Proposed Etna – Trade Route 88kV Powerline and Switching Station, Johannesburg, Gauteng Province

Wetland/Riparian Delineation and Functional Assessment
October 2016

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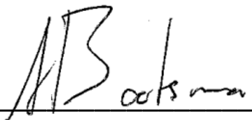
Declaration of Independence

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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2016.11.04
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 was appointed by Nsovo Consulting to undertake a wetland and/or riparian delineation and functional assessment to inform the Environmental Authorization process for the proposed Etna – Trade Route 88kV Powerline and Switching Station, Johannesburg, Gauteng Province.

Fieldwork was conducted on the 19th of October 2016.

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,
- Undertake a 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.

A total of three wetlands were recorded on the study site. All of these wetlands were classified as channelled valley bottom wetlands except for a non-perennial system (drainage lines) in the middle of the site. More wetlands not included in the assessment are located within the surrounding area. Another channelled valley bottom wetland not affected by the proposed alignment is located to the east of the R553. Two small artificial depressions one just south of the Trade Route substation (under construction) and one just to the south of the existing Etna substation (created by sand mining) are also located within the surrounding area.

Both the channelled valley bottom and non-perennial drainage lines have been impacted. These impacts are summarised in the table below:

Nr	Affected Watercourse	Approximate central coordinates	Recorded Impacts	PES/EC Score	EIS/QHI Score
1	**Channelled valley bottom**	26°19'17.69"S and 27°53'3.45"E	The increased hardened surfaces in the local catchment of the wetland and associated storm water together with extensive continues input of sewage due to leaking pipes and dysfunctional treatment plants resulted in increased flow-peaks and associated canalisation in the wetland areas. The hydrology of the wetland was altered over the years and erosion is evident.	**PES: D**	**B - High**
2	**Non-perennial Area**	26°21'35.24"S and 27°52'58.49"E	Erosion caused by excavations in the local catchment, trampling and burning practises.	**EC: B/C**	**QHI: C**
3	**Channelled valley bottom**	26°22'41.53"S and 27°53'15.17"E	The wetland is transformed due to residential and informal settlement development. Other impacts include pollution and increased storm water.	**PES: E**	**C - Moderate**

The study area is located within Quaternary Catchments A22A and C22H and is in the eighth water management area, the Upper Vaal. In this water management area, the major rivers include the Vaal-, Wilge, Suikerbosrant and Klip River.

The proposed powerline alignment does not traverse any major rivers but rather the wetland areas associated with the Klip River and/or tributaries that drain into the Klip River and Rietspruit.

The important factors relevant to the project are summarised in the table below:

	Quaternary Catchment and WMA areas	**Important Rivers possibly affected**	**Buffers**
	A22A, C22H Upper Vaal (WMA)	Wetland areas associated with the Klip River and/or tributaries that drain into the Klip River and Rietspruit.	**30 m for all the wetlands/riparian areas**
Does the specialist support the development?	Yes, electrical infrastructure in the study area is in dire need of upgrading. However it should be done in a manner that does not further alter wetland areas and their catchments. The proposed alignment traverses important and ecological support areas and care should be taken to limit impacts in these areas to a minimum.		
Major concerns	• Changing the quantity and fluctuation properties of the watercourse • 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) • Erosion in the Klip River and downstream wetlands		
Recommendations	Powerline infrastructure should be excluded from the wetland areas as far as possible. However, linear developments such as the proposed powerline are rarely able to avoid crossing any watercourses whatsoever. Where alternatives have been investigated and watercourse crossings have been shown to be necessary it is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology.		
CBA and other Important areas	The proposed alignment traverses important and ecological support areas. The northern section of the proposed powerline alignment traverse the Klipriver Highveld Grassland ecosystem which is critically endangered (NEMBA, 2011).		

Two aspects of the activities associated with this project were given score that fall in the Medium risk category according to the Department of Water and Sanitation risk assessment matrix. These activities are:

- Dismantling of towers; Excavation to remove foundation; Backfilling foundation holes and the use of heavy machinery (score of 57.75);
- Maintenance and repair of existing access roads (score of 60).

The score for both these activities could be lowered to fall in the Low class (in which authorization could proceed under a GA) should method statements and position of pylon footprints be available for inclusion into an updated assessment. Method statements should aim to favour low-impact methods that have the least effect to changed hydrology, vegetation loss and pollution.

It is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology. Mitigation should focus on:

- Rehabilitation / restoration of indigenous vegetative cover.
- Management of point discharges during construction activities.
- Alien plant control.
- Implementation of best management practices regarding stormwater and earthworks.
- Provision of adequate sanitation facilities located outside of the wetland area or its associated buffer zone during construction activities.
- Implementation of appropriate stormwater management around excavations to prevent the ingress of run-off into the excavations.
- Prevention of erosion, and where necessary rehabilitation of eroded areas.

To minimise the ecological impacts some site specific mitigation measures should be applied together with the generic mitigation measures:

- The existing dirt road/servitude should be used as far as possible to limited disturbance to undisturbed areas.
- Erosion control methods should be implemented within and adjacent to the road/servitude to prevent further erosion and erosional gullies.
- Vehicular movement should be restricted to a single access roadway only.
- When paths need to be established through wetland areas for erection of new towers/poles a 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 and/or the non-perennial areas should be stored in the layers 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 revegetated with plant species specific to the area.

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1 INTRODUCTION

Limosella Consulting was appointed by Nsovo Consulting to undertake a wetland and/or riparian delineation and functional assessment to inform the Environmental Authorization process for the proposed Etna – Trade Route 88kV Powerline and Switching Station, Johannesburg, Gauteng Province. The extent of the project entails construction of an 88kV powerline (built at 132kV specification) that will connect existing Etna, Lehae and the Trade - Route substation which is under construction.

Fieldwork was conducted on the 19th of October 2016.

1.1 Terms of Reference

The terms of reference for the study were as follows:

- Delineate the wetland and riparian areas;
- Classify the watercourse according to the system proposed in the national wetlands,
- Undertake a 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.

1.2 Assumptions and Limitations

Although the study was conducted in spring taking into consideration the current drought, a time during which many plant species are still not visible/limited, the delineation is deemed accurate since it relied on soil and landscape indicators. Given the disturbed nature of the site, it is unlikely that sensitive plant species remain which could affect the PES and EIS scores obtained in this assessment. However, this can only be confirmed in wetter conditions.

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.

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.

During the site visit some areas of the wetland and surroundings was grazed very short, burned or cut short and not all vegetation could be identified. Furthermore, infilling of the area has encroached on the wetland vegetation and disturbed the soil profile which is used to delineate wetlands.

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 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, unless the impacts score as low in the requires risk assessment matrix. 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 area where the proposed activities will take place is located close to Lenasia, Lehae, Vlakfontein and surroundings within Gauteng Province (Figure 1). The project extends from Etna substation near Vlakfontein to the Trade - Route substation (under construction) near Lenasia.

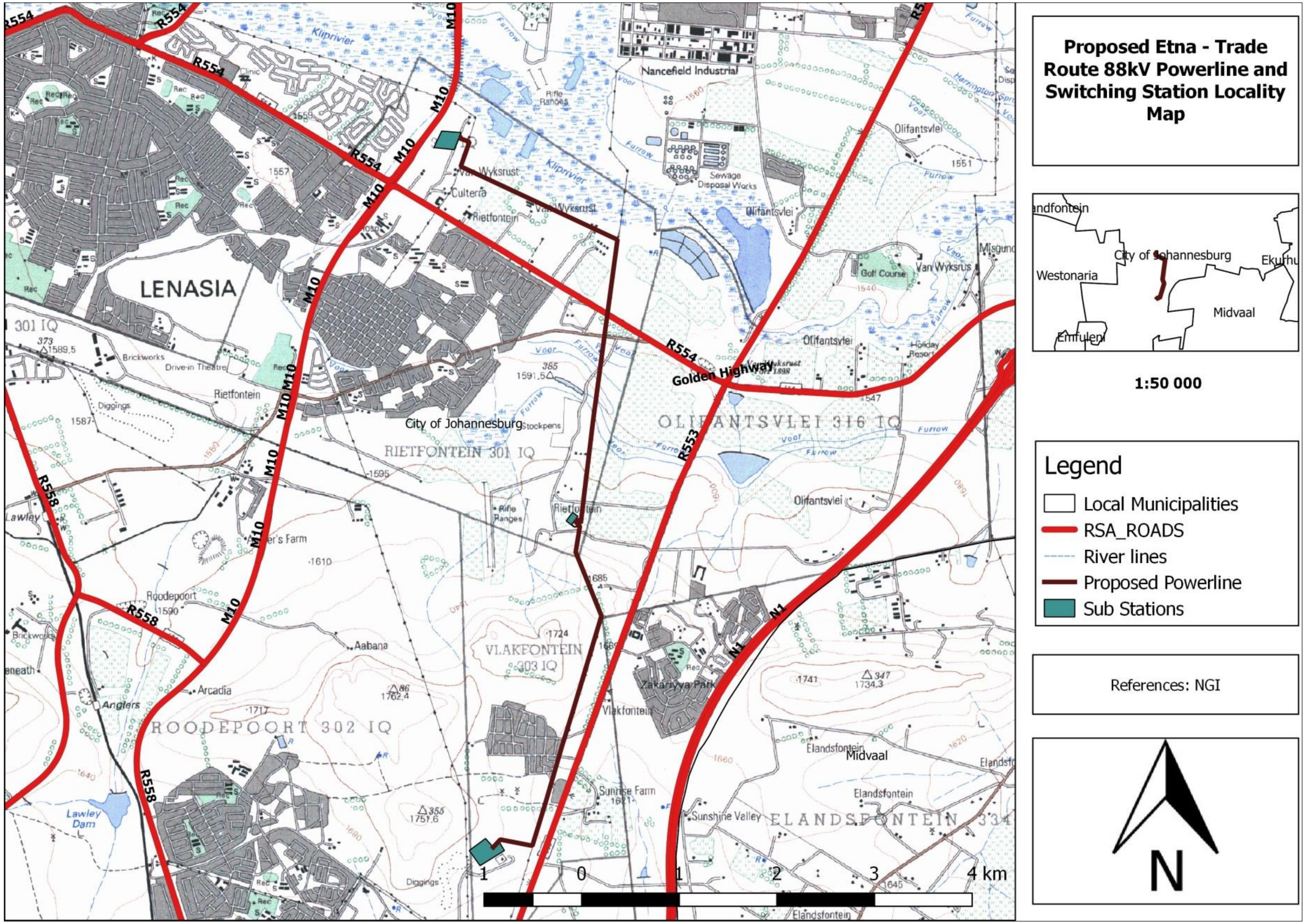


Figure 1: Locality Map

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 Quaternary Catchments A22A and C22H. In these catchments, the precipitation rate is lower than the evaporation rate with a Mean Annual Precipitation (MAP) to Potential Evapotranspiration (PET) of 0.29 (A22A) and 0.32 (C22H). The Median Annual Simulated Runoff (mm) is 39.1 (A22A) and 32.9 (C22H). Consequently, watercourses in these areas are sensitive to changes in regional hydrology, particularly where their catchment becomes transformed and the water available to sustain them becomes redirected.

The study area is located in the eight water management area (WMA) known as the Upper Vaal. In this water management areaWMA, the major rivers include rivers include the Vaal-, Wilge, Suikerbosrant and Klip River.

The proposed powerline alignment does not traverse any major rivers but rather the wetland areas associated with the Klip River and/or tributaries that drain into the Klip River.

Hydrology:

Surface water spatial layers such as the National Freshwater Ecosystems Priority Areas (NFEPA) Wetland Types for South Africa (SANBI, 2010), City of Johannesburg wetland layers and Gauteng Department of Agriculture and Rural Development (GDARD) were consulted for the presence of wetlands, perennial and non-perennial rivers on or in proximity to the site. Based on these spatial layers several watercourses are located in the area including the Klip River (Figure 1 and 2).

Regional Vegetation:

According to the Vegetation Map of South Africa, Lesotho and Swaziland, the study area is situated in the Eastern Temperate Freshwater Wetlands, Carletonville Dolomite Grassland, Gauteng Shale Mountain Bushveld and Soweto Highveld Grassland (vulnerable vegetation types). The northern section of the proposed powerline alignment traverses the Klipriver Highveld Grassland, which is a critically endangered terrestrial ecosystem (NEMBA, 2011) associated with the Eastern Temperate Freshwater Wetlands. The Eastern Temperate Freshwater Wetlands is dominated by aquatic and hydrophilic vegetation while the Carletonville Dolomite Grassland includes a variety of grass species, Gauteng Shale Mountain Bushveld short (3–6 m tall), semi-open thicket dominated by a variety of woody species and the Soweto Highveld Grassland is dominated by *Themeda triandra* (Mucina & Rutherford, 2006).

Geology and soils:

The geology of the area is dominated by the Transvaal, Rooiberg and Griqualand-Wet groups followed by the Ventersdorp group in the north (Council of Geoscience, 1997). The Carletonville Dolomite Grassland is associated with Dolomite and chert of the Malmani Subgroup (Transvaal Supergroup). The remainder of the study area is dominated by shale (Mucina & Rutherford, 2006).

The wetland areas in the study area include mostly dRg20, xHu16, Ms/R including vMs10 soil types (Figure 4). The soil type mostly associated with wetlands in the study area is Rensburg (dRg20), found at the Klip River wetland system, which is a dark coloured and chemically fertile soil with a high clay content (Fey, 2005). A large area of the study area include red to yellow Hutton soils with a variable depth (xHu26). Some areas of the study area are classified as Unconsolidated (Figure 4) which is characteristic of highly disturbed soil often associated with urban areas

Gauteng Conservation Plan

The Gauteng Conservation Plan (Version 3.3) (GDARD, 2011) classified areas within the province on the basis of its contribution to reach the conservation targets within the province. Critical Biodiversity Areas (CBAs) contain irreplaceable, important and protected areas (terms used in C-Plan 2) and are areas needed to reach the conservation targets of the Province. In addition, 'Ecological Support Areas' (ESAs), mainly around riparian areas and other movement corridors were also classified to ensure sustainability in the long term. Landscape features associated with ESAs is essential for the maintenance and generation of biodiversity in sensitive areas and requires sensitive management where incorporated into C-Plan 3.

The proposed alignment traverses important and ecological support areas (Figure 5).

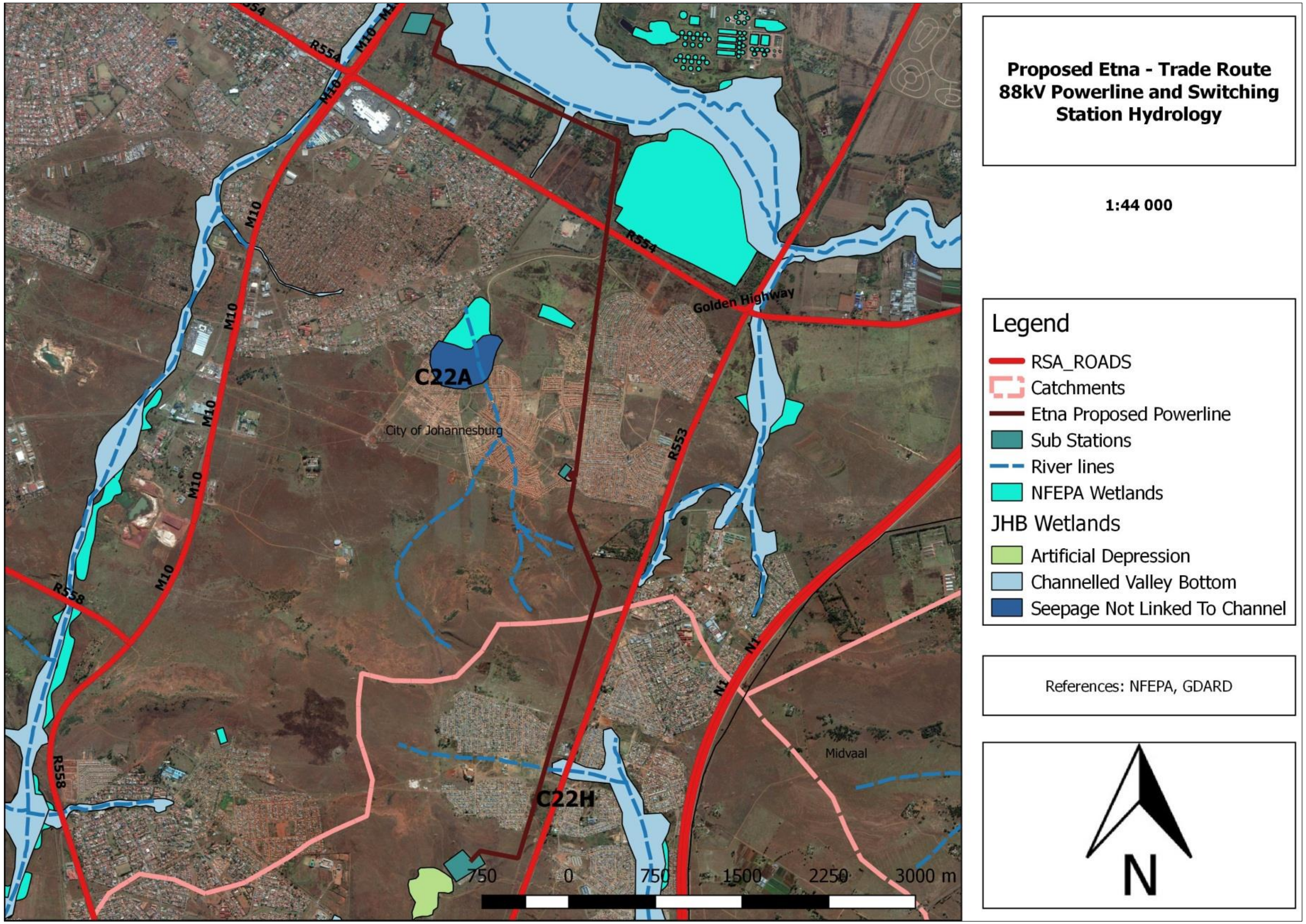


Figure 2: Regional hydrology

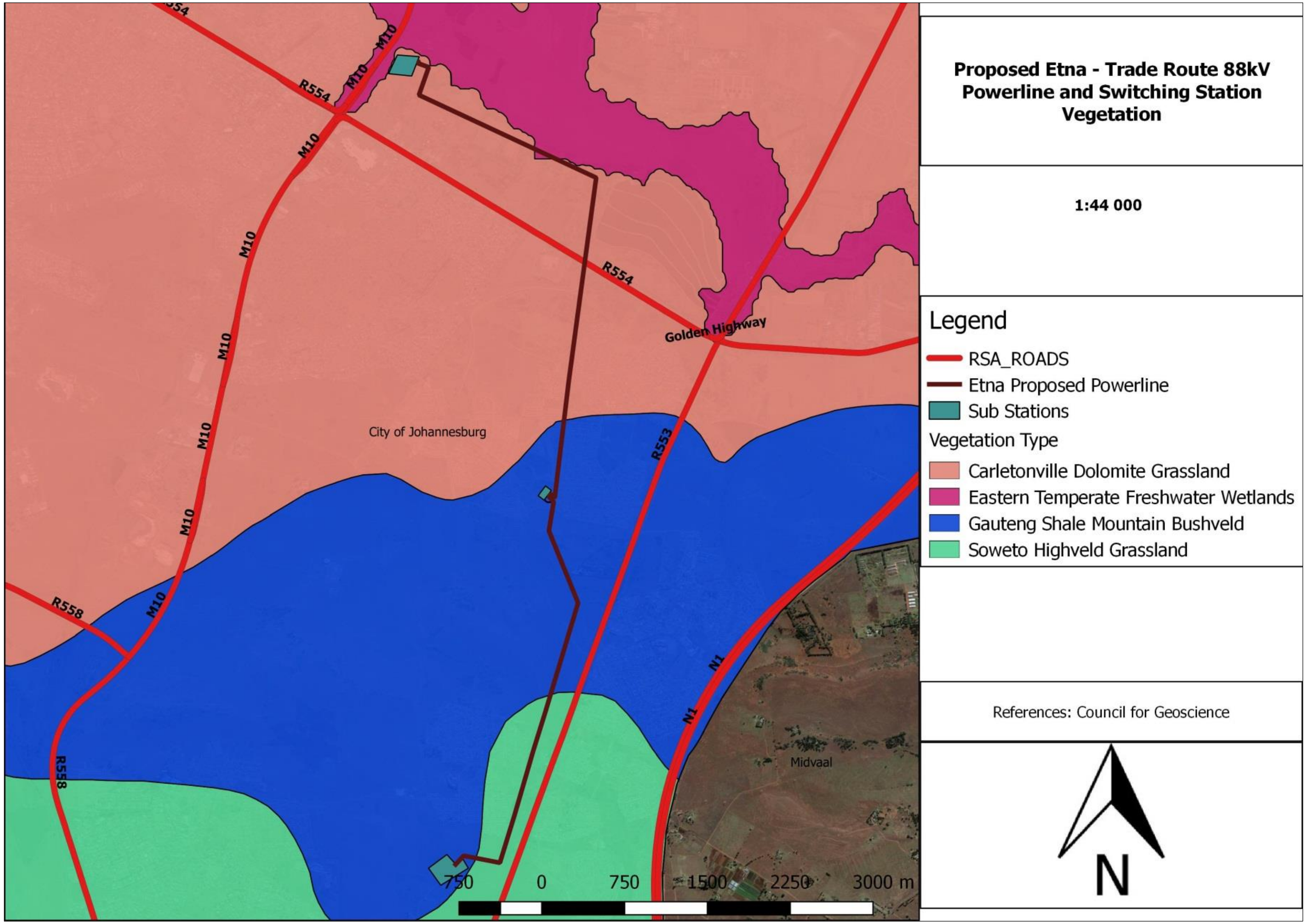


Figure 3: Vegetation types of the study area.

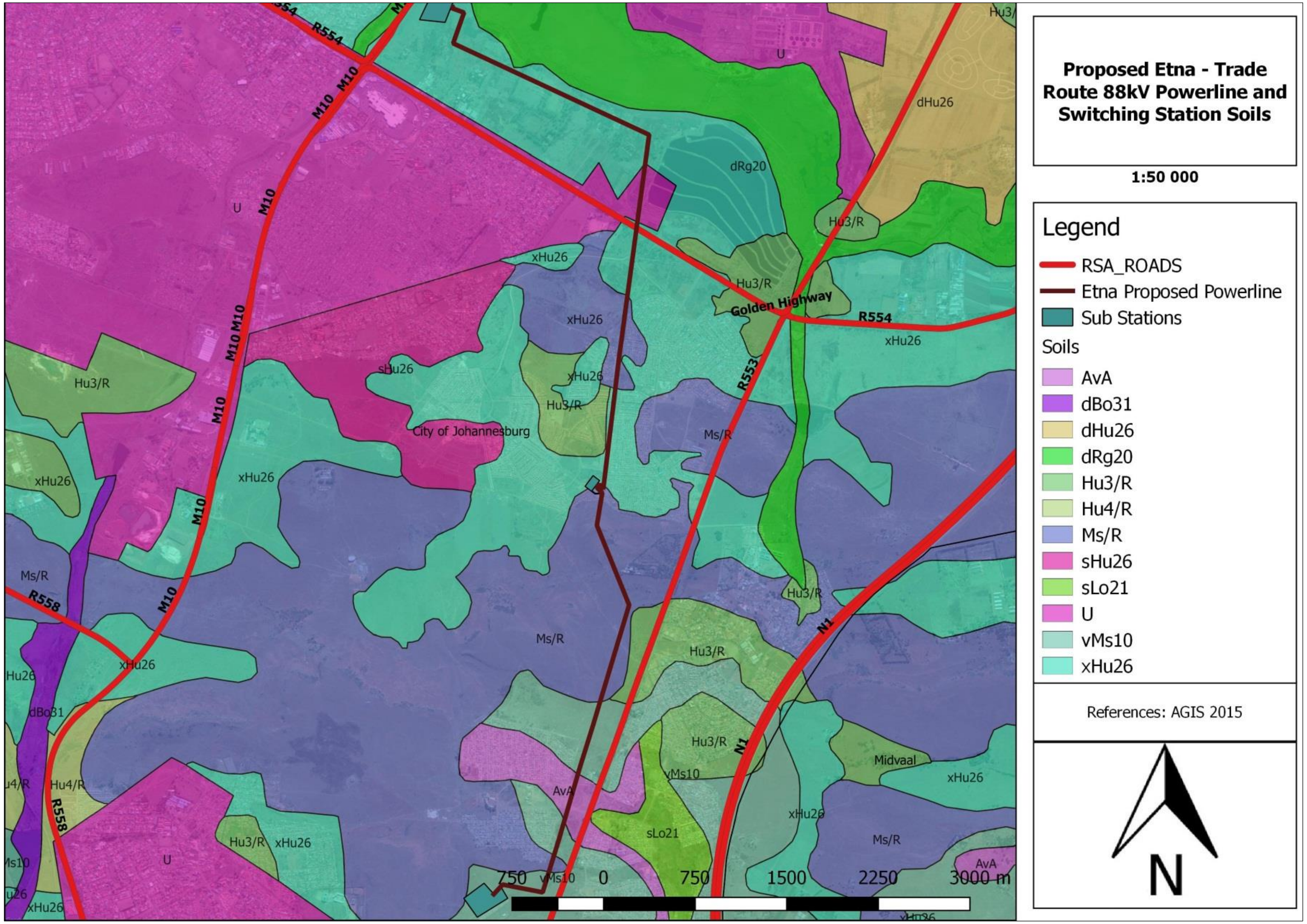


Figure 4: Soil classes of the study area.

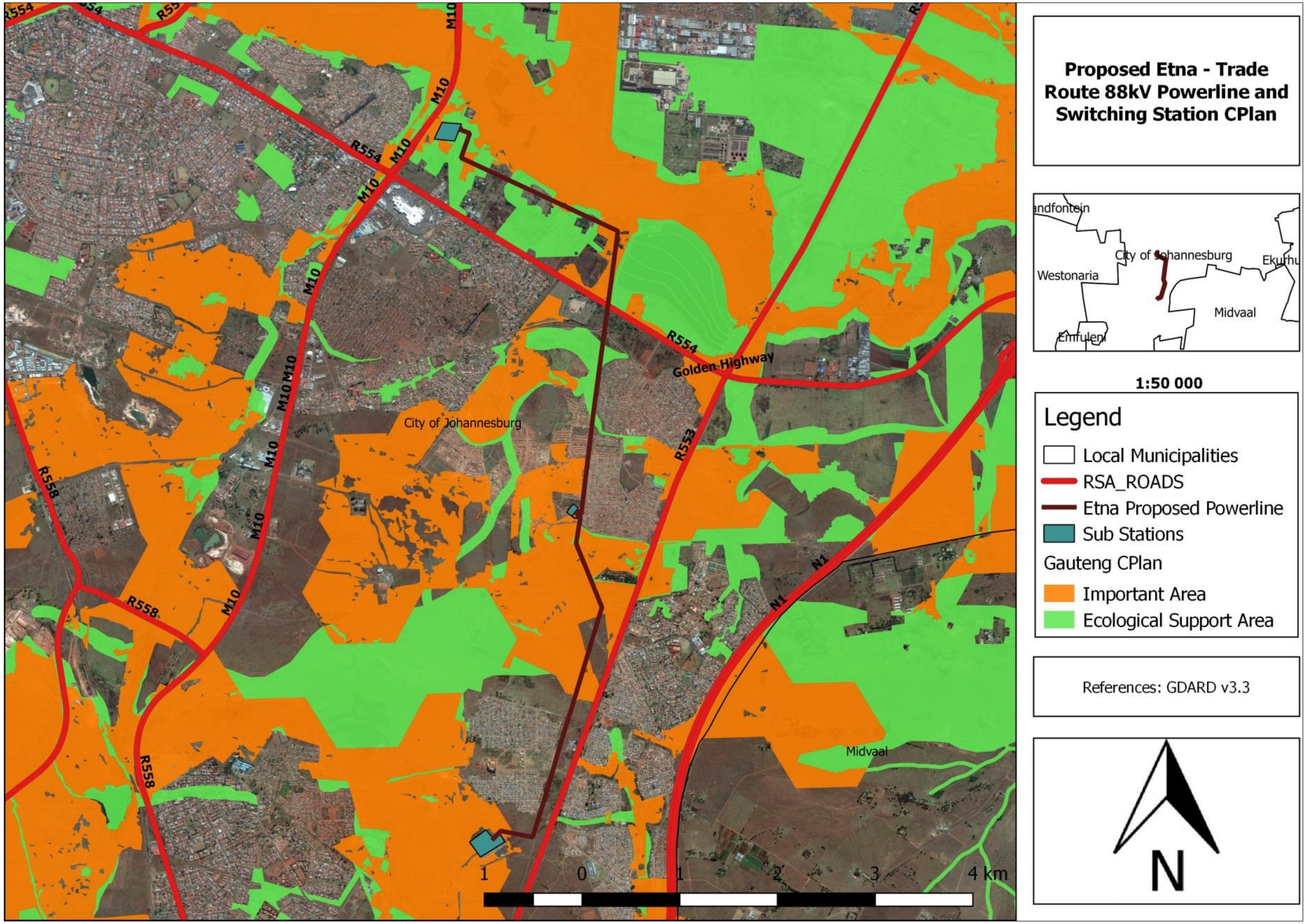


Figure 5: Gauteng Conservation Areas associated with the study site.

2 METHODOLOGY

The delineation method documented by the Department of Water affairs and Forestry in their document "Manual for identification and delineation of wetlands and riparian areas" (DWAF, 2005), and the Minimum Requirements for Biodiversity Assessments (GDARD, 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 etrex 30x 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 delineated based on scientifically sound methods, and utilizes a tool from the Department of Water and Sanitation 'A practical field procedure for identification and delineation of wetlands and riparian areas' (DWAF, 2005). The delineation of the watercourses of the proposed powerline infrastructure is based on both desktop delineation and groundtruthing.

Desktop Delineation

A desktop assessment was conducted of the proposed powerline alignment, with wetland and riparian units crossed by these infrastructures identified using a range of tools, including:

- 1: 50 000 topographical maps;
- S A Water Resources;
- Recent, relevant aerial and satellite imagery, including Google Earth.

All areas suspected of being wetland and riparian habitat based on the visual signatures on the digital base maps were mapped using Google Earth.

Ground Truthing

Wetlands are identified based on one or more of the following characteristic attributes (DWAF, 2005) (Figures 6 & Figure 7):

- The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur (Figure 7 and Figure 8);
- 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.

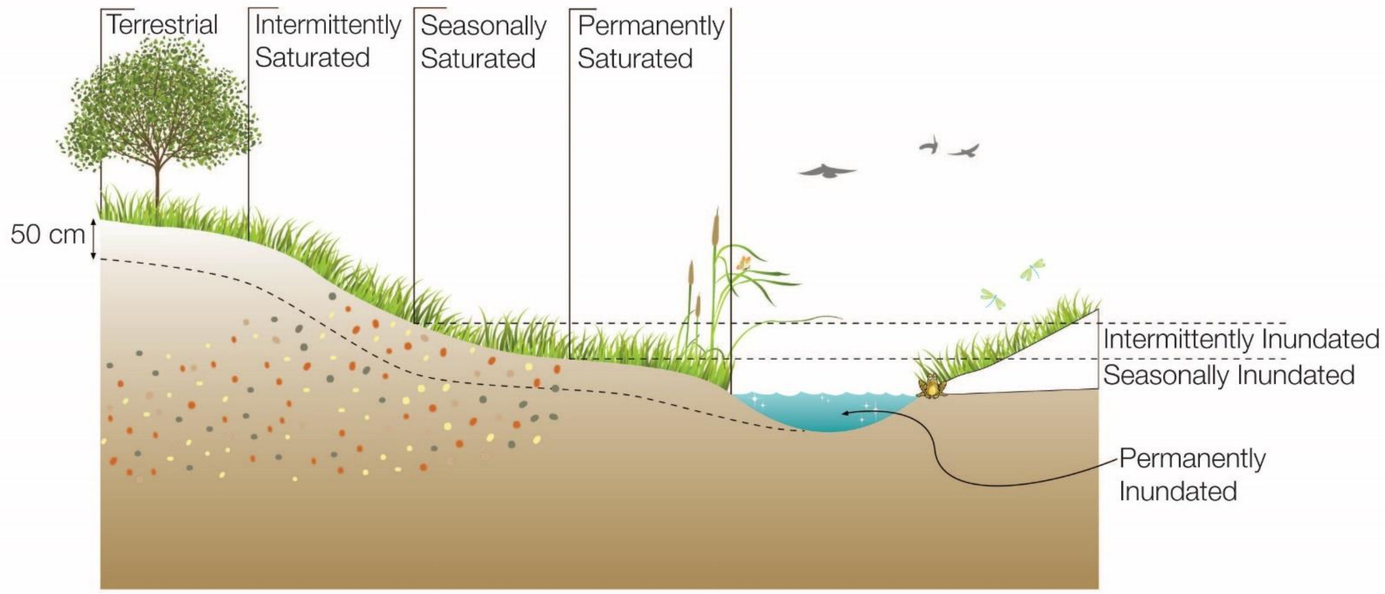


Figure 6: Typical cross section of a wetland (Ollis, 2013)

The Terrain Unit Indicator

The terrain unit indicator (Figure 7) 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).

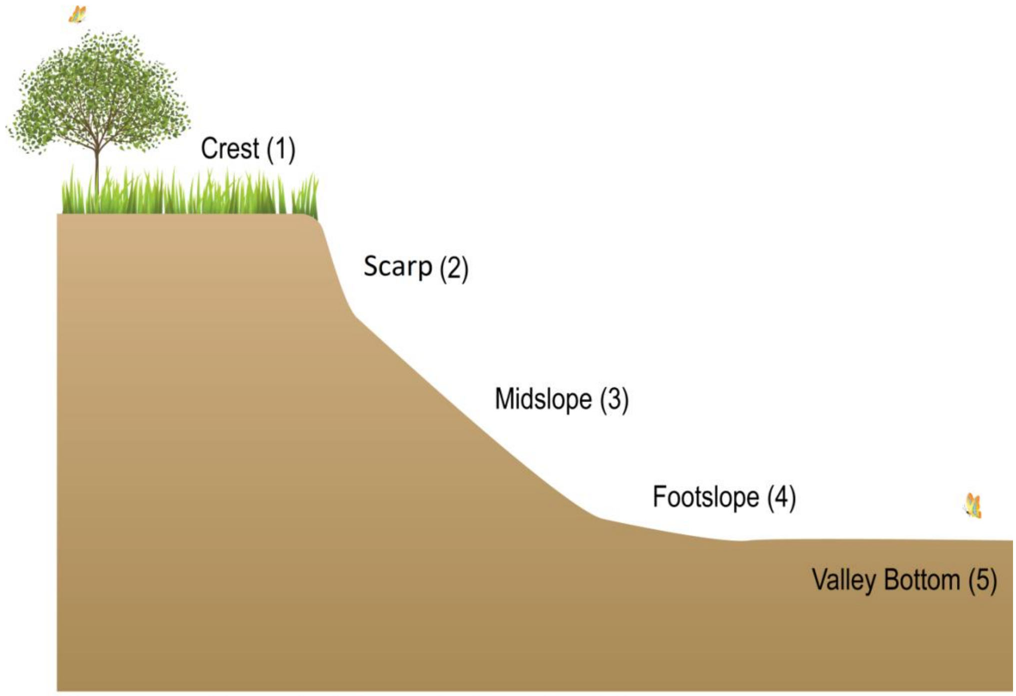


Figure 7. Terrain units (DWAF, 2005).

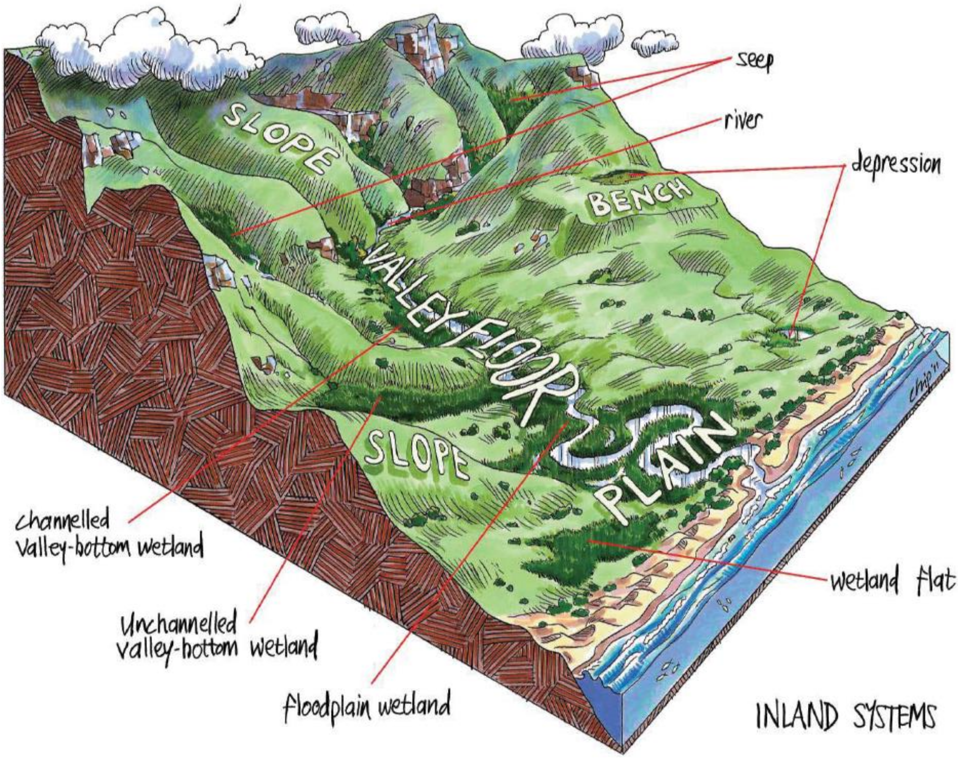


Figure 8: Wetland Units based on hydrogeomorphic types (Ollis *et al.* 2013)

Difficult to Delineate Wet Areas

Table 1 summarises the types of difficult wetland/ wetland-like areas and the best approach to take in such circumstances.

Table 1: List of types of sites that are difficult to delineate. (Job, 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	• Thoroughly document soil and landscape conditions, develop rationale for considering the area to be a wetland.

Type of "difficult site"	Approach
(e.g. annual vegetation or seasonal saturation)	• 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 9).

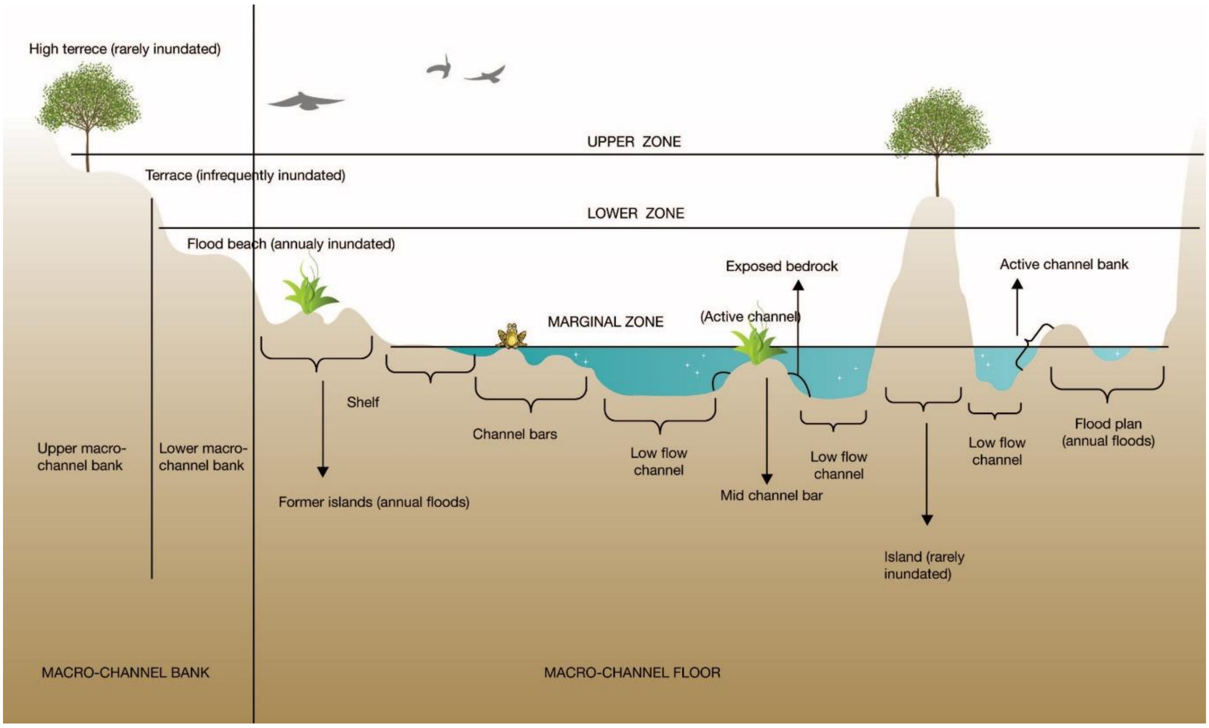


Figure 9: Schematic diagram illustrating an example of where the 3 zones would be placed relative to geomorphic diversity (Kleynhans *et al*, 2007)

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

<u>Riparian Area:</u>

A riparian area can be defined as a linear fluvial, eroded landform which carries channelized flow on a permanent, seasonal or ephemeral/episodic basis. The river channel flows within a confined valley (gorge) or within an incised macro-channel. The "river" includes both the active channel (the portion which carries the water) as well as the riparian zone (Figure 10) (Kotze, 1999).

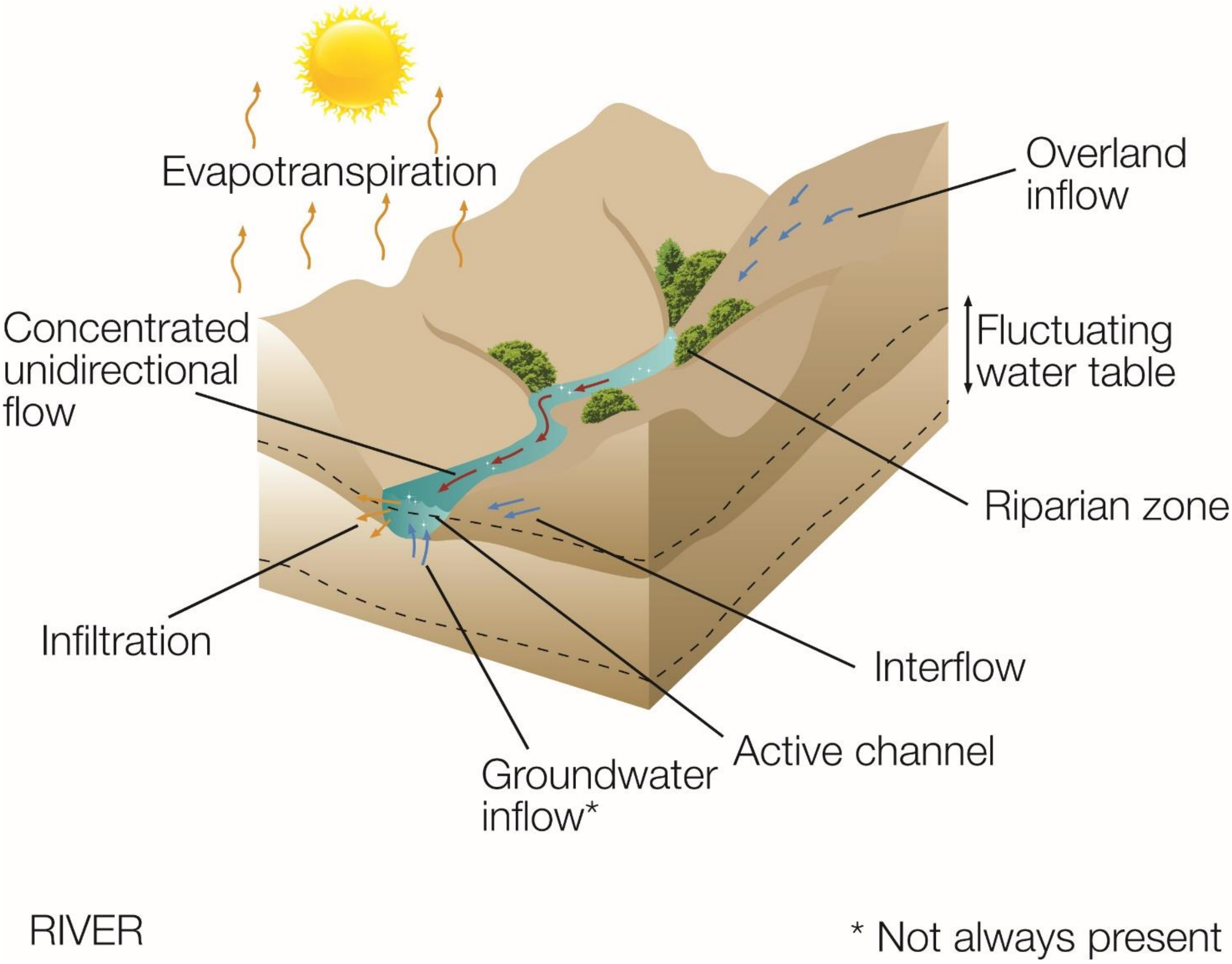


Figure 10: A schematic representation of the processes characteristic of a river area (Ollis *et al*, 2013).

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 11). 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).

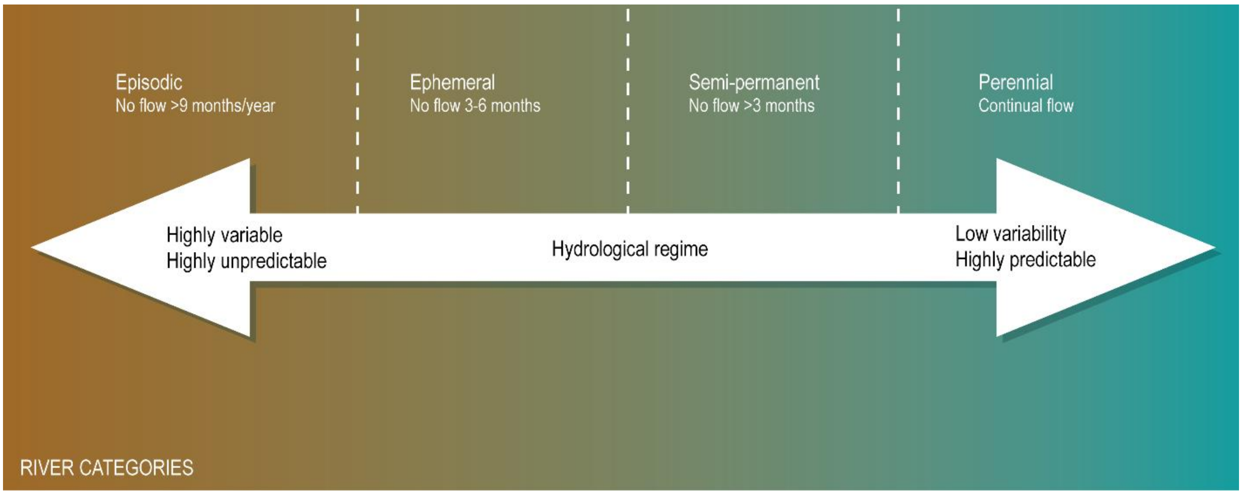


Figure 11: The four categories associated with rivers and the hydrological continuum. Dashed lines indicate that boundaries are not fixed (Seaman *et al*, 2010).

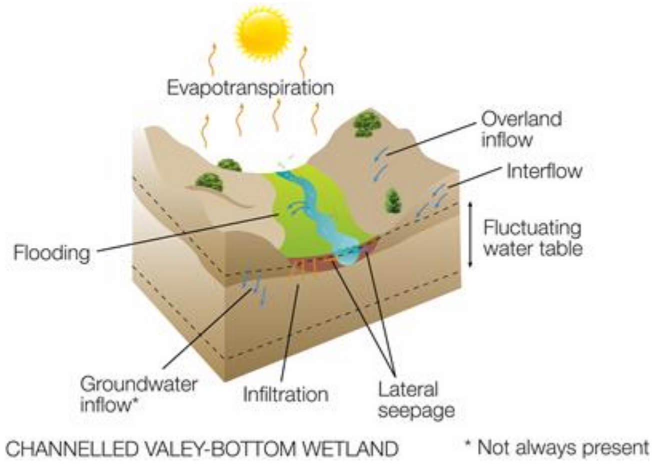
2.2 Wetland Classification and Delineation

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 Classification of wetland areas found during the study visit within the study site and/or within 500 m of the study site (adapted from Brinson, 1993; Kotze, 1999, Marneweck and Batchelor, 2002 and DWAF, 2005) are as follows (Table 3):

Table 3: Wetland Types and descriptions

Wetland Type:	Description:
Valley bottom without a channel 	Linear fluvial, net depositional valley bottom surfaces which have a straight channel with flow on a permanent or seasonal basis. Episodic flow is thought to be unlikely in this wetland setting. The straight channel tends to flow parallel with the direction of the valley (i.e. there is no meandering), and no ox-bows or cut-off meanders are present in these wetland systems. The valley floor is, however, a depositional environment such that the channel flows through fluvially-deposited sediment. These systems tend to be found in the upper catchment areas.

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 4 below.

Table 4: 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.

Primary Role	Buffer Functions
	• 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.

New buffer tools have been developed and been published as "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries. Consolidated Report" by the WRC (Macfarlane *et al* 2015). This new buffer tools aims to calculate the best suited buffer for each wetland or section of a wetland based on numerous on-site observations. The resulting buffer area can thus have large differences depending on the current state of the wetland as well as the nature of the proposed development. Developments with a high risk factor such as mining are likely to have a larger buffer area compared to a residential development with a lower risk factor. The minimum accepted buffer for low risk developments are however 15 meters from the edge of the wetland (Macfarlane, *et al* 2015) as opposed to the generic recommendation of 30 m for wetlands inside the urban edge and 50 m outside the urban edge (GDARD, 2012).

The current report suggests a generic 30 m as prescribed by the Johannesburg Catchment Management Policy.

Figure 12 images represent the buffer zone setback for the wetland types discussed in this report.

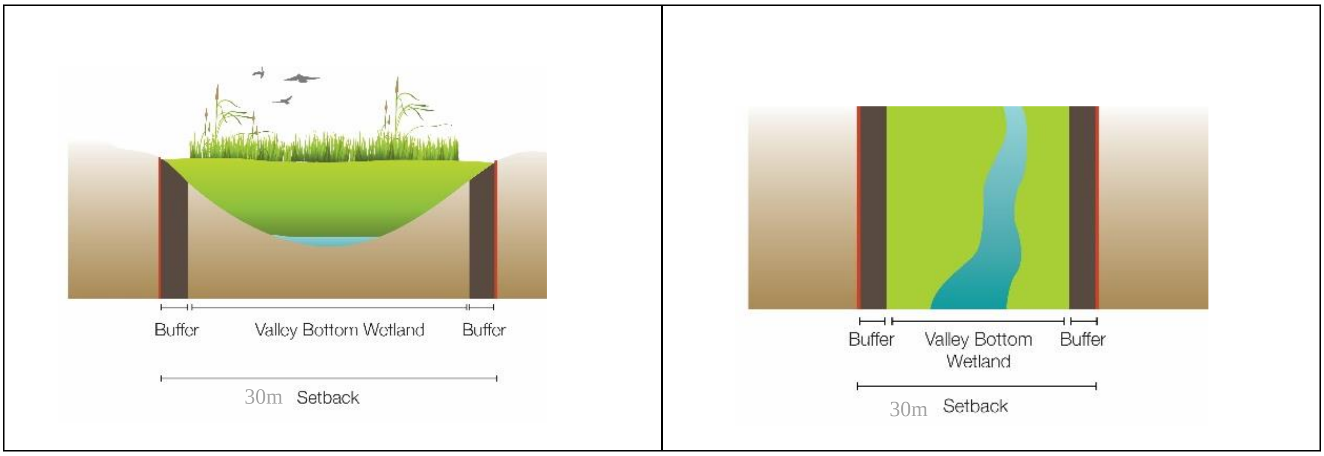


Figure 12: A represent the buffer zone setback for the wetland types discussed in this report

2.4 Impact Assessments

2.4.1 NEMA (2014) Impact Ratings

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

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

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

probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
  - The significance, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
  - The status, which will be described as either positive, negative or neutral.
  - The degree to which the impact can be reversed.
  - The degree to which the impact may cause irreplaceable loss of resources.
  - The degree to which the impact can be mitigated.

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

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

The **significance weightings** for each potential impact will be determined as follows (Table5):

Table 5: Significance Weightings

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

2.4.2 DWS (2014) Impact Register and Risk Assessment

Section 21(c) and (i) water uses (Impeding or diverting low and/or impacts to the bed and banks of watercourses) are non-consumptive and their impacts more difficult to detect and manage. They are also generally difficult to clearly quantify. However, if left undetected these impacts can significantly change various attributes and characteristics of a watercourse, and water resources, especially if left unmanaged and uncontrolled.

Risk-based management has value in providing an indication of the potential for delegating certain categories of water use “risks” to DWS regional offices (RO) or Catchment Management Agencies (CMA). Risk categories obtained through this assessment serve as a guideline to establish the appropriate channel of authorisation of these water uses

The DWS has therefore developed a risk assessment matrix to assist in quantifying expected impacts. The scores obtained in this assessment are useful in evaluating how the proposed activities should be authorised.

The formula used to derive a risk score is as follows:

RISK = CONSEQUENCE x LIKELIHOOD

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

Table 6 below provides a description of the classes into which scores are sorted, and their implication for authorization.

Table 6: An extract from DWS (2014) indicating the risk scores and classes as well as the implication for the appropriate authorization process

RATING	CLASS	MANAGEMENT DESCRIPTION	AUTHORISATION	DELEGATION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated. Wetlands are excluded.	GA	Regional Head
56 – 169	(M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. Wetlands are excluded.	WUL	Regional Head
170 – 300	(H) High Risk	Always involves wetlands. Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve.	WUL	Director General

2.5 Wetland Functionality, Status and Sensitivity

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

2.5.1 Present Ecological Status (PES) – WET-Health

The Present Ecological Score is based on the ability of the wetland to preform indirect benefits (Table 7).

Table 7: Indirect Benefits provided by wetland habitats (Macfarlane *et al*, 2007).

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

A summary of the three components of the WET-Health namely Hydrological; Geomorphological and Vegetation Health assessment for the wetlands found on site is described in Table 8. 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 8: 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	1-1.9	B	High

Description	Impact Score Range	PES Score	Summary
habitats and biota may have taken place.			
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 9.

Table 9: Trajectory class, change scores and symbols used to evaluate Trajectory of Change to wetland health (Macfarlane *et al*, 2007)

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

2.5.2 Ecological Importance and Sensitivity (EIS)

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

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

- Ecological Importance in terms of ecosystems and biodiversity such as species diversity and abundance.
- Ecological functions including groundwater recharge, provision of specialised habitat and dispersal corridors.
- Basic human needs including subsistence farming and water use (Table 10).

Table 10: Direct human benefits associated with wetland habitats (Macfarlane *et al*, 2007).

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

The Ecological Importance and Sensitivity of the seepage wetland is represented are described in the results section. Explanations of the scores are given in Table 11.

Table 11: 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

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
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

2.6 Riparian Functionality, Status and Sensitivity

2.6.1 Present Ecological Category (EC): Riparian

In the current study, the Ecological Category of the riparian areas were assessed using a level 3 VEGRAI (Riparian Vegetation Response Assessment Index) (Kleynhans et al, 2007). Table 12 below provides a description of each EC category.

Table 12: Generic ecological categories for EcoStatus components (modified from Kleynhans, 1996 & Kleynhans, 1999)

ECOLOGICAL CATEGORY	DESCRIPTION	SCORE (% OF TOTAL)
A	Unmodified, natural.	90-100
B	Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.	80-89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60-79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40-59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20-39
F	Critically modified. Modifications have reached a critical level and the lotic system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible	0-19

2.6.2 Quick Habitat Integrity Model (Riparian

To accommodate a less-detailed process, a desktop habitat integrity assessment (using the Quick Habitat Integrity model) that allows for a coarse assessment was developed. This assessment rates the habitat according to a scale of 0 (close to natural) to 5 (critically modified) according to the following metrics (Seaman et al, 2010):

- Bed modification.
- Flow modification.
- Introduced In-stream biota.
- Inundation.
- Riparian / bank condition.
- Water quality modification.

3 RESULTS

3.1 Land Use, Cover and Ecological State

The study site is dominated by open grassland with residential areas and small holdings in between including urban informal housing. Some farming is also taking place within and next to wetland areas especially at the Klip River.

3.2 Wetland Classification and Delineation

A total of three wetlands were recorded on the study site. All of these wetlands were classified as channelled valley bottom wetlands except for a non-perennial system (drainage lines) in the middle of the site. More wetlands not included in the assessment are located within the surrounding area. Another channelled valley bottom wetland not affected by the proposed alignment is located to the east of the R553. Two small artificial depressions, one just south of the Trade Route substation (under construction) and one just to the south of the existing Etna substation (created by sand mining), are also located within the surrounding area.

Wetland 1 was classified as a channelled valley bottom due to the longitudinal profile of this section of the Klip River wetland system (upstream areas are classified as a floodplain).

Watercourse 2 was classified as non-perennial drainage system. These drainage lines are non-perennial episodic streams that mostly only carry water during rainfall events. The drainage lines flow into a seepage wetland in the valley downstream from the site. It is important to note that the catchment of these drainage lines is located on a koppie close to where the current/proposed powerline servitude is located. The catchment of these streams are important to avoid erosion such as the erosional gullies

Wetland 3 (channelled valley bottom) a tributary of the Rietspruit is transformed due to residential development. Other impacts include pollution and increased storm water.

The wetlands were delineated up to a 500 m from the proposed alignment where applicable (Figure 13).

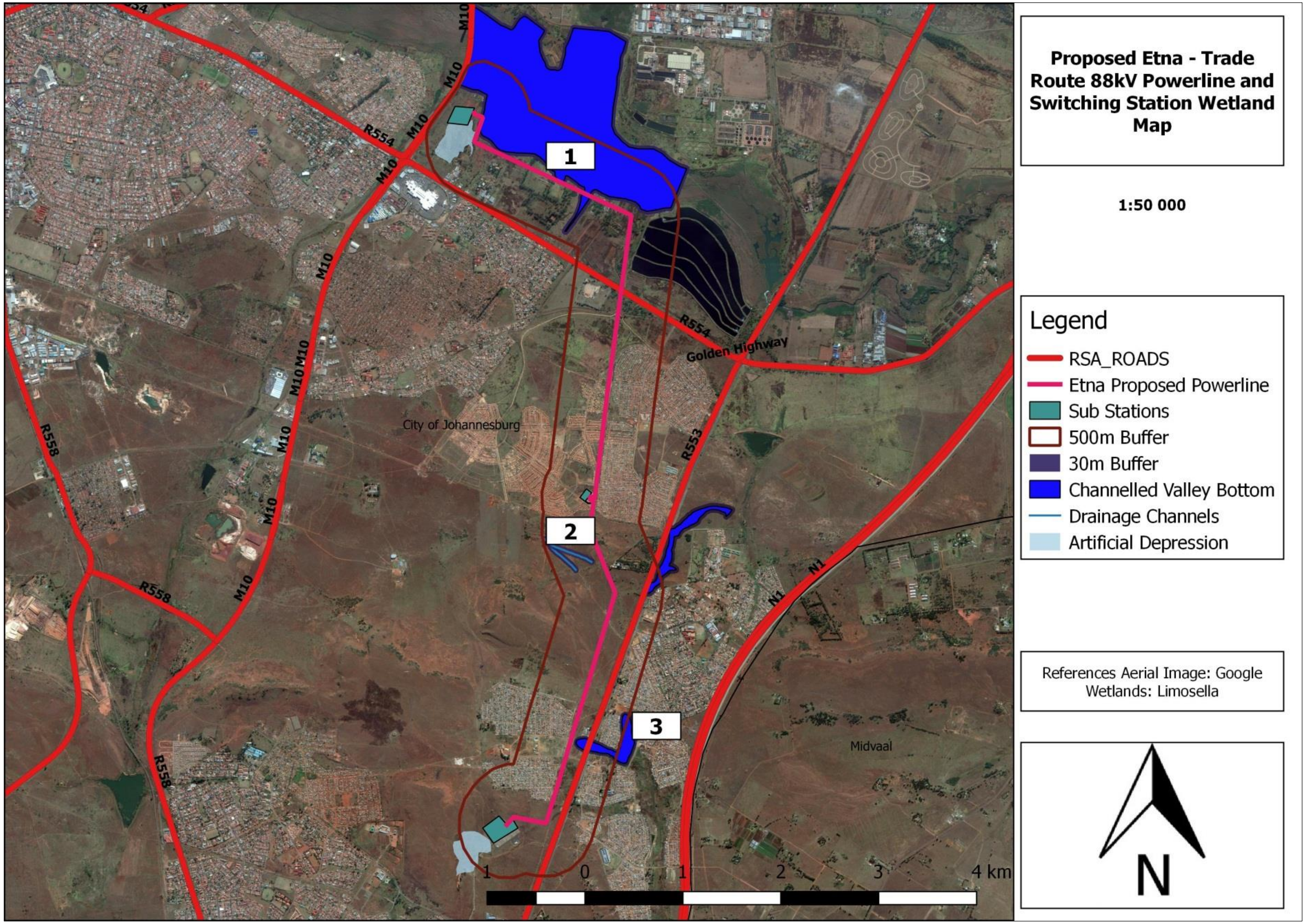


Figure 13: Wetlands associated with the study area.

3.3 Wetland Functional Assessment

3.3.1 Scores

The PES and EIS scores were calculated for all of the wetlands likely to be impacted by the proposed project. All of the wetlands recorded on site have been impacted due to the urban area in which they occur. The PES scores calculated in this assessment resulted into a moderate D (wetland 1) and a low E (wetland 3).

Extensive change of the hydrological regime took place within wetland 1, mostly due to extensive changes in the catchment including urbanisation and mining. This wetland receives increased runoff from urban stormwater and sewage inputs in the catchment, which leaded to erosion. The hydrological regime of wetland 3 changed to its current state as a result of residential development, urban informal settlements including pollution, increased storm water, alien vegetation including trampling by-humans and animals (grazing).

Common wetland plant species in the study area included *Phragmites australis* and *Typha capensis*. The woody vegetation was dominated by alien species such as *Acacia mearnsii* (Black Wattle), *Eucalyptus* spp, *Populus x canescens* (Poplar), *Melia azedarach* (Seringa) and *Salix babylonica* (Weeping Willow). Other alien and invasive species included *Tagates minuta* (tall Khakiweed) and *Cynodon dactylon* (Kweek grass).

The PES and EIS scores of the wetlands are reflected in the figure and table below (Table 13).

Table 13: Summary of hydrology, geomorphology and vegetation health assessment for the wetlands located on the proposed alignment (Macfarlane *et al*, 2009).

Wetland Unit	Ha	Hydrology		Geomorphology		Vegetation		Overall Health Score	
		Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
Channelled Valley Bottom 1 (wetland 1)	33	7.0	-1	3.5	-1	6.7	-1	5.9	-1
PES Category and Projected Trajectory		**E**	↓	**C**	↓	**E**	↓	**D**	↓
Channelled Valley Bottom 2 (wetland 3)	8	7.0	-1	4.2	-1	7.8	-1	6.4	-1
PES Category and Projected Trajectory		**E**	↓	**D**	↓	**E**	↓	**E**	↓

Ecological Importance and Sensitivity (EIS)

The EIS score of **2.63** and **1.3** respectively falls into a category characterised by **Moderate** ecological importance and sensitivity except for the channelled valley bottom 1 (Klip River) which have a **High** importance and sensitivity. This wetlands 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.

The wetlands in the moderate category 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 14 and Table 15). **The Recommended Ecological Management Class for the channelled valley bottom 1 is a B and a C for the channelled valley bottom 3.**

Table 14: Combined EIS scores obtained for the channelled valley bottom 1 (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	3.2	4.2
Hydro-functional importance	2.6	4.5
Direct human benefits	2.1	3.8
Overall EIS score		**2.63**

Table 15: Combined EIS scores obtained for the channelled valley bottom 3 (DWAF, 1999).

WETLAND IMPORTANCE AND SENSITIVITY	Importance	Confidence
Ecological importance & sensitivity	1.8	4.2
Hydro-functional importance	1.6	4.0
Direct human benefits	0.5	1.0
Overall EIS score		**1.3**

Riparian Vegetation Response Assessment Index (VEGRAI) & Quick Habitat Integrity (QHI)

The impacts in the non-perennial drainage line system (watercourse 2) include erosion caused by excavations in the local catchment, some trampling and evidence of burning practises. The Riparian Vegetation Response Assessment Index (VEGRAI and the Quick Habitat Integrity (QHI) assessment was done do determine the Ecological Category (EC) non-perennial systems/drainage areas (Tables 15-16).

Table 16: Results of the Ecosystem Services provided by the non-perennial drainage line system (watercourse 2) (Kleynhans *et al*, 2008).

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	80.0	40.0	3.0	1.0	10.0
NON MARGINAL	75.5	37.8	2.8	2.0	10.0
	2.0				20.0
LEVEL 3 VEGRAI (%)				77.8	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				2.9	

Table 17: QHI for the non-perennial riparian areas on the study site.

QUATERNARY CATCHMENT	**RIVER**	Bed modification	Flow modification (0-5)	Inundation (0-5)	Riparian/Bank condition (0-5)	Water quality modification (0-5)	**DESKTOP HABITAT INTEGRITY**	**INSTREAM EC%**	**INSTREAM EC**	Vegetation Rating (0-5)	**ECOSTATUS %**	**ECOSTATUS EC**	CONFIDENCE (1-5)
C22A	Non-Perennial System 1	1	1.5	4	1.5	0.5	**73.0**	**73.0**	**C**	2	**75.3**	**C**	**3:MODERATE**

a. b. c. d.

Figure 14: a. Wetland 1 (Klip River) with stands of *Phragmites australis*. b. The construction of the Trade –Route substation visible in the background. c. The current powerline and associated track. d. A section of the non-perennial drainage line system (watercourse 2) visible in the background. Note the burning of waste in the background within the catchment of this watercourse.

3.4 Impacts and Mitigations

Infrastructure development such as powerlines and substations 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. Site specific mitigation measures should be included in an Environmental Management Plan.

The impacts relevant to the proposed residential development is likely to include:

- Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow. The sources of this impacts include the compaction of soil, the removal of vegetation, surface water redirection and construction of infrastructure.
- Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). 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.
- The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a wetland, and outcompete natural vegetation, decreasing the natural biodiversity.
- Loss and disturbance of wetland/riparian habitat and fringe vegetation due to direct development on the wetland as well as changes in management, fire regime and habitat fragmentation.
- Construction and operational activities will result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in wetland function as well as human and animal waste. Could possibly impact on groundwater.

Suggested mitigation/management measures are summarised in Table 18– 22.

Table 18: Changes in water flow regime impact ratings

Nature: Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow		
ACTIVITY: Changing the quantity and fluctuation properties of the watercourse by for example stormwater input, or restricting water flow. The sources of this impacts include: • The compaction of soil, the removal of vegetation, surface water redirection and construction of infrastructure		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly probable (4)	Probable (3)
Duration	Long term (4)	Short term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**48 (medium)**	**24 (low)**
Status (positive or negative)	Negative	Negative

OPERATIONAL PHASE		
Probability	Improbable (2)	Improbable (2)
Duration	medium term (3)	medium term (3)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Moderate (6)	Low (4)
Significance	**22 (low)**	**16 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- No activities should take place in the watercourses and associated buffer zone. Where the above is unavoidable, only the construction footprint and no access roads can be considered. This is subjected to authorization by means of a water use license
- Construction must be restricted to the dryer winter months where possible.
- A temporary fence or demarcation must be erected around No-Go Areas outside the proposed works area prior to any construction taking place as part of the contractor planning phase when compiling work method statements to prevent access to the adjacent portions of the watercourse.
- Effective stormwater management should be a priority during both construction and operational phase. This should be monitored as part of the EMP. High energy stormwater input into the watercourses should be prevented at all cost. Changes to natural flow of water (surface water as well as water flowing within the soil profile) on the site above the river/wetland area resulting from the proposed powerline should be taken into account.

Cumulative impacts: Construction activities throughout the proposed powerline alignment may result in cumulative impact to the water courses within the local catchments and beyond. It is very important that protective measures should be put into place and monitored. A rehabilitation plan should be put into action should any degradation be observed as a result from stormwater or sediment input.

Residual Risks: Impacts to the flow characteristics of this watercourse are likely to be permanent unless rehabilitated.

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

Nature: Changes in sediment entering and exiting the system.

Activity: Changing the amount of sediment entering water resource and associated change in turbidity (increasing or decreasing the amount). 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 powerline construction
- Clearing of surface vegetation will expose the soils, which in rainy events would wash through the watercourse, causing sedimentation. In addition, indigenous vegetation communities are unlikely to colonise eroded soils successfully and seeds from proximate alien invasive trees can spread easily

into these eroded soil.

- Disturbance of soil surface
- Disturbance of slopes through creation of roads and tracks adjacent to the watercourse
- Erosion (e.g. gully formation, bank collapse)

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Highly Probable (4)	Probable (3)
Duration	Medium-term (3)	Medium-term (3)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**48 (medium)**	**27 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Highly probable (4)	Improbable (2)
Duration	Permanent (4)	Permanent (4)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Low (4)	Low (4)
Significance	**40 (medium)**	**18 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Water may seep into earthworks. It is likely that water will be contaminated within these earthworks and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Effective sediment traps should be installed.
- Construction in and around watercourses must be restricted to the dryer winter months where possible.
- Retain vegetation and soil in position for as long as possible, removing it immediately ahead of construction / earthworks in that area (DWAF, 2005).
- 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.
- 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 the construction area must be managed to avoid erosion and pollution problems.
- Implementation of best management practices

• Source-directed controls • Buffer zones to trap sediments • Monitoring should be done to ensure that sediment pollution is timeously dressed
Cumulative impacts: Expected to be moderate. Should mitigation measure not be implemented and changes made to the bed or banks of watercourse unstable channel conditions may result causing erosion, meandering, increased potential for flooding and movement of bed material, which will result in property damage adjacent to and downstream of the site. Reversing this process is unlikely and should be prevented in the first place.
Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 20: Introduction and spread of alien vegetation impact ratings.

Nature: Introduction and spread of alien vegetation.		
• ***Activity:*** The moving of soil and vegetation resulting in opportunistic invasions after disturbance and the introduction of seed in building materials and on vehicles. Invasions of alien plants can impact on hydrology, by reducing the quantity of water entering a wetland, and outcompete natural vegetation, decreasing the natural biodiversity. Once in a system alien invasive plants can spread through the catchment. If allowed to seed before control measures are implemented alien plans can easily colonise and impact on downstream users.		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**36 (Medium)**	**16 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Improbable (2)	Very Improbable (1)
Duration	Short-term (2)	Very Short (1)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	High (6)	Low (4)
Significance	**20 (low)**	**6 (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 moderate to high. Construction areas within the watercourses along the proposed servitude can experience an increased invasion if mitigation is not implemented or implemented correctly. Regular monitoring should be implemented during construction, rehabilitation including for a period after rehabilitation is completed.

Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 21: Loss and disturbance of wetland/riparian habitat and fringe vegetation impact ratings.

Nature: Loss and disturbance of wetland/riparian habitat and fringe vegetation impact ratings.

- ***Activity:*** Direct development within wetland/riparian areas. Loss and disturbance of wetland/riparian habitat and fringe vegetation due to direct development on the wetland as well as changes in management, fire regime and habitat fragmentation.

	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Medium-term (3)	Short-term (2)
Extent	Limited to Local Area (2)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (medium)**	**16 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Improbable (2)	Very Improbable (1)
Duration	Short duration (2)	Very short duration (1)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Low (4)	Minor (2)
Significance	**16 (low)**	**4 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation: • The development footprint should be designed around current wetland and wetland buffers. • Where construction occurs in the demarcated wetland and buffer, extra precautions should be implemented to so as to minimise wetland loss. • Where wetlands are lost, compensation should be made to protect the remaining wetlands and their catchments, increase their buffers and rehabilitate their condition and functionality. • Other than approved and authorized structure, no other development or maintenance infrastructure is allowed within the delineated watercourse or associated buffer zones. • Demarcate the watercourse areas and buffer zones to limit disturbance, clearly mark these areas as no-go areas • 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 take immediate corrective action where invasive species are observed to establish • Operational activities should not take place within watercourses or buffer zones, nor should edge effects impact on these areas • Operational activities should not impact on rehabilitated or naturally vegetated areas
Cumulative impacts: Expected to be moderate.
Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

Table 22: Changes in water quality due to foreign materials and increased nutrients impact ratings.

Nature: Changes in water quality due to foreign materials and increased nutrients impact ratings.		
• ***Activity:*** Construction, operational and decommissioning activities will result in the discharge of solvents and other industrial chemicals, leakage of fuel/oil from vehicles and the disposal of sewage resulting in the loss of sensitive biota in the wetlands/rivers and a reduction in wetland function as well as human and animal waste. Could possibly impact on groundwater		
	Without mitigation	**With mitigation**
CONSTRUCTION PHASE		
Probability	Probable (3)	Improbable (2)
Duration	Short duration (2)	Very short duration (1)
Extent	Limited to Local Area (3)	Limited to Local Area (2)
Magnitude	Moderate (6)	Low (4)
Significance	**33 (medium)**	**14 (low)**
Status (positive or negative)	Negative	Negative
OPERATIONAL PHASE		
Probability	Improbable (2)	Very Improbable (1)
Duration	Very short duration (1)	Very short duration (1)
Extent	Limited to Local Area (2)	Limited to the Site (1)
Magnitude	Low (4)	Low (4)
Significance	**14 (low)**	**6 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Moderate

Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	

Mitigation:

- Provision of adequate sanitation facilities located outside of the watercourse/riparian area or its associated buffer zone.
- Implementation of appropriate stormwater management around the excavation to prevent the ingress of run-off into the excavation and to prevent contaminated runoff into the watercourse.
- During decomissioning activities, workers are not allowed to use watercourse and associated buffers as ablution facilities.
- Provision of adequate sanitation facilities located outside of the wetland/riparian area or its associated buffer zone
- The development footprint must be fenced off from the watercourse and no related impacts may be allowed into the watercourse e.g. water runoff from cleaning of equipment, vehicle access etc.
- 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.
- Maintenance of construction vehicles / equipment should not take place within the watercourse or watercourse buffer.
- Control of waste discharges
- Maintenance of buffer zones to trap sediments with associated toxins
- Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects.
- Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse
- Ensure that no operational activities impact on the watercourse or buffer area. This includes edge effects.
- Control of waste discharges and do not allow dirty water from operational activities to enter the watercourse
- Regular independent water quality monitoring should form part of operational procedures in order to identify pollution
- Treatment of pollution identified should be prioritized accordingly.

Cumulative impacts: Expected to be moderate. Once in the system it may take many years for some toxins to be eradicated.

Residual Risks: Expected to be limited provided that the mitigation measures are implemented correctly and effective rehabilitation of the site is undertaken where necessary.

In addition to the impact ratings a risk assessment was completed establish and quantify the 'uncertainty of the outcome' associated with a particular section 21(c) or (i) water use as specified in DWS (2014). An extract from the Risk Matrix spreadsheet presented in Tables 23 to 25 below show that the expected risk score falls within the Medium risk category which refers to risk and impact on watercourses that are notable and require mitigation measures on a higher level, which costs more and require specialist input. Activities which fall within this category should be authorised through a Water Use Licence.

Table 23: The severity score derived from the DWS (2014) risk assessment matrix for the proposed powerline construction and operation

Activity	Aspect	Phase	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph+ Vegetation)	Biota	Severity
Decommissioning of Pylons	Dismantling of tower, Excavation to remove foundation; Backfilling foundation holes use of heavy machinery	Decommissioning	Altering the river bed & bank; Impeding the flow. Siltation & sedimentation. Rutting and compaction	2	2	3	2	**2.25**
Clearing of vegetation in close proximity to or in a watercourse	Maintenance and repair of existing access roads.	Construction	Impact posed by Damage to bank. Loss of biodiversity & habitat; impeding the flow of the watercourse to	2	2	2	2	**2**
	Vegetation maintenance within wetlands (Reeds, etc.)			2	2	3	2	**2.25**
	Creating a platform for Infrastructure (site for tower, crane, batch plant)			2	2	2	2	**2**
Construction of Pylons	Excavation for Foundations		Impeding the flow of water. Damage to banks. Siltation of water course.	2	2	2	2	**2**
	Denuding the area			2	2	2	2	**2**

	Stormwater structures		Erosion of water course.	2	2	2	2	**2**
	Creating a platform for tower erection			2	2	2	2	**2**
Operation of the powerline and infrastructure	Operation and ad hoc maintenance of the powerline/ road servitude	Operation	littering, changed hydrology, input of hydrocarbons	1	1	1	1	**1**

RISK = CONSEQUENCE x LIKELIHOOD
CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION
LIKELIHOOD = FREQUENCY OF THE ACTIVITY + FREQUENCY OF THE IMPACT +LEGAL ISSUES + DETECTION

Table 24: The significance score derived from the DWS (2014) risk assessment matrix for the proposed activities

Activity	Aspect	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Significance	Risk Rating
Decommissioning of Pylons	Dismantling of tower, Excavation to remove foundation; Backfilling foundation holes use of heavy machinery	1	2	5.25	1	3	5	2	57.75	**M**
Clearing of vegetation in close proximity to or in a	Maintenance and repair of existing access roads.	2	2	6	1	2	5	2	60	**M**
	Vegetation maintenance within wetlands (Reeds, etc.)	1	2	5.25	1	2	5	2	52.5	**L**

watercourse	Creating a platform for Infrastructure (site for tower, crane, batch plant)	1	2	5	1	2	5	2	50	**L**
Construction of Pylons	Excavation for Foundations	1	2	5	1	3	5	2	55	**L**
	Denuding the area	1	2	5	1	3	5	2	55	**L**
	Stormwater structures	1	2	5	1	3	5	2	55	**L**
	Creating a platform for tower erection	1	2	5	1	3	5	2	55	**L**
Operation and ad hoc maintenance of the access road	Operation and ad hoc maintenance of the access road	1	4	6	1	1	5	2	54	**L**

Table 25: Severity scores with mitigation measures

Activity	**Aspect**	**Risk Score**	**Control Measure**	**Type of Watercourse**
Decommissioning of Pylons	Dismantling of tower, Excavation to remove foundation; Backfilling foundation holes	**M**	• Water may seep into excavations. It is likely that water will be contaminated within these excvations and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Effective sediment traps should be installed. • Construction in and around watercourses must be restricted to the dryer winter months where possible.	Channelled Valley bottom wetlands and non-perennial watercourses on

	use of heavy machinery		• Retain vegetation and soil in position for as long as possible, removing it immediately ahead of earthworks in that area (DWAF, 2005). • Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • When earthworks and excavations are undertaken 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 the construction area must be managed to avoid erosion and pollution problems. • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas) • Stockpiled soil should be protected from erosion due to water runoff.	site
Clearing of vegetation in close proximity to or in a watercourse	Maintenance and repair of existing access roads.	**M**	• Stripping of vegetation for construction must occur in a phased manner and must be restricted to the construction footprint to reduce the risk of erosion during times of precipitation • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas) • All sloped areas where vegetation cover was destroyed must be re-vegetated by either using removed sods or by seeding with a grass mixture containing species naturally occurring in the area. Sloped areas where vegetation has been removed or destroyed should be replanted immediately after completion of construction to avoid erosion • Areas where minimal disturbances took place, can be ripped and allowed to naturally re-vegetate (take note that this excludes sloped areas) – also the area should be monitored for emerging alien invasive plant species	Channelled Valley bottom wetlands and non-perennial watercourses on site
	Creating a platform for Infrastructure (site for tower, crane, batch plant)	**L**		

			• If natural re-vegetation is unsuccessful, corrective action should be taken and includes seeding and planting by an appropriate specialist as stipulated in the EMP • All declared alien invasive plant species must be removed prior to construction as well as when they become evident for the duration of construction • All construction vehicles and equipment, as well as construction material should be free of plant material. Equipment and vehicles should be thoroughly cleaned other prior to access on to the construction site. • All declared alien invasive plant species must be removed from the servitude prior to r construction as well as when they become evident for the duration thereof • After construction, compacted areas should be ripped and topsoil replaced from the areas where it was removed. Note that the topsoil likely contain numerous alien invasive plant seeds and that the rehabilitated area must be monitored for the emergence of such species. • Ripping of compacted shall be done to a depth of 250mm in two directions at right angles • Do not rip and / or scarify areas under wet conditions, as the soil will not break up and compaction will be worsened • Do not permit vehicular or pedestrian access into natural areas or into seasonally wet areas during and immediately after rainy periods, until such a time that the soil has dried out (DAWF, 2005) • Stockpiled soil should be protected from erosion due to water runoff	
	Vegetation maintenance within wetlands (Reeds, etc.)	**L**	• If natural re-vegetation does not occur replanting of indigenous plants should be done at sites of concern • Prevent livestock and pedestrians from entering rehabilitated areas • If re-vegetation is not successful at the end of a 3-year period, develop and implement (in consultation with a professional wetland ecologist) a remedial re-vegetation plan to actively re-vegetate the wetland. Continue re-vegetation efforts until wetland re-vegetation is successful	Channelled Valley bottom wetlands and non-perennial watercourses on site
Construction of Pylons	Excavation for Foundations	**L**	• The final alignment of the powerline should attempt to avoid wetland and riparian habitat, with pylons located outside of these areas.	Channelled Valley bottom wetlands and non-

			• The alignment should attempt to maximise the spanning across wetland and riparian areas, reducing the proximity of infrastructure and disturbance to these habitats; • The alignment should maintain a buffer zone of 30m from the identified wetlands/watercourses. This buffer would be a precautionary measure to protect the systems from sediment or disturbance that occurs during the construction phase. • In those instances where wetland/riparian habitat cannot be avoided, construction should be scheduled for the dry season; and the alignment and positioning of infrastructure should make use of the disturbed 'islands' within these wetland areas; This would align the powerline with existing impacts and reduce impacts on intact portions of the system; • The final alignment and positioning of infrastructure should be informed by additional specialist input infield during the Environmental Implementation Plan phase. • When paths need to be established through wetland areas for erection of new towers/poles a 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. • Water may seep into excavations. It is likely that water will be contaminated within these excvations and should thus be cleaned or dissipated into a structure that allows for additional sediment input and slows down the velocity of the water thus reducing the risk of erosion. Effective sediment traps should be installed. • When earthworks and excavations are undertaken 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 the construction area must be managed to avoid erosion and pollution problems • Retain vegetation and soil in position for as long as possible, removing it immediately ahead of earthworks in that area (DWAF, 2005). • 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	perennial watercourses on site
	Denuding the area	**L**		Channelled Valley bottom wetlands and non-perennial watercourses on site

		construction and that plan must be implemented immediately upon completion of construction. • Cordon off areas that are under rehabilitation as no-go areas using appropiate demarcation. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.	
Stormwater structures	L	• Other than approved and authorized structure (where stormwater structures is required), no other development or maintenance infrastructure is allowed within the delineated wetland or associated buffer zones • Construct any necessary erosion protection works where the powerline intersects the channel of the wetland in order to prevent scouring or bank erosion. Gabions, reno mattresses or other stabilising structures and materials could be considered (Teixeira-Leite, 2009) • Wetlands sediments/debris are not to be used for construction (e.g.: rocks for use in gabion baskets/reno mattresses) or to be permanently removed from the system (Teixeira-Leite, 2009) • Removed sediment should be stockpiled for rehabilitation • Excavate and backfill trenches on a progressive basis • Do not allow excavations to stand open for longer than 2 days where at all possible. Excavations should preferably be opened and closed on the same day (DWAF, 2005) • Trenching through wetlands and drainage lines may only be undertaken upon instruction by the EO / ECO. In such a situation be sure to return the profile of the wetland to one similar to the pre-construction profile. No ridge or channel feature may remain (Teixeira-Leite, 2009) • During construction through a wetland, the majority of the flow of the wetland must be allowed to pass down the stream channel (i.e. damming must not be allowed to take place). In-stream diversions should be used rather than the construction of new channels (Teixeira-Leite, 2009)	Channelled Valley bottom wetlands and non-perennial watercourses on site
Creating a platform for tower erection	L	• Remove only the vegetation where essential for construction and do not allow any disturbance to the adjoining natural vegetation cover. • Where soils are removed, the topsoil and subsoil must be stockpiled separately in low heaps (Topsoil are deemed to be the top layer of soil containing organic material, nutrients and	Channelled Valley bottom wetlands and non-perennial

			plant grass seed. For this reason it is an extremely valuable resource for the rehabilitation and vegetation of disturbed areas). • After construction, compacted areas should be ripped and topsoil replaced from the areas where it was removed. Note that the topsoil likely contain numerous alien invasive plant seeds and that the rehabilitated area must be monitored for the emergence of such species. • Ripping of compacted shall be done to a depth of 250mm in two directions at right angles • Do not rip and / or scarify areas under wet conditions, as the soil will not break up and compaction will be worsened	watercourses on site
Operation and ad hoc maintenance of the access road	Operation and ad hoc maintenance of the access road	**L**	• Provision of adequate dustbins and signs to prevent littering • Annual monitoring should highlight degradation of wetlands and downstream areas • Should degradation be observed, a detailed rehabilitation plan should be implemented • Maintenance activities should be subject to the same mitigation measures as for construction of the powerline and associated infrastructure as specified above	Channelled Valley bottom wetlands and non-perennial watercourses on site

4 CONCLUSION

A total of three wetlands were recorded on the study site. All of these wetlands are classified as Channelled Valley Bottom except for a non-perennial system (drainage lines) in the middle of the site. More wetlands not included in the assessment are located within the surrounding area. Another Channelled Valley Bottom not affected by the proposed alignment is located to the east of the R553. Two small artificial depressions one just south of the Trade Route substation (under construction) and one just to the south of the existing Etna substation (created by sand mining) are also located within the surrounding area.

Both the channelled valley bottom and non-perennial drainage lines have been impacted. These impacts are summarised in the table below:

Nr	Affected Watercourse	Approximate central coordinates	Recorded Impacts	PES/EC Score	EIS/QHI Score
1	**Channelled valley bottom**	26°19'17.69"S and 27°53'3.45"E	The increased hardened surfaces in the local catchment of the wetland and associated storm water together with extensive continues input of sewage due to leaking pipes and dysfunctional treatment plants resulted in increased flow-peaks and associated canalisation in the wetland areas. The hydrology of the wetland was altered over the years and erosion is evident.	**PES: D**	**B - High**
2	**Non-perennial Area**	26°21'35.24"S and 27°52'58.49"E	Erosion caused by excavations in the local catchment, trampling and burning practises.	**EC: B/C**	**QHI: C**
3	**Channelled valley bottom**	26°22'41.53"S and 27°53'15.17"E	The wetland is transformed due to residential and informal settlement development. Other impacts include pollution and increased storm water.	**PES: E**	**C - Moderate**

The proposed powerline alignment does not traverse any major rivers but rather the wetland areas associated with the Klip River and/or tributaries that drain into the Klip River and Rietspruit.

The important factors relevant to the project are summarised in the table below:

	Quaternary Catchment and WMA areas	Important Rivers possibly affected	Buffers
	A22A, C22H Upper Vaal (WMA)	Wetland areas associated with the Klip River and/or tributaries that drain into the Klip River and Rietspruit	**30 m for all the wetlands/riparian areas**
Does the specialist support the development?	Yes, electrical infrastructure in the study area is in dire need of upgrading. However it should be done in a manner that does not further alter wetland areas and their catchments.		

	The proposed alignment traverse important and ecological support areas and care should be taken to limit impacts in these areas to a minimum.
Major concerns (potential impacts)	• Changing the quantity and fluctuation properties of the watercourse • 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) • Erosion in the Klip River and downstream wetlands
Recommendations	Powerline infrastructure should be excluded from the wetland areas as far as possible. However, linear developments such as the proposed powerline are rarely able to avoid crossing any watercourses whatsoever. Where alternatives have been investigated and watercourse crossings have been shown to be necessary it is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology.
CBA and other Important areas	The proposed alignment traverses important and ecological support areas. The northern section of the proposed powerline alignment traverse the Klipriver Highveld Grassland ecosystem which is critically endangered (NEMBA, 2011).

It is important to note that the level of impact to the wetlands will likely deteriorate in the next 5 to 10 years given the amount of development occurring in the wetland's catchment, unless care is taken to develop with an approach that is sensitive to the hydrology of the landscape.

Two aspects of the activities associated with this project were given score that fall in the Medium risk category according to the DWS (2014) risk assessment matrix. These activities are:

- Dismantling of towers; Excavation to remove foundation; Backfilling foundation holes and the use of heavy machinery (score of 57.75);
- Maintenance and repair of existing access roads (score of 60).

The score for both these activities could be lowered to fall in the Low class (in which authorization could proceed under a GA) should method statements and position of pylon footprints be available for inclusion into an updated assessment. Method statements should aim to favour low-impact methods that have the least effect to changed hydrology, vegetation loss and pollution.

It is important that appropriate mitigation measures are put into place and carefully monitored to ensure minimal impact to regional hydrology. Mitigation should focus on:

- Rehabilitation / restoration of indigenous vegetative cover.
- Management of point discharges during construction activities.
- Alien plant control.
- Implementation of best management practices regarding stormwater and earthworks.
- Provision of adequate sanitation facilities located outside of the wetland area or its associated buffer zone during construction activities.

- Implementation of appropriate stormwater management around excavations to prevent the ingress of run-off into the excavations.
- Prevention of erosion, and where necessary rehabilitation of eroded areas.

To minimise the ecological impacts some site specific mitigation measures should be applied together with the generic mitigation measures:

- The existing dirt road/servitude should be used as far as possible to limited disturbance to undisturbed areas.
- Erosion control methods should be implemented within and adjacent to the road/servitude to prevent further erosion and erosional gullies.
- Vehicular movement should be restricted to a single access roadway only.
- When paths need to be established through wetland areas for erection of new towers/poles a 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 and/or the non-perennial areas should be stored in the layers 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 revegetated with plant species specific to the area.

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Van der Waals J, Rossouw PS and Van Zyl LG. (2015). Implications of the Erosion Susceptibility of Soils and Wetlands on the Halfway House Granite Dome. Gauteng Wetland Forum 28/08/2015

APPENDIX A: Abbreviated CVs of participating specialists

Name:	**ANTOINETTE BOOTSMA nee van Wyk**
ID Number	7604250013088
Name of Firm:	Limosella Consulting
Position:	Director - Principal Specialist
SACNASP Status:	Professional Natural Scientist # 400222-09 Botany and Ecology
Nationality:	South African
Marital Status:	Married
Languages:	Afrikaans (mother tongue), English, basic French

EDUCATIONAL QUALIFICATIONS

- B. Sc (Botany & Zoology), University of South Africa (1997 - 2001)
- B. Sc (Hons) Botany, University of Pretoria (2003-2005). Project Title: A phytosociological Assessment of the Wetland Pans of Lake Chrissie
- Short course in wetland delineation, legislation and rehabilitation, University of Pretoria (2007)
- Short course in wetland soils, Terrasoil Science (2009)
- MSc Ecology, University of South Africa (2010 - ongoing). Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management

PUBLICATIONS

- P.L. Grundling, A Lindstrom., M.L. Pretorius, A. Bootsma, N. Job, L. Delport, S. Elshahawi, A.P Grootjans, A. Grundling, S. Mitchell. 2015. Investigation of Peatland Characteristics and Processes as well as Understanding of their Contribution to the South African Wetland Ecological Infrastructure Water Research Comission KSA 2: K5/2346
- A.P. Grootjans, A.J.M Jansen , A, Snijdewind, P.C. de Hullu, H. Joosten, A. Bootsma and P.L. Grundling. (In Press). In search of spring mires in Namibia: the Waterberg area revisited
- Haagner, A.S.H., van Wyk, A.A. & Wassenaar, T.D. 2006. *The biodiversity of herpetofauna of the Richards Bay Minerals leases.* CERU Technical Report 32. University of Pretoria.

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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 250 fine scale wetland and ecological assessments in Gauteng, Mpumalanga, KwaZulu Natal, Limpopo and the Western Cape. 2007, ongoing.
- 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:	**MARINUS AXEL BOON**
ID Number	811015 5053 084
Name of Firm:	Limosella Consulting
Position:	Wetland Specialist
SACNASP Status:	Cert. Nat. Sci (Reg. No. 200083/15)
Nationality:	South African
Marital Status:	Married
Languages:	Afrikaans (mother tongue), English, basic Dutch

EDUCATIONAL QUALIFICATIONS

- National Diploma Nature Conservation, University of South Africa (2008)
- B. Sc (Hons) Environmental Management University of South Africa (2012)
- Tools for Wetland Assessment – Certificate of Competence, Rhodes University (2012)
- Environmental Law for Environmental Managers, North-West University (NWU), 2011
- ISO 14001:2004 Lead Auditor (DQS German Association for Accreditation), 2010
- XXIII International Society for Photogrammetry and Remote Sensing (ISPRS) 2016 Summer School (Czech Republic): Natural Resource Management from data to publishing
- MSc Aquatic Health, University of Johannesburg (2016). Project Title: Unmanned Aerial Vehicle (UAV) Photogrammetry as a Tool in Aquatic ecosystem mapping, assessment and planning

PUBLICATIONS

- Boon, M., Greenfield, R., and Tesfamichael, S., 2016. Wetland Assessment Using Unmanned Aerial Vehicle (UAV) Photogrammetry. International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Prague, Czech Republic, Vol. XLI-B1, pp. 781-788
- Boon, M.A., Greenfield, R. and Tesfamichael, S., 2016. Unmanned Aerial Vehicle (UAV) photogrammetry produces accurate high-resolution orthophotos, point clouds and surface models for mapping wetlands. South African Journal of Geomatics, 5(2), pp.186-200.

KEY EXPERIENCE

Marinus has more than 11 years' experience in Environmental Management and compliance monitoring by working for both the government and the private sector. Marinus developed himself in the field of Wetland specialist Studies over the last years. He completed a competency course for wetland assessments at Rhodes University in 2012. He completed and still currently undertook a number of wetland delineation and functional assessments including wetland rehabilitation and monitoring plans. Marinus is also responsible for construction projects which require a wetland specialist for detailed site planning and design as part of Water Use License requirements. He is a member of the South African Wetland Society and Gauteng

Wetland Forum. Marinus recently completed his MSc in Aquatic Health at the University of Johannesburg (UJ). This MSc enables knowledge in a wide field in terms of aquatic ecosystems including: functional freshwater and wetland ecology; wetland and river management; estuaries and near shore marine environment; monitoring of wetlands and rivers; legislative aspects related to rivers and wetlands; water quality and pollution; wetland and river remediation and rehabilitation. Marinus completed his MSc thesis in a new field, which involves the use of drones (Unmanned Aerial Vehicles) for the enhancement of aquatic ecosystem studies. Project Title: Unmanned Aerial Vehicle (UAV) Photogrammetry as a Tool in Aquatic ecosystem mapping, assessment and planning (This is not a complete list of projects completed, rather an extract to illustrate diversity);

- April 2016 to current Mhkondo Township development: Mpumalanga Wetland Delineation and Functional Assessment at Dirkiesdorp and Amsterdam
- March 2016 Dunsby Bridge, Pietermaritzburg Rehabilitation: Wetland Delineation, Functional Assessment and Rehabilitation Plan for Msunduzi Local Municipality
- September 2015 to current: Wetland Delineation and Functional Assessment (current project) for the Matjhabeng 500MW PV Project at Odendaalrus for Sunelex
- October 2015: Wetland Delineation and Functional Assessment for the Reserve Bank Development at the Mint, City of Johannesburg, Gauteng Province for South African Reserve Bank
- March 2012 to current: Wetland Specialist (detailed site planning, design and wetland rehabilitation) for the N11 Section 10 Rehabilitation Project (current project) for SANRAL.
- March 2012 to November 2015: Wetland Specialist (detailed site planning, design and wetland rehabilitation) for the N14 Baberspan Bridge Project located within the Baberspan RAMSAR site (current project) for SANRAL
- September 2014: Wetland/Riparian Delineation and Functional Assessment for the Proposed mixed-scheme development in Ga-Rankuwa on Erf 8873, Ga-Rankuwa Unit 5, City of Tshwane , City of Tshwane, Gauteng Province.
- September 2014: Ecological Importance and Sensitivity (EIS) classification of the Klip River Wetland system and wetlands in the catchment for the Eskom Taunus Reef alignment; Gauteng.
- November 2014: Wetland rehabilitation- and monitoring plan to mitigate the construction related impacts for the Diversion of Crownwood Road, City of Johannesburg, Gauteng Johannesburg Roads Agency.
- December 2014: Wetland rehabilitation- and monitoring plan for the Doornkop Stormwater Pipes, Thulani, City of Johannesburg, Gauteng in terms of Section 24G of the National Environmental Management Act (Act No. 107 of 1998) NEMA.
- March 2014: Wetland Delineation and Functional Assessment for the Weltevreden Park Erosion Mitigation Project, City of Johannesburg, Gauteng Province..
- February 2015 Wetland Specialist for the Louieville Pipeline Project, Mpumalanga Province.
- January 2014 August 2014: Surface Water Specialist Scoping Study for the Environmental Impact Assessment of Weskusfleur Substation at Koeberg.

- March 2012: Environmental Screening Report for Kielder and Witvlei, Northern Cape for the proposed 1GW Siyathemba Solar Park for CEF (SOC).
- March 2012: Completed the Surface Water Specialist Scoping Study for the 1GW Upington Solar Park for CEF (SOC) Ltd
- March 2012 to June 2012: Completed the Wetland Delineation Specialist Study for the Closure of the existing Landfill and the opening of the new Danielskuil Landfill for Kgatelopele Municipality.

MEMBERSHIPS

- Gauteng Wetland Forum
- SAWS (South African Wetland Society) Founding member
- SACNASP (Cert. Nat. Sci. Reg. No. No 200083/15 in Ecological Science
- Certified Environmental Assessment Practitioner (EAP) with the ICB
- Member of the International Association of Impact Assessment of South Africa (IAIAsa)
- Member of the African Association of Remote Sensing of the Earth (AARSE)

APPENDIX B: 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