Proposed construction of an overhead powerline from Boschmankop substation, near Pullenshope, 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

2017.12.08
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 Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09 Rudi Bezuidenhoudt Wetland specialist / Ecologist SACNASP Reg. No. 500024/13
Field work and data analysis	Antoinette Bootsma Ecologist/Botanist/Wetland specialist SACNASP Reg. No. 400222-09 Rudi Bezuidenhoudt Wetland specialist / Ecologist 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 proposed construction of an overhead powerline from the Boschmankop Substation near Pullenshope, Mpumalanga Province.

The scope of work for this project is as follows:

- Establish a T-Off between Hendrina MTS and Abina traction station.
- Build 1x1.94km 132kV Chickadee lines from the T-off to the proposed Boschmanskop POS
- Establish a 132kV metering point at the proposed Boschmanskop traction station.

Three alternatives were studied:

- Alternative 1 (Preferred alternative)
- Alternative 2
- Alternative 3

Fieldwork was conducted on the 29th of November 2017.

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.

Three wetland areas were recorded directly in line with the powerline alternatives or within 500 m of the powerlines. The wetlands recorded are classified as an unchannelled valley bottom wetland (crossed by Alternative 2), a seepage wetland (associated with the existing substation and with Alternatives 1 and 2) and a depressional pan wetland (crossed by Alternative 3) The seepage wetland links up with an unchannelled valley bottom wetland south east from the study site. The seepage wetland has a drain located within it adjacent and parallel to the railway. The drain also extends over the railway in a western direction where it links up with the unchannelled valley bottom wetland. The unchannel valley bottom drains northwards into the Woes-Alleenspruit River which drains into the Klein-Olifants River.

From the fieldwork conducted and the aerial imagery it can be seen that the seepage wetland and the unchannelled valley bottom wetland have been the most impacted followed by the depressional pan wetland. The seepage wetland has been impacted by the construction of a slime dam, a substation and various infrastructure within the wetland. The unchannelled valley bottom has been impacted by prolonged farming practices as well as the construction of various infrastructure within the wetland. Furthermore, the unchannelled valley bottom wetland has been dammed up in three areas just within the study area. The pan has been left relatively intact over the years although the catchment has been greatly altered.

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)
Seepage Wetland	5.3 D	1.6 C	Toxicant removal 2,2 Nitrate removal 2,3 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Unchannelled Valley Bottom	6.2 E	2.7 B	Flood attenuation 2,4 Nitrate removal 2,5 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Depressional Pan	2.3 C	1.4 C	Erosion control 1,8 Flood attenuation 2,0 Threats 2,0	30 m	28 m (Construction) 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	Seepage wetland and Unchannelled valley wetland drains into the Woes-Alleenspruit River.	Scientific buffer (Macfarlane *et al*, 2014) is calculated as 15 m during operation and 28 m 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. Sedimentation during the construction phase has a high impact before mitigation and a moderate impact after mitigation.		
Does the specialist support the development?	• Alternative 1 is the preferred choice as it crosses no wetland areas. It does however run parallel to the valley bottom wetland and this should be factored in to potential impacts that should be mitigated and monitored • Alternative 2 & 3 are the second preferred options. However, impacts associated with these lines can be effectively mitigated or rehabilitated and should not cause permanent damage to regional hydrological systems		
Major concerns	Sediment input into the wetlands and downstream areas Colonisation of exotic vegetation		

	Compaction of soil Erosion
Recommendations	Effective mitigation measures should be implemented throughout the development as set out in the accompanying General Rehabilitation and Monitoring Plan.
CBA and other Important areas	• Other Natural areas • Moderately modified/Old Lands • Heavily Modified (Majority of study site)

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1 INTRODUCTION

Limosella Consulting (Pty) Ltd was appointed by Envirolution Consulting to undertake a wetland delineation and functional assessment for the proposed construction of a powerline from the Boschmankop Substation near Pullenshope, Mpumalanga Province.

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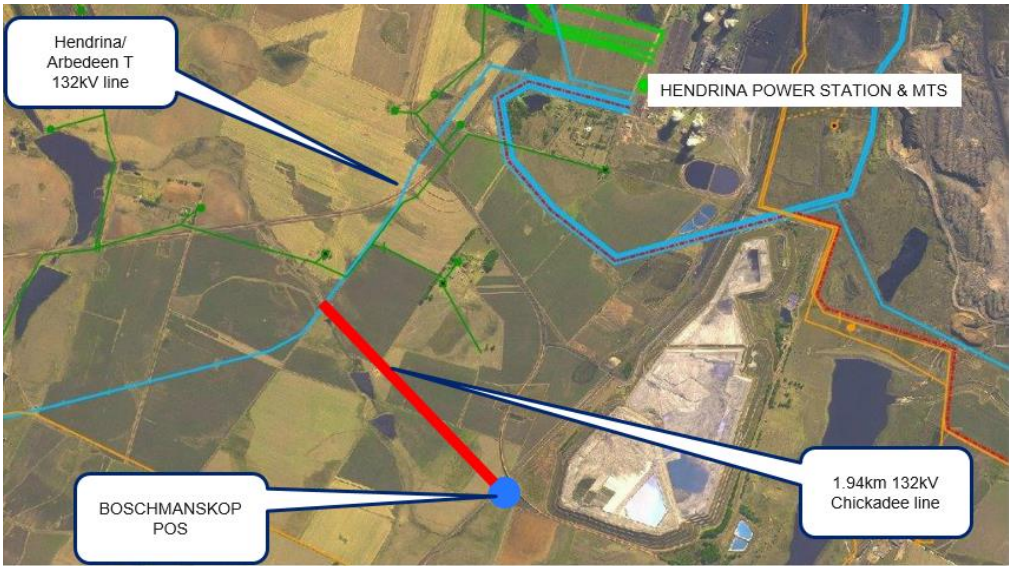

Figure 1: A representation of the proposed activities for the Boschamnskop project as provided by Eskom

Three alternatives were studied (Figure 2):

- Alternative 1 (Preferred alternative)
- Alternative 2
- Alternative 3

Fieldwork was conducted on the 29th of November 2017.

1.1 Terms of Reference

The terms of reference for the study were as follows:

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- 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 5 km south of Pullens Hope and approximately 10 km west of Groot Drakenstein in the Mpumalanga Province (Figure 2). The study site is bordered by a Transnet railway and a dirt road and is surrounded by farming and mining areas. The approximate central coordinates of the study site are 26° 3'45.31"S and 29°35'10.24"E. An existing substation is located on the study site. Three alternative lines were studied.

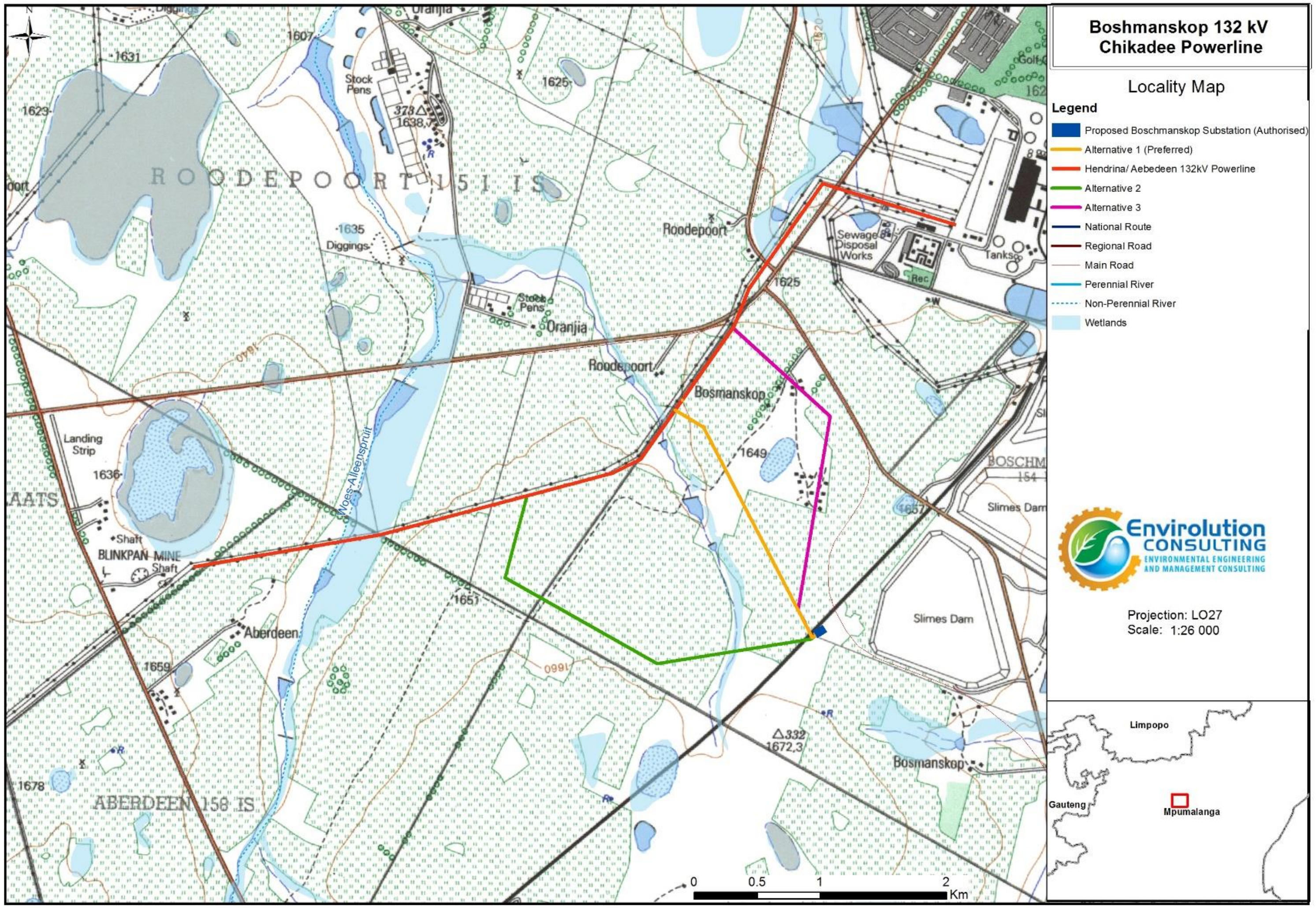


Figure 2: Locality Map

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. Quaternary Catchment B12B falls within the second WMA, the Olifants WMA. The major rivers in this WMA include the Elands, Wilge, Steelpoort and Olifants and Letaba Rivers. The wetland recorded on the study site drains into the Woes-Alleenspruit River which drains into the Klein-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 river/wetland flowing though the centre of the study area as well as a depressional pan wetland (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). The soil type is Bb4 (AGIS. Date unknown) and the soil class is S3 (ENPAT, date unknown) (Figure 4). S3 soils class is characterised by red or yellow structureless soils with a plinthic horizon and is known to have favourable water-holding properties. The soil type Bb4 is characterised by a Plinthic catena: dystrophic and/or mesotrophic; red soils not widespread, upland duplex and margalitic soils rare as well as Shale, sandstone, clay and conglomerate of the Ecca Group, Karoo Sequence; dolerite; occasional felsitic lava of the Rooiberg Group, Transvaal Sequence (Fey, 2005). The Geology of the area is characterised by the Madzaringwe Formation, Karoo Supergroup.

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 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 areas classified as (Figure 5):

- Other Natural areas
- Moderately modified/Old Lands
- Heavily Modified (Majority of study site)

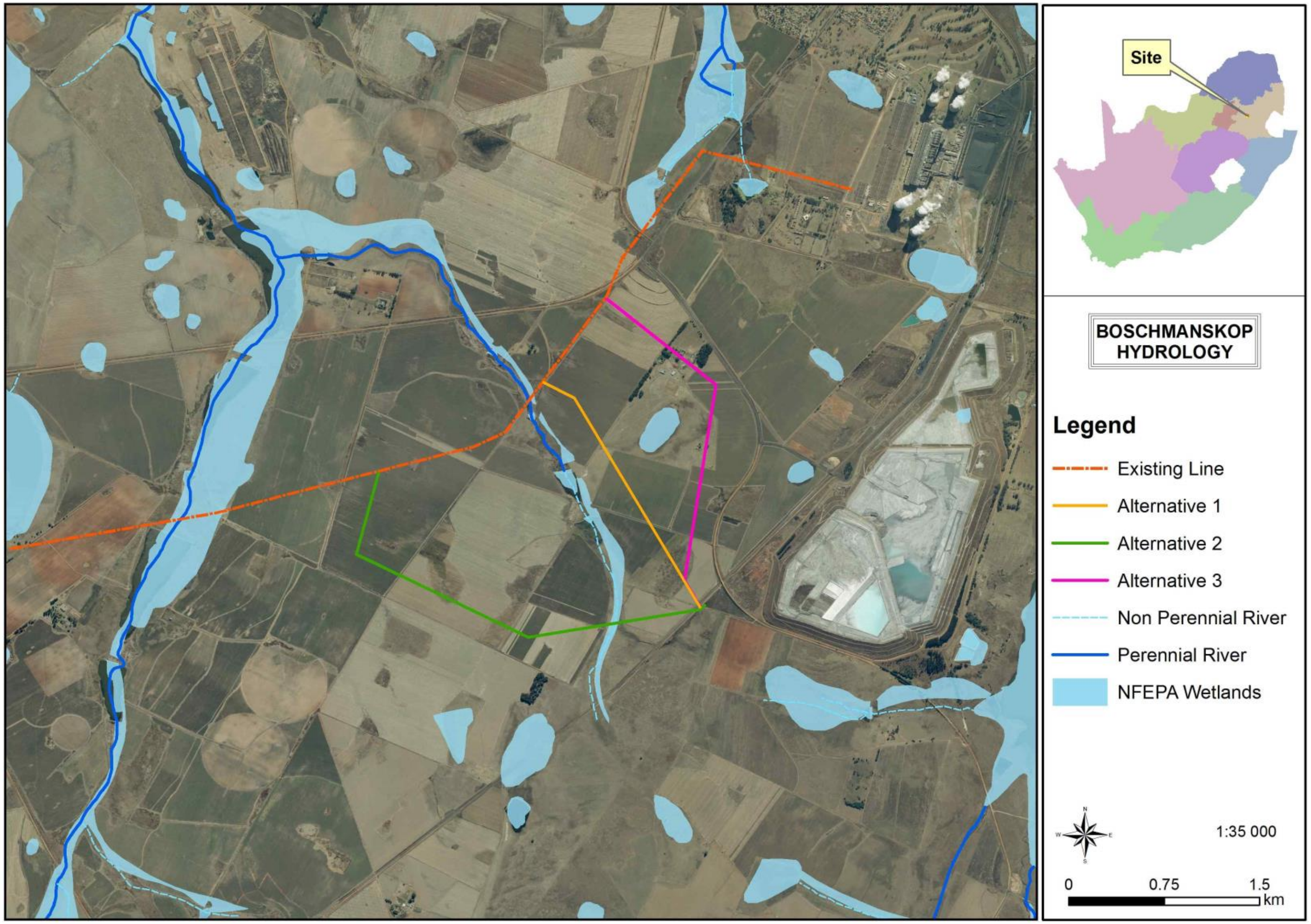


Figure 3: Hydrology of the study area.

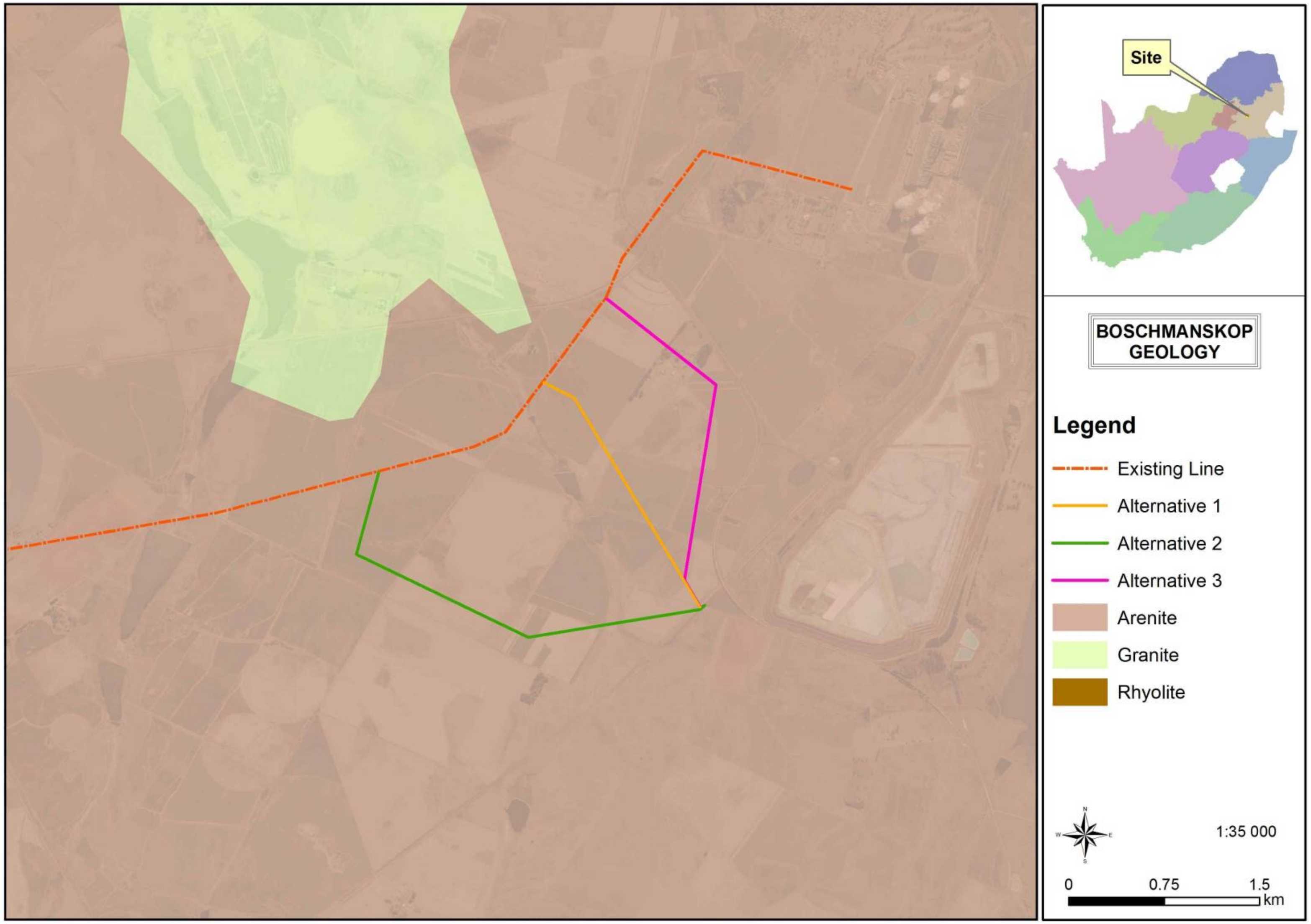


Figure 4: Geology of the study area.

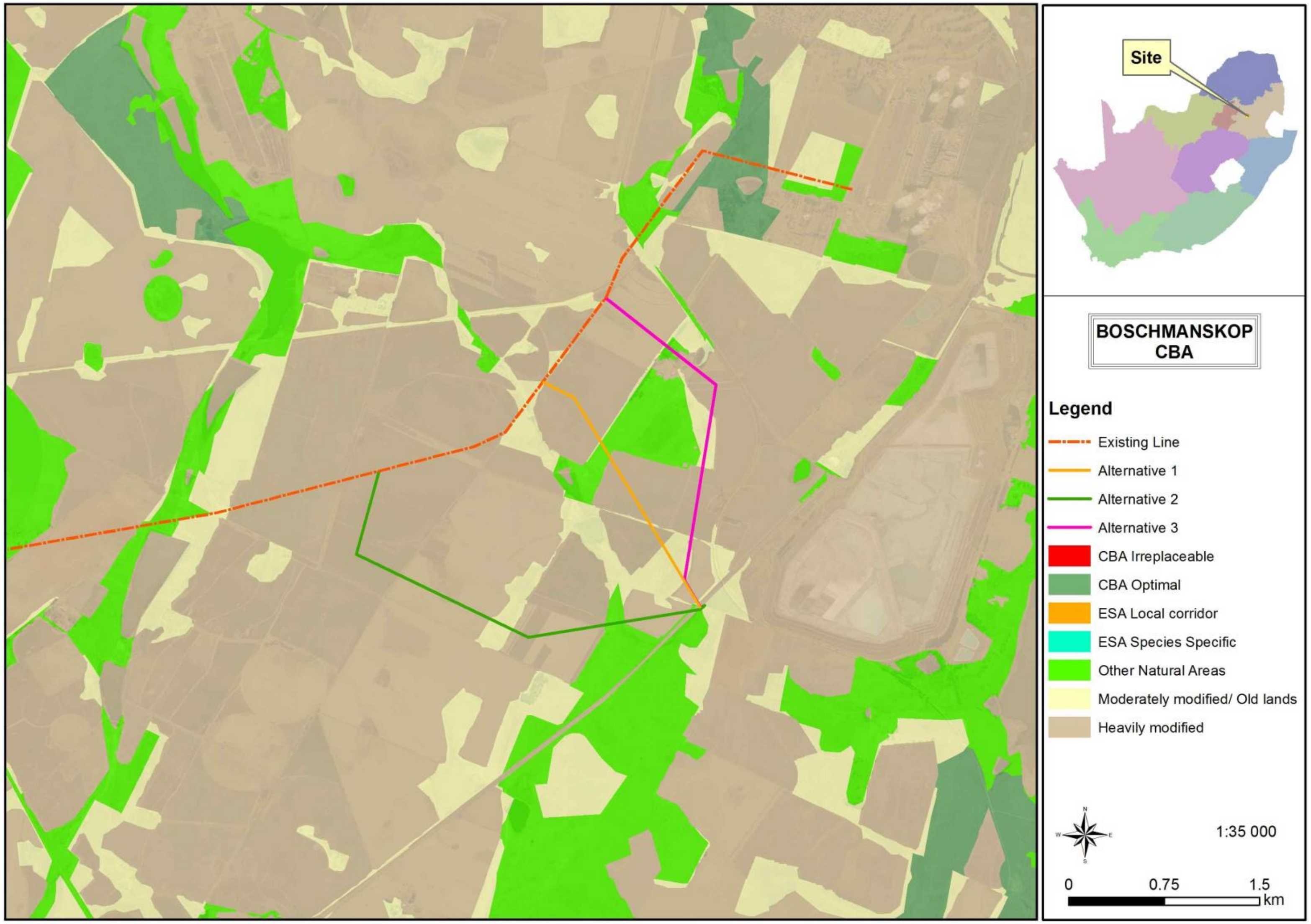


Figure 5: Critical biodiversity areas of the study site.

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, 2014) 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 6):

- 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.

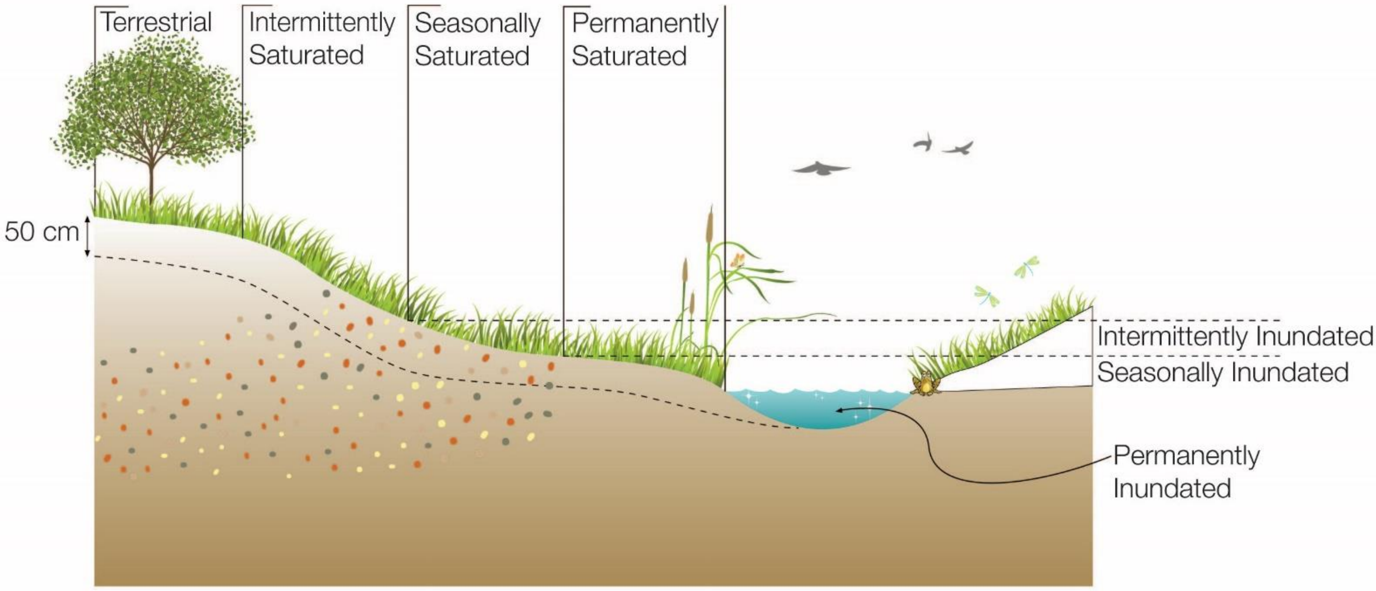


Figure 6: Typical cross section of a wetland (Ollis, 2013)

<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 8).

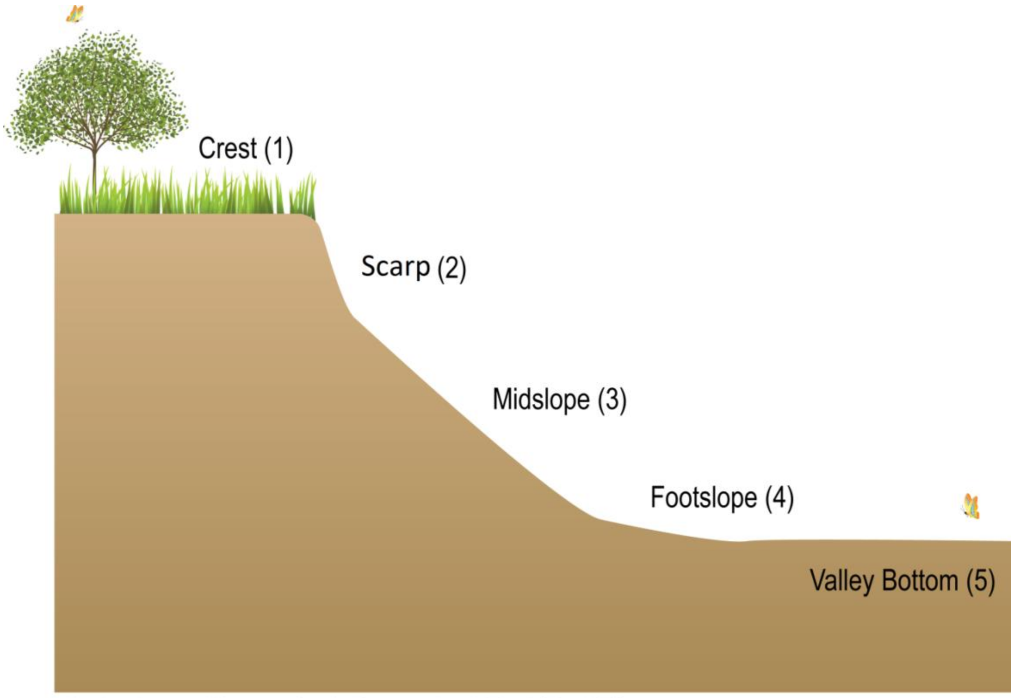


Figure 7. Terrain units (DWAF, 2005).

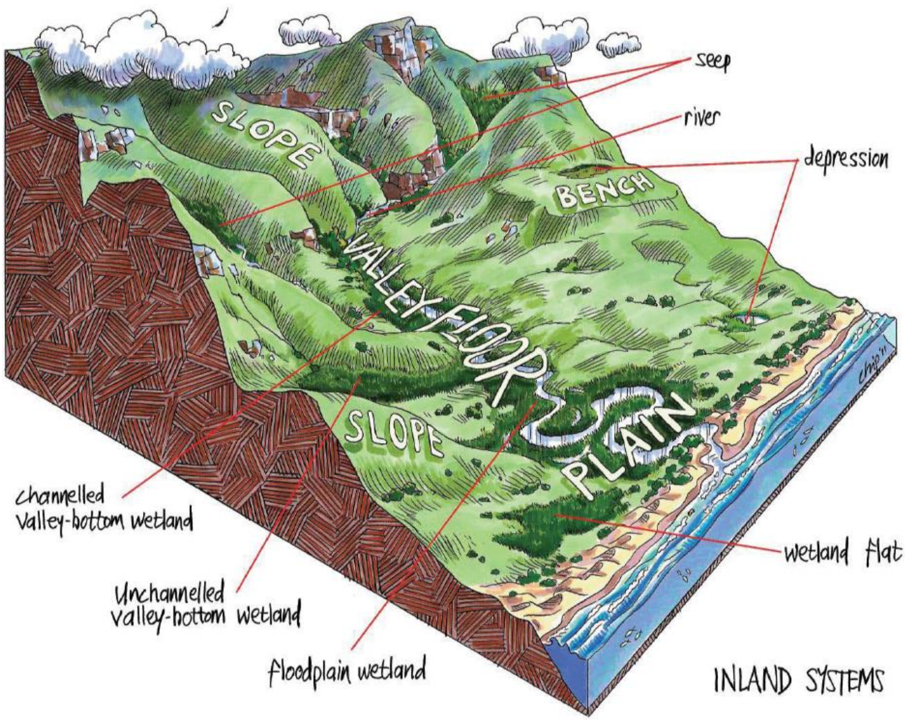


Figure 8: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

Riparian Area:

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 9) (Kotze, 1999).

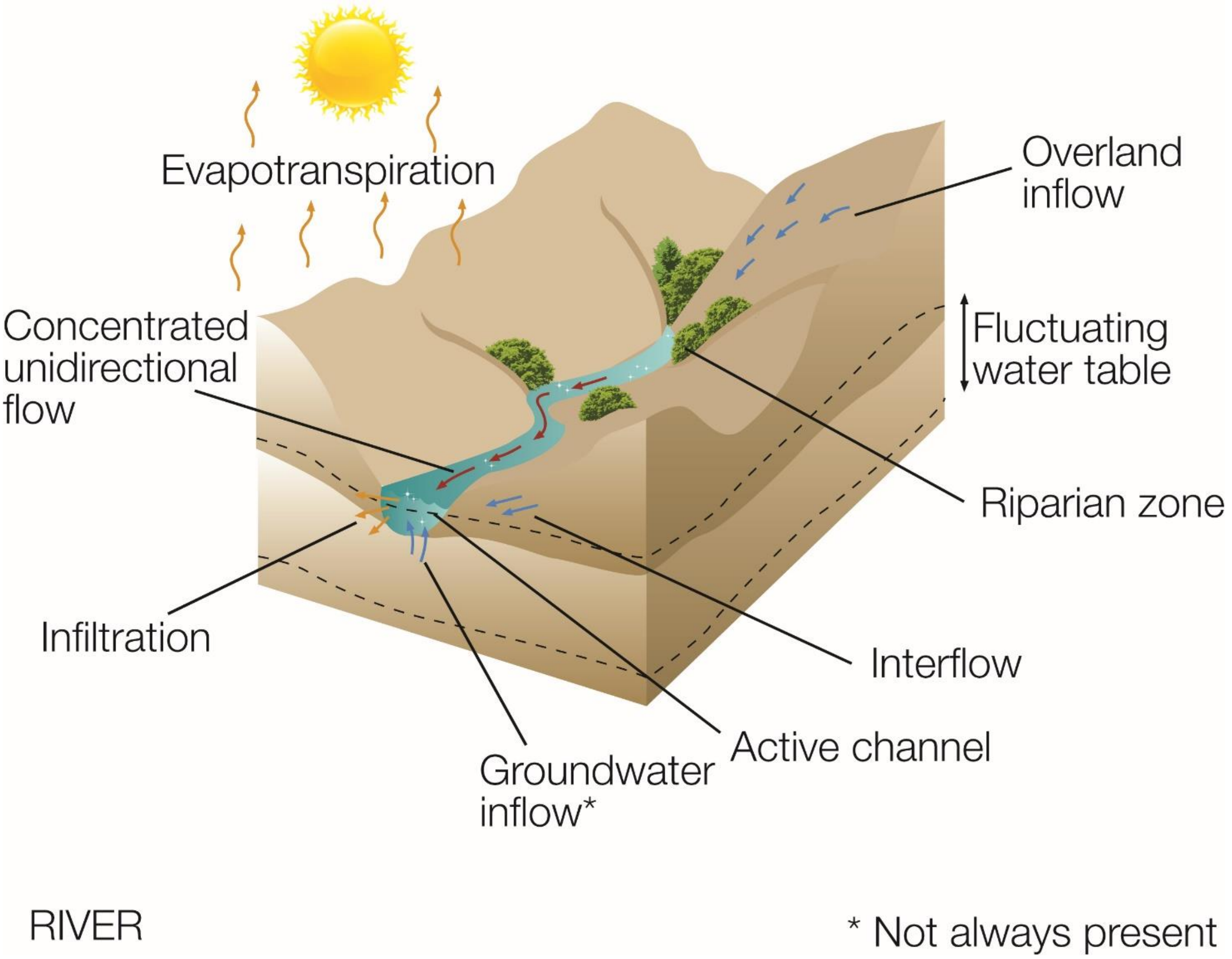


Figure 9: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

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 10). 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.

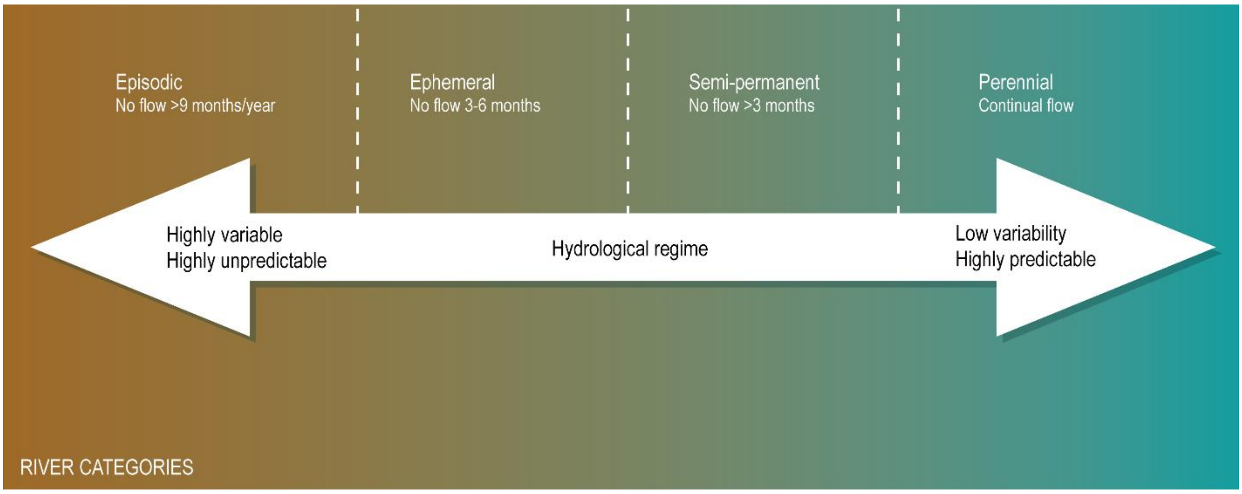


Figure 10: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

2.2 Wetland Classification and Delineation

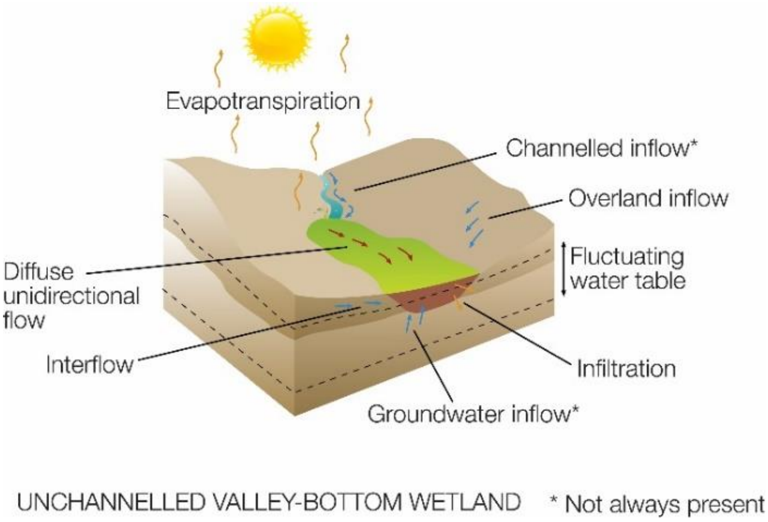
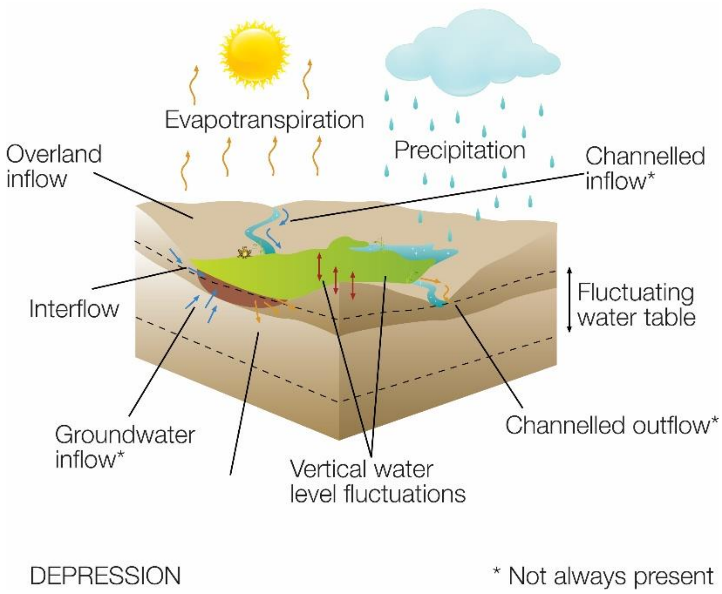
The classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ollis *et al*, 2013). The current wetland study follows the same approach by classifying wetlands in terms of a functional unit in line 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 classification of wetland areas found during the study (adapted from Brinson, 1993; Kotze, 1999, Marneweck and Batchelor, 2002 and DWAF, 2005) are as follows (Table 1):

Table 1: Wetland Hydro-geomorphic types and descriptions.

Hydro-geomorphic types	Description

Hydro-geomorphic types	Description
Valley bottom without a channel 	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.
Depressional pans 	Small (deflationary) depressions which are circular or oval in shape; usually found on the crest positions in the landscape. The topographic catchment area can usually be well-defined (i.e. a small catchment area following the surrounding watershed). Although often apparently endorheic (inward draining), many pans are "leaky" in the sense that they are hydrologically connected to adjacent valley bottoms through subsurface diffuse flow paths.

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 2 below.

Table 2: 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 from adjoining lands thus reducing the sediment load of surface waters. • 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. • 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. • 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.

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. In section 3.1 below the calculated buffer zones are discussed for each wetland. A representation of the placement of a buffer zone is presented in Figure 11 below.

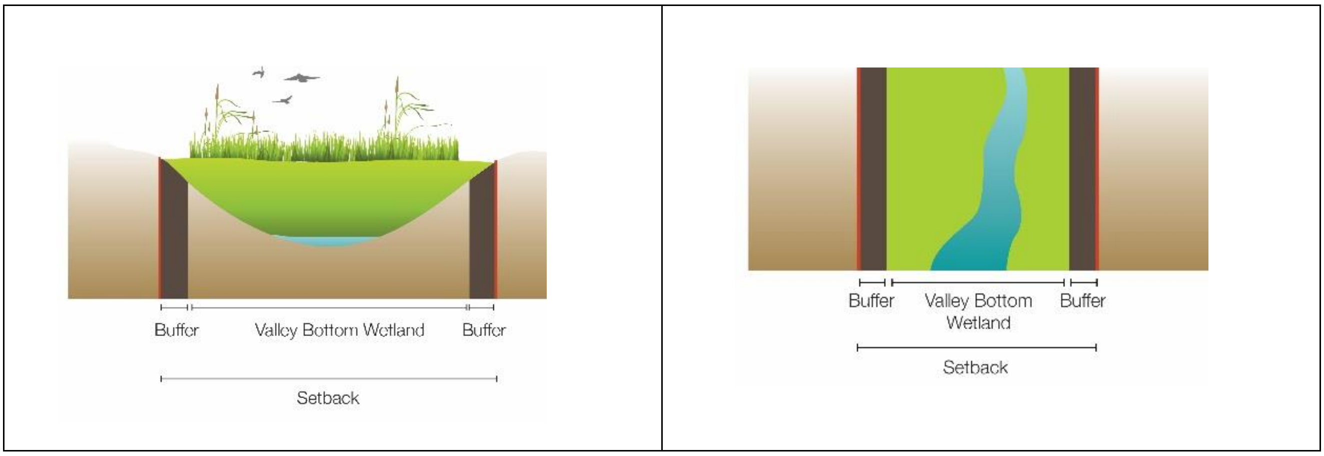


Figure 11: A represent the buffer zone setback for the wetland types discussed in this report

2.4 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). The impacts observed for the affected wetlands on the study site are summarised for each wetland under section 3.2. 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 *et al*, 2006).

2.4.1 Present Ecological Status (PES) – WET-Health

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 3).

Table 3: 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
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 4.

Table 4: 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	(↓↓)

2.4.2 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 DWS.

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.

The Ecological Importance and Sensitivity of the wetlands is represented are described in the results section. Explanations of the scores are given in Table 5.

Table 5: 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 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 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
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	>1 and <=2	C
Low/Marginal 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

2.4.3 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 Impact Assessments

2.5.1 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 6):

Table 6: Criteria for Assessment of Impacts

Severity (Magnitude)	
The severity of the impact is considered by examining whether the impact is destructive or benign, whether it destroys the impacted environment, alters its functioning, or slightly alters the environment itself. The intensity is rated as	
(I)nsignificant	The impact alters the affected environment in such a way that the natural processes or functions are not affected.
(M)oderate	The affected environment is altered, but functions and processes continue, albeit in a modified way.
(V)ery High	Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.
Duration	
The lifetime of the impact that is measured in relation to the lifetime of the proposed development.	
(T)emporary	The impact will either disappear with mitigation or will be mitigated through a natural process in a period shorter than that of the construction phase.
(S)hort term	The impact will be relevant through to the end of a construction phase (1.5–2 years).
(M)edium term	The impact will last up to the end of the development phases, where after it will be entirely negated.
(L)ong term	The impact will continue or last for the entire operational lifetime i.e. exceed 30 years of the development, but will be mitigated by direct human action or by natural processes thereafter.
(P)ermanent	This is the only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or in such a time span that the impact is transient.
Spatial scale	
Classification of the physical and spatial scale of the impact	
(F)ootprint	The impacted area extends only as far as the activity, such as the footprint occurring within the total site area.
(S)ite	The impact could affect the whole, or a significant portion of, the site.
(R)egional	The impact could affect the area including the neighbouring farms, the transport routes and the adjoining towns.
(N)ational	The impact could have an effect that expands throughout the country (South Africa).
(I)nternational	Where the impact has international ramifications that extend beyond the boundaries of South Africa.
Probability	
This describes the likelihood of the impacts actually occurring. The impact may occur for any length of time during the life cycle of the activity, and not at any given time. The classes are rated as follows:	
(I)mprobable	The possibility of the impact occurring is none, due either to the circumstances, design or experience. The chance of this impact occurring is zero (0 %).
(P)ossible	The possibility of the impact occurring is very low, due either to the circumstances, design or experience. The chance of this impact occurring is defined as 25%.
(L)ikely	There is a possibility that the impact will occur to the extent that provisions must therefore be made. The chance of this impact occurring is defined as 50%.
(H)ighly Likely	It is most likely that the impacts will occur at some stage of the development. Plans must be drawn up before carrying out the activity. The chance of this impact occurring is defined as 75%.
(D)efinite	The impact will take place regardless of any prevention plans, and only mitigation actions or contingency plans to contain the effect can be relied on. The chance of this impact occurring is defined as 100%.

In order to assess each of these factors for each impact, the following ranking scales were used (Table 7).

Table 7: Assessment Criteria: Ranking Scales

PROBABILITY		MAGNITUDE	
Description / Meaning	Score	Description / Meaning	Score
Definite/don't know	5	Very high/don't know	10
Highly probable	4	High	8
Probable	3	Moderate	6
Possible	2	Low	4
Improbable	1	Insignificant	2
DURATION		**SPATIAL SCALE**	
Description / Meaning	Score	Description / Meaning	Score
Permanent	5	International	5
Long Term	4	National	4
Medium Term	3	Regional	3
Short term	2	Local	2
Temporary	1	Footprint	1/0

Details of the significance of the various impacts identified are presented in Table 8 and Table 9.

Determination of Significance – With Mitigation

Determination of significance refers to the foreseeable significance of the impact after the successful implementation of the necessary mitigation measures. The Significance Rating (SR) is determined as follows:

Significance Rating (SR) = (Extent + Intensity + Duration) x Probability

Identifying the Potential Impacts without Mitigation Measures (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned probabilities, resulting in a value for each impact (prior to the implementation of mitigation measures). Significance without mitigation is rated on the following scale (Table 8):

Table 8: Significance Rating Scales without mitigation

SR < 30	Low (L)	Impacts with little real effect and which should not have an influence on or require modification of the project design or alternative mitigation. No mitigation is required.
30 < SR < 60	Medium (M)	Where it could have an influence on the decision unless it is mitigated. An impact or benefit which is sufficiently important to require management. Of moderate significance - could influence the decisions about the project if left unmanaged.
SR > 60	High (H)	Impact is significant, mitigation is critical to reduce impact or risk. Resulting impact could influence the decision depending on the possible mitigation. An impact which could influence the decision about whether or not to proceed with the project.

Identifying the Potential Impacts with Mitigation Measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it will be necessary to re-evaluate the impact. Significance with mitigation is rated on the following scale (Table 9):

Table 9: Significance Rating Scales with mitigation

SR < 30	Low (L)	The impact is mitigated to the point where it is of limited importance.
30 < SR < 60	Medium (M)	Notwithstanding the successful implementation of the mitigation measures to reduce the negative impacts to acceptable levels, the negative impact will remain of significance. However, taken within the overall context of the project, the persistent impact does not constitute a fatal flaw.
SR > 60	High (H)	The impact is of major importance. Mitigation of the impact is not possible on a cost-effective basis. The impact is regarded as high importance and taken within the overall context of the project, is regarded as a fatal flaw. An impact regarded as high significance after mitigation could render the entire development option or entire project proposal unacceptable.

3 RESULTS

3.1 Land Use and Land Cover

The study site is located on open land and is bordered by a railway and a dirt road. The areas surrounding the study site are predominantly farming land and mining areas with a large slime dam directly east of the study site. The area has been impacted by agriculture and farming from as early as 1963 (Figure 12). From this historical imagery it can be seen that the unchannelled valley bottom wetland was already dammed up in two areas compared to today's three areas. The pan wetland associated with Alternative 3 has been relatively unaffected by large scale impacts. Several moist areas can be seen from the historical aerial imagery, these areas have however been extensively farmed for at least 54 years and as a result wetness gradients can no longer be seen in the disturbed soil profile and these areas no longer considered function wetland areas.

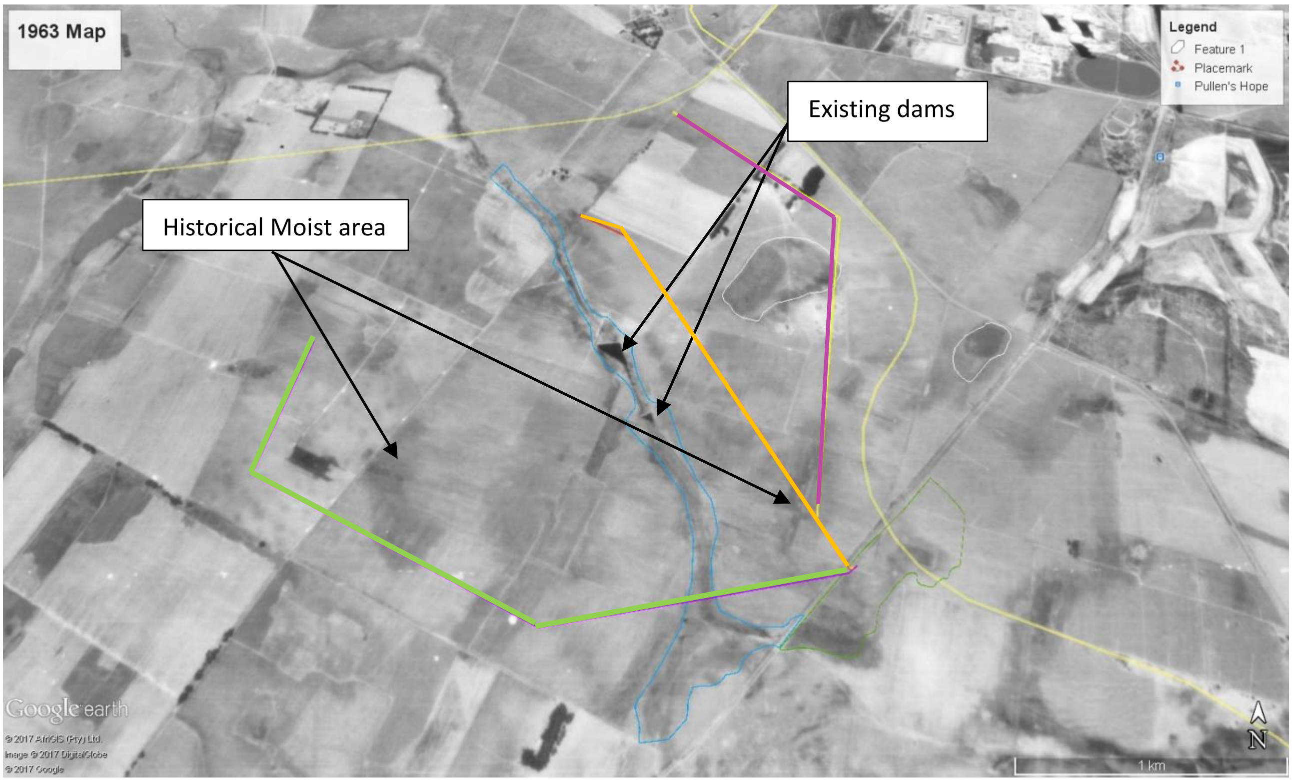


Figure 12: 1963 map of the study area.

3.2 Wetland/Riparian Classification and Delineation

Three wetland areas were recorded directly in line with the powerline alternatives or within 500 m of the powerlines (Figure 13). The wetlands recorded are classified as an unchannelled valley bottom wetland (associated with Alternative 2), a seepage wetland (associated with the existing substation) and a depressional pan wetland (associated with Alternative 3). The seepage wetland links up with an unchannelled valley bottom wetland south east from the study site (Figure 13). The seepage wetland has a drain located within it adjacent and parallel to the railway. The drain also extends over the railway in a western direction where it links up with the unchannelled valley bottom wetland. The unchannel valley bottom drains northwards into the Woes-Alleenspruit River which drains into the Klein Olifants River.

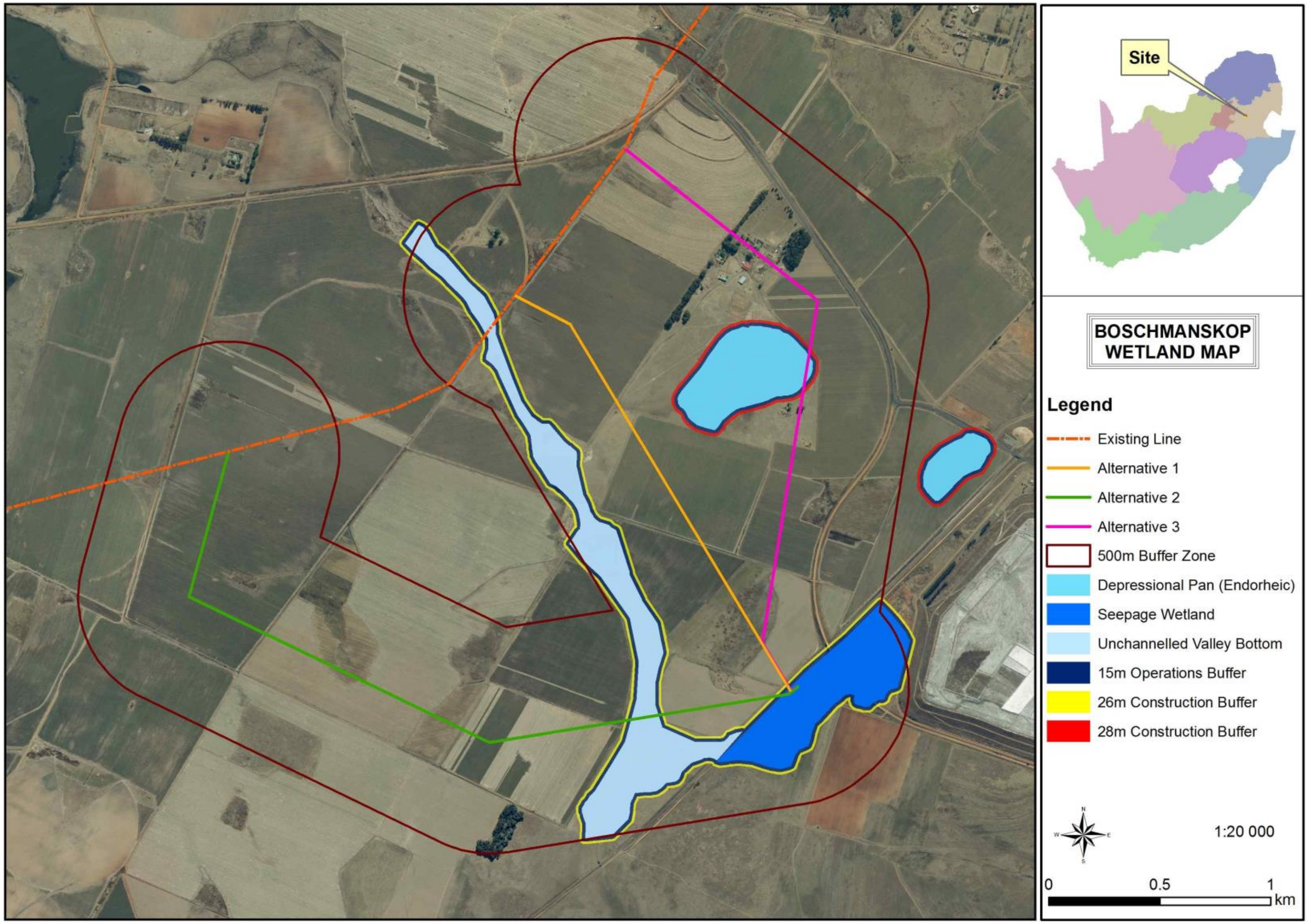


Figure 13: Delineated wetlands and their associated buffer zones relative to the powerline route alternatives.

3.2.1 Soil and Vegetation Indicators

Soil

Iron precipitation was recorded within and adjacent to the drain in the seepage wetland where standing water gathered (Figure 14). The soil of the upper areas of the seepage wetland was dominated by red and brown sandy soils with some root oxidation while the lower areas of the seepage area near the drain was dominated by grey sandy soils with clear mottling and root oxidation (Figure 15). Salt deposits were also recorded in some areas of the wetland. Some organic matter was recorded in the unchannelled valley bottom although limited to the upper 10 cm of the soil. The soil profile in some section of the wetlands near farming areas, especially the unchannelled valley bottom wetland, were disturbed due to prolonged farming.

Figure 14: Iron precipitation on standing water located near the drain in the seepage wetland.

Figure 15: Mottling recorded in the Seepage wetland.

A summary of the soil characteristics is given in the table below (Table 10):

Table 10: Summary of wetland conditions on site (Adapted from Job, 2010).

Site Conditions:	
Do normal circumstances exist on the site?	Yes
Is the site significantly disturbed (difficult site)?	Yes (Farming and Slime dam present)
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	No

Mottles or concretions	Yes
Organic streaking or oxidised rhizopheres	Yes
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 majority of vegetation in the seepage wetland was homogenous and dominated by dense stands of *Imperata cylindrica* and *Typha capensis* (Figure 16). The area near the drain where more water was present was dominated by *Juncus rigidus* with *Typha capensis* in the drain. Wetland grasses recorded on site include *Paspalum dilatum* and *Andropogon huilensis.* Exotic vegetation recorded on the site includes *Verbena bonariensis, Cortoderia selloana* and *Seriphium plumosus.* The drier areas were dominated by grasses such as *Hypparhenia hirta.*

The unchannelled valley bottom wetland was dominated by *Typha capensis, Persicaria lapathifolia, Phragmites australis, Schoenoplectus corymbosus, Imperata cylindrica.* Other species recorded include *Cyperus congestus, Pycreus macranthus, Eragrsotis plana, Paspalum urvillei, Monopsis decipiens* and *Crinum latifolium.*

The depressional pan was characterised by *Cynodon dactylon.* Other species recorded in the area include *Pycreus macranthus* and *Fimbristylis complanata.*

Exotic vegetation recorded on the study site includes *Stoebe plumosa, Acacia mearnsii, Verbena bonariensis* and *Cirsium vulgare.*

Figure 16: General vegetation characteristics of the wetlands on the study area.

3.3 Present Ecological Status (PES)

From the fieldwork conducted and the aerial imagery it can be seen that the seepage wetland and the unchannelled valley bottom wetland has been the most impacted followed by the depressional pan wetland. The seepage wetland has been impacted by the construction of a slime dam, a substation and various infrastructure located in the wetland. The unchannelled valley bottom has been impacted by prolonged farming practices as well as the construction of various infrastructure within the wetland. Furthermore, the unchannelled valley bottom wetland has been dammed up in three areas just within the study area. The pan has been left relatively intact over the years although its catchment has been greatly altered.

The combined PES scores for the **unchannelled valley bottom wetland** is **E - Largely modified**. 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). For the **Seepage wetland** combined PES scores is **D - Largely modified**. A large change in ecosystem processes and loss of natural habitat and biota has occurred (Macfarlane *et al*, 2007). And for the **pan** the combined PES scores is **C - Moderately modified**. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact. (Macfarlane *et al*, 2007). All of the wetlands are likely to remain stable over the next 5 years

The scores are summarised in the tables below (Table 11):

Table 11: Summary of hydrology, geomorphology and vegetation health assessment for the wetlands located on the proposed pipeline (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
Seepage Wetland	100	5.4	0	6.0	0	4.6	0	5.3	0
PES Category and Projected Trajectory		**D**	→	**E**	→	**D**	→	**D**	→
Unchannelled Valley Bottom	100	6.8	0	6.4	0	5.2	0	6.2	0
PES Category and Projected Trajectory		**E**	→	**E**	→	**D**	→	**E**	→
Depressional Pan	100	2.6	0	2.1	0	2.1	0	2.3	0
PES Category and Projected Trajectory		**C**	→	**C**	→	**C**	→	**C**	→

Ecological Importance and Sensitivity (EIS)

The EIS scores for the wetlands studied during the study site visit are summarised below (Table 12 - Table 14). The **seepage and depressional 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). The **unchannelled valley bottom score a B (High)** - 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 (DWAF, 1999).

Table 12: WIS scores obtained for the Seepage wetland on the study site including the EIS score (DWAF, 1999).

Wetland	WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Seepage Wetland	Ecological importance & sensitivity	1.2	3.0
	Hydro-functional importance	1.6	3.0
	Direct human benefits	0.5	3.0
	EIS score	**1.2 C**	

Table 13: WIS scores obtained for the unchannelled valley bottom wetland on the study site including the EIS score (DWAF, 1999).

Wetland	WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Unchannelled Valley Bottom	Ecological importance & sensitivity	2.7	3.0
	Hydro-functional importance	1.9	3.0
	Direct human benefits	0.5	3.0
	EIS score	**2.7 B**	

Table 14: WIS scores obtained for the pan on the study site including the EIS score (DWAF, 1999).

Wetland	WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Depressional Pan	Ecological importance & sensitivity	1.4	3.0
	Hydro-functional importance	1.3	3.0
	Direct human benefits	0.5	3.0
	EIS score	**1.4 C**	

Details for the components assessed in the combined EIS score are presented in Appendix B.

The ecosystem services provided by the wetlands on the study site is summarised in the table below (Table 15 – Table 17). The table is listed from the lowest scores to the highest scores:

Table 15: Results and brief discussion of the Ecosystem Services provided by the seepage wetland

Function	Score	Significance
Cultural significance	0,0	Low
Education and research	0,3	Low
Natural resources	0,4	Low
Cultivated foods	0,4	Low

Function	Score	Significance
Tourism and recreation	0,6	Low
Opportunities	1,0	Low
Streamflow regulation	1,5	Moderately Low
Maintenance of biodiversity	1,5	Moderately Low
Water supply for human use	1,6	Moderately Low
Carbon storage	1,7	Moderately Low
Flood attenuation	2,0	Moderate
Threats	2,0	Moderate
Sediment trapping	2,1	Moderately High
Phosphate trapping	2,1	Moderately High
Toxicant removal	2,2	Moderately High
Nitrate removal	2,3	Moderately High
Erosion control	2,5	Moderately High

Table 16: Results and brief discussion of the Ecosystem Services provided by the unchannelled valley bottom wetland

Function	Score	Significance
Cultural significance	0,0	Low
Education and research	0,3	Low
Natural resources	0,4	Low
Cultivated foods	0,4	Low
Opportunities	1,0	Low
Water supply for human use	1,6	Moderately Low
Tourism and recreation	1,6	Moderately Low
Streamflow regulation	1,8	Moderately Low
Sediment trapping	1,8	Moderately Low
Threats	2,0	Moderate
Phosphate trapping	2,2	Moderately High
Toxicant removal	2,3	Moderately High
Carbon storage	2,3	Moderately High
Maintenance of biodiversity	2,3	Moderately High
Flood attenuation	2,4	Moderately High
Nitrate removal	2,5	Moderately High
Erosion control	2,5	Moderately High

Table 17: Results and brief discussion of the Ecosystem Services provided by the pan wetland

Function	Score	Significance
Cultural significance	0,0	Low
Streamflow regulation	0,3	Low
Education and research	0,3	Low
Natural resources	0,4	Low
Cultivated foods	0,4	Low
Water supply for human use	0,7	Low
Opportunities	1,0	Low
Tourism and recreation	1,1	Moderately Low
Maintenance of biodiversity	1,4	Moderately Low
Nitrate removal	1,5	Moderately Low
Sediment trapping	1,7	Moderately Low
Phosphate trapping	1,7	Moderately Low
Toxicant removal	1,7	Moderately Low
Carbon storage	1,7	Moderately Low

Function	Score	Significance
Erosion control	1,8	Moderately Low
Flood attenuation	2,0	Moderate
Threats	2,0	Moderately High

3.4 Summary of Findings

Table 18 provides a summary of the results recorded for each wetland unit potentially affected by the proposed powerline upgrade.

Table 18: Summary of results for each wetland unit discussed

Classification (Ollis *et al*, 2013)	PES (Macfarlane *et al*, 2007)	EIS (DWAF, 1999)	WetEcoServices (3 most prominent scores)	Generic Buffer (GDARD, 2014)	Scientific Buffer (Macfarlane et al 2015)
Seepage Wetland	5.3 D	1.2 C	Toxicant removal 2,2 Nitrate removal 2,3 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Unchannelled Valley Bottom	6.2 E	2.7 B	Flood attenuation 2,4 Nitrate removal 2,5 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Depressional Pan	2.3 C	1.4 C	Erosion control 1,8 Flood attenuation 2,0 Threats 2,0	30 m	28 m (Construction) 15 m (Operational)

3.5 Impacts and Mitigation

A development has several impacts on the surrounding environment and particularly on a river. 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 19 – Table 20.

Table 19: Changes in sediment entering and exiting the system impact ratings

Nature: Changes in sediment entering and exiting the system. This impact is equally relevant to each alternative		
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: • Earthwork activities during structure construction and upgrade • Disturbance of soil surface including soil compaction • Disturbance of slopes through creation of access roads and tracks adjacent to the wetland		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly probable (4)	Probable (3)
Duration	Long-term (4)	Medium-term (3)
Extent	Regional (3)	Limited to Local Area (2)
Magnitude	High (8)	Moderate (6)
Significance	**60 (high)**	**33 (moderate)**
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 (3)	Low (3)
Significance	**24 (low)**	**14 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • *In the case of Alternative 1 where the proposed line runs parallel to the valley bottom wetland, particular care should be taken during the construction phase to prevent sediment ingress into the wetland by installing temporary sediment barriers and effective monitoring* • Pylons/towers should not be located in the wetlands or their buffer zone • Prevent access of heavy vehicles and machinery in the wetlands • Work in wet conditions should be avoided • 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 high unless effective mitigation measures are applied. Refer to the accompanying General Monitoring and Rehabilitation report.		
Residual Risks: Expected to high unless the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.		

Table 20: Changes in water /hydrology

Nature: Changes in the hydrology of wetlands also impacts downstream areas.
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 the wetland
- Disturbance of vegetation cover through trampling
- Creation of additional access roads, particularly parallel to wetlands

	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	High (8)	Moderate (6)
Significance	**42 (medium)**	**20 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Possible (2)	Possible (2)
Duration	Long-term (4)	Short-term (2)
Extent	Regional (3)	Limited to Local Area (2)
Magnitude	High (8)	Moderate (6)
Significance	**30 (medium)**	**20 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Prevent access of heavy vehicles and machinery in the wetlands
- Rehabilitation plans must be submitted and approved for rehabilitation of damage during upgrade 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
- Source-directed controls

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

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

Table 21: 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	High (8)	Low (4)
Significance	**70 (high)**	**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	High (8)	Low (4)
Significance	**45 (moderate)**	**10 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Weed control
- 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.
- 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.
- Rehabilitate or revegetate disturbed areas

Cumulative impacts: Expected to be high to moderate. 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 moderate provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

4 CONCLUSION

Three wetland areas were recorded directly in line with the powerline alternatives or within 500 m of the powerlines. The wetlands recorded are classified as an unchannelled valley bottom wetland (crossed by Alternative 2), a seepage wetland (associated with the existing substation and with Alternatives 1 and 2) and a depressional pan wetland (crossed by Alternative 3) The seepage wetland links up with an unchannelled valley bottom wetland south east from the study site. The seepage wetland has a drain located within it adjacent and parallel to the railway. The drain also extends over the railway in a western direction where it links up with the unchannelled valley bottom wetland. The unchannel valley bottom drains northwards into the Woes-Alleenspruit River which drains into the Klein-Olifants River.

From the fieldwork conducted and the aerial imagery it can be seen that the seepage wetland and the unchannelled valley bottom wetland has been the most impacted followed by the depressional pan wetland. The seepage wetland has been impacted by the construction of a slime dam, a substation and various infrastructure within the wetland. The unchannelled valley bottom has been impacted by prolonged farming practices as well as the construction of various infrastructure within the wetland. Furthermore, the unchannelled valley bottom wetland has been dammed up in three areas just within the study area. The pan has been left relatively intact over the years although the catchment has been greatly altered.

The main impacts that were recorded during the site visits include farming, mining, drains and roads. A summary of the results of the wetland functional assessment are presented in Table 22 below:

Table 22: Summary of the function and integrity scores

Classification (Ollis *et al*, 2013)	PES (Macfarlane *et al*, 2007)	EIS (DWAF, 1999)	WetEcoServices (3 most prominent scores)	Generic Buffer (GDARD, 2014)	Scientific Buffer (Macfarlane et al 2015)
Seepage Wetland	5.3 D	1.6 C	Toxicant removal 2,2 Nitrate removal 2,3 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Unchannelled Valley Bottom	6.2 E	2.7 B	Flood attenuation 2,4 Nitrate removal 2,5 Erosion control 2,5	30 m	26 m (Construction) 15 m (Operational)
Depressional Pan	2.3 C	1.4 C	Erosion control 1,8 Flood attenuation 2,0 Threats 2,0	30 m	28 m (Construction) 15 m (Operational)

The important findings discussed in this report are summarised in Table 23 below:

Table 23: Summary of important findings

	Quaternary Catchment and WMA areas	Important Rivers possibly affected	Buffers
	B12B, 2nd, Olifants WMA	Seepage wetland and Unchannelled valley wetland drains into the Woes-Alleenspruit River.	Scientific buffer (Macfarlane *et al*, 2014) is calculated as 15 m during operation and 28 m 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. Sedimentation during the construction phase has a high impact before mitigation and a moderate impact after mitigation.		
Does the specialist support the development?	• Alternative 1 is the preferred choice as it crosses no wetland areas. It does however run parallel to the valley bottom wetland and this should be factored in to potential impacts that should be mitigated and monitored • Alternative 2 & 3 are the second preferred options. However, impacts associated with these lines can be effectively mitigated or rehabilitated and should not cause permanent damage to regional hydrological systems		
Major concerns	Sediment input into the wetlands and downstream areas Colonisation of exotic vegetation Compaction of soil Erosion		
Recommendations	Effective mitigation measures should be implemented throughout the development as set out in the accompanying General Rehabilitation and Monitoring Plan.		
CBA and other Important areas	• Other Natural areas • Moderately modified/Old Lands • Heavily Modified (Majority of study site)		

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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 24: Ecological Importance and Sensitivity Calculations (Seepage wetland)

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	2	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	1	4.00	Wetland is not rare or very large	Identification and rareity assessment of the wetland types
Diversity of habitat types	1	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	No Seepage area	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	No Seepage area water inputs from slime dam	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	1	4.00	No Seepage area water inputs from slime dam	Esp naturally low nutrient waters - lower nutrients likely to be more sensitive

ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.0**	**4.0**		

Table 25: Hydrological Functional Importance Calculations (Seepage Wetland)

HYDRO-FUNCTIONAL IMPORTANCE			**Score (0-4)**	**Confidence (1-5)**	**Motivation**	**Scoring Guideline**
Regulating & supporting benefits	Flood attenuation		2	2	Seepage area has a large area to spread out water	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	Slime dam adjacent, robust vegetation layer helps abosrb	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			**1.6**	**2.5**		

Table 26: Direct Human Benefits Calculations (Seepage wetland)

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**		

Table 27: Ecological Importance and Sensitivity Calculations (Unchannelled valley bottom)

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Biodiversity support		4.00		
Presence of Red Data species	3	4.00	Crinum species recorded	Endangered or rare Red Data species presence
Populations of unique species	3	4.00	Crinum species recorded	Uncommonly large populations of wetland species
Migration/breeding/feeding sites	3	4.00	Numerous bird nesting sites recorded	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	1	4.00	Wetland is not rare or very large	Identification and rareity assessment of the wetland types
Diversity of habitat types	1	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	Unchannelled valley bottom with numerous dams	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	Unchannelled valley bottom with numerous dams	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	1	4.00	Unchannelled valley bottom with numerous dams	Esp naturally low nutrient waters - lower nutients likely to be more sensitive
ECOLOGICAL IMPORTANCE & SENSITIVITY	**3.0**	**4.0**		

Table 28: Hydrological Functional Importance Calculations (Seepage Wetland)

HYDRO-FUNCTIONAL IMPORTANCE		**Score (0-4)**	**Confidence (1-5)**	**Motivation**	**Scoring Guideline**
Regulating & supporting benefits	Flood attenuation	2	2	Wetland with large buffer area and open land for flooding as well as dams	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	Adjacent to farming areas thus an increase in sediment and foreign material	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		1	3	Thin layer of organic material	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**1.9**	**2.5**		

Table 29: Direct Human Benefits Calculations (Seepage wetland)

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**		

Table 30: Ecological Importance and Sensitivity Calculations (Depressional Pan)

ECOLOGICAL IMPORTANCE AND SENSITIVITY	Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Biodiversity support		4.00		
Presence of Red Data species	1	4.00	Unlikely	Endangered or rare Red Data species presence
Populations of unique species	1	4.00	Unlikely	Uncommonly large populations of wetland species
Migration/breeding/feeding sites	1	4.00	Few recorded	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	1	4.00	Wetland is not rare or very large	Identification and rareity assessment of the wetland types
Diversity of habitat types	1	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	Depressional Pan	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	Depressional Pan	Unchannelled VB's probably most sensitive
Sensitivity to changes in water quality	1	4.00	Depressional Pan	Esp naturally low nutrient waters - lower nutrients likely to be more sensitive
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.3**	**4.0**		

Table 31: Hydrological Functional Importance Calculations (Depressional Pan)

HYDRO-FUNCTIONAL IMPORTANCE			Score (0-4)	Confidence (1-5)	Motivation	Scoring Guideline
Regulating & supporting benefits	Flood attenuation		1	2	Wetland with large buffer area and open land for flooding as well as dams	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	1	2	Adjacent to farming areas thus an increase in sediment and foreign material	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

			Score	Confidence	Motivation	Scoring Guideline
		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		1	3	Clay soil	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE			**1.4**	**2.5**		

Table 32: Direct Human Benefits Calculations (Seepage wetland)

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
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- 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
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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)