Proposed Construction of a 5MW 3Kv DC Transnet Substation, Rietkuil, near Rietkuil, Mpumalanga Province.

Wetland/Riparian Delineation and Functional Assessment
June 2015 (Updated July 2015)

Drafted by
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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.

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2015.06.23
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.

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Qualification of Specialists

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EXECUTIVE SUMMARY

Limosella Consulting (Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake a wetland delineation and functional assessment for the Proposed Construction of a 5MW 3Kv DC Transnet Substation Rietkuil, near Rietkuil, Mpumalanga Province. Fieldwork was conducted on the 2nd of June 2015.

The terms of reference for the study were as follows:

- Delineate the wetland areas;
- Classify the watercourse according to the system proposed in the national wetlands inventory if relevant,
- Undertake the functional assessment of wetlands areas within the area assessed;
- Recommend suitable buffer zones; and
- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland areas on the site.

Currently a large unchannelled valley bottom wetland is located on site with two dams located within the wetland. The wetland is delineated up to 600 m from the substation although it extends farther north and east. The northern section of the wetland is linked to the Bosmanspruit. From historical aerial imagery from 2003 it is clear that the wetland area was not as large as it is currently and no dams existed. However, in 2014 two large dams can be seen south of the study site as well as large wet areas. It is unclear if the wetland is natural or as a result of drains and the possible construction of dams adjacent to the study site. In order to determine the origin of the wetland it is suggested that piezometers be installed within the wetland. Piezometer are also suggested to be installed within the adjacent farming lands in order to determine if there is any ground water movement within the first 50 cm in order to classify these areas as wetlands since natural wetland indicators have been transformed in these areas.

The current study site (including the alternative site) thus falls directly within the wetland area and is thus not an ideal site. Even if the wetland is found to be artificial it is likely to remain present for a long period. It is advised that a more suitable area for a new substation would be in close association with the coal deposit area as this area is already greatly disturbed.

Wetland/Riparian area	Approximate central coordinates	Present Ecological Score (PES) and Ecological Importance and Sensitivity (EIS) Scores
Unchannelled Valley Bottom	25°54'47.03"S and 29°47'5.91"E	PES: 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.
		EIS: Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale.

Wetland/Riparian area	Approximate central coordinates	Present Ecological Score (PES) and Ecological Importance and Sensitivity (EIS) Scores
		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).

Expected impacts to the preferred site and the alternative site are the same due to the proximity of the two sites. Broad potential impacts that may be associated with the proposed development include:

- Changing the quantity and fluctuation properties of the watercourse by changing runoff characteristics of the area surrounding the wetland/riparian area (by for example compacting soils)
- Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)
- Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate)
- Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons
- Changing the physical structure within a water resource (habitat) including its associated buffer zone

These mitigation measures should be refined when the final layout plan becomes available in order to mitigate more specific areas of concern.

In order to limit the impact on the hydrology of the area, the current assessment finds that a 50 m buffer zone should be recognised from the edge of all the riparian area. The wetland area is located within the riparian area and therefore shares the same buffer. Where construction of access roads and the construction activities within the 1:100 year floodline or the riparian area (whichever is the greatest), as well as within wetlands and associated buffers is unavoidable and a Water Use License granted, the buffer areas should still be respected as an area where impacts must be kept to an absolute minimal. The buffer areas should be clearly marked during construction and workers must be informed that activities and traffic beyond the buffer zone must be limited to only that which is necessary.

Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (Regulation 1199 of 2009 in terms of the National Water Act, 1998). Development activities close to wetlands are excluded from General Authorisation (GA) for Section 21 (c) and (i) water uses (published in Government Gazette No. 389). In this instance the Department of Water Affairs should be contacted regarding the application for a Water Use License.

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1 INTRODUCTION

Limosella Consulting (Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake a wetland delineation and functional assessment for the Proposed Construction of a 5MW 3Kv DC Transnet Substation Rietkuil, near Rietkuil, Mpumalanga Province. Fieldwork was conducted on the 2nd of June 2015.

1.1 Terms of Reference

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- Discuss potential impacts, mitigation and management procedures relevant to the conserving wetland areas on the site.

1.2 Assumptions and Limitations

The recreation grade GPS used for wetland and riparian delineations is accurate to within five meters. Therefore, the 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.

Furthermore, the assessment of wetlands is based on environmental indicators such as vegetation, that are subjected to seasonal variation as well as factors such as fire and drought. Although background information was gathered, the information provided in this report was mainly derived from what was observed on the study site at the time of the field survey. A Red Data scan, fauna and flora, and aquatic assessments were not included in the current study. Description of the depth of the regional water table and geohydrological processes falls outside the scope of the current assessment. Wetlands located within 500 m of a study site is not delineated during site visits but rather estimated through aerial imagery. Where possible wetlands within 500 m are assessed during the site visit for impacts rather than species and soil composition to minimise time spent outside of the study areas where the highest impacts can be expected. The study was conducted in the winter month of June and numerous wetland vegetation could not be identified due to not being in flower, furthermore large sections surrounding the site was fenced off or off limits and could not be studied. Extrapolation was used to delineate these areas. A section of the study area was off-limits according to Transnet staff and security due to subsidence risks and only limited sampling took place within this area. The areas without access are displayed in Appendix C.

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 Affairs (DWA). The NWA sets out a range of water use related principles that are to be applied by DWA 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 perform 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 DWA 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 Notices R.1198 and R.1199 of 18 December 2009. GN 1198 and 1199 of 2009 grants General Authorisation (GA) for the above water uses on certain conditions:
GN R.1198: Any activity in a wetland for the rehabilitation of a wetland for conservation purposes.
GN R.1199: Any activity more than 500 m from the boundary of a wetland.

These regulations also stipulate that these 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. Wetlands situated within 500 m of proposed activities should be regarded as sensitive features potentially affected by the proposed development (GN 1199). 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).

1.4 Locality of the study site

The site is located approximately 4 km north of Arnot Power Station.The N4 lies approximately 9km to the north of the site. A Transnet railway forms the southern border of the site. The approximate central coordinates of the study site are 25°54'52.69"S and 29°47'3.37"E. An existing substation is located on the study site. The upgraded area will be approximately 80 m x 80 m. An alternative site lies approximately 20m to the west of the existing infrastructure (Figure 1). Figure 2 shows the location of the study area.

Figure 1: Position of the site and alternative on either side of the existing infrastructure

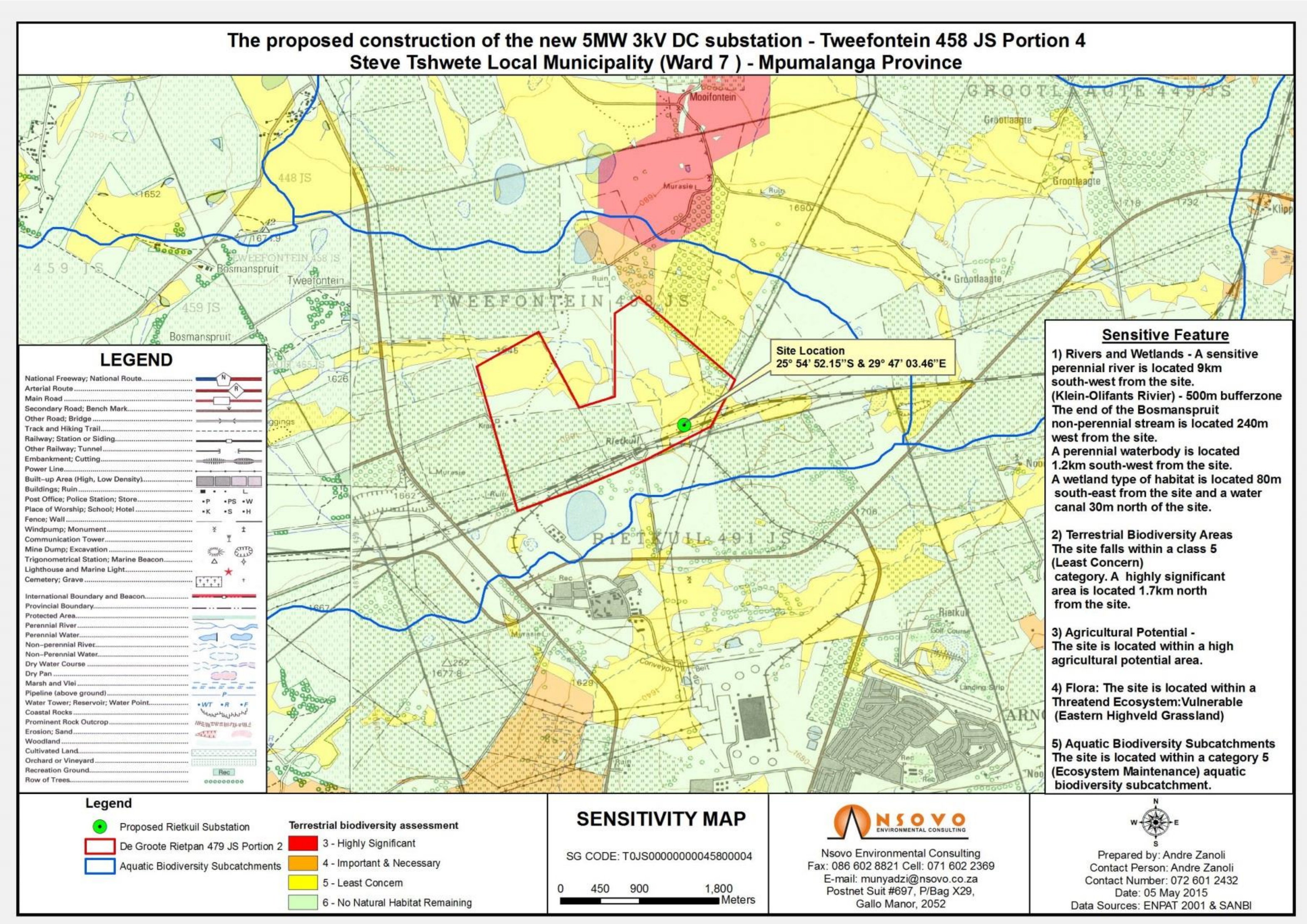

Figure 2: Locality Map

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.

Nineteen Water management areas were established by, and their boundaries defined in Government Notice No. 1160 on 1st October 1999. Quaternary Catchment B12B falls within the fourth (4) WMA and is classified as the Olifants WMA. The major rivers that are located within this WMA include the Elands, Wilge, Steelpoort and Olifants Rivers.

Hydrology:

The NFEPA spatial layer indicates a non-perennial river (Bosmanspruit) approximately 250 m North-West of the site.

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 Ba19 (AGIS. Date unknown) and the soil class is S17 (ENPAT, date unknown). S17 soils class is an association of Classes 1 to 4 and is characterised by undifferentiated structureless soils, red or yellow structureless soils with a plinthic horizon and is known to have favourable water-holding properties. The soil type Ba19 is characterised by Plinthic catena: dystrophic and/or mesotrophic; red soils widespread, upland duplex and margalitic soils rare.

Furthermore it is also characterised by mainly shale, grit, sandstone and conglomerate (Ecca Group); volcanic rocks (Selonsrivier Formation, Rooiberg Group); granophyre (Rashoop Suite, Bushveld Complex); ferro-gabbro, ferro-diorite and diorite (Rustenburg Suite, Bushveld Complex) and rhyolite (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 2007). 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 an area known as an area that is of least concerned.

2 METHODOLOGY

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

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

2.1 Wetland and Riparian Delineation

Wetlands are identified based on the following characteristic attributes (DWAF, 2005) (Figure 3):

- 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.

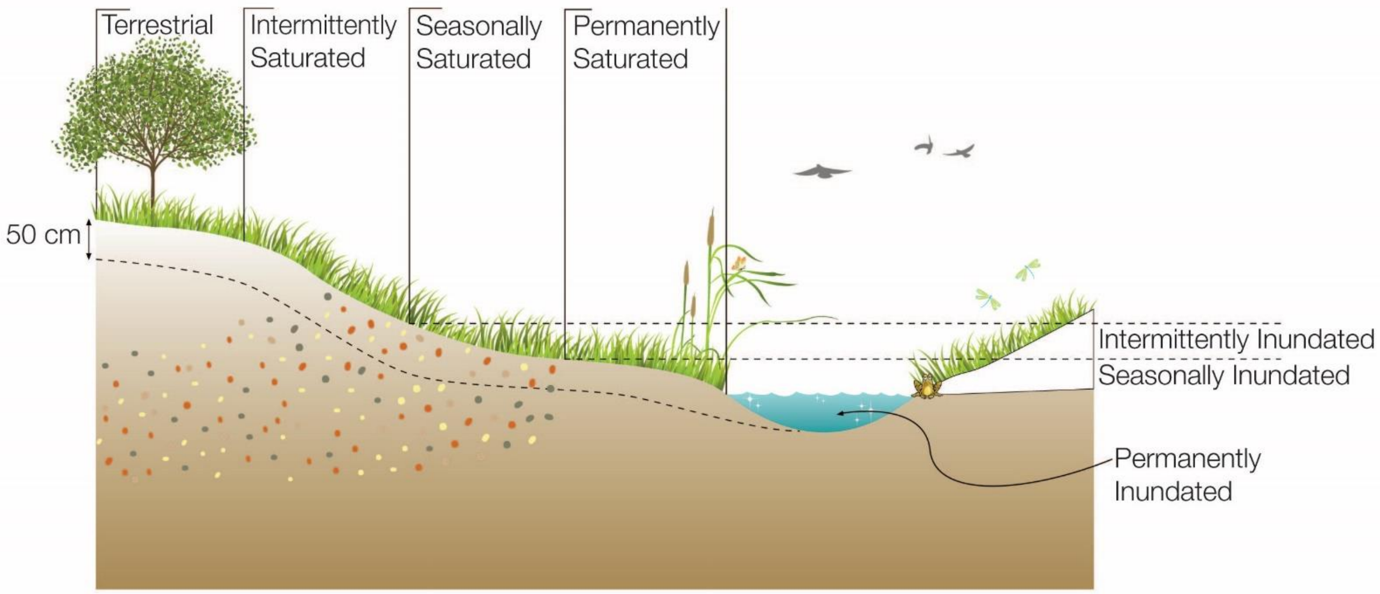

Figure 3: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 4) 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 5).

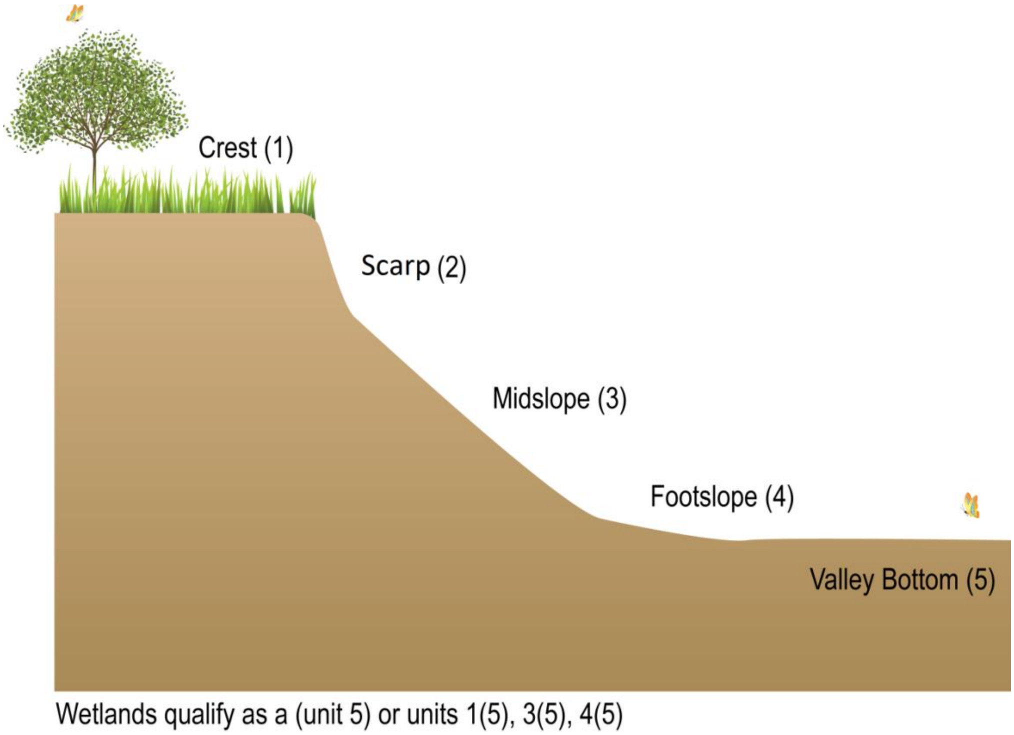

Figure 4. Terrain units (DWAF, 2005).

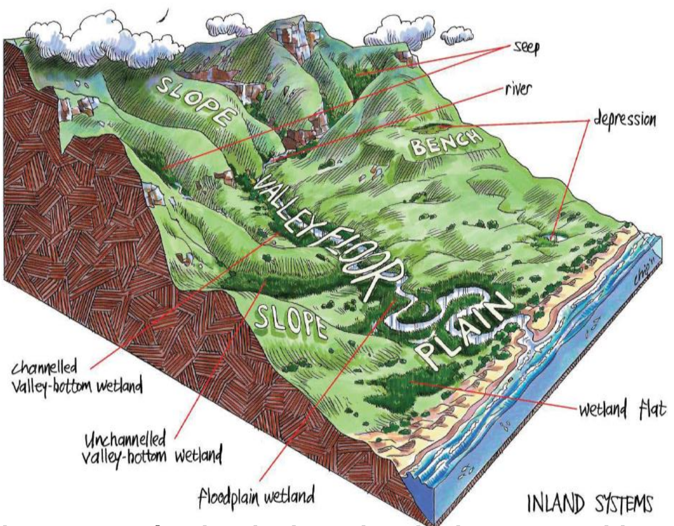

Figure 5: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

Difficult to Delineate Wet Areas

Table 1 summarises the types of difficult wetland/ wetland-like areas.

Table 1: List of types of sites that are difficult to delineate. (Jobs, 2009)

Type of "difficult site"	Approach
Some or all, wetland indicators are present but is a non-natural wetland (e.g. some dams, road islands)	• Decide on the relative permanence of the change and whether the area can now be said to be functioning as a wetland. • Time field observations during the wet season, when natural hydrology is at its peak, to help to differentiate between naturally-occurring versus human-induced wetland. • Decide appropriate policy/management i.e. can certain land uses be allowed due to "low" wetland functional value, or does the wetland perform key functions despite being artificial.
Indicators of soil wetness are present but no longer a functioning wetland (e.g. wetland has been drained)	• Look for evidence of ditches, canals, dikes, berms, or subsurface drainage tiles. • Decide whether or not the area is currently functioning as a wetland.
Indicators of soil wetness are present but no longer a functioning wetland (e.g. relic / historical wetland)	• Decide whether indicators were formed in the distant past when conditions were wetter than the area today. • Obtain the assistance of an experienced soil scientist.
Some, or all, wetland indicators are absent at certain times of year (e.g. annual vegetation or seasonal saturation)	• Thoroughly document soil and landscape conditions, develop rationale for considering the area to be a wetland. • Recommend that the site be revisited in the wet season.
Some, or all, wetland indicators are absent due to human disturbance (e.g. vegetation has been cleared, wetland has been ploughed or filled)	• Thoroughly document landscape conditions and any remnant vegetation, soil, hydrology indicators, develop rationale for considering the area to be wetland. • Certain cases (illegal fill) may justify that the fill be removed and the wetland rehabilitated.

Riparian Indicators

Riparian habitat is classified primarily by identifying riparian vegetation along the edge of the macro stream channel. The macro stream channel is defined as the outer bank of a compound channel and should not be confused with the active river bank. The macro channel bank often represents a dramatic change in the energy with which water passes through the system. Rich alluvial soils deposit nutrients making the riparian area a highly productive zone. This causes a very distinct change in vegetation structure and composition along the edges of the riparian area (DWAF, 2008). The marginal zone includes the area from the water level at low flow, to those features that are hydrologically activated for the greater part of the Year (WRC Report No TT 333/08 April, 2008). The non-marginal zone is the combination of the upper and lower zones (Figure 6).

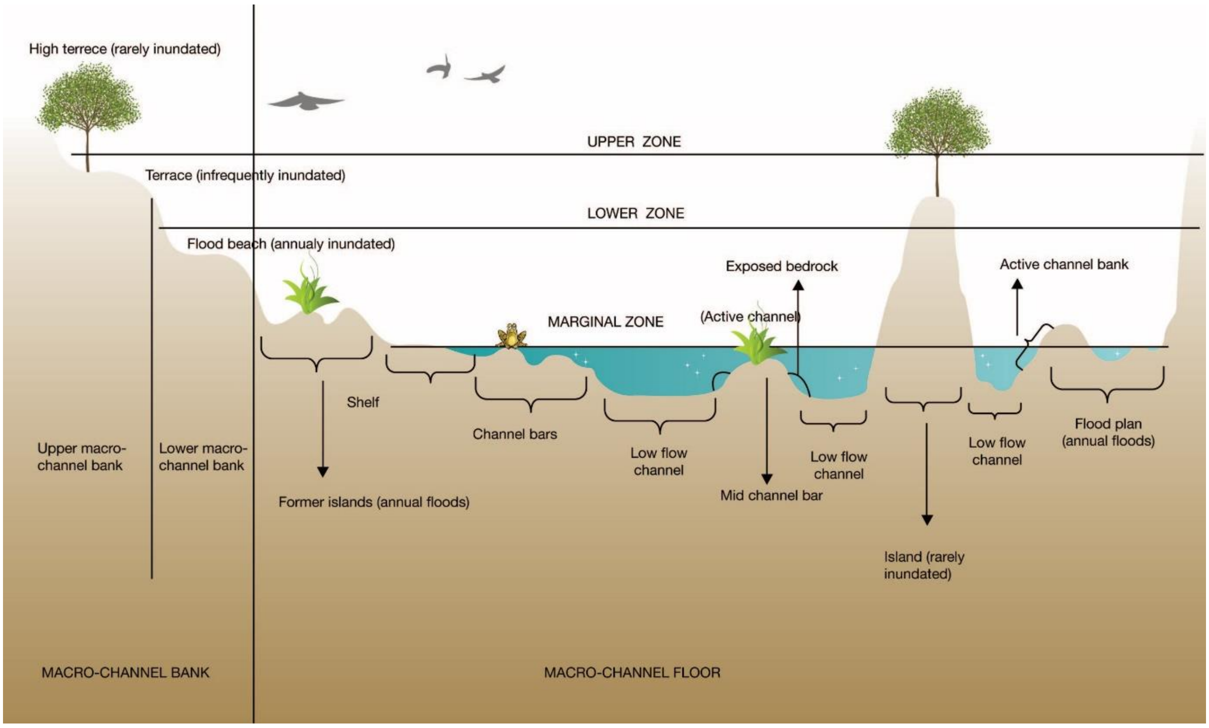

Figure 6: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

The vegetation of riparian areas is divided into three zones, the marginal zone, lower non-marginal zone and the upper non-marginal zone (Table 2). The different zones have different vegetation growth.

Table 2: Description of riparian vegetation zones (Kleynhans *et al*, 2007).

	Marginal	(Non-marginal) Lower	(Non-marginal) Upper
Alternative descriptions	Active features Wet bank	Seasonal features Wet bank	Ephemeral features Dry bank
Extends from	Water level at low flow	Marginal zone	Lower zone
Extends to	Geomorphic features / substrates that are hydrologically activated (inundated or moistened) for the Greater part of the year.	Usually a marked increase in lateral Elevation.	Usually a marked decrease in lateral elevation
Characterized by	See above ; Moist substrates next to water's edge; water loving- species usually vigorous due to near permanent access to soil moisture	Geomorphic features that are hydrologically activated (inundated or moistened) on a Seasonal basis. May have different species than marginal zone	Geomorphic features that are hydrological activated (inundated or moistened) on an Ephemeral basis. Presence of riparian and terrestrial species Terrestrial species with increased stature

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 7) (Kotze, 1999).

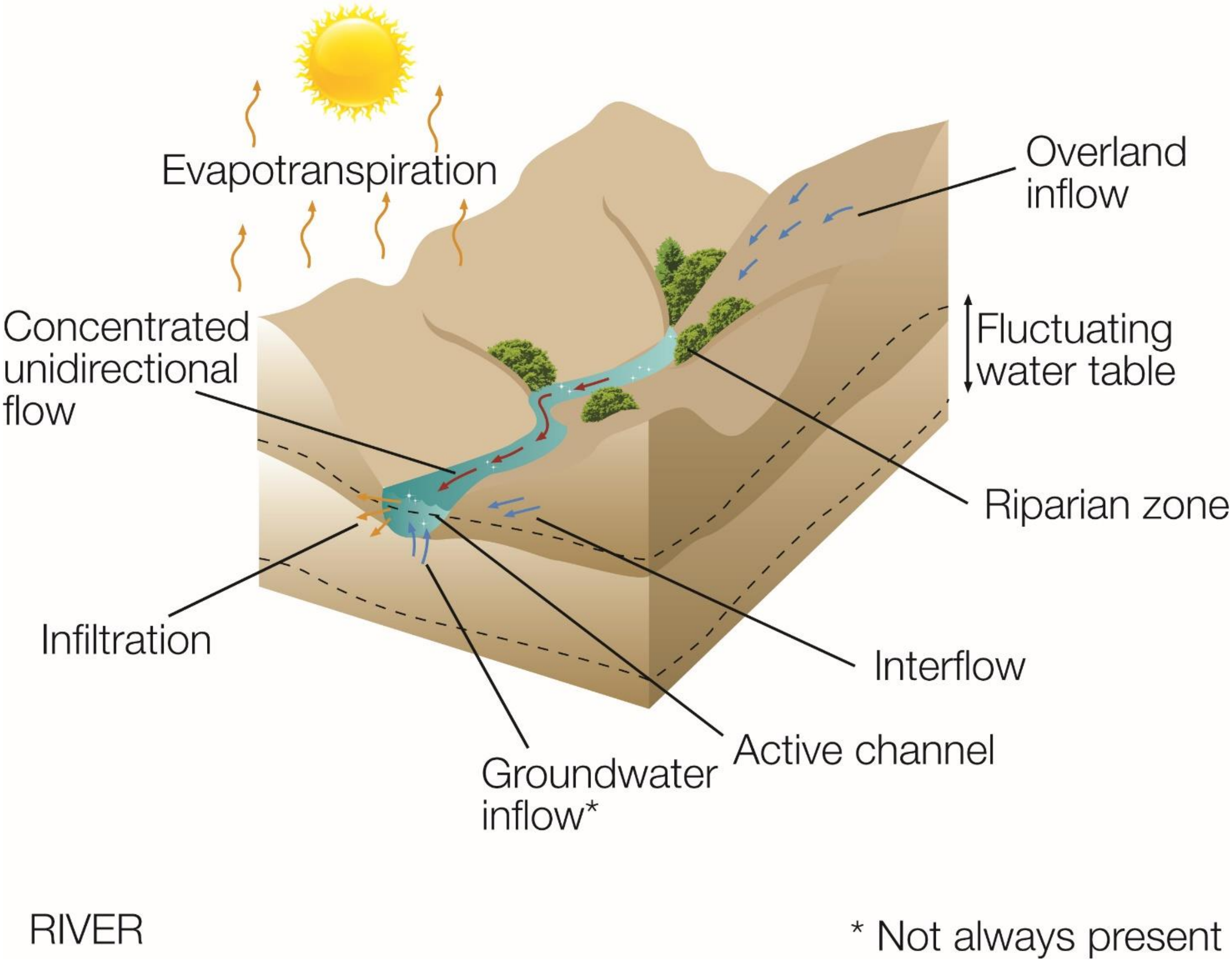

Figure 7: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

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 8). 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.

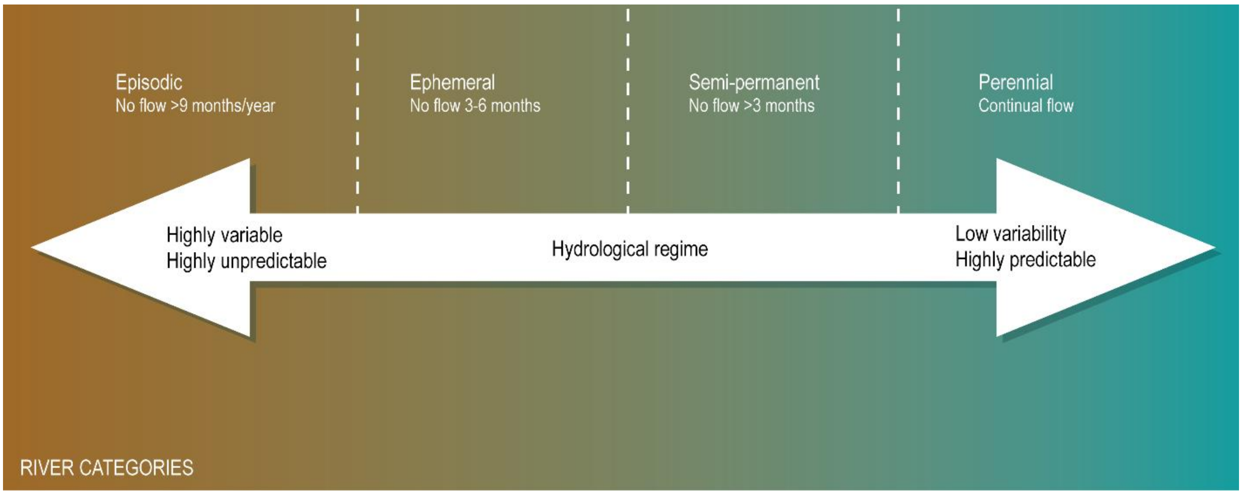

Figure 8: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

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 (SANBI, 2009). 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 SANBI (2009). HGM units take into consideration factors that determine the nature of water movement into, through and out of the wetland system. In general HGM units encompass three key elements (Kotze *et al,* 2005):

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

The wetland identified on the study site is a seepage wetland linked to an unchannelled valley bottom wetland.

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

Unchannelled valley bottom wetlands are described as a linear fluvial, net depositional valley bottom surfaces which do not have a channel. The valley floor is a depositional environment composed of fluvial or colluvial deposited sediment. These systems tend to be found in the upper catchment areas, or at tributary junctions where the sediment from the tributary smothers the main drainage line (Figure 9) (Kotze, 1999).

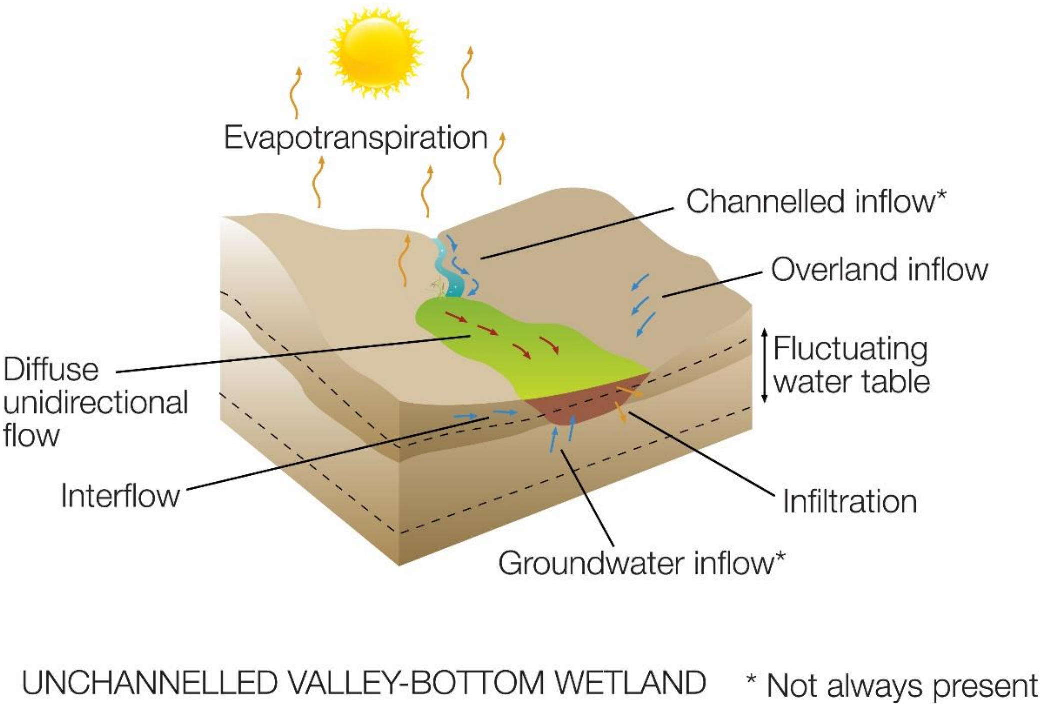

Figure 9: A schematic representation of the processes characteristic of unchannelled valley bottom wetlands (Ollis *et al*, 2013).

2.3 Buffer Zones

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

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining landuses; (iii) providing habitat for various aspects of biodiversity. A brief description of each of the functions and associated services is outlined in Table 3 below.

Table 3: 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.

Local government policies require that protective buffer zones be calculated from the outer edge of the temporary zone of a wetland (Grundling 2006; CoCT, 2008; GDACE, 2009). Although research is underway to provide further guidance on appropriate defensible buffer zones, there is no current standard other than the generic recommendation of 30m for wetlands inside the urban edge and 50 m outside the urban edge (GDARD, 2012). The current report suggests that a generic 30 m buffer zone be applied to the outer edge of the wetlands in the urban edge and 50 m buffer zone be applied to the outer edge of the wetlands outside of the urban edge. As for riparian areas a 32 m buffer zone should be applied from the outer edge of the riparian area within the urban edge and a 100 m buffer zone should be applied to the edge of the riparian area outside of the urban edge. An understanding of the origin of water that results in the wetland/riparian conditions should ideally form the basis of refining this generic buffer zone through an analysis of empirical data.

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) and EIS (DWAF, 1999).

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

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

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

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

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

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

2.4.2 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 Department of Water Affairs.

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 seepage wetland is represented are described in the results section. Explanations of the scores are given in Table 6.

Table 6: 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

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 railway access road. The areas surrounding the study site is predominantly farming land and mining areas with a large coal deposit area south west of the study site. A small substation is currently located on the study site and the larger proposed substation will be located on the same area although the proposed substations will extent farther. The proposed site will be approximately 80 m x 80 m or 0.65 ha. Although no specific alternative site is suggested in this report it is advised that a more suitable area for a new substation would be in close association with the coal deposit area as this area is already greatly disturbed.

3.2 Wetland/Riparian Classification and Delineation

Currently a large unchannelled valley bottom wetland is located on site with two dams located within the wetland (Figure 10). The wetland is delineated up to 600 m from the substation although it extends farther north and east. The northern section of the wetland is linked to the Bosmanspruit. From historical aerial imagery from 2003 (Google earth timeline function) it is clear that the wetland area was not as large as it is currently and no dams existed. However, in 2014 (Google earth timeline function) two large dams can be seen south of the study site as well as large wet areas (Figure 11). It is unclear if the wetland is natural or as a result of drains and the possible construction of dams adjacent to the study site. In order to determine the origin of the wetland it is suggested that piezometers be installed within the wetland. Piezometer are also suggested to be installed within the adjacent farming lands in order to determine if there is any ground water movement within the first 50 cm in order to classify these areas as wetlands.

The current study site thus falls directly within the wetland area and is thus not an ideal site. Even if the wetland is found to be artificial it is likely to remain present for a long period. An alternative site located near the coal deposit area will be more suitable as this area is already greatly impacted.

Where wetlands form due to unnatural disturbances or are created for a specific purpose certain approaches are proposed. In the case of the uncertain origin of the seepage wetland the same approaches can be taken. These approaches are summarised in the table below (Table 7).

Table 7: Approach to be taken for types of sites that are difficult to delineate. (Jobs, 2009)

Type of "difficult site"	Approach	Approach Taken
Some or all, wetland indicators are present but is a non-natural wetland (e.g. some dams, road islands)	• Decide on the relative permanence of the change and whether the area can now be said to be functioning as a wetland. • Time field observations during the wet season, when natural hydrology is at its peak, to help to differentiate between naturally-occurring versus human-induced wetland. • Decide appropriate policy/management i.e. can certain land uses be allowed due to "low" wetland functional value, or does the wetland perform key functions despite being artificial.	• Soil samples indicate that water has been present for a sufficiently long time to create wetland characteristics and the dams remain full. • The study did not take place within the wet season and a follow up site visit is recommended. • It is likely that the wetland does perform some key functions such as water purification.

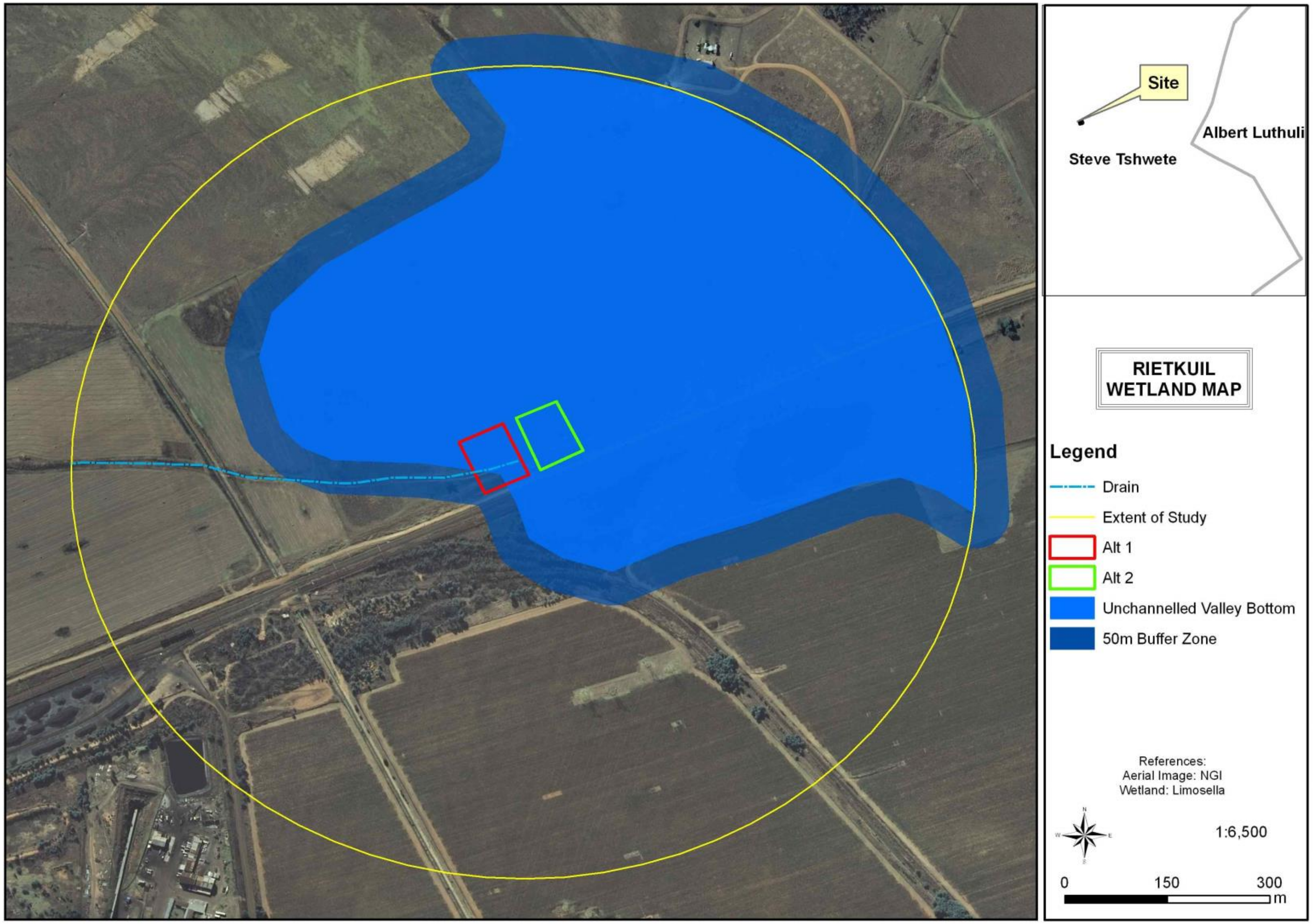

Figure 10: Wetland sensitivity areas delineated together with associated buffer zones.

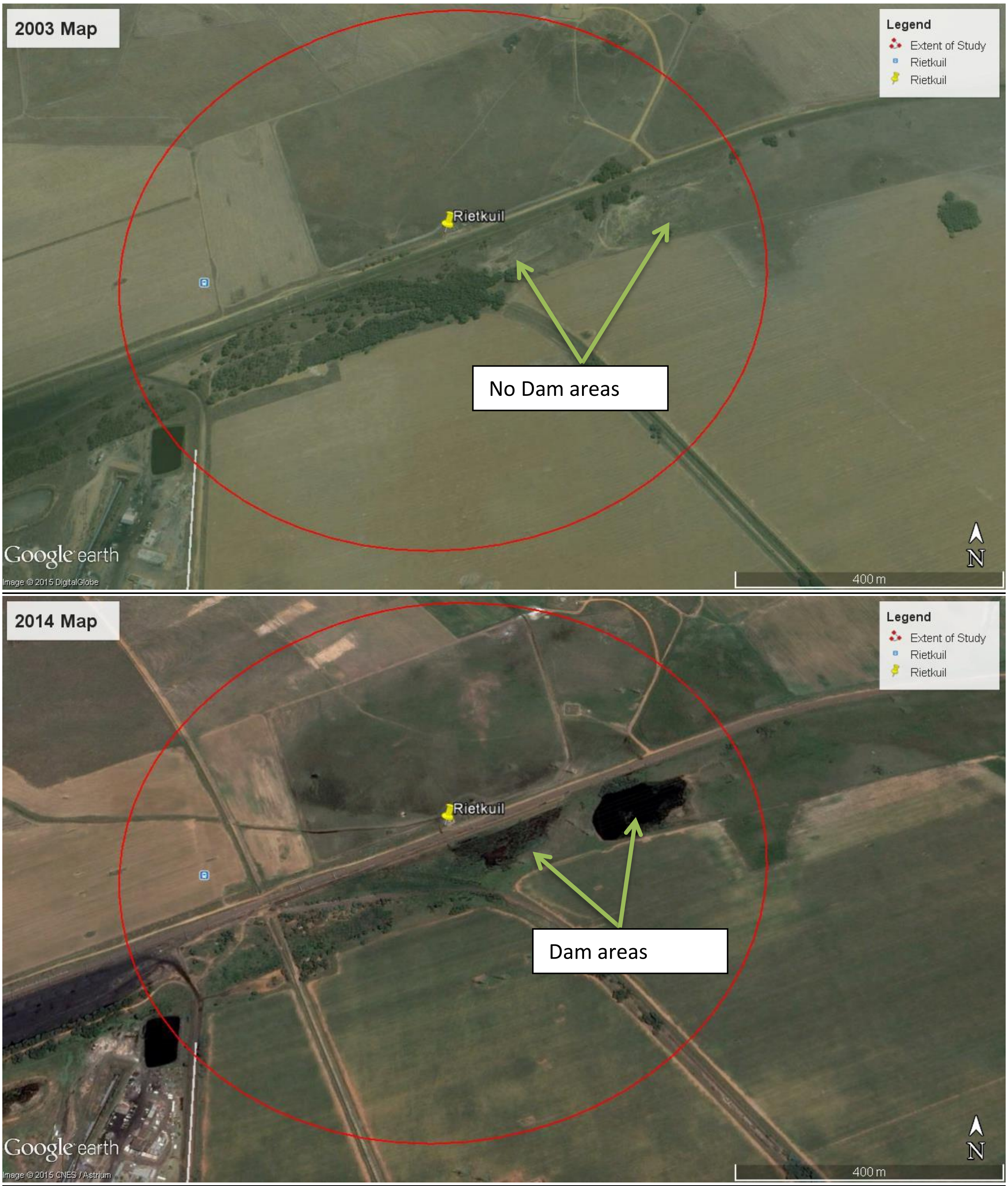

Figure 11: 2003 with limited wetland characteristics (Top) compared to the 2014 map with numerous wetland evidence as well as the presence of two dams (Bottom).

3.2.1 Soil and Vegetation Indicators

Soil

The soil was characterised by grey sandy soil with distinct mottling and gleying (Figure 12). Large areas of bare soil were present although the cause of the bare soil is unknown.

Figure 12: Mottling and gleying present in the soil profile of the study site.

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

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

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

Vegetation

The majority of the wetland vegetation has been grazed or was not in bloom during the site visit thus all the species could not be identified. The species that was dominant that could be identified include *Imperata cylindrica, Andropogon eucomus, Andropogon huilensis, Pycreus macranthus* and *Juncus oxycarpus.* Large section of the surrounding areas was under farming and was thus cleared of vegetation. Exotic vegetation was present throughout the site and especially adjacent to the railway road. Large sections were also clear of vegetation (Figure 13).

Figure 13: Vegetation of the study site and the surroundings.

3.3 Present Ecological Status (PES)

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

Table 9: Summary of hydrology, geomorphology and vegetation health assessment for the wetlands 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	6.5	0	6.1	0	5.4	-1	6.1	0
PES Category and Projected Trajectory		E	→	E	→	D	↓	E	→

<u>Ecological Importance and Sensitivity (EIS)</u>

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

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

Wetland	WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Seepage Wetland	Ecological importance & sensitivity	1.0	3.0
	Hydro-functional importance	1.6	3.0
	Direct human benefits	0.5	3.0
	Overall EIS score	**1.0 C**	

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

3.4 Impacts and Mitigations

A development has several impacts on the surrounding environment and particularly on a wetland. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater run-off, and therefore the hydrological regime of the site. Since the two site alternatives are so close together, the potential impacts expected on the preferred site will be the same as on the alternative site.

To minimise the ecological impacts some site specific mitigation measures should be taken together with generic mitigation measures. Further site specific mitigation measures should be included in an Environmental Management Plan.

- The existing dirt road should be used rather than constructing new access roads.
- Erosion control methods should be implemented within and adjacent to the road to prevent further erosion and erosional gullies.
- Vehicular movement should be restricted to a single access roadway only.
- If a path through the wetland will have to be established these sections within the wetland, geotextile should be laid down, which should be covered with a layer of soil. Material such as wooden planks should then cover this. The material should allow for the distribution of the vehicle’s weight, reducing the compaction of the wetland soils.
- Any soil that is removed from the wetland areas should be stored in the layers it was removed.
- Upon completion of the substation the stored soil should be replaced in the trench in the layers that it was removed.
- Soil compaction should be avoided in the wetland, if soil compaction has occurred the soil should be loosened.
- The bare soil should be re-vegetated with plant species specific to the area.

3.4.1 Significance Ranking Matrix

The significance of potential impacts is presented in Table 11. These scores are calculated based on the available infrastructure information. These scores are calculated for the substation discussed in this report. Significance is calculated as Consequence (Magnitude+ Duration+ Extent + Reversibility) X Probability (Tables 11, 12 and 13) wherein the following meaning applies:

- The Magnitude of the impact is quantified as either:
  - Low: Will cause a low impact on the environment;
  - Moderate: Will result in the process continuing but in a controllable manner;
  - High: Will alter processes to the extent that they temporarily cease; and
  - Very High: Will result in complete destruction and permanent cessation of processes.
- The Probability: which shall describe the likelihood of impact occurring and will be rated as follows:
  - Extremely remote: Which indicates that the impact will probably not happen;
  - Unusual but Possible: Distinct possibility of occurrence;
  - Can Occur: there is a possibility of occurrence;
  - Almost Certain: Most likely to occur; and

- Certain/ Inevitable: Impact will occur despite any preventative measures put in place.

- The duration (Exposure) which indicates whether:
  - The impact will be of an immediate;
  - The impact will be of a short tem (Between 0-5 years);
  - The impact will be of medium term (between 5-15 years);
  - The impact will be long term (15 and more years); and
  - The impact will be permanent.
- Reversibility/ Replaceability. This refers to the degree to which the impact can be reversed or the lost resource can be replaced.

Table 11: Summary of the Significance Ranking Classes

Ranking	Magnitude	Reversibility	Extent	Duration	Probability
5	Very high/ don't know	Irreversible	International	Permanent	Certain/inevitable
4	High		National	Long term (impact ceases after operational life of asset)	Almost certain
3	Moderate	Reversibility with human intervention	Provincial	Medium term	Can occur
2	Low		Local	Short term	Unusual but possible
1	Minor	Completely reversible	Site bound	Immediate	Extremely remote
0	None		None		None

Significance= Consequence (Magnitude+ Duration+ Extent + Reversibility) X Probability

Table 12: Significance of Impact Table

SIGNIFICANCE OF IMPACT = CONSEQUENCE (Magnitude + Duration +Extent + Reversibility) X PROBABILITY					
RANKING	65-100	64-36	35-16	15-5	1-4
SIGNIFICANCE	Very High	High	Moderate	Low	Minor

Table 13: Impact significance table for Alternative 1

Threat / Impact	Magnitude	Duration	Reversibility	Extent	Probability	Ranking	Significance
Changing the quantity and fluctuation properties of the watercourse	High (4)	Permanent (5)	Reversibility with human intervention (3)	Local (2)	Almost certain (4)	56	High

Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)	Low (2)	Medium Term (3)	Reversibility with human intervention (3)	Local (2)	Can occur (3)	30	Moderate
Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate)	Low (2)	Short term (2)	Reversibility with human intervention (3)	Site Bound (1)	Unusual but possible (2)	16	Moderate
Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons	Low (2)	Short term (2)	Reversibility with human intervention (3)	Site Bound (1)	Unusual but possible (2)	16	Moderate
Changing the physical structure within a water resource (habitat)	Very High (5)	Permanent (5)	Reversibility with human intervention (3)	Local (2)	Almost certain (4)	60	High

Table 14: Impact significance table for Alternative 2

Threat / Impact	Magnitude	Duration	Reversibility	Extent	Probability	Ranking	Significance
Changing the quantity and fluctuation properties of the watercourse	High (4)	Permanent (5)	Reversibility with human intervention (3)	Local (2)	Almost certain (4)	56	High

Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)	Low (2)	Medium Term (3)	Reversibility with human intervention (3)	Local (2)	Can occur (3)	30	Moderate
Alteration of water quality – increasing the amounts of nutrients (phosphate, nitrite, nitrate)	Low (2)	Short term (2)	Reversibility with human intervention (3)	Site Bound (1)	Unusual but possible (2)	16	Moderate
Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons	Low (2)	Short term (2)	Reversibility with human intervention (3)	Site Bound (1)	Unusual but possible (2)	16	Moderate
Changing the physical structure within a water resource (habitat)	Very High (5)	Permanent (5)	Reversibility with human intervention (3)	Local (2)	Almost certain (4)	60	High

Generic suggested primary management procedures are summarised in Table 15.

Table 15: Impacts and suggested management procedures relevant to the proposed development (modified from Macfarlane *et al*, 2010)

Threat / Impact	Source of the threat	Primary Management Procedure
Changing the quantity and fluctuation properties of the watercourse.	*Construction:* • Development within wetland. • Lack of adequate rehabilitation resulting in invasion by exotic plants into the wetland.	• No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable. • Construction in and around watercourses must be restricted to the dryer winter months. • A temporary fence or demarcation must be erected around the works area to prevent access to sensitive

Threat / Impact	Source of the threat	Primary Management Procedure
		environs. The works areas generally include the servitude, construction camps, areas where material is stored. • Prevent pedestrian and vehicular access into the wetland and buffer. • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Management of on-site water use and prevent stormwater or contaminated water directly entering the watercourse • Management of point discharges • Planning of construction site must include eventual rehabilitation / restoration of indigenous vegetative cover • Alien plant eradication and follow-up control activities prior to construction, to prevent spread into disturbed soils, as well as follow-up control during construction • The amount of vegetation removed should be limited to the least amount possible. • Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction and that plan must be implemented immediately upon completion of construction. • Conduct monthly independent water analysis test to ensure that the quality of the water does not decrease.
Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount)	Construction: • Earthwork activities to construct towers. • Clearing of surface vegetation will expose the soils, which in rainy events would wash down into wetlands, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate exotic vegetation can spread easily into these eroded soil. • Disturbance of soil surface • Disturbance of slopes through creation of roads and tracks	• Construction in and around watercourses must be restricted to the dryer winter months. • A temporary fence or demarcation must be erected around the works area to prevent water runoff and erosion of the disturbed or heaped soils into wetland areas. • Access roads and bridges should span the wetland area, without impacting on the permanent or seasonal zones. • Formalise access roads and make use of existing roads and tracks where feasible, rather than creating new routes through naturally vegetated areas. • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005). • A vegetation rehabilitation plan should be implemented. Grassland can be removed as sods and stored within transformed vegetation. The sods must preferably be removed during the winter months and be replanted by latest springtime. The sods should not

Threat / Impact	Source of the threat	Primary Management Procedure
	• Changes in runoff characteristics • Erosion (e.g. gully formation, bank collapse) *Operational:* • Vehicles impacting on surface vegetation • Access dirt roads.	be stacked on top of each other or within sensitive environs. Once construction is completed, these sods should be used to rehabilitate the disturbed areas from where they have been removed. In the absence of timely rainfall, the sods should be watered well after planting and at least twice more over the next 2 weeks. • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Rehabilitation plans must be submitted and approved for rehabilitation of damage during construction 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. • Delay the re-introduction of livestock (where applicable) to all rehabilitation areas until an acceptable level of re-vegetation has been reached. • During the construction phase measures must be put in place to control the flow of excess water so that it does not impact on the surface vegetation. • Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and work areas. • Runoff from roads must be managed to avoid erosion and pollution problems. • Implementation of best management practices • Source-directed controls • Buffer zones to trap sediments • Active rehabilitation • It is advisable that dirt roads not be located close to a wetland area as sediment input is likely to increase.
Alteration of water quality – toxic contaminants (including toxic metal ions (e.g. copper, lead, zinc) and hydrocarbons.	Construction: • Runoff from road surfaces • Discharge of solvents, and other industrial chemicals *Operational:* • Runoff from road surfaces	• After construction, the land must be cleared of rubbish, surplus materials, and equipment, and all parts of the land shall be left in a condition as close as possible to that prior to use. • Ensure that maintenance work does not take place haphazardly, but, according to a fixed plan, from one area to the other.

Threat / Impact	Source of the threat	Primary Management Procedure
	• Discharge of solvents, and other industrial chemicals	• Maintenance of construction vehicles • Control of waste discharges • Guidelines for implementing Clean Technologies • Maintenance of buffer zones to trap sediments with associated toxins • Conduct monthly independent water analysis test to ensure that the quality of the water does not decrease.
Changing the physical structure within a water resource (habitat)	Construction: • Deposition of wind-blown sand • Loss of fringing vegetation and erosion • Alteration in natural fire regimes	• Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated wetland or their associated buffer zones. • Demarcate the wetland areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas • Linear developments (e.g. roads) should span the watercourse • Weed control in buffer zone • Monitor rehabilitation and the occurrence of erosion twice during the rainy season for at least two years and take immediate corrective action where needed. • 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.

4 CONCLUSION

Currently a large unchannelled valley bottom wetland is located on site with two dams located within the wetland. The wetland is delineated up to 600 m from the substation although it extends farther north and east. The northern section of the wetland is linked to the Bosmanspruit. From historical aerial imagery from 2003 (Google earth timeline function) it is clear that the wetland area was not as large as it is currently and no dams existed. However, in 2014 (Google earth timeline function) two large dams can be seen south of the study site as well as large wet areas. It is unclear if the wetland is natural or as a result of drains and the possible construction of dams adjacent to the study site. In order to determine the origin of the wetland it is suggested that piezometers be installed within the wetland. Piezometer are also suggested to be installed within the adjacent farming lands in order to determine if there is any ground water movement within the first 50 cm in order to classify these areas as wetlands. Chemical analysis may also be done in order to determine the origin of the water. For this a reference water source is needed, for example a borehole located on an adjacent farm. Such a borehole should be emptied twice to ensure that water collected for analysis is not contaminated by seepage from the surrounding area.

The current study site as well as the alternative fall directly within the wetland area and is thus not an ideal site. Even if the wetland is found to be artificial it is likely to remain present for a long period. It is suggested that a more suitable area for a new substation would be in close association with the coal deposit area as this area is already greatly disturbed.

In order to limit the impact on the hydrology of the area, the current assessment finds that a minimum buffer of 50 m from the edge of the wetland boundaries should be respected.

A development has several impacts on the surrounding environment and particularly on a wetland. The development changes habitats, the ecological environment, infiltration rates, amount of runoff and runoff intensity of stormwater run-off, and therefore the hydrological regime of the site. Expected impacts to the preferred site are also relevant to the alternative site since they are so close together.

To minimise the ecological impacts some site specific mitigation measures should be taken together with generic mitigation measures. Further site specific mitigation measures should be included in an Environmental Management Plan.

- The existing dirt road should be used rather than construction of new access roads.
- Erosion control methods should be implemented within and adjacent to the road to prevent further erosion and erosional gullies.
- Vehicular movement should be restricted to a single access roadway only.
- If a path through the wetland will have to be established these sections within the wetland, geotextile should be laid down, which should be covered with a layer of soil. Material such as wooden planks should then cover this. The material should allow for the distribution of the vehicle’s weight, reducing the compaction of the wetland soils.
- Any soil that is removed from the wetland areas should be stored in the layers it was removed.
- Upon completion of the substation the stored soil should be replaced in the trench in the layers that it was removed.
- Soil compaction should be avoided in the wetland, if soil compaction has occurred the soil should be loosened.

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

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

Sensitivity to changes in water quality	1	4.00	Somewhat	Esp naturally low nutrient waters - lower nutrients likely to be more sensitive
ECOLOGICAL IMPORTANCE & SENSITIVITY	**1.0**	**4.0**		

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

HYDRO-FUNCTIONAL IMPORTANCE			**Score (0-4)**	**Confidence (1-5)**	**Motivation**	**Scoring Guideline**
Regulating & supporting benefits		Flood attenuation	2	2	Large valley bottom area	The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
		Streamflow regulation	1	2		Sustaining streamflow during low flow periods
	Water Quality Enhancement	Sediment trapping	3	2	Vegetation layer relatively in tact	The trapping and retention in the wetland of sediment carried by runoff waters
		Phosphate assimilation	2	3		Removal by the wetland of phosphates carried by runoff waters, thereby enhancing water quality
		Nitrate assimilation	2	3		Removal by the wetland of nitrates carried by runoff waters, thereby enhancing water quality
		Toxicant assimilation	2	3		Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters, thereby enhancing water quality
		Erosion control	1	2	Relatively intact vegetation is still present	Controlling of erosion at the wetland site, principally through the protection provided by vegetation.

	Carbon storage	0	3	No organic material recorded	The trapping of carbon by the wetland, principally as soil organic matter
HYDRO-FUNCTIONAL IMPORTANCE		**1.4**	**2.5**		

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

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

Appendix B: No Access Areas.

Figure 14: No access areas indicated by red cicles

Figure 15: Dangerous subsidence area that was off-limits according to on-site staff.