulation | 1,7 | Moderately Low |
| Sediment trapping | 1,7 | Moderately Low |
| Water supply for human use | 1,9 | Moderately Low |
| Nitrate removal | 2,2 | Moderately High |
| Phosphate trapping | 2,3 | Moderately High |
| Toxicant removal | 2,4 | Moderately High |
| Threats | 3,0 | High |

## 3.4 Summary of Findings

Table 12 provides a summary of the results recorded for the wetland unit potentially affected by the proposed construction of the powerline.

**Table 12: Summary of results for each wetland unit discussed**

| Classification (SANBI, 2013) | PES (Macfarlane *et al*, 2007) | EIS (DWAF, 1999) | WetEcoServices (3 most prominent scores) | Generic Buffer (GDARD, 2014) | Scientific Buffer (Macfarlane et al 2015) |
|---|---|---|---|---|---|
| Unchannelled Valley Bottom | 6.1 E | 1.6 C | Phosphate trapping 2,3 Toxicant removal 2,4 Threats 3,0 | 30 m | 29 m (Construction) 15 m (Operational) |

## 3.5 Impacts and Mitigation

A development has several impacts on the surrounding environment and particularly on a wetland. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater, and therefore the hydrological regime of the area. A range of management measures are available to address threats posed to water resources. In the context of the proposed powerlines, the mitigation measures proposed below are intended to prevent further degradation to the wetland areas as a result of the powerline upgrade. It is important to note that this section aims to highlight areas of concern. The details of the mitigation measures that are finally put in place should ideally be based on these issues, but must necessarily take into consideration the physical and economical feasibility of mitigation. It is important that any mitigation be implemented in the context of an Environmental Management Plan to in order to ensure accountability and ultimately the success of the mitigation.

### 3.5.1 NEMA (2014) Impact Assessment

Suggested mitigation/management measures are summarised in Table 13–15.

**Table 13: Changes in sediment entering and exiting the system impact ratings**

| | | |
|---|---|---|
| ***Nature:*** Changes in sediment entering and exiting the system. | | |
| ***Activity:*** Changing the amount of sediment entering the wetland. Construction and operational activities will result in earthworks and soil disturbance as well as the removal of natural vegetation. This could result in the loss of topsoil, sedimentation of the wetland and increase the turbidity of the water. Possible sources of the impacts include:<br>• Earthwork activities during construction<br>• Disturbance of soil surface including soil compaction<br>• Disturbance of slopes through creation of roads and tracks adjacent and within the wetland | | |
| | **Without mitigation** | **With mitigation** |
| **CONSTRUCTION PHASE** | | |
| ***Probability*** | Probable (3) | Possible (2) |
| ***Duration*** | Short-term (2) | Short-term (2) |
| ***Extent*** | Regional (3) | Limited to Local Area (2) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Significance*** | **27 (low)** | **16 (low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| **OPERATIONAL PHASE** | | |
| ***Probability*** | Probable (3) | Possible (2) |
| ***Duration*** | Short-term (2) | Short-term (2) |
| ***Extent*** | Regional (3) | Limited to Local Area (2) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Significance*** | **27 (low)** | **16 (low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| | | |
| ***Reversibility*** | Moderate | High |
| ***Irreplaceable loss of resources?*** | Low | Low |
| ***Can impacts be mitigated?*** | Yes | |

***Mitigation:***

- Do not work in the wetland in wet conditions
- Prevent access of heavy vehicles and machinery in the wetlands
- Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction activities and that plan must be implemented immediately upon completion of construction.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Implementation of best management practices

***Cumulative impacts:*** May be moderate unless effective mitigation measures are applied. Refer to the accompanying General Monitoring and Rehabilitation report.

***Residual Risks:*** Expected to moderate unless the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

**Table 14: Changes in water flow ratings (hydrology)**

***Nature:*** Changes in water flow in wetlands directly affected as well as downstream watercourses.

***Activity:*** Any activities that change the catchment of a wetland will affect the way in which water enters into the wetlands. This has an effect on water flow volumes as well as energy Possible sources of the impacts include:

- Soil compaction through movement of heavy vehicles
- Disturbance of slopes through creation of roads and tracks adjacent to or within the wetland
- Disturbance of vegetation cover through trampling

| | **Without mitigation** | **With mitigation** |
|---|---|---|
| | **CONSTRUCTION PHASE** | |
| ***Probability*** | Probable (3) | Possible (2) |
| ***Duration*** | Medium-term (3) | Short-term (2) |
| ***Extent*** | Regional (3) | Limited to Local Area (2) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Significance*** | **30 (medium)** | **16 (low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| | **OPERATIONAL PHASE** | |
| ***Probability*** | Probable (3) | Possible (2) |
| ***Duration*** | Medium-term (3) | Short-term (2) |
| ***Extent*** | Limited to Local Area (2) | Limited to Local Area (2) |
| ***Magnitude*** | Low (4) | Low (4) |
| ***Significance*** | **27 (low)** | **16 (low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| | | |
| ***Reversibility*** | Moderate | High |
| ***Irreplaceable loss of resources?*** | Low | Low |
| ***Can impacts be mitigated?*** | Yes | |

***Mitigation:***

- Do not work in the wetland in wet conditions
- Prevent access of heavy vehicles and machinery in the wetlands
- Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction activities and that plan must be implemented immediately upon completion of construction.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Implementation of best management practices

| |
|---|
| ***Cumulative impacts:*** May be moderate unless effective mitigation measures are applied. Refer to the accompanying General Monitoring and Rehabilitation report. |
| ***Residual Risks:*** Expected to moderate unless the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary. |

**Table 15: Introduction and spread of alien vegetation impact ratings.**

| | | |
|---|---|---|
| ***Nature:*** Introduction and spread of alien vegetation. | | |
| ***Activity:*** Any activities that damage the natural vegetation cover will result in opportunistic invasions after disturbance and the introduction of seed in construction materials and on vehicles. Invasions of alien plants can impact on hydrology, by outcompeting natural vegetation and decreasing the natural biodiversity. | | |
| | **Without mitigation** | **With mitigation** |
| **CONSTRUCTION PHASE** | | |
| ***Probability*** | Definite (5) | Highly probable (4) |
| ***Duration*** | Long-term (4) | Medium-term (3) |
| ***Extent*** | Limited to Local Area (2) | Limited to Local Area (2) |
| ***Magnitude*** | Moderate (6) | Low (4) |
| ***Significance*** | **60 (moderate)** | **36 (moderate)** |
| ***Status (positive or negative)*** | Negative | Negative |
| **OPERATIONAL PHASE** | | |
| ***Probability*** | Probable (3) | Improbable (1) |
| ***Duration*** | Permanent (5) | Permanent (5) |
| ***Extent*** | Limited to Local Area (2) | Limited to the Site (1) |
| ***Magnitude*** | Moderate (6) | Low (4) |
| ***Significance*** | **39 (moderate)** | **10 (low)** |
| ***Status (positive or negative)*** | Negative | Negative |
| | | |
| ***Reversibility*** | Low | Moderate |
| ***Irreplaceable loss of resources?*** | Low | Low |
| ***Can impacts be mitigated?*** | Yes | |
| ***Mitigation:***<br>• Implement an Alien Plant Control Plan<br>• Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area and returning it where possible afterwards.<br>• Monitor the establishment of alien invasive species within the areas affected by the construction and maintenance and take immediate corrective action where invasive species are observed to establish.<br>• Rehabilitate or revegetate disturbed areas | | |
| ***Cumulative impacts:*** Expected to be moderate to low. Regular monitoring should be implemented during construction, rehabilitation including for a period after rehabilitation is completed. Refer to the accompanying General Rehabilitation and Monitoring Report | | |
| ***Residual Risks:*** Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary. | | |

# 4 CONCLUSION

One wetland was recorded on the study site. The wetland is classified as an unchannelled valley bottom wetland. The wetland forms the headwaters of the Bosmanspruit River which drains into the Klein Plifants River to the north. From historical aerial imagery (Google earth timeline function and 1963 photos) it can be seen that no dams or ponding existed south of the railway however, in 2014 (Google earth timeline function) two large areas of standing water can be seen south of the study site as well as large wet areas. It is likely that the railway line and its associated berm has resulted in the interception of water that would naturally have fed into the wetland. The wetland is therefore probably much drier than it would have been. However, clear soil and vegetation indicators still remain on and around the area earmarked for the proposed overhead powerline.

The main impacts that were recorded during the site visits include farming and related impacts, anthropogenic activities such as urbanisation including infrastructure and exotic vegetation. A summary of the results of the wetland functional assessment are presented in the table below:

| Classification (SANBI, 2013) | PES (Macfarlane *et al*, 2007) | EIS (DWAF, 1999) | WetEcoServices (3 most prominent scores) | Generic Buffer (GDARD, 2014) | Scientific Buffer (Macfarlane et al 2015) |
|---|---|---|---|---|---|
| Unchannelled Valley Bottom | 6.1 E | 1.6 C | Phosphate trapping 2,3 Toxicant removal 2,4 Threats 3,0 | 30 m | 29 m (Construction)<br>15 m (Operational) |

The important findings discussed in this report are summarised below:

| | Quaternary Catchment and WMA areas | Important Rivers possibly affected | Buffers |
|---|---|---|---|
| | B12B, 2nd, Olifants WMA | The wetland forms part of the headwaters of the Bosmanspruit River which drains into the Klein-Olifants River | Scientific buffer (Macfarlane *et al*, 2014) is calculated as 15 m during operation and 29 m during construction. |
| **NEMA Impact assessment** | Activities have a medium or low impact score before implementation of mitigation measures and a low score after mitigation | | |
| **Does the specialist support the development?** | Yes. Although the powerline is located on a confirmed wetland, due to the extent of current impacts already associated with the wetland and the small ecological footprint likely to occur from the proposed powerline. | | |
| **Major concerns** | Colonisation of exotic vegetation<br>Compaction of soil<br>Downstream sedimentation | | |
| **Recommendations** | Effective mitigation measures should be implemented throughout the development. Rehabilitation of disturbed areas should follow the construction phase. Activities in the wetland during wet conditions should be avoide.d | | |
| **CBA and other Important areas** | The powerline traverse areas classified as CBA Optimal (Entire Site) | | |

**REFERENCES**

Department of Water Affairs and Forestry, (2005): Environmental Best Practice Specifications: Construction for Construction Sites, Infrastructure Upgrades and Maintenance Works. Version 3

Department of Water Affairs (2008): Updated Manual for the Identification and Delineation of Wetlands and Riparian areas.

Department of Water Affairs (2010). National Water Act, 1998 (Act No 36 of 1998) S21(c) & (i) Water Uses. Version: February 2010. Training Manual.

Gauteng Department of Agriculture Conservation & Environment (2002). Gauteng Agricultural Potential Atlas. Johannesburg

Gauteng Department of Agriculture, Conservation & Environment (2014) GDARD Minimum Requirements for Biodiversity Assessments Version 3. Directorate Nature Conservation, Johannesburg.

Gauteng Department of Agriculture and Rural Development, (2011): Gauteng Conservation Plan Version 3 ArcGIS Spatial data

Job, N. (2009). Application of the Department of Water Affairs and Forestry (DWAF) Wetland Delineation Method to Wetland Soils of the Western Cape.

Kleynhans, C.J. (1999): A procedure for the determination of the determination of the ecological reserve for the purpose of the national water balance model for South African Rivers. Institute for Water Quality Studies Department of Water Affairs and Forestry, Pretoria.

Kleynhans C.J., MacKenzie J. and Louw M.D. (2007). Module F: Riparian Vegetation Response Assessment Index in River Classification: Manual for EcoStatus Determination (version 2). Joint Water Research Commission and Department of Water Affairs and Forrestry report. WRC Report No. TT 333/08

Kotze D C, (1999): A system for supporting wetland management decisions. Ph.D. thesis. School of Applied Environmental Sciences, University of Natal, Pietermaritzburg.

Macfarlane D.M., Kotze D.C., Ellery W.N., Walters D, Koopman V, Goodman P and Goge C. (2008). WET-Health: A technique for rapidly assessing wetland health. Water Research Commission, Pretoria. WRC Rport TT340/08 February 2008

Macfarlane D.M., Teixeira-Leite A., Goodman P., Bate G and Colvin C. (2015) Report on the Development of a Method and Model for Buffer Zone Determination. Water Research Commission project K5/1789. The Institute of Natural Resources and its Associates

Mucina L., & Rutherford M. C. (2006). Vegetation Map of South Africa, Lesotho and Swaziland, 1:1 000 000 scale sheet maps. South African National Biodiversity Institute., Pretoria.

Schultze R.E. (1997). South African Atlas of Agrohydrology and Climatology. Water Research Commission, Pretoria, Report TT82/96

Ollis, D.J., Snaddon, C.D., Job, N.M., &Mbona, N. (2013). Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland System. SANBI Biodiversity Series 22. South African National Biodiversity Institute, Pretoria

Rountree M.W, Malan H.L and Weston B.C (2013). Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0). WRC Report No. 1788/1/12. Water Research Commission, Pretoria, South Africa

**APPENDIX A: GLOSSARY OF TERMS**

| | |
|---|---|
| Buffer | A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area |
| Hydrophyte | any plant that grows in water or on a substratum that is at least periodically deficient in oxygen as a result of soil saturation or flooding; plants typically found in wet habitats |
| Hydromorphic soil | soil that in its undrained condition is saturated or flooded long enough during the growing season to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils) |
| Seepage | A type of wetland occurring on slopes, usually characterised by diffuse (i.e. unchannelled, and often subsurface) flows |
| Sedges | Grass-like plants belonging to the family Cyperaceae, sometimes referred to as nutgrasses. Papyrus is a member of this family. |
| Soil profile | the vertically sectioned sample through the soil mantle, usually consisting of two or three horizons (Soil Classification Working Group, 1991) |
| Wetland: | "*land which is transitional between terrestrial and aquatic systems 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*." (National Water Act; Act 36 of 1998). |
| Wetland delineation | the determination and marking of the boundary of a wetland on a map using the DWAF (2005) methodology. This assessment includes identification of suggested buffer zones and is usually done in conjunction with a wetland functional assessment. The impact of the proposed development, together with appropriate mitigation measures are included in impact assessment tables |

## Appendix B: Functional Assessment Data

**Table 16: Ecological Importance and Sensitivity Calculations (Unchannelled Valley Bottom 1)**

| ECOLOGICAL IMPORTANCE AND SENSITIVITY | Score (0-4) | Confidence (1-5) | Motivation | Scoring Guideline |
|---|---|---|---|---|
| Biodiversity support | | 4.00 | | |
| Presence of Red Data species | 0 | 4.00 | Highly unlikely | Endangered or rare Red Data species presence |
| Populations of unique species | 0 | 4.00 | None recorded | Uncommonly large populations of wetland species |
| Migration/breeding/feeding sites | 1 | 4.00 | Recorded some species | Importance of the unit for migration, breeding site and/or a feeding. |
| Landscape scale | | 4.00 | | |
| Protection status of the wetland | 1 | 4.00 | All wetlands are protected under the NWA | National (4), Provincial, private (3), municipal (1 or 2), public area (0-1) |
| Protection status of the vegetation type | 2 | 4.00 | Untransformed vegetation type is regionally important | SANBI guidance on the protection sutatus of the surrounding vegetation |
| Regional context of the ecological integrity | 1 | 4.00 | Majority of wetland in this region is disturbed | Assessment of the PES (habitat integrity), especially in light of regional utilisation |
| Size and rareity of the wetland type/s present | 0 | 4.00 | Wetland is not rare or very large | Identification and rareity assessment of the wetland types |
| Diversity of habitat types | 0 | 4.00 | Mainly farming areas | Assessment of the variety of wetland types present within a site. |
| Sensitivity of the wetland | | | | |
| Sensitivity to changes in floods | 1 | 4.00 | Somewhat | floodplains at 4; valley bottoms 2 or 3; pans and seeps 0 or 1. |
| Sensitivity to changes in low flows/dry season | 1 | 4.00 | Somewhat | Unchannelled VB's probably most sensitive |
| Sensitivity to changes in water quality | 1 | 4.00 | Somewhat | Esp naturally low nutrient waters - lower nutrients likely to be more sensitive |

| | | | | |
|---|---|---|---|---|
| **ECOLOGICAL IMPORTANCE & SENSITIVITY** | **1.0** | **4.0** | | |

**Table 17: Hydrological Functional Importance Calculations (Unchannelled Valley Bottom 1)**

| **HYDRO-FUNCTIONAL IMPORTANCE** | | | **Score (0-4)** | **Confidence (1-5)** | **Motivation** | **Scoring Guideline** |
|---|---|---|---|---|---|---|
| Regulating & supporting benefits | Flood attenuation | | 2 | 2 | Large valley bottom area | The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream |
| | Streamflow regulation | | 1 | 2 | | Sustaining streamflow during low flow periods |
| | Water Quality Enhancement | Sediment trapping | 3 | 2 | Vegetation layer relatively in tact | The trapping and retention in the wetland of sediment carried by runoff waters |
| | | Phosphate assimilation | 2 | 3 | | Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality |
| | | Nitrate assimilation | 2 | 3 | | Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality |
| | | Toxicant assimilation | 2 | 3 | | Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality |
| | | Erosion control | 1 | 2 | Relatively intact vegetation is still present | Controlling of erosion at the wetland site, principally through the protection provided by vegetation. |
| | Carbon storage | | 0 | 3 | No organic material recorded | The trapping of carbon by the wetland, principally as soil organic matter |
| **HYDRO-FUNCTIONAL IMPORTANCE** | | | **1.4** | **2.5** | | |

**Table 18: Direct Human Benefits Calculations (Unchannelled Valley Bottom 1)**

| DIRECT HUMAN BENEFITS | | Score (0-4) | Confidence (1-5) | Motivation | Scoring Guideline |
|---|---|---|---|---|---|
| Subsistence benefits | Water for human use | 0 | 3 | None | The provision of water extracted directly from the wetland for domestic, agriculture or other purposes |
| | Harvestable resources | 0 | 3 | None current | The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc. |
| | Cultivated foods | 3 | 3 | Farming areas | Areas in the wetland used for the cultivation of foods |
| | | | | | |
| Cultural benefits | Cultural heritage | 0 | 3 | Unlikely | Places of special cultural significance in the wetland, e.g., for baptisms or gathering of culturally significant plants |
| | Tourism and recreation | 0 | 3 | Unlikely | Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife |
| | Education and research | 0 | 3 | None known | Sites of value in the wetland for education or research |
| **DIRECT HUMAN BENEFITS** | | **0.5** | **3** | | |

# APPENDIX C: Abbreviated CVs of participating specialists

| | |
|---|---|
| Name: | **ANTOINETTE BOOTSMA nee van Wyk** |
| ID Number | 7604250013088 |
| Name of Firm: | Limosella Consulting |
| SACNASP Status: | Professional Natural Scientist # 400222-09 Botany and Ecology |

## EDUCATIONAL QUALIFICATIONS

- MSc Ecology, University of South Africa (2017) Awarded with distinction. Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management
- Short course in wetland soils, Terrasoil Science (2009)
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)

## PUBLICATIONS

- A.A. Boostma, S. Elshehawi, A.P. Grootjans, P.L Grundling, S. Khosa. *In Press.* Ecohydrological analysis of the Matlabas Mountain mire, South Africa. Mires and Peat
- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Comission KSA 2: K5/2346
- A.P. Grootjans, A.J.M Jansen , A, Snijdewind, P.C. de Hullu, H. Joosten, A. Bootsma and P.L. Grundling. (2014). In search of spring mires in Namibia: the Waterberg area revisited. Mires and Peat. Volume 15, Article 10, 1–11, http://www.mires-and-peat.net/, ISSN 1819-754X © 2015 International Mire Conservation Group and International Peat Society
- Haagner, A.S.H., van Wyk, A.A. & Wassenaar, T.D. 2006. *The biodiversity of herpetofauna of the Richards Bay Minerals leases.* CERU Technical Report 32. University of Pretoria.
- van Wyk, A.A., Wassenaar, T.D. 2006. *The biodiversity of epiphytic plants of the Richards Bay Minerals leases.* CERU Technical Report 33. University of Pretoria.
- Wassenaar, T.D., van Wyk, A.A., Haagner, A.S.H, & van Aarde, R.J.H. 2006. *Report on an Ecological Baseline Survey of Zulti South Lease for Richards Bay Minerals*. CERU Technical Report 29. University of Pretoria

**KEY EXPERIENCE**

The following projects provide an example of the application of wetland ecology on strategic as well as fine scale as well as its implementation into policies and guidelines. (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- More than 90 external peer reviews as part of mentorship programs for companies including Gibb, Galago Environmental Consultants, Lidwala Consulting Engineers, Bokamoso Environmental Consultants, 2009 ongoing
- More than 300 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape 2007, ongoing
- Strategic wetland specialist input into the Open Space Management Framework for Kyalami and Ruimsig, City of Johannesburg, 2016
- Fine scale wetland specialist input into the ESKOM Bravo Integration Project 3, 4, 5 and Kyalami – Midrand Strengthening.
- Wetland/Riparian delineation and functional assessment for the proposed maintenance work of the rand water pipelines and valve chambers exposed due to erosion in Casteel A, B and C in Bushbuckridge Mpumalanga Province
- Wetland/Riparian delineation and functional assessment for the Proposed Citrus Orchard Establishment, South of Burgersfort (Limpopo Province) and North of Lydenburg (Mpumalanga Province).
- Scoping level assessment to inform a proposed railway line between Swaziland and Richards Bay. April 2013.
- Environmental Control Officer. Management of onsite audit of compliance during the construction of a pedestrian bridge in Zola Park, Soweto, Phase 1 and Phase 2. Commenced in 2010, ongoing.
- Fine scale wetland delineation and functional assessments in Lesotho and Kenya. 2008 and 2009;
- Analysis of wetland/riparian conditions potentially affected by 14 powerline rebuilds in Midrand, Gauteng, as well submission of a General Rehabilitation and Monitoring Plan. May 2013.
- Wetland specialist input into the Environmental Management Plan for the upgrade of the Firgrove Substation, Western Cape. April 2013
- An audit of the wetlands in the City of Johannesburg. Specialist studies as well as project management and integration of independent datasets into a final report. Commenced in August 2007
- Input into the wetland component of the Green Star SA rating system. April 2009;
- A strategic assessment of wetlands in Gauteng to inform the GDACE Regional Environmental Management Framework. June 2008.
- As assessment of wetlands in southern Mozambique. This involved a detailed analysis of the vegetation composition and sensitivity associated with wetlands and swamp forest in order to inform the development layout of a proposed resort. May 2008.

- An assessment of three wetlands in the Highlands of Lesotho. This involved a detailed assessment of the value of the study sites in terms of functionality and rehabilitation opportunities. Integration of the specialist reports socio economic, aquatic, terrestrial and wetland ecology studies into a final synthesis. May 2007.
- Ecological studies on a strategic scale to inform an Environmental Management Framework for the Emakazeni Municipality and an Integrated Environmental Management Program for the Emalahleni Municipality. May and June 2007

| | |
|---|---|
| Name: | **RUDI BEZUIDENHOUDT** |
| ID Number | 880831 5038 081 |
| Name of Firm: | Limosella Consulting |
| Position: | Wetland Specialist |
| SACNASP Status: | Cert. Nat. Sci (Reg. No. 500024/13) |

**EDUCATIONAL QUALIFICATIONS**

- B.Sc. (Botany & Zoology), University of South Africa (2008 - 2012)
- B.Sc. (Hons) Botany, University of South Africa (2013 – Ongoing)
- Introduction to wetlands, Gauteng Wetland Forum (2010)
- Biomimicry and Constructed Wetlands. Golder Associates and Water Research Commission (2011)
- Wetland Rehabilitation Principles, University of the Free State (2012)
- Tools for Wetland Assessment, Rhodes University (2011)
- Wetland Legislation, University of Free-State (2013)
- Understanding Environmental Impact Assessment, WESSA (2011)
- SASS 5, Groundtruth (2012)
- Wetland Operations and Diversity Management Master Class, Secolo Consulting Training Services (2015)
- Tree Identification, Braam van Wyk – University of Pretoria (2015)
- Wetland Buffer Legislation – Eco-Pulse & Water Research Commission (2015)
- Wetland Seminar, ARC-ISCW & IMCG (2011)
- Tropical Coastal Ecosystems, edX (2015 – ongoing)

**KEY EXPERIENCE**

- **Wetland Specialist**

This entails all aspects of scientific investigation associated with a consultancy that focuses on wetland specialist investigations. This includes the following:

- Approximately 200+ specialist investigations into wetland and riparian conditions on strategic, as well as fine scale levels in Gauteng, Limpopo, North-West Province Mpumalanga KwaZulu Natal, North-West Province, Western Cape, Eastern Cape & Northern Cape
- Ensuring the scientific integrity of wetland reports including peer review and publications.

**Large Eskom projects include:**

- Eskom 88kV Rigi – Sonland
- Eskom 88kV Simmerpan Line
- Eskom 88kV Meteor Line
- Eskom 88kV Kookfontein – Jaguar
- Eskom 132kV Dipomong
- Eskom 132kV Everest – Merapi
- Eskom 132kV Vulcan – Enkangala
- Eskom 400kV Helios – Aggenys
- Eskom 400kV Hendrina – Gumeni
- Eskom 765kV Aries – Helios
- Eskom 765kV Aries – Kronos
- Eskom 765kV Kronos – Perseus
- Eskom 765kV Perseus – Gamma
- Eskom 765kV Helios – Juno
- Eskom 765kV Aries- Helios

➢ **Biodiversity Action Plan**

This entails the gathering of data and compiling of a Biodiversity action plan.

➢ **Wetland Rehabilitation**

This entailed the management of wetland vegetation and rehabilitation related projects in terms of developing proposals, project management, technical investigation and quality control.

➢ **Wetland Ecology**

Experience in the delineation and functional assessment of wetlands and riparian areas in order to advise proposed development layouts, project management, report writing and quality control.

➢ **Environmental Controlling Officer**

Routine inspection of construction sites to ensure compliance with the City's environmental ordinances, the Environmental Management Program and other laws and by-laws associated with development at or near wetland or riparian areas.

- Soweto Zola Park 2011-2013
- Orange Farm Pipeline 2010-2011

➢ **Wetland Audit**

Audit of Eskom Kusile power station to comply with the Kusile Section 21G Water Use Licence (Department of Water Affairs, Licence No. 04/B20F/BCFGIJ/41, 2011), the amended Water Use Licence (Department of water affairs and forestry, Ref. 27/2/2/B620/101/8, 2009) and the WUL checklist provided by Eskom.

- Kusile Powerstation 2012-2013.

**EMPLOYEE EXPERIENCE:**

➢ **<u>GIS Specialist – AfriGIS</u>**

**January 2008 – August 2010**

**Tasks include:**

- GIS Spatial layering
- Google Earth Street View Mapping
- Data Input

➢ **<u>Wetland Specialist - Limosella Consulting</u>**

**September 2010 – Ongoing**

**Tasks include:**

- GIS Spatial layering
- Wetland and Riparian delineation studies, opinions and functional assessments including data collection and analysis
- Correspondence with stakeholders, clients, authorities and specialists
- Presentations to stakeholders, clients and specialists
- Project management
- Planning and executing of fieldwork
- Analysis of data
- GIS spatial representation
- Submission of technical reports containing management recommendations
- General management of the research station and herbarium
- Regular site visits
- Attendance of monthly meetings
- Submission of monthly reports

**MEMBERSHIPS IN SOCIETIES**

- Botanical Society of South African
- SAWS (South African Wetland Society) Founding member

SACNASP (Cert. Nat. Sci. Reg. No. 500024/13)