NZUMBULULO HERITAGE SOLUTIONS

Proposed Construction of a Single 400kV Power Line from Borutho-Nzehlehle, Limpopo Province.

Surface Water Impact Assessment Report

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environmental affairs

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DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

Proposed Construction of a Single 400kV Power Line from Borutho-Nzehlehle, Limpopo Province – Surface Water Impact Assessment Report

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The specialist appointed in terms of the Regulations

I, **Shaun Taylor**, declare that --

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist

SiVEST Environmental

Name of company (if applicable)

30 November 2012

Date

NZUMBULULO HERITAGE SOLUTIONS

CONSTRUCTION OF A 400 KV POWER LINE FROM BORUTHO TO NZEHLEHLE

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1 INTRODUCTION

Nzumbululo Heritage Solutions South Africa (hereafter referred to as "Nzumbululo") were appointed by Eskom Transmission to undertake an Environmental Impact Assessment (EIA) for a single 400kV power line that is to route from the Borutho Substation to the Bokmakierie Substation for a distance of approximately 250km in the Limpopo Province (hereafter referred to as "the proposed development"). As part of the greater EIA, specialist input is required on various environmental parameters, including (but not limited to) wetland studies. As such, SiVEST South Africa (Pty) Ltd have been sub-contracted to Nzumbululo to undertake a surface water resource delineation and impact assessment for the proposed development.

At present, the proposed development is in the EIA phase. Therefore, the ultimate purpose of this study is to build on the already established baseline information compiled for the surface water resources environment in the scoping phase, verify and ground-truth surface water resources identified in the scoping phase and assess the level and importance of the ecosystem services provided by the identified wetlands. Having identified and delineated the surface water resources along the proposed power line routes, a comparative assessment was also undertaken to assess which alternative will be more suitable from a surface water perspective for the proposed development. In addition, this study will then also investigate the potential legislative implications or constraints imposed by the identified surface water resources on the proposed development. In terms of impacts, this study will evaluate and build on the identified scoping phase anticipated potential impacts of the proposed development, rate these impacts and provide appropriate mitigation measures. Finally, specialist recommendations will be proposed for the final selection of the preferred proposed power line alternative route.

1.1 Legislative Context

1.1.1 National Water Act, 1998 (NWA)

The National Water Act, 1998 (No. 36 of 1998) (NWA) was created in order to ensure the protection and sustainable use of water resources (including wetlands) in South Africa. The NWA recognises that the ultimate aim of water resource management is to achieve the sustainable use of water for the benefit of all users. Bearing these principles in mind, there are a number of stipulations within the NWA that are relevant to the potential impacts on surface water resources that may be associated with the proposed development. These stipulations are explored below and are discussed in the context of the proposed development.

Firstly, it is important to discuss the type of water resources (surface) protected under the NWA. Under the NWA, a 'water resource' includes a watercourse, surface water, estuary, or aquifer. Specifically, a watercourse is defined as (*inter alia*):

- *a river or spring;*
- *a natural channel in which water flows regularly or intermittently; and*
- *a wetland, lake or dam into which, or from which, water flows.*

In this context, it is important to note that reference to a watercourse includes, where relevant, its bed and banks. Furthermore, it is important to note that water resources, including wetlands, are protected under the NWA. 'Protection' of a water resource, as defined in the NWA, entails the:

- maintenance of the quality and the quality of the water resource to the extent that the water use may be used in a sustainable way;
- prevention of degradation of the water resource; and
- rehabilitation of the water resource.

In the context of the proposed development, the definition of pollution and pollution prevention contained within the NWA is relevant. 'Pollution', as described by the NWA, is the direct or indirect alteration of the physical, chemical or biological properties of a water resource, so as to make it (*inter alia*):

- *less fit for any beneficial purpose for which it may reasonably be expected to be used; or*
- *harmful or potentially harmful to the welfare or human beings, to any aquatic or non-aquatic organisms, or to the resource quality.*

The inclusion of physical properties of a water resource within the definition of pollution entails that any physical alterations to a water body, for example the excavation of a wetland or changes to the morphology of a water body can be considered to be pollution. Activities which cause alteration of the biological properties of a watercourse, i.e. the fauna and flora contained within that watercourse are also considered pollution.

In terms of section 19 of the NWA, owners / managers / people occupying land on which any activity or process undertaken which causes, or is likely to cause pollution of a water resource must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring. These measures may include measures to (*inter alia*):

- *cease, modify, or control any act or process causing the pollution;*
- *comply with any prescribed waste standard or management practice;*
- *contain or prevent the movement of pollutants;*
- *remedy the effects of the pollution; and*
- *remedy the effects of any disturbance to the bed and banks of a watercourse.*

1.1.2 National Environmental Management Act, 1998 (NEMA)

The National Environmental Management (Act 107 of 1998) (NEMA) was created essentially to establish:

- *principles for decision-making on matters affecting the environment;*
- *institutions that will promote co-operative governance; and*
- *procedures for co-ordinating environmental functions exercised by organs of the state to provide for the prohibition, restriction or control of activities which are likely to have a detrimental effect on the environment.*

It is stipulated in NEMA *inter alia* that everyone has the right to an environment that is not harmful to his or her health or well-being. Moreover, everyone has the right to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that prevent pollution and ecological degradation, promote conservation and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

Accordingly, several of the principles of NEMA contained in Chapter 1 Section 2, as applicable to wetlands, stipulate that:

- *development must be socially, environmentally and economically sustainable;*
- *sustainable development requires the consideration of all relevant factors including the following:*
    - *that the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied;*
    - *that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and*
    - *that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.*

- *the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.*
- *sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.*

In line with the above, Chapter 5 further elaborates on the application of appropriate environmental management tools in order to ensure the integrated environmental management of activities. In other words, this chapter of NEMA addresses the tools that must be utilised for effective environmental management and practice. Under these auspices, the Environmental Impact Regulations (2010) were devised in order to give effect to the objectives set out in NEMA. Subsequently, activities were defined in a series of listing notices for various development activities. Should any of these activities be triggered, an application for environmental authorisation is to be applied for. Fundamentally, applications are to be applied for so that any potential impacts on the environment in terms of the listed activities are considered, investigated, assessed and reported on to the competent authority charged with granting the relevant environmental authorisation.

The above stipulations of the NWA and NEMA have implications for the proposed development in the context of surface water resources. Accordingly, the potential impacts and issues of the proposed development are identified later in this report (**Section 10**).

1.2 Definition of Surface Water Resources as Assessed in this Study

Using the definition of a surface water resource under the NWA, water resources assessed as part of this study include rivers or springs, a natural channel in which water flows regularly or intermittently, wetlands, lakes or dams into which, or from which, water flows.

For wetlands specifically, the lawfully accepted definition of a wetland in South Africa is that within the NWA. Accordingly, 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".

Moreover, wetlands are accepted as an area of land in which the period of saturation of water on the surface or within the root zone for extended periods throughout the year is sufficient to allow for the development of hydric soils, which in normal circumstances would support hydrophytic vegetation (i.e. vegetation adapted to grow in saturated and anaerobic conditions).

Wetlands may either be palustrine (marsh-like) or lacustrine (lake-like) in nature. Palustrine and lacustrine wetlands can be divided up into different hydrogeomorphic forms, based on their position within the landscape, hydrological connectivity and water input. **SANBI (2009)** have described a number of different wetland hydrogeomorphic forms:

- Hillslope Seepage feeding a stream
- Hillslope Seepage not feeding a stream
- Channelled Valley Bottom
- Un-channelled Valley Bottom
- Pan / Depression
- Floodplain

Any of the above mentioned wetland forms may occur within the study area (please refer to **Appendix A** for a more detailed description on each hydrogeomorphic form). The type of surface water resources and wetlands identified by the study are addressed later in the report (**Section 6**).

1.3 Wetlands and Hydric Soils

Wetlands are a very important component of the natural environment. Wetlands are typically characterised by high levels of biodiversity (particularly faunal diversity) and are critical for the sustaining of human livelihoods through the provision of water for drinking and other human uses. Wetlands are sensitive features of the natural environment, and pollution or degradation of surface water can result in a loss of biodiversity, as well as an adverse impact on the human users which depend on the resource to sustain their livelihoods. As such, wetlands are specifically protected under the NWA and generally under NEMA as elaborated on in **Section 1.1**.

Hydric soils, which are soils that are found within wetlands, are defined by the U.S. Department of Agriculture Natural Resources Conservation Service (NRCS) as being, "soils that formed under conditions of saturation, flooding or ponding long enough during the growing season to develop anaerobic conditions in the upper part". These anaerobic conditions would typically support the growth of hydromorphic vegetation (vegetation adapted to grow in soils that are saturated and oxygen deficient) and are typified by the presence of redoximorphic features. Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygenless) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered ‘hydric soils’. The presence of hydric (wetland) soils in the corridors of the proposed development is significant, as the alteration or destruction of these wetland soil areas, or development within a certain radius of these wetland soil areas would require either a license terms of the NWA and/or an environmental authorisation in terms of the Environmental Impact Assessment Regulations promulgated under NEMA.

1.4 Assumptions and Limitations

This study has focused on the delineation of surface water resources along the proposed corridors provided to SiVEST by Nzumbululo. A full delineation and mapping of all surface water resources and wetlands in the wider area has therefore not been undertaken.

This impact level assessment has primarily sought to verify identified wetland from a desktop level by means of groundtruthing and include any other surface water resources that were not identified initially. Given the scale of the proposed development and budget and time limitations, accurate in-field surface water delineations could not be undertaken for all surface water resources. The delineation exercise was therefore primarily conducted at a desktop level except where delineations could be performed in the field. Ultimately, should authorisation be granted for a preferred alternative corridor, a surface water walk-down study should be conducted on the final alignment to accurately determine the boundaries of the surface water resources that are to be avoided where possible.

Accessibility to all surface water resources was not always possible due to the isolated location of various surface water resources and those located in areas where permission to access had not been granted. However, these surface water resources could still be identified at a desktop level and were delineated as such.

The baseline surface water resource environment is derived from available information databases and scientific literature that is accessible and available. The baseline assessment of the surface water resources study is therefore subject to accessibility and availability limitations.

2 TECHNICAL DETAILS OF THE PROJECT

Eskom Transmission is proposing the construction of a single 400kV power line that is to travel from the Borutho Substation to the Bokmakierie Substation for a distance of approximately 250km in the Limpopo Province. The Polokwane Customer Load Network (CLN) consists mainly of platinum and zinc mining activities as well as rural loads. The Polokwane CLN, including the Tabor and Spencer power corridor, remains susceptible to voltage instability and is the weakest part of the Northern Grid network due to being operated beyond its reliability power transfer limit. In addition, the Polokwane CLN (i.e. Tabor and Spencer 275kV and132kV network) is susceptible to low voltages regardless of the approved and commissioned network strengthening in 2010. This project will help in addressing the existing network constraints and ensure infrastructural reliability and adequate supply of electricity.

The proposed project consists of three alternative corridors from which a preferred route will be chosen. These include a Western Corridor (Bor-Nzh1), Central Corridor (Bor-Nzh2) and an Eastern Corridor (Bor-Nzh3). The Western Corridor has a length of approximately 200km and serves as the only corridor for the final third of the propsoed route. The Central Corridor is a short re-alignment corridor from the Western Corridor and is approximately 72km long. Lastly, the Eastern Corridor too serves as a short realignment alternative to the Western and Central Corridors for the southern section of the route and is approximately 125km long. Each corridor has an approximate width of 3.7km to allow for flexibility during construction. An illustration of the three alternative corridors and the locality information is shown in **Figure 1** below.

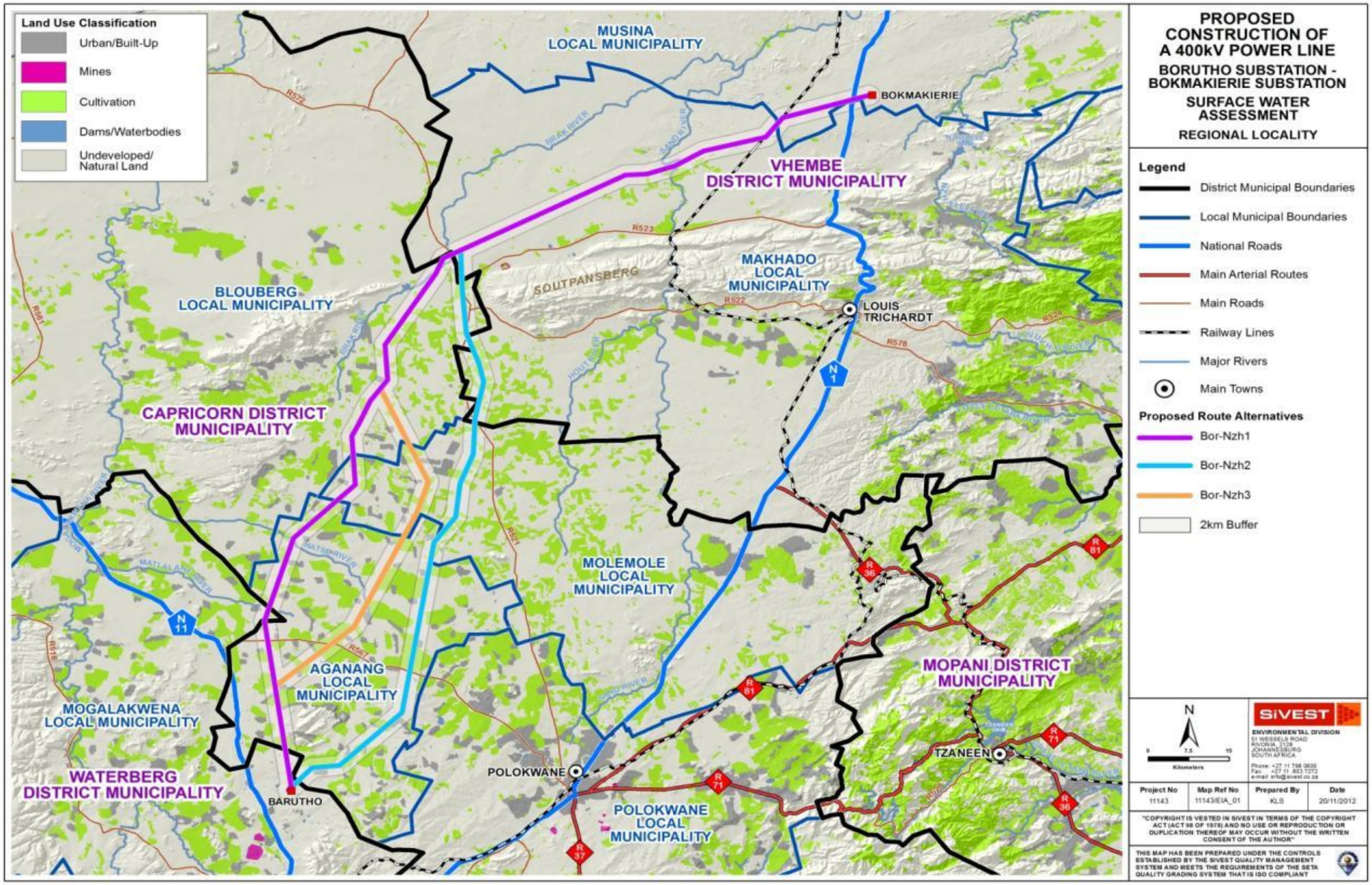

Figure 1. Locality of the proposed development showing the three alternative power line Corridors.

2.1 Tower Type

The servitude width that will accompany the 400kV power line will be 55 metres in total. The type of tower to be used may include a Crossrope tower or a self supporting structure that is likely to be used on bends. The Crossrope tower type is to occupy a footprint of 41,6 metres x 70,6 metres. The self-supporting structure will have a footprint of 12,6 metres x 12,6 metres. The foundation depth necessary for the tower types will be approximately 3 metres on average depending on the soil type (clay material might require a foundation depth of up to 6 metres). The average spanning length is approximately 430 metres. A conceptual example of a 400kV diagram of the proposed tower is included in **Figure 2** below.

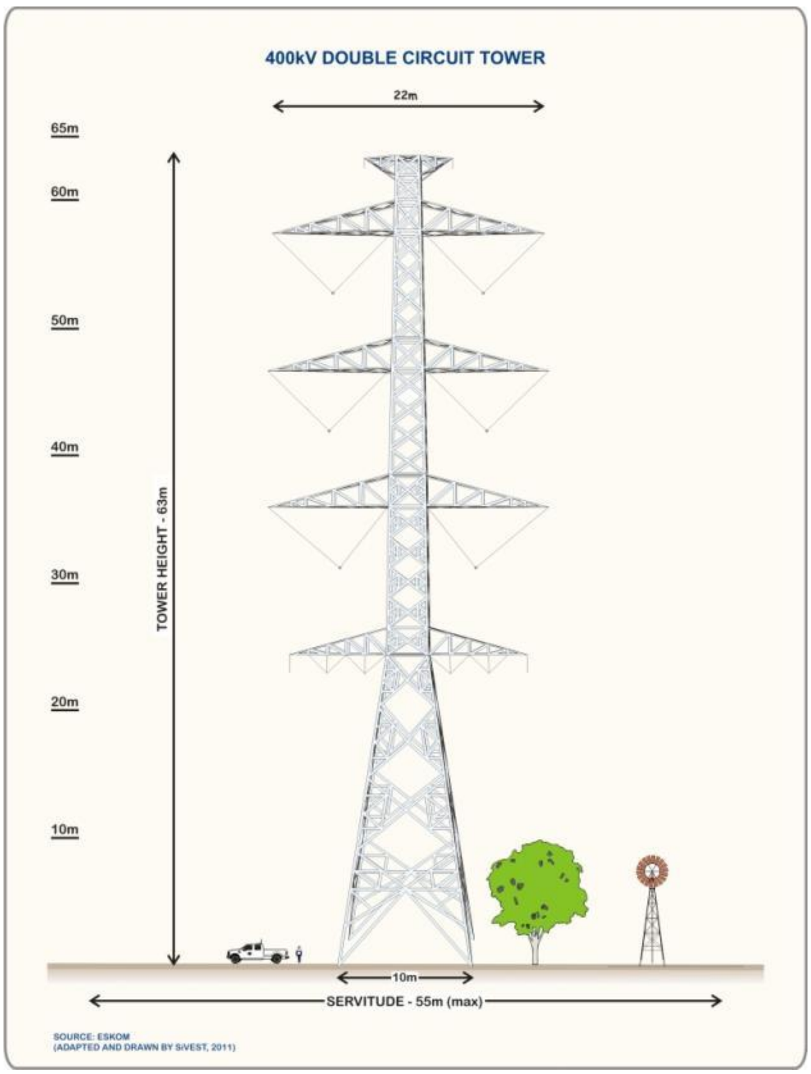

Figure 2. Conceptual example of a 400kV Tower Type.

3 METHODOLOGY

3.1 Desktop Delineation of Surface Water Resources

The first step in the surface water resource assessment process is to identify at a desktop level any potential wetlands and other surface water resources using various information sources. This is undertaken using a Geographic Information System (GIS) software package, namely ArcView (version 9.3) developed by ESRI. The collection of data source information encompasses the National Freshwater Priority Areas **(NFEPA, 2011)** database, Environmental Potential Atlas **(ENPAT, 2000 & 2002)** and the SANBI **(RSA Wetlands, 2010)** databases. The use of Google Earth™ imagery supplemented these data sources.

Utilising these resources, wetlands and any other surface water resources that were identified according to the databases were mapped and highlighted for the in-field phase of the assessment. The supplementary use of aerial photography and satellite imagery allowed other potentially overlooked wetland areas, not contained within the above mentioned databases, to be identified at a desktop level to be verified in the field work phase. On colour (Google Earth™) satellite imagery, soil colour is able to be used as a further means of identifying wetland boundaries through remote sensing, especially where agricultural activities have transformed the natural vegetation within the wetlands and within the surrounding wetland catchment. For example, wetland soil colours are often 'greyer' in hue, reflecting the gleyed soils that typically occur within wetlands. These can be differentiated from the orange / brown / yellow more oxidised non-wetland soils that exist outside of the wetland.

All surface water resources were then investigated in in-field assessment component. Where surface water resources were verified and others were identified, these were primarily delineated at a desktop level using Google Earth™ sateliite imagery.

3.2 Establishing the Surface Water Resources Environmental Baseline

In order to establish the environmental baseline for surface water resources within the proposed alternative corridor routes, it is important to consult with the available scientific literature. Scientific literature often provides specific and important information on the state, condition and characteristics of the hydrological systems that are present in the study area. This can be defined as secondary research and has been undertaken as far as possible in this study.

3.3 Field-based Wetland Delineation and Assessment Techniques

Wetland delineations are based primarily on soil wetness indicators. For an area to be considered a wetland, redoximorphic features must be present within 50cm of the surface soil profile **(Collins, 2005)**. Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen-less) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils be considered 'hydric soils'. Redoximorphic features typically occur in three types **(Collins, 2005)**:

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe^{3+} ions which are characterised by "grey" colours of the soil matrix.
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur.
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles). These can occur as:

i) Concretions - harder, regular shaped bodies;

ii) Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;

iii) Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots, and are also referred to as oxidised rhizospheres.

The potential occurrence / non-occurrence of wetlands and wetland (hydric) soils on the study site have been assessed according to the **DWAF (2005)** guidelines, "A practical field procedure for the identification and delineation of wetlands and riparian areas". According to the DWAF guidelines, soil wetness indicators (i.e. identification of redoximorphic features) are the most important indicator of wetland occurrence. This is mainly due to the fact that soil wetness indicators remain in wetland soils, even if they are degraded or desiccated. It is important to note that the presence or absence of redoximorphic features within the upper 50cm of the soil profile alone is sufficient to identify the soil as being hydric or non-hydric (non-wetland soil) (Collins, 2005). Three other indicators (vegetation, soil form and terrain unit) are used in combination with soil wetness indicators to supplement findings. Where soil wetness and/or soil form could not be identified, information and personal professional judgment was exercised using the other indicators to determine what area would represent the outer edge of the wetland.

Importantly, it must be recognised that there are normally three zones to every wetland including the permanent zone, seasonal zone and the temporary zone. Each zone is based on the degree that each zone reflects the duration of inundation in the soils. The permanent zone usually reflects soils that indicate inundation cycles that last more or less throughout the year, whilst the seasonal zone may only reflect soils that indicate inundation cycles for a significant period during the rainy season. Lastly, the temporary zone reflects soils that indicate the shortest period(s) of inundation that are long enough, under normal circumstances, for the formation of hydromorphic soils and the growth of wetland vegetation **(DWAF, 2005)**.

The actual delineation process essentially entails drawing soil samples, using a soil augur, at depths between 0.5 to 1.5metres in the soil profile. This is done in order to determine the location of the outer edge of the temporary zone for wetlands. The outer edge of the temporary zone will usually constitute the full extent of the wetland, thereby encompassing any other inner lying zones that are saturated for longer periods. The appropriate soil form is of interest and is usually determined for each zone of the wetland where different zones of saturation are present. Points are then recorded at these locations for an appropriate length (usually 10 metres) taking into account the topography along the length of the wetland for each identified wetland zone. However, in this case, budgetary and time restrictions limited accurate in-field delineation for some of the identified surface water resources. Additionally, the extensive nature of some of the surface water resources (particularly the perennial and non-perennial hydrological systems) placed further time restrictions on undertaking an accurate delineation exercise. Hence, the delineation procedure was undertaken primarily at a desktop level. Nonetheless, where delineations could be performed in the field, a conventional handheld Global Positioning System (GPS) was used to record the points taken in the field. The GPS points were then imported into a GIS system to map the identified zones. The GPS is expected to be accurate from 15 to 5 metres. A GIS shapefile was created to represent the boundaries of the delineated wetlands.

Depending on the type of land use or development proposed, an appropriate buffer zone to protect the surface water resources should also be delineated **(DWAF, 2005)**. Buffer zones are typically required to ensure that the ecotones between aquatic/wetlands and terrestrial landscapes are protected. Ecotones are ecologically significant, especially for species that utilise contrasting habitats for different stages of their lifecycle (for example, Bull Frogs). Hence, buffer zones are necessary where developments involve the transformation of land from the prevailing natural condition. At present, there are no official requirements for buffer zones in the Limpopo province. However, there are guidelines for the Gauteng province which necessitate the implementation of buffer zones **(GDACE, 2009)**. In the case of the proposed development and in the interest of best environmental practice, the Gauteng minimum requirements for Biodiversity studies **(GDACE, 2009)** have been utilised as tool for the determination of buffer zones. Accordingly, a buffer zone of 50 metres has been applied to wetlands and a buffer zone of 100 metres has been applied to any perennial or non-perennial watercourses occurring within the proposed alternatives corridors.

Generic potential impacts on surface water resources that may be caused by or associated with the construction and operation of the proposed development were identified and evaluated. These potential impacts are addressed later in this report (**Section 10**).

Where relevant, recommendations have been made regarding the suitable location of the proposed development taking into account the proximity of the proposed development to surface water resources as well as potential identified impacts.

3.4 WET-EcoServices Assessment

Individual wetlands differ according to their hydro-geomorphic characteristics and the particular ecosystem services that they supply to society **(Kotze *et al.*, 2007)**. Ecosystem services refer to the benefits (such as flood attenuation etc.) provided to people (society) by wetland ecosystems. These benefits may derive from outputs that can be consumed directly; indirect uses which arise from the functions or attributes occurring within the ecosystem; or possible future direct outputs or indirect uses **(Howe *et al.*, 1991)**. The ecosystem services that are assessed through the WET-EcoServices methodology are listed in **Table 1** below. The overall goal of the WET-EcoServices assessment is to assist decision makers, government officials, planners, consultant and educators in undertaking quick assessments of wetlands in order to reveal the ecosystem services that they supply. This ultimately provides an indication of the importance of the wetland unit. The WET-EcoServices applies only to palustrine wetlands.

Table 1. Ecosystems services included in WET-EcoServices (Kotze *et al.* 2007).

Ecosystem services supplied by wetlands	Indirect benefits	Hydro-geochemical benefits	Flood attenuation	
			Streamflow regulation	
			Water quality enhancement benefits	Sediment trapping
				Phosphate assimilation
				Nitrate assimilation
				Toxicant assimilation
				Erosion control
			Carbon storage	
		Biodiversity maintenance		
	Direct benefits	*Provision of water for human use*		
		Provision of harvestable resources[2]		
		Provision of cultivated foods		
		Cultural significance		
		Tourism and recreation		
		Education and research		

Each hydrogeomorphic wetland unit that was delineated along the powerlines was assessed using the the WET-EcoServices tool. Each hydrogeomorphic unit has been labelled according to the corridor it is located in (for example, Western Corridor – W; Central Corridor – C; Eastern Corridor – E) as well as according to the hydrogeomorphic wetland unit it is classified as (for example, Pan). Where more than one of the same hydrogeomorphic wetland unit is identified within the same quaternary catchment it is simply assigned a new number. An example of an assessed hydrogeomorphic wetland unit label is Pan_W1.

In the following sections outlining the findings for each hydrogeomorphic wetland unit, the output diagram indicating the ecosystem services offered by the reach (as produced by the WET-EcoServices assessment) is included. A table outlining the various aspects of functionality offered by the specific hydrogeomorphic wetland unit is also included.

3.5 Wetland Prioritisation and Sensitivity

WET-EcoServices does not provide an overall assessment of wetland functionality, thus professional judgement has been used to classify each hydrogeomorphic wetland unit into one of three classes of functionality (low, moderate, high). The overall assessment of functionality is used to inform the wetland prioritisation assessment.

The wetland units identified within the proposed power line alternative corridors will be subjected to a prioritisation exercise in order to assign a level of sensitivity to the respective wetland units. The prioritisation / sensitivity assessment has taken into account the following factors:

- Level of Wetland Functionality
- Wetland State
- Presence / Absence of important biodiversity features
- Wetland HGM being a rare type (in the context of the study area)
- Geology underlying the wetland

In terms of how important biodiversity features were characterised, the following characteristics were deemed to be important biodiversity features:

- Wetland / aquatic Red Data Species present
- Habitat suitable for Red Data Species
- Charismatic species recorded or habitat suitable for charismatic wetland species (e.g. Marsh Owls)
- Completely natural catchment of the hydrogeomorphic wetland unit

Four categories of sensitivity have been assigned:

- Very High
- High
- Moderately High
- Moderate

It should be noted that *all wetlands* should be regarded as being sensitive areas. The classification of wetland units into different classes of sensitivity has been undertaken in order to indicate those wetlands that should be offered maximum protection, and which should be avoided when aligning the proposed power lines.

4 GENERAL STUDY AREA

The study area is located within the Limpopo Province of South Africa (see **Figure 1** above). The proposed development crosses over three district municipal boundaries and six local municipalities. The three district municipalities include the Vhembe District Municipality, Waterberg District Municipality and the Capricorn District Municipality. The six local municipalities include the:

- Mogalakwena Local Municipality;
- Makhado Local Municipality;
- Blouberg Local Municipality;
- Molemole Local Municipality;
- Musina Local Municipality; and
- Aganang Local Municipality.

The greater landscape can be described as flat to gently undulating in areas. Areas of higher relief can be found to the immediate east of the Western Corridor near Ga-Phofu (Kgokolong) at the southern end of the corridor. Areas of higher relief can also be found at the northern end of the Eastern Corridor lying to the east where the Soutpansberg mountain range can be found as well as to the west of the Western Corridor near to where the Western and Eastern Corridor. At this point, the Blouberg can be found.

In terms of built up areas, the three alternative corridors route through or on the edge of numerous rural villages and settlements. Subsistence farming is dense in certain areas, along with expansive areas of commercial farming (centre pivot) activities especially near the linear hydrological systems (perennial and non-perennial systems). Extensive game and cattle farming areas are also prominent activities and land uses in the study region.

A number of provincial and national roads bisect the proposed alternative corridors. Provincial and National roads include the R567 in the southern section of the alternative corridors, the R521, R522 and R523 at the northern most area of the Eastern Corridor, and lastly the R525 and the N1 at the end point of the Western Corridor in the north. A railway line crosses the Western Corridor in the northern section of the route.

5 SURFACE WATER RESOURCES BASELINE OF THE PROPOSED DEVELOPMENT STUDY AREA

5.1 Surface Water Resources in the Proposed Development Study Area

The greater Limpopo Province is situated in a dry savannah subregion that is characterised by open grasslands with scattered trees and bushes **(M'Marete, 2003)**. The summers are very hot whilst winters are mild **(Calvin, 2010)** and dry **(Mucina & Rutherford, 2006)**. The average annual rainfall in the Limpopo Province ranges between 300mm to 400mm and 600mm although the mountain zones can receive an annual rainfall of about 2 000mm **(M'Marete, 2003)**. Most rain (approximately 90%) falls in the summer months. The average evaporation for the Limpopo Province is well in excess of the annual rainfall and therefore appreciably affects surface run-off and causes high evaporation losses **(M'Marete, 2003)**.

The study area falls entirely within the Limpopo Water Management Area (WMA) or catchment. The main tributaries of the Limpopo WMA include the Matlabas, Mokolo, Palala, Mogalakwena, Sand, Nzhelele, Nwanedi, Levuvhu and Mutale rivers which drain the western part of the Limpopo province and generally flow in a northerly direction into the Limpopo River **(M'Marete, 2003)**.

Much of the study area falls within the Polokwane Plain geomorphic province **(Figure 3)** which is underlain by granite-gneiss (with schist pods) as described by **Partridge *et al*. (2010)**. The distinguishing feature of this province is the heavily etched surface that is reflected in broad open valleys interspaced with numerous rocky koppies occupied by rocks of the Limpopo Belt, sinous ridges and koppies formed by more resistant lithologies **(Partridge *et al*., 2010)**. Two main tributaries of the Limpopo River that drain more than 95% the Polokwane Plain include the Sand and the Mokgalakwena rivers **(Partridge *et al*., 2010)**. Of interest is the Sand River which falls within the study area. The Sand River is classified as having a medium sediment storage capacity due to the relatively flat slopes and wider valleys which have a greater potential for sediment storage capacity **(Partridge *et al*., 2010)**. The maximum discharge is usually recorded in late summer, especially from January to March (inclusive), and minimum flows normally occur in July or August for the Brak and Sand River **(Calvin, 2010)**. Due to the seasonal nature of rainfall in the study area, the discharge of these hydrological systems can be said to be highly variable **(Calvin, 2010)**. In general however, due to the rocks of the study area exhibiting low storage capacity and transmissivity, most of the water courses are predominantly ephemeral, active during the wet season only and flowing primarily after heavy local rainstorms **(Calvin, 2010)**.

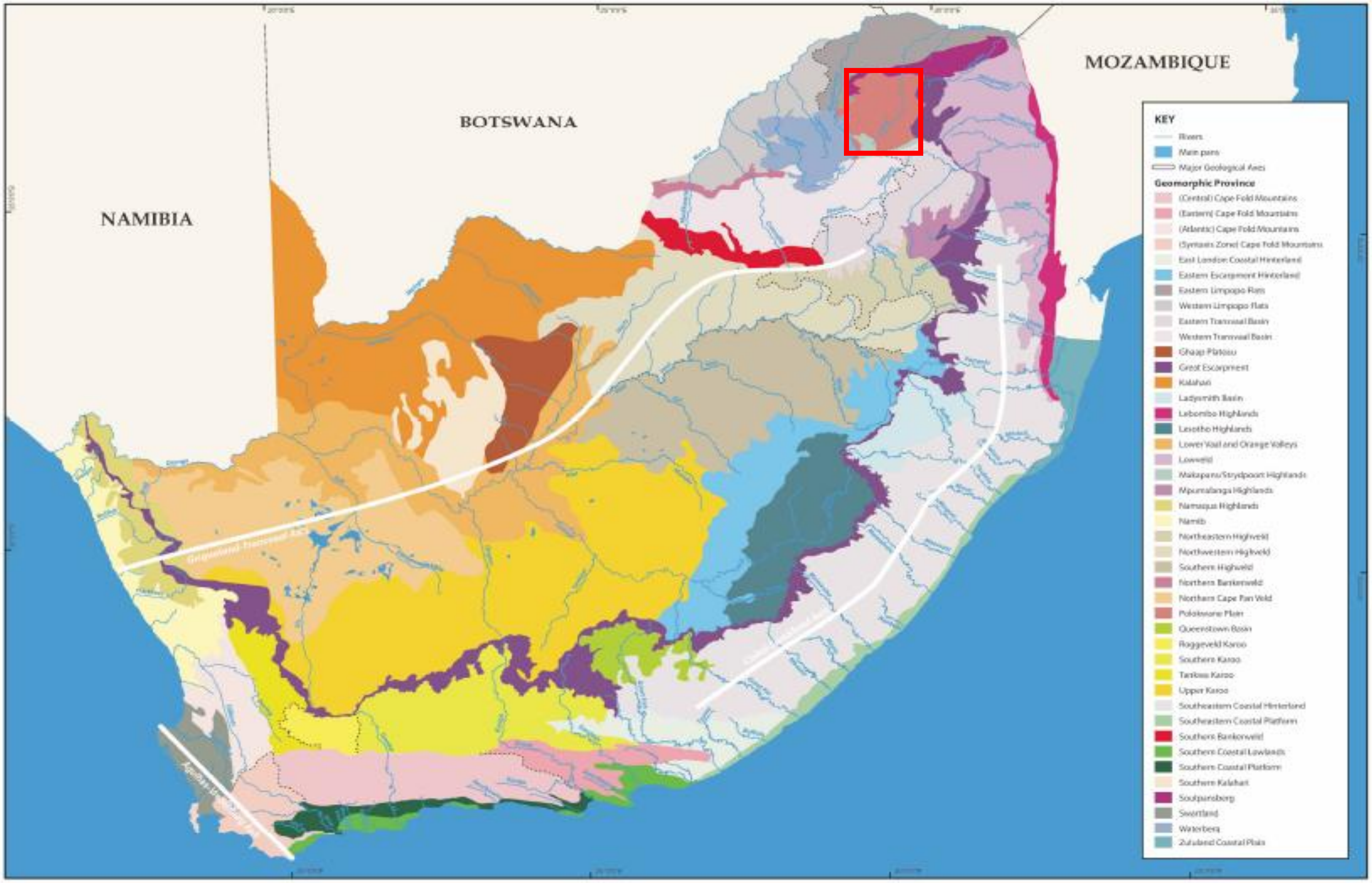

Figure 3. Geomorphic provinces of South Africa, Lesotho and Swaziland (Partridge *et al*., 2010). Polokwane Plain geomorphic province contained in the red square.

Very little information is available on wetlands, specifically in the Limpopo Province with the exception of the swamp and floodplain wetlands in the Limpopo River basin (**World Resources Institute, 2003)**. These wetlands however fall outside of the concerned study area and are not reported on due to differential bioregional characteristics from the study area. **Cowan (1995)** however, has classified South Africa according to wetland regions which are essentially areas within which similar characteristic wetlands develop in locations that have comparable topography, hydrology and nutrient regimes. Four wetland regions as identified by **Cowan (1995)** broadly overlap to various degrees within the study area including the Bankenveld, Waterberg, Bushveld basin and Pietersburg Plateau (**Figure 3**) making up the majority of the study area. The Bankenveld region is an area dominated by a series of dip and scarp slopes leading to a trellis drainage pattern where riparian and reed swamp wetlands are characteristic **(Cowan, 1995)**. The Waterberg region is known for its seep (wetlands) and small reed marshes **(Cowan, 1995)**. The Bushveld basin is a flat area dominated by norite that has weathered to deep clays or black turf where the best known wetland of the region (Nylsvlei) can be found **(Cowan, 1995)**. Finally, the Pietersburg plateau has characteristic riparian wetlands **(Cowan, 1995)**.

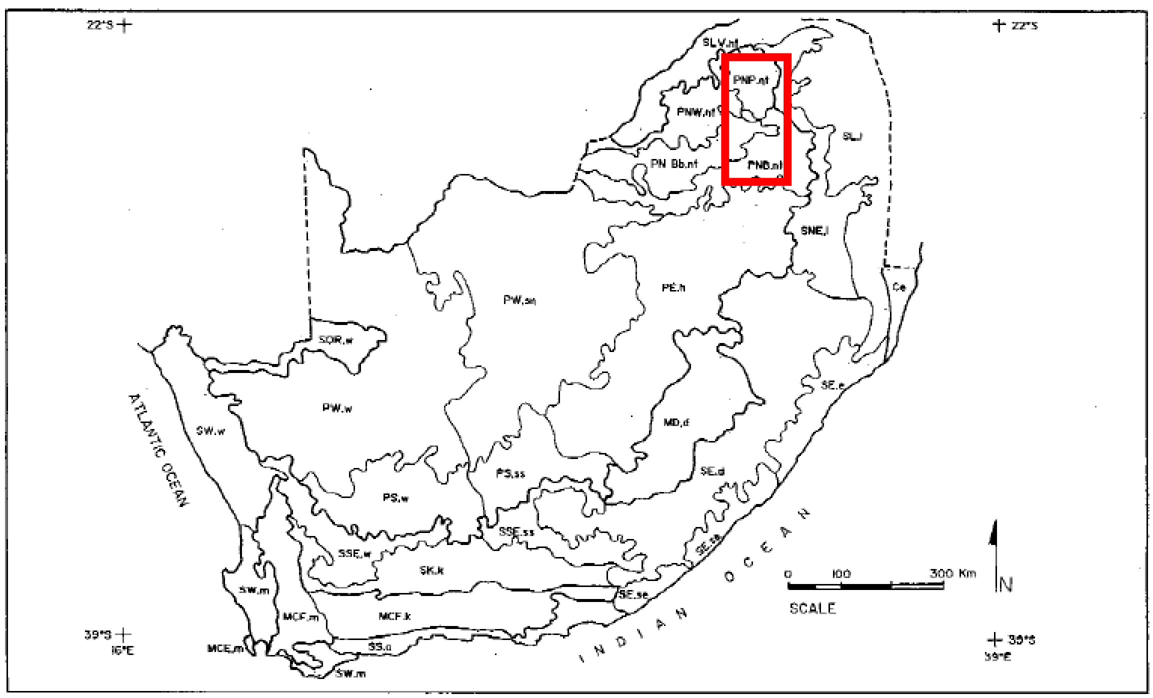

Figure 4. Wetland Regions of South Africa (Cowan, 1995). The red square indicates the general study area of the proposed development. The four main wetland regions of concern relate to PN Bb.nt (Bushveld basin); PNW.nt (Waterberg); PNP.nt (Pietersburg Plateau) and PNB.nt (Bankenveld).

There are several identified threats to surface water resources in the Limpopo Province and the immediate study area. The Limpopo Province is one of South Africa's richest agricultural areas, however, water scarcity has been identified as the major limiting factor to agriculture (**Calvin, 2010)**. Overall, land use in the study area predominantly consists of rural villages which practice subsistence crop and cattle\goat farming. Commercial agriculture is additionally extensively undertaken mainly in the form of centre-pivot crop irrigation. Game farming is another prevalent but not dominant land use. Given that agricultural production comprises the main land use in the study area, water provision is a critical factor. In this context, **Jogo and Hassan (2010)** state that the ability of wetlands to store water during the wet season and release it during the dry season provides farmers living in semi-arid areas opportunities to grow crops all-year round thereby improving their food security and incomes. However, it is also acknowledged that altering the wetland environment through conversion to cropland and other uses can potentially degrade wetlands and undermine their capacity to provide services in the future **(Jogo & Hassan, 2010)**. The conversion of wetlands where prevalent to croplands therefore can be seen as a major threat to surface water resources degradation and loss in the study area.

M'Marete (2003) identifies that various dams have been created in the Limpopo Province to help meet the water needs of the region. Dams along river systems or drainage lines constitute an additional threat to surface water resources in the study area by means of altering the natural hydrological regime of these sensitive systems.

Possible nitrate sources of pollution to surface water resources in the study area have been highlighted. **Xu *et al.* (1991)** noted in their study of groundwater in the northern areas of South Africa that high nitrate concentrations to water resources could be ascribed to the proximity of kraals close to water sources. Having established that cattle farming is a common activity in the study area, potential nitrate pollution poses a possible threat to surface water resources.

In terms of the proposed development, threats to other important components of surface water resources have been identified. Avi-fauna constitute an integral biotic component to surface water resources and functionality. However, **Snyman (2004)** identified that secondary power lines pose an electrocution threat to vultures in the Blouberg. Whereas vultures are not identified as waterfowl that inherently live or frequent many different types of surface water resources, this type of impact can similarly apply to different avi-faunal species and must be acknowledged as potential a threat accompanying surface water resources in the context of power lines and the proposed development.

5.2 Drainage Context

Due to the length of the proposed development, several bioregional areas, as described by **Mucina and Rutherford (2006)**, are traversed by the proposed development each bearing its own general biophysical features in terms of vegetation, geology, soil and drainage ability. The bioregional areas that overlap with the three alternative corridors include the Polokwane Plateau Bushveld, the Makhado Sweet Bushveld, the Roodeberg Bushveld, Limpopo Sweet Bushveld, Musina Mopane Bushveld and finally, the Limpopo Ridge Bushveld **(Figure 5)**. As such, various surface water resources exhibiting differential characteristics can be distinguished based on the bioregional features. This is elaborated on in the section below.

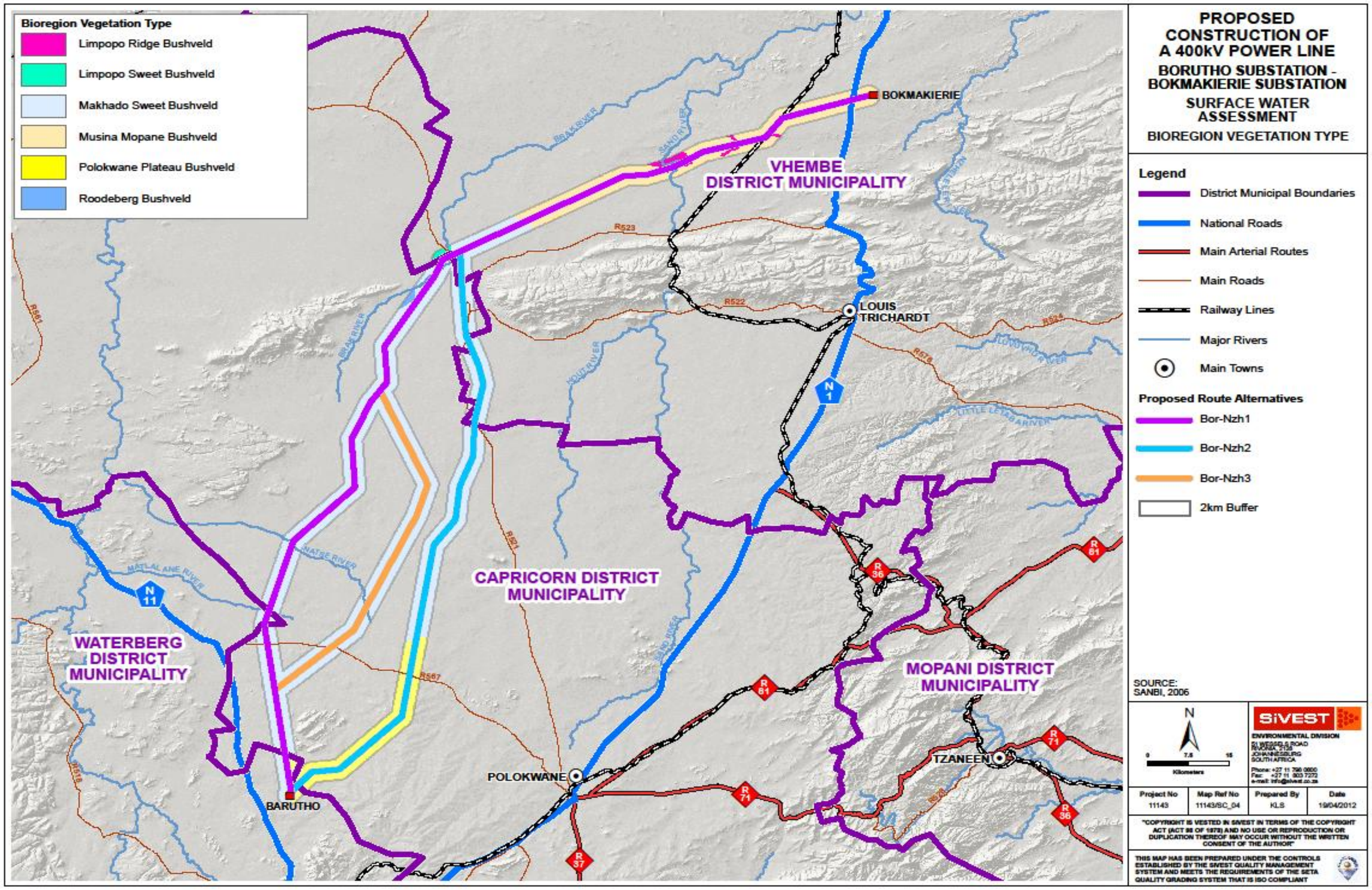

Figure 5. Bioregional areas overlapping with the proposed corridors.

5.2.1 General Study Area Topography

The general topography of the study area is predominantly flat and can be described as plains with gently undulating terrain and low hills. The elevation can be between 600 and 900 metres above mean sea level (amsl) **(M'Marete, 2003)**. However, there are areas of higher relief near to the various alternative corridors including the Soutpansberg (which can reach up to 1 700 metres amsl **(M'Marete, 2003)**) and Blouberg towards the northern section of the Western and Eastern alternative corridors where both join. Additionally, there is the Kgokolong small mountain range to the immediate east of the Western Corridor near Ga-Phofu near the southern end of the corridor. None of these higher areas are within the alternative corridors. However, the nearby proximity of these smaller and larger mountain ranges does have a bearing on surface water input and drainage for the study area. The identified mountain ranges receive a higher amount of annual rainfall as mentioned in previous sections which can be up to about 2000mm of which a proportion feeds the surface water resources in the lower lying terrain.

5.2.2 Polokwane Plateau Bushveld

The southern most part of the proposed alternative corridors stem from within the Polokwane Plateau Bushveld bioregion. Whilst only a small proportion of this bioregion can be found with the Western and Central Corridors, approximately a third of the southern section of the Eastern Corridor alternative comprises Polokwane Plateau Bushveld. This bioregion is characterised by higher lying plains around Polokwane. The landscape can be described as moderately undulating plains with a short open tree layer with a well developed grass layer to grass plains with occasional trees at higher altitudes **(Mucina & Rutherford, 2006)**. The geology of this bioregion is primarily made up of Migmatities and gneiss of the Hout River Gneiss and the Turfloop Granite (both of Randian Erathem) **(Mucina & Rutherford, 2006)**. The soils are variable, with freely drained soils with high base status (some dystophic/mesotrophic), eutrophic plinthic catenas, Glenrosa and Mispah soil forms **(Mucina & Rutherford, 2006)**. The moderately undulating plains and plinthic nature of the soils make the area conducive to surface water resources where hydrological input is sufficient for surface water to occur (even if only seasonally/temporarily). Seasonal to temporary wetlands such as pans and channelled\un-channelled valley bottom wetlands can be expected along with perennial and non-perennial river/stream systems.

5.2.3 Makhado Sweet Bushveld

The Makhado Sweet Bushveld makes up the majority of the middle sections of the Western and Eastern Corridors whereas this bioregion also envelopes the entire Central Corridor thereby comprising the largest proportion of the study area. This bioregion features slightly to moderately undulating plains sloping generally to the north **(Mucina & Rutherford, 2006)**. The vegetation can be identified as predominantly short and shrubby bushveld with a poorly developed grass layer **(Mucina & Rutherford, 2006)**. Gneiss and migmatites of the Hout River Gneiss (Randian Erathem) and potassium-deficient gneisses of the Goudplaats Gneiss comprise the main geological units of the bioregion **(Mucina & Rutherford, 2006)**. Sandstones and mudstones of the Matlabas Subgroup (Mokolian Waterberg Group) however are also found **(Mucina & Rutherford, 2006)**. The soils include deep, greyish sands, eutrophic plinthic catenas, red-yellow apedal freely drained soils with high base status, clayey in the bottomlands **(Mucina & Rutherford, 2006)**. The poorly developed grass layer means that surface run-off can contribute to erosion of the landscape and consequent sedimentation in the lower lying valley bottom areas. Clay accumulation in depression areas can contribute to water retention in these positions of the landscape giving rise to pan wetlands. Rivers and drainage lines with variable degrees of erosion may also be characteristic of the bioregion.

5.2.4 Roodeberg Bushveld

A small fraction of the Western Corridor overlaps with the Roodeberg Bushveld bioregion to the west at the foothills of the Blouberg mountain range. Plains and slightly undulating plains, including some low hills, with short closed woodland to tall open woodland and a poorly developed grass layer generally represents the vegetation and landscape features of the bioregion **(Mucina & Rutherford, 2006)**. The geology is mainly sandstone, conglomerate, siltstone and shale of the Kransberg and Matlabas Subgroups (Mokolian Waterberg Group) **(Mucina & Rutherford, 2006)**. Granite of the Lebowa Granite Suite (Bushveld Igneous Complex) are also present **(Mucina & Rutherford, 2006)**. A variety of soils types can be found but are mostly sandy soils that are red-yellow apedal with high base status **(Mucina & Rutherford, 2006)**. The sandy nature of the soils means that there is likely to be good permeability of surface run-off and infiltration. Non-perennial hydrological systems can be expected in this region.

5.2.5 *Limpopo Sweet Bushveld*

Another small fraction of the Western Corridor overlaps with the Limpopo Sweet Bushveld, this time to the north east of the foothills of the Blouberg mountain range. Here, the landscape of the bioregion is mainly characterised by plains, sometimes undulating or irregular, traversed by several tributaries of the Limpopo River **(Mucina & Rutherford, 2006)**. The vegetation consists of short open woodland with *Acacia erubescens*, *A. mellifera* and *Dichrostachys cinerea* impenetrable thickets in disturbed areas **(Mucina & Rutherford, 2006)**. Sandstone, siltstone and mudstone of the Clarens Formation (Karoo Supergroup) as well as of the Matlabas Subgroup (Mokolian Waterberg Group) are found in the west near the study area **(Mucina & Rutherford, 2006)**. Soils with calcrete and surface limestone layers, brownish sandy (Clovelly soil form) and clayey-loamy soils (Hutton soil form) can be found on the plains and low-lying areas, with shallow, gravely, sandy soils on the slightly undulating areas and localised areas of black clayey soils (Valsrivier or Arcadia soil forms) **(Mucina & Rutherford, 2006)**. Kalahari sand is also prevalent **(Mucina & Rutherford, 2006)**. The presence of surface calcrete and limestone layers may act as a physical barrier to groundwater seepage as well as sub-surface drainage. Hence, ephemeral pan wetlands could be a prominent surface water feature in this region in addition to non-perennial hydrological systems.

5.2.6 *Musina Mopane Bushveld*

Almost a third of the northern section of the Western Corridor can be found within the Musina Mopane Bushveld bioregion. The terrain is described as undulating to very irregular plains, with some hills **(Mucina & Rutherford, 2006)**. In the western section of the bioregion, open woodland to moderately closed shrubland dominated by *Colophospermum mopane* can be found in the bottomlands and *Combretum apiculatum* can be found on the hills **(Mucina & Rutherford, 2006)**. In the eastern section of the bioregion on basalt, moderately closed to open shrubland is dominated by *C. mopane* and *Terminalia prunoides* **(Mucina & Rutherford, 2006)**. On areas with deep sandy soils, moderately open savanna dominated by *C. mopane*, *T. sericea*, *Grewia flava* and *C. apiculatum* can be evidenced **(Mucina & Rutherford, 2006)**. The field layer is well developed (especially on the basalt), open during the dry season, whereas the herbaceous layer is poorly developed in areas with dense cover of *C. mopane* shrubs **(Mucina & Rutherford, 2006)**. Most of the area is underlain by the Archaean Beit Bridge Complex, except where it is covered by much younger Karoo sandstones and basalts **(Mucina & Rutherford, 2006)**. The Beit Bridge Complex consists of gneisses and metasediments and is structurally very complex **(Mucina & Rutherford, 2006)**. Variable soils can be found ranging from deep red/brown clays to moderately deep dark, heavy clays; to deep, freely drained sandy soils; to shallower types including skeletal Glenrosa and Mispah soil forms **(Mucina & Rutherford, 2006)**. Given the diverse nature and constituency of the soils prevalent, a number of wetland types can potentially be found including riparian wetlands, floodplain wetlands, pan wetlands and channelled/un-channelled valley bottom wetlands in this region. Seasonal and temporary rivers and drainage lines are also expected to be present.

5.2.7 Limpopo Ridge Bushveld

Isolated areas within the last third of the Western Corridor to the north contain the Limpopo Ridge Bushveld bioregion. This bioregion displays extremely irregular plains with ridges and hills **(Mucina & Rutherford, 2006)**. It is characterised by moderately open savanna with a poorly developed ground layer **(Mucina & Rutherford, 2006)**. The geology mostly consists of rocks of the Beit Bridge Complex (Swazian Erathem) as well as sediments (including sandstones of the Clarens formation) and basalt (particularly in the east) of the Karoo Supergroup **(Mucina & Rutherford, 2006)**. The soils are generally shallow gravel and sand, as well as calcareous clayey soil **(Mucina & Rutherford, 2006)**. Due to the characteristics of the terrain and the soils, channelled, un-channelled and riparian wetlands as well as perennial and non-perennial hydrological systems can be expected in the region.

6 FINDINGS OF ASSESSMENT

6.1 Desktop Database Surface Water Features

The **NFEPA (2011)** database is the most comprehensive and updated database as far as surface water resources are concerned for the country and best reflects the occurrence of surface water resources. The occurrence of wetlands and other surface water resources for the greater study area were primarily drawn from this database information (**Figure 5**).

In terms of the **NFEPA (2011)** database, the proposed development falls within is the Limpopo primary catchment. The proposed corridors therefore also lie within numerous quarternary catchments. These include A61G, A62F, A62E, A71E, A62H, A72A, A71G, A72B, A71J, A80F and A71K. Seven river systems can be found within the three proposed corridors. These include the Matlala **(Class B: Largely natural system, 1999)**, Seokeng **(Class B: Largely natural system, 1999)**, Tshipu **(Class B: Largely natural system, 1999)**, Natse **(Class B: Largely natural system, 1999)**, Brak **(Class D: Largely modified system)**, Mogwatsane **(Class D: Largely modified system)** and the Sand **(Class B: Largely natural system, 1999)** rivers. The quality of these systems as indicated in studies undertaken in 1999 is variable ranging from largely natural systems to largely modified systems.

With regards to wetlands, each alternative corridor contains a certain number and type of wetlands according to the database. It must be noted that some wetlands overlap with certain corridors. The number of wetlands therefore accounts for this. Accordingly, the Western Corridor contains **one hundred (100)** wetlands according to the database of which **forty eight (48)** are channelled valley bottom wetlands, **seventeen (17)** are depression wetlands, **fifteen (15)** are flat wetlands, **seventeen (17)** are seep wetlands, **two (2)** are un-channelled valley bottom wetlands and there is **one (1)** valley head seep wetland. The Central Corridor contains **fifteen (15)** wetlands according to the database of which four (**4)** are depression wetlands, seven (**7)** are flat wetlands, **three (3)** are valley head seep wetlands and there is **one (1)** un-channelled valley bottom wetland. Lastly, the Eastern Corridor contains **sixty nine (69)** wetlands of which **twenty (20)** are channelled valley bottom wetlands, **twenty four (24)** are depression wetlands, **ten (10)** are flat wetlands and **fifteen (15)** are seep wetlands.

The above mentioned information on rivers and wetlands were taken into the field for groundtruthing and verification. Other potentially overlooked surface water resources not identified at a desktop level were also sought in the impact phase. The results of these findings are provided in section below.

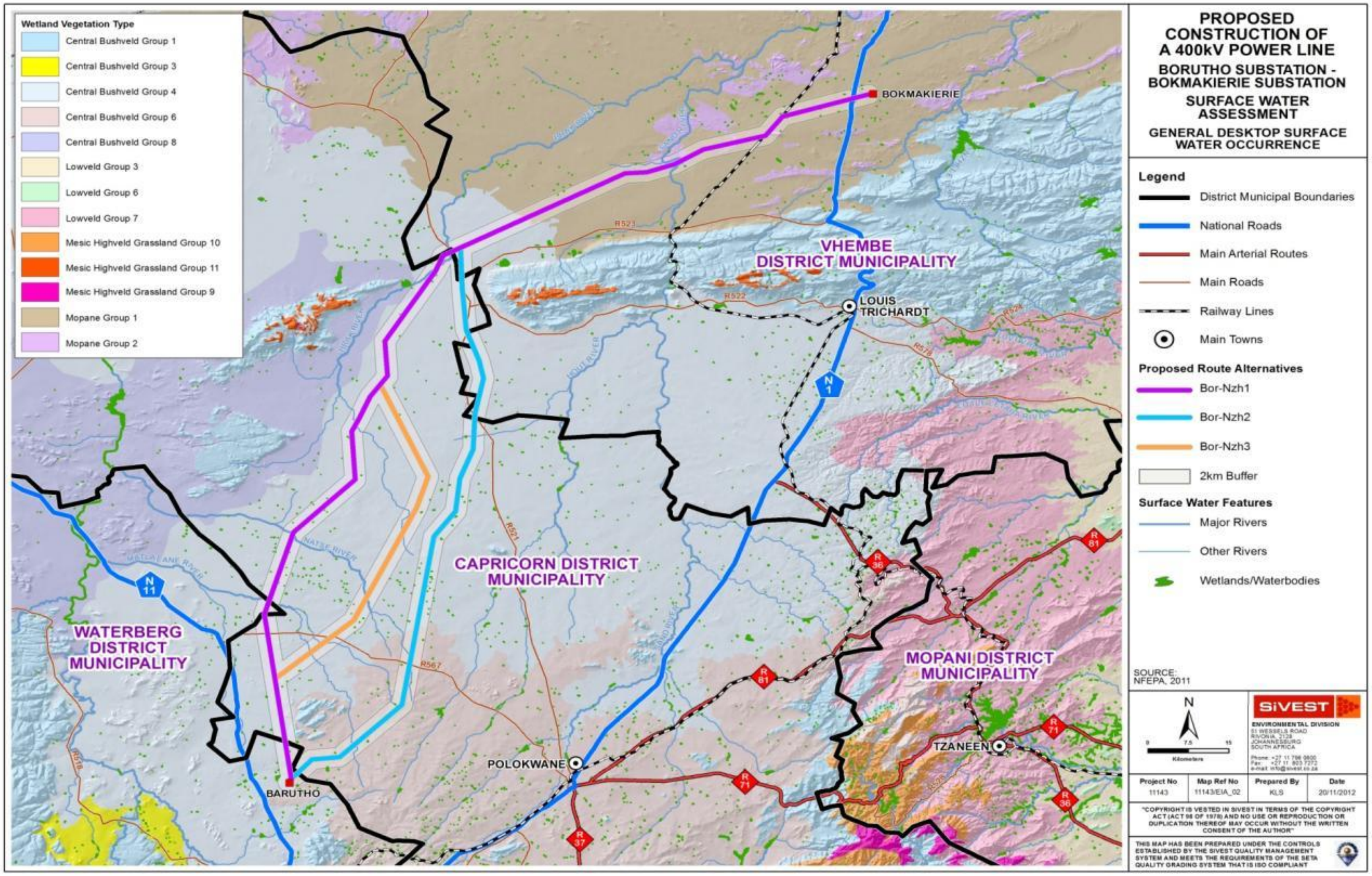

Figure 6. General desktop surface water occurrence within the region of the proposed corridors.

6.2 Field-assessed Wetlands and Watercourses

The fieldwork component of the wetland assessment took place on the 23, 24 and 25th of October 2012. The results are elaborated on below for each of the proposed alternative Corridors and ultimately resulted in a major refinement of the desktop study.

An illustration of the delineated wetlands can be seen in **Figure 7** to **Figure 13**. **Plate 1** and **Plate 2** provides photographic evidence of the field wetland assessment for this proposed alternative corridor. Overall, in the Western Corridor Alternative (Bor-Nzh1), it was found that there were **thirty (30)** non-perennial watercourses; **two (2)** perennial watercourses; **ten (10)** pan wetlands and **four (4)** man-made dams (artificial wetlands). In the Eastern Corridor Alternative (Bor-Nzh2), it was found that there were **eighteen (18)** non-perennial watercourses. Lastly, in the Central Corridor Alternative (Bor-Nzh3), it was found that there were **nine (9)** non-perennial watercourses; **one (1)** perennial watercourse and **eleven (11)** pan wetlands. Given the general homogeneity of majority of the study area falling within the Polokwane Plain geomorphic province as well as the majority of the surface water resources located in this region particularly, a description on the surface water resources for all three alternative Corridors is provided below.

6.2.1 General Topographical Characteristics

The Western Corridor alternative is directly positioned over what has earlier been described as the Polokwane Plain. As such, the landscape of this alternative Corridor is predominantly characterised by gently undulating to flat plain areas. The flat to gently undulating terrain provides a suitable template for the formation of Endorheic pan wetlands **(Photo 1)** in isolated depression areas, whilst the lower lying valley bottoms between the undulating landscape acts as a drainage pathway for the surrounding areas **(Photo 2)**.

6.2.2 Soils

The soil profile tends to be very shallow particularly in the valley bottom areas of the Polokwane Plain region, with exposed bedrock extruding in the dry watercourses during low flows **(Photo 3)**. However, deeper soil profiles were evident in the northern section of the Western Corridor (areas within the Musina Mopane Bushveld and Limpopo Ridge Bushveld vegetation types). Shallow layers of ferruginised iron or “ferricrete” similarly restrict soil depth **(Photo 4)** in watercourse and pan wetland areas, and therefore the degree of subsurface vertical and lateral drainage. The relatively thin soil profile in the pan wetlands has a bearing on the length of time wetlands remain inundated for (or the “hydroperiod”) in conjunction with other external controls such as climate.

The pan wetlands were identified as being temporary to seasonal wetlands. The fraction of clay sediments does however contribute to the pan wetlands ability to retain water. Upon inspection, soil samples drawn from within the pan wetlands showed signs of wetness in the form of iron oxide mottles and mineral depletions **(Photo 5)**. These characteristics comprised the majority of the soil profile making it the diagnostic horizon. These characteristics are also commonly associated with a soft plinthic soil horizon. As a result, the Westleigh soil form could be attributed to the soil profile of the identified pan wetlands.

In contrast, the sediments in the watercourse systems are coarse and sandy **(Photo 6).** Hydrogeomorphism was evident in the form of a bleached E horizon in the channel banks of the watercourse systems. However, these were identified as watercourses and not channelled valley bottom wetlands due to the clearly evident channel structure of the watercourses, level of incision, associated riparian vegetation and lack of distinctive wetland vegetation in areas along the length of the various watercourses.

6.2.3 Vegetation Characteristics

The high level of grazing in the area is clearly evident, with graminoid species being grazed down to base level at the time that the assessment was undertaken. The general lack of groundcover has also resulted in severe erosion in drainage areas along the watercourses down to bedrock given the relatively thin soil profile in the lower lying areas. The pan areas were mainly characterised by a mix of short and taller graminoid, mainly *Hemarthria altimissa* – Swamp couch **(Photo 7),** dominated assemblages with few tree species on the pan fringe (*Combretum imberbe* and *Acacia karoo*). Other shorter grass species were also present but could not be identified at the time of the assessment as a result of recent grazing activity.

Grass species, mainly *Diheteropogon amplectens* – Broad-leaved Bluestem **(Photo 8)**, were also evident on the channel banks of the watercourses where overgrazing was not so severe. Some forb species were identified. *Hypoxis hemerocallidea* **(Photo 9)** were identified around the pan wetlands. Overall groundcover was poor, with a poorly developed grass layer. Relatively densely covered herbaceous to medium sized trees were present within the riparian zones of the watercourses where *Acacia karroo* (sweet thorn – **Photo 10**), *Acacia caffra*, *Ziziphus mucronata* (Buffalo thorn – **Photo 11**), *Searsia lancea* (Karee) species were particularly evident. Other hydrophytic vegetation and vegetation associated with damp conditions associated with the watercourses include *Phragmites australis* (Common reed) and *Cyperus sexangularis* **(Photo 12)**.

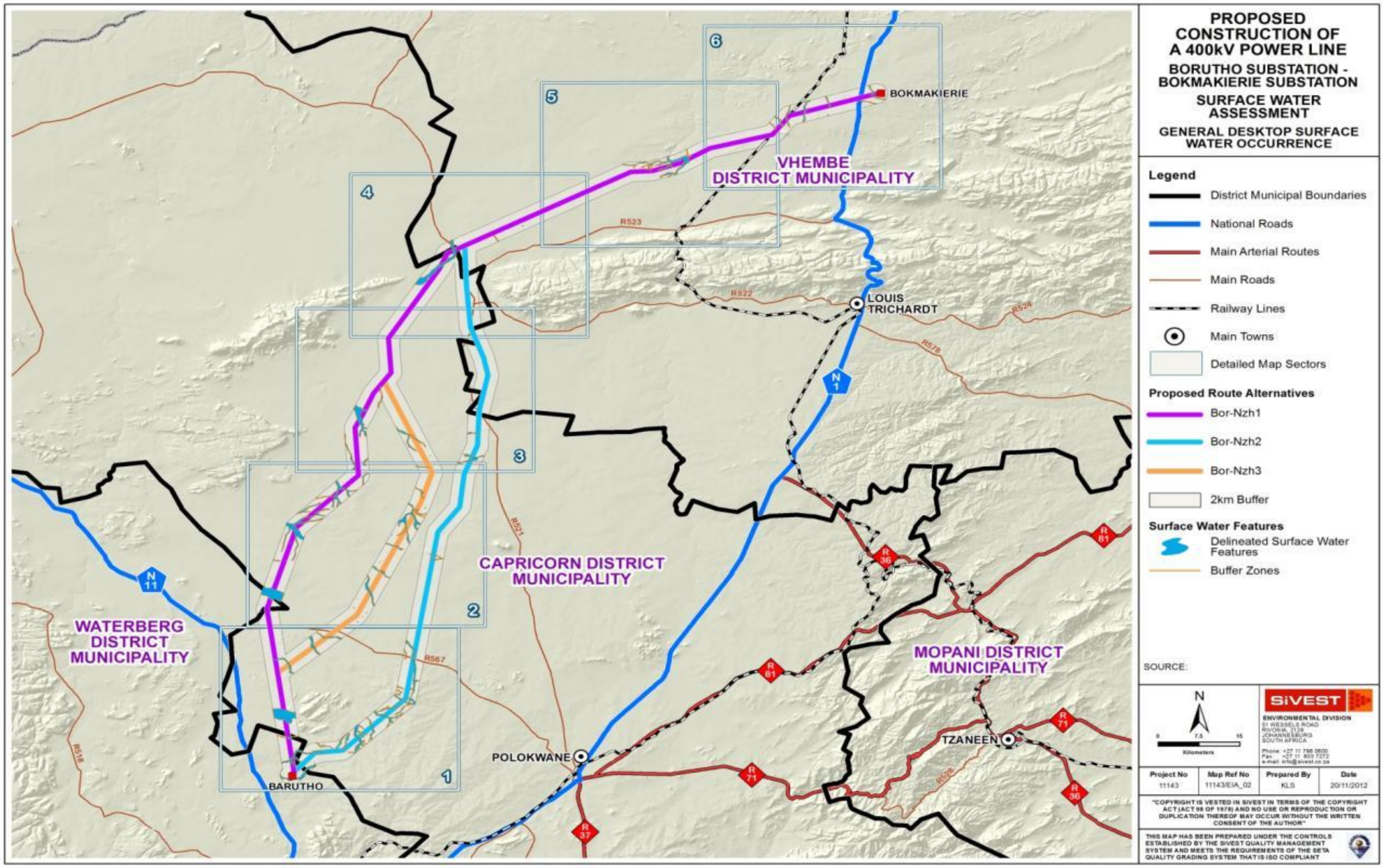

Figure 7. Surface water delineation overview map.

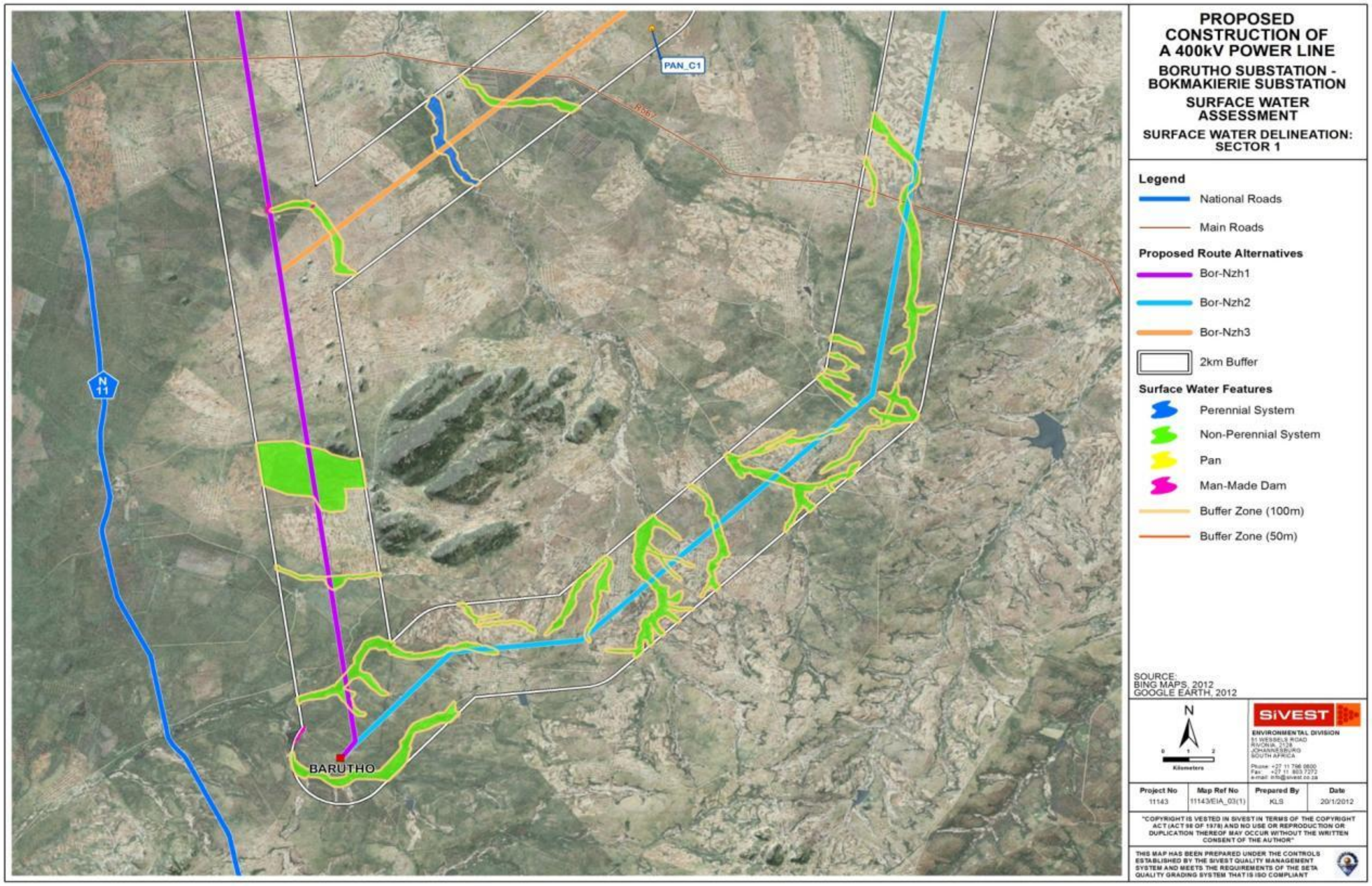

Figure 8. Surface water delineation map – Sector one.

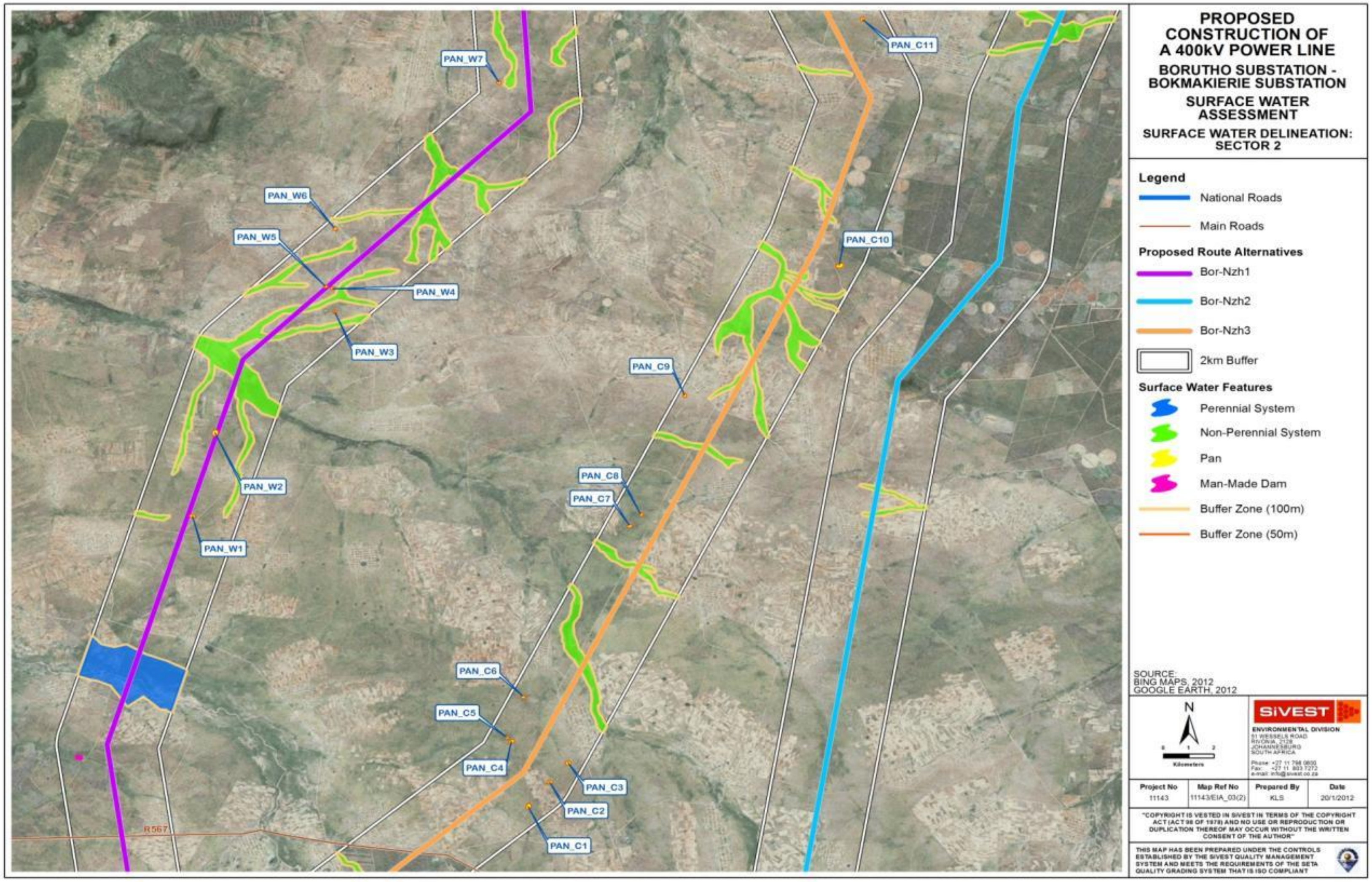

Figure 9. Surface water delineation map – Sector two.

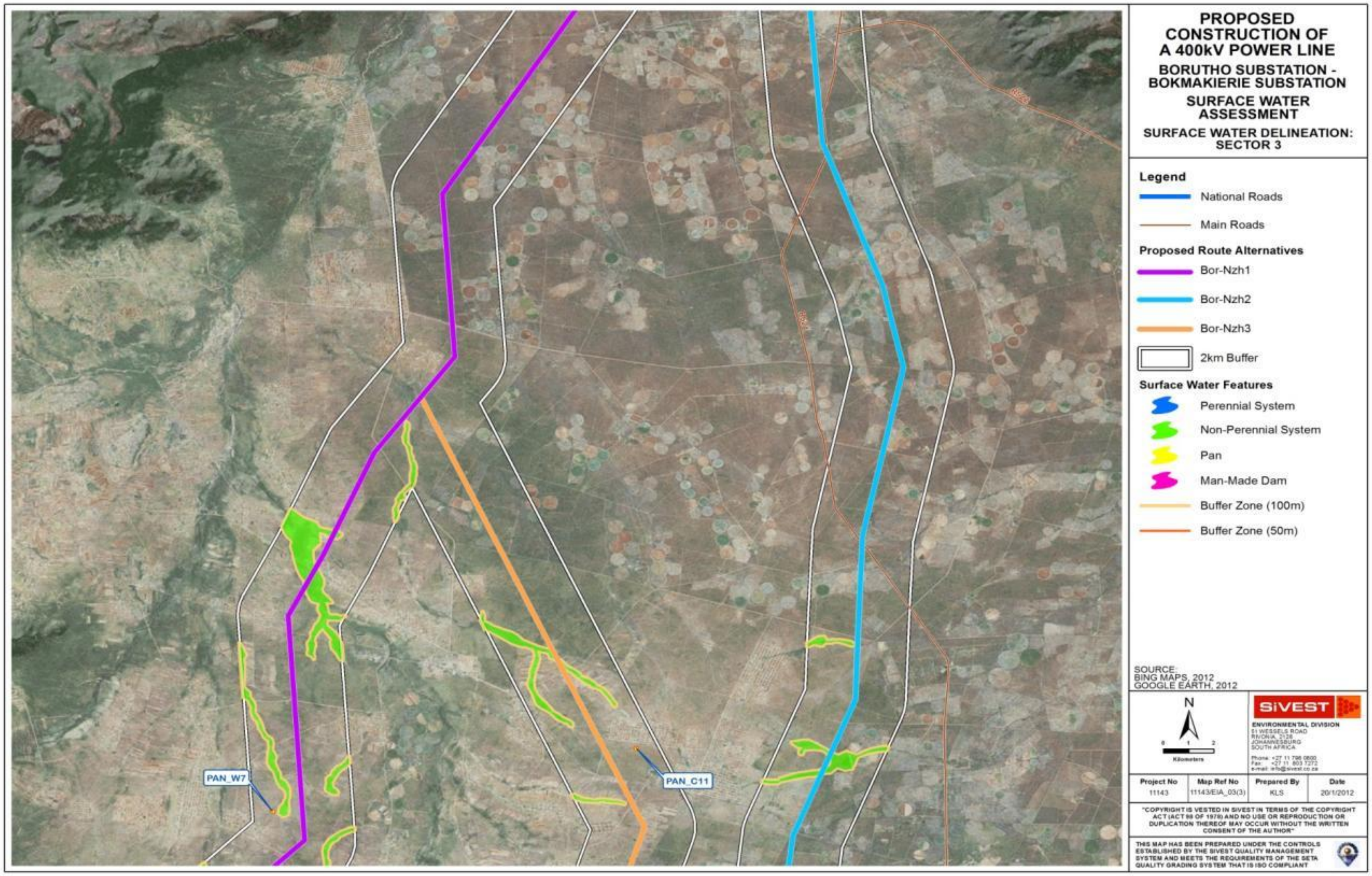

Figure 10. Surface water delineation map – Sector three.

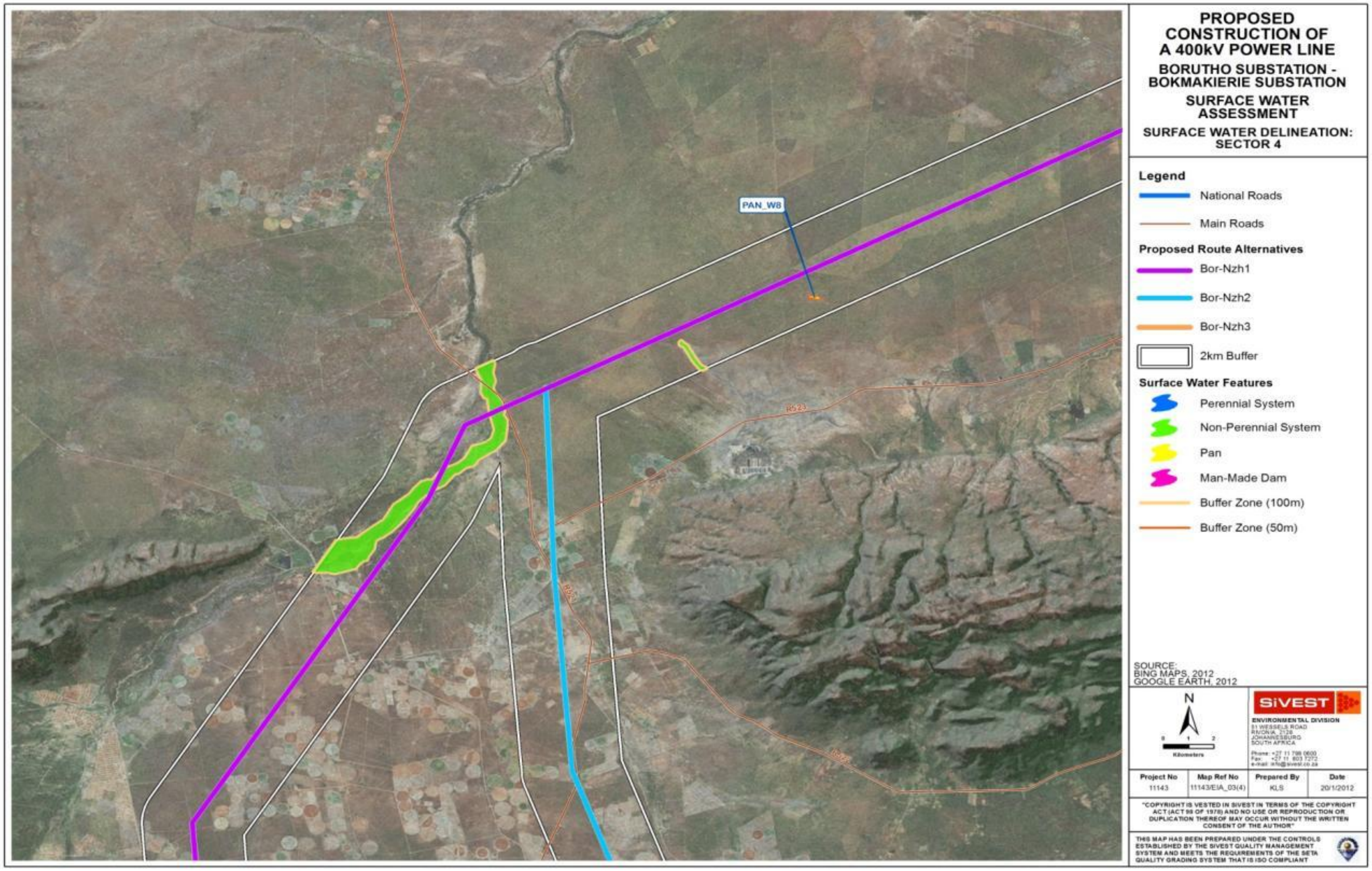

Figure 11. Surface water delineation map – Sector four.

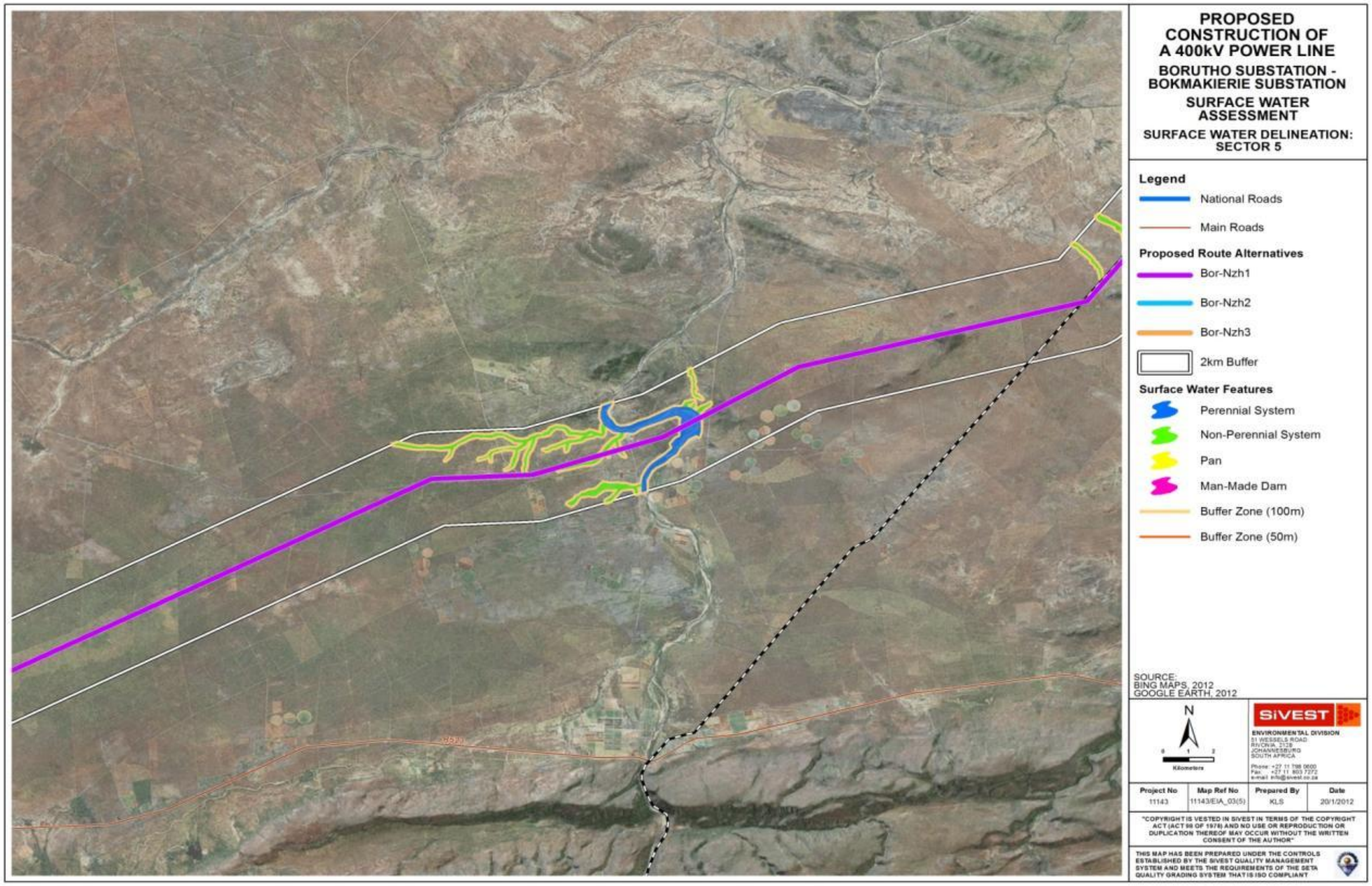

Figure 12. Surface water delineation map – Sector five.

Figure 13. Surface water delineation map – Sector six.

Plate 1. Photographic evidence of the topography and soils assessment conducted for all three alternative Corridors.

		
Photo 1. Isolated pan wetland in localised depression area.	Photo 2. Incised drainage pathway (non-perennial watercourse) in the lower lying areas of the gently undulating landscape.	Photo 3. Exposed bedrock on the channel bed of a watercourse at low flow.
		
Photo 4. Ferricrete exposed at the surface near a wetland pan in the study area.	Photo 5. Clayey nature of the substrate beneath a pan wetland. Note the red and black mottling.	Photo 6. Sandy nature of the deposited sediments in the watercourses of the study area.

Plate 2. Photographic evidence of the vegetation assessment conducted for all three alternative Corridors.

Photo 7. *Hemarthria altimissa* in one of the pan wetlands.

Photo 8. *Diheteropogon amplectens* fringing the watercourses.

Photo 9. *Hypoxis hemerocallidea* found near one of the pan wetlands.

Photo 10. *Acacia karoo* encroaching on the watercourses in the study area.

Photo 11. *Ziziphus mucronata* found fringing the banks of a watercourse

Photo 12. *Cyperus sexangularis* found in the Sand River.

6.2.4 Surface Water Resources Buffer Zones

There are no official guidelines that dictate that a buffer zone is required for surface water resources in the Limpopo province. However, it is best practice to ensure that buffer zones are implemented and avoided as far as possible. The Gauteng Minimum Requirements for Biodiversity Studies (GDACE, 2009) stipulates buffer zones that are applicable to rivers and wetlands. These buffer zones have been adopted in this study. Accordingly, in terms of the Gauteng Minimum Requirement for Biodiversity Studies, a 100 metre buffer zone has been applied to all watercourses and a 50 metre buffer has been applied to all wetlands.

All identified surface water resources are classified as highly sensitive features that are to be avoided by the proposed development as far as possible by routing the proposed power lines around the identified pan wetlands or spanning the pan wetlands with the power lines only where absolutely necessary. The same is to be applied where possible for all perennial and non-perennial watercourses. The surface water resource buffers are classified as moderately sensitive areas.

7 WET-ECOSERVICES ASSESSMENT AND WETLAND PRIORITISATION

This section reports on the findings of the WET-EcoServices assessment and wetland prioritisation exercise.

7.1 WET-EcoServices Assessment of wetland units Pan_W1 to Pan_W10

Figure 14 to **Figure 23** presents the scores for the eco-services assessment for the wetland units Pan_W1 to Pan_W7, whilst **Table 2** to provides details in terms of their general characteristics.

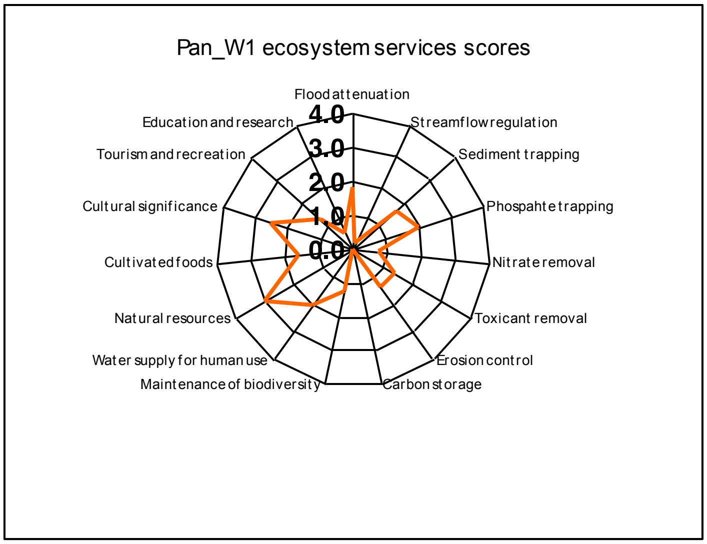

Figure 14. Eco-services provided by wetland unit Pan_W1.

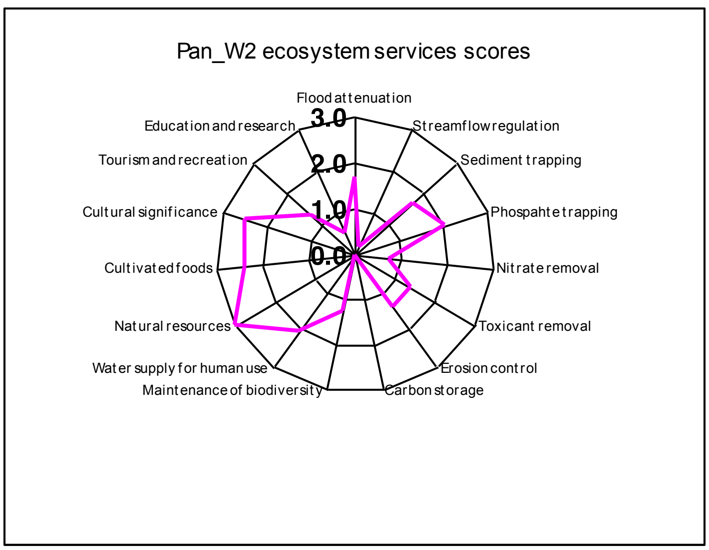

Figure 15. Eco-services provided by wetland unit Pan_W2.

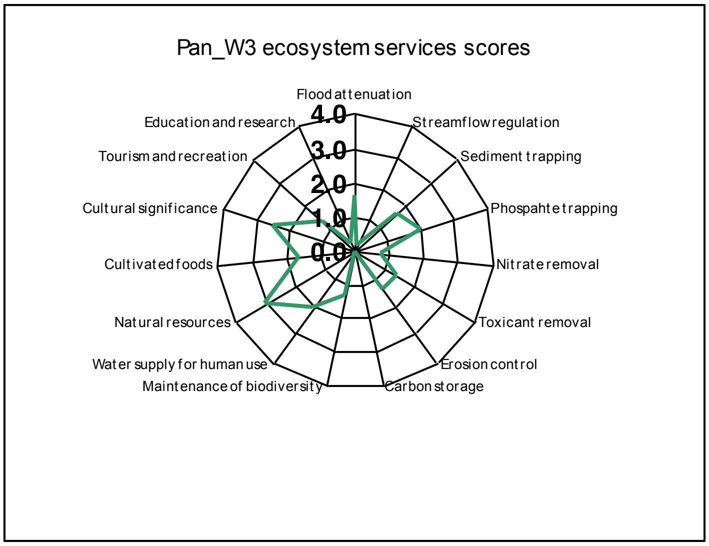

Figure 16. Eco-services provided by wetland unit Pan_W3.

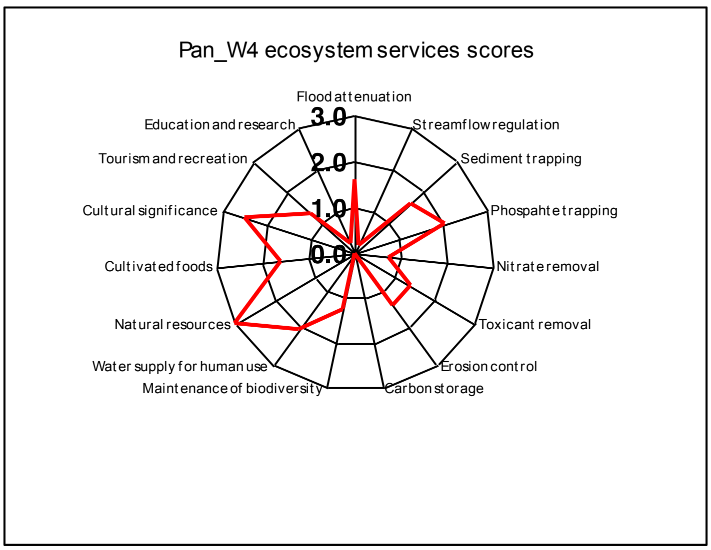

Figure 17. Eco-services provided by wetland unit Pan_W4.

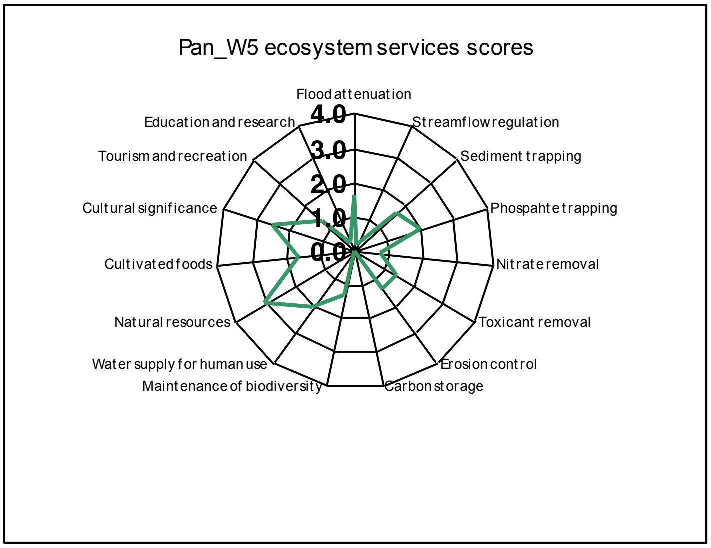

Figure 18. Eco-services provided by wetland unit Pan_W5.

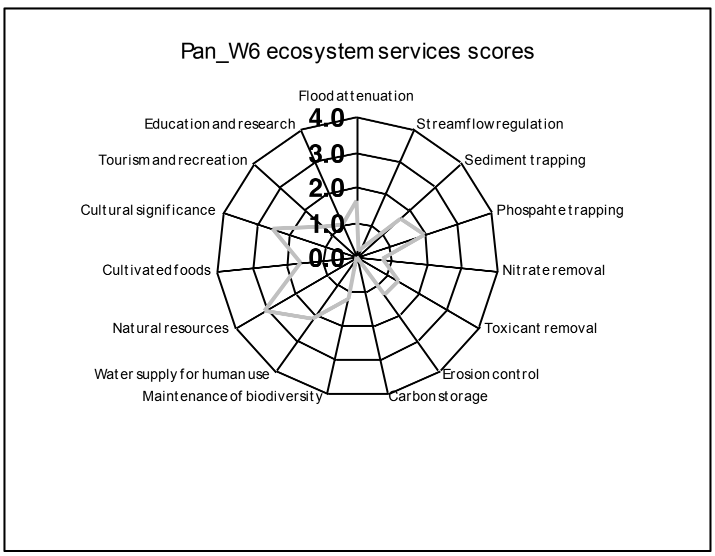

Figure 19. Eco-services provided by wetland unit Pan_W6.

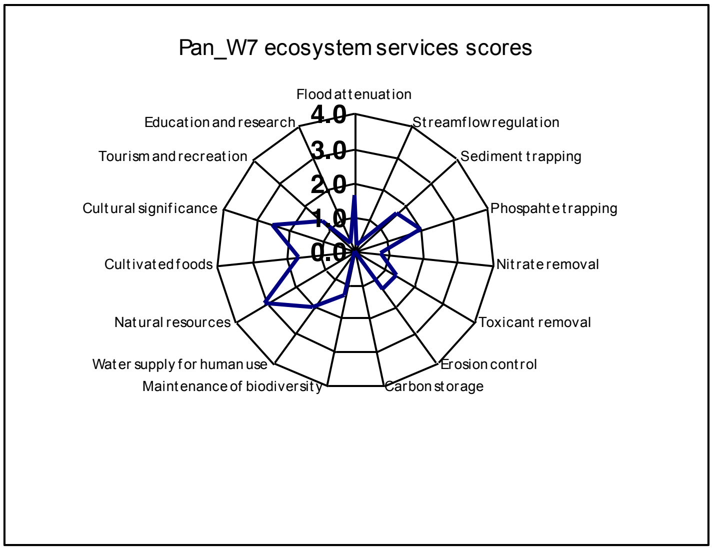

Figure 20. Eco-services provided by wetland unit Pan_W7.

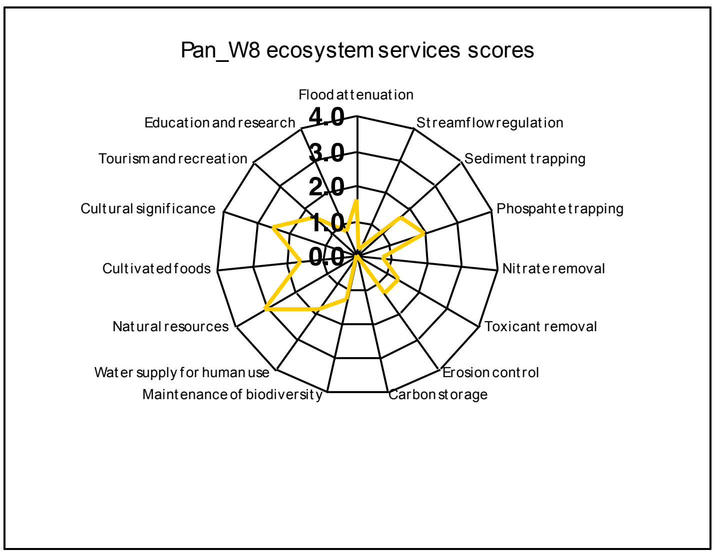

Figure 21. Eco-services provided by wetland unit Pan_W8.

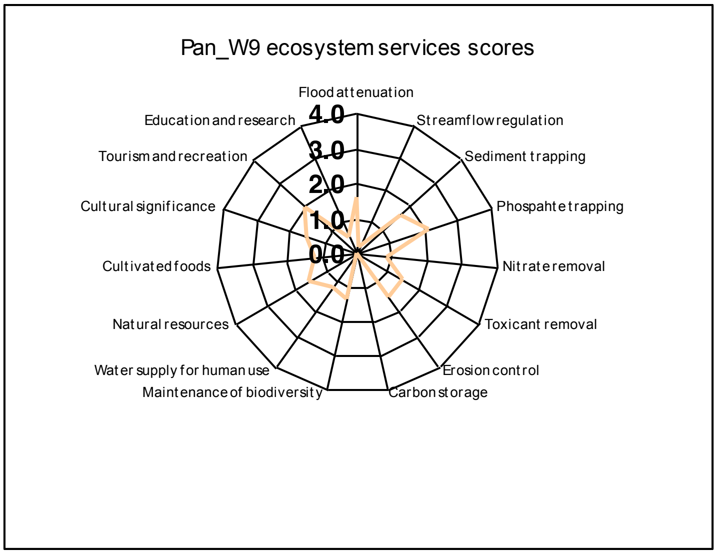

Figure 22. Eco-services provided by wetland unit Pan_W9.

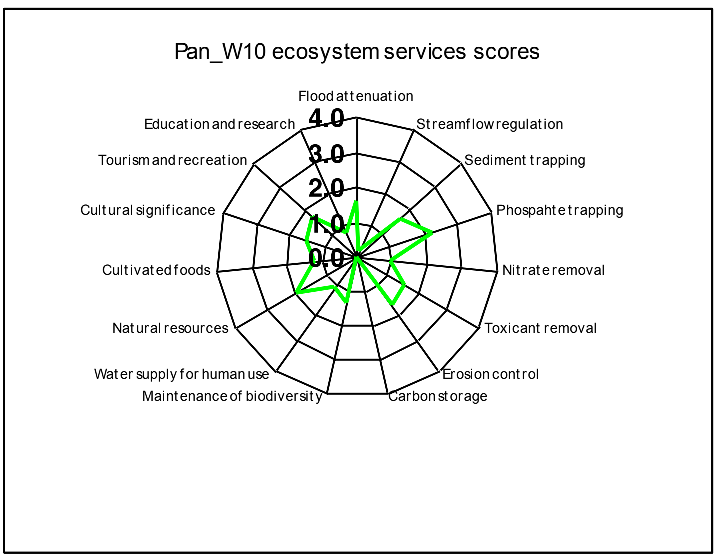

Figure 23. Eco-services provided by wetland unit Pan_W10.

The general baseline of the surrounding environment for the pan wetlands identified in the Western Corridor Alternative can be described as natural bushveld but with a relatively strong presence of subsistence agriculture (cattle farming and crop cultivation). Given these details, read in conjunction with the nature and characteristics of the pan wetlands as described earlier in the report, a number of functional aspects have been identified that the pan wetlands provide in the region of the Polokwane Plain geomorphic province. These are relatively similar for the pan wetlands with variable degrees of significance between the essential eco-services offered. In general, the pan wetlands within this region scored low to moderate on sediment trapping, phosphate trapping, flood attenuation, toxicant removal and erosion control eco-services as could be expected from pan wetlands due to the limited extent, Endorheic and isolated nature of these wetland systems. However, the pan wetlands were found to provide a higher degree of significance on water supply for human use, cultural significance, cultural resources and natural resources mainly as a result of the climate of the region, and the dependency on wetlands by the nearby surrounding communities. The general characteristics of the pan wetlands are provided below.

Table 2. General characteristics of wetland unit Pan_W1.

Wetland unit size (Ha)	1.65
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 3. General characteristics of wetland unit Pan_W2.

Wetland unit size (Ha)	3.11
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 4. General characteristics of wetland unit Pan_W3.

Wetland unit size (Ha)	0.67
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent

	agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 5. General characteristics of wetland unit Pan_W4.

Wetland unit size (Ha)	0.98
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.

Wetland Unit Sensitivity	Moderate.

Table 6. General characteristics of wetland unit Pan_W5.

Wetland unit size (Ha)	0.7
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 7. General characteristics of wetland unit Pan_W6.

Wetland unit size (Ha)	1.06
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock.

	▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 8. General characteristics of wetland unit Pan_W7.

Wetland unit size (Ha)	1.02
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment.

	▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 9. General characteristics of wetland unit Pan_W8.

Wetland unit size (Ha)	2.8
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 10. General characteristics of wetland unit Pan_W9.

Wetland unit size (Ha)	3.75
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Marble
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical

	degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 11. General characteristics of wetland unit Pan_W10.

Wetland unit size (Ha)	3.21
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Marble
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate.

	▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

In consideration of the various factors and impacts to the wetland units, the *overall functional class* is **moderate**. The wetlands are not especially biodiverse in terms of overall vegetation composition but may provide habitat to charismatic (Cranes for example) and sensitive species (such as Bull frogs). The principal role of the wetlands in supplying water, offering cultural significance, cultural resources and natural resources for the immediate catchment and the relative size of the wetland in relation to the catchment contributes to the *sensitivity* of the wetland unit being classified as **moderate**.

7.2 WET-Ecoservices Assessment of wetland units Pan_C1 to Pan_C11

Figure 24 to **Figure 34** provides the general characteristics of wetland units Pan_C1 to Pan_C11. **Table 12** to **Table 22** presents the scores for the eco-services assessment.

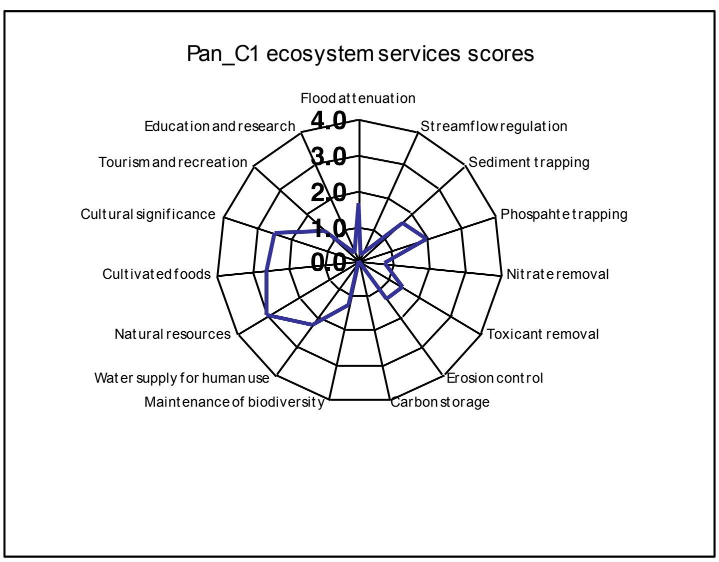

Figure 24. Eco-services provided by wetland unit Pan_C1.

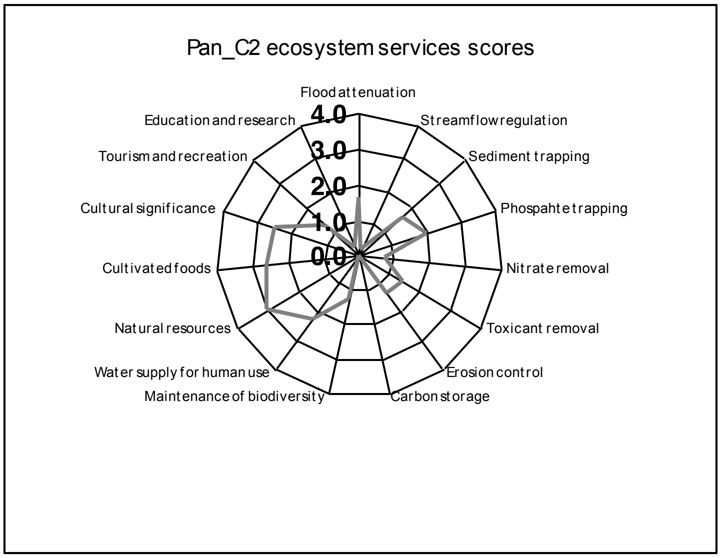

Figure 25. Eco-services provided by wetland unit Pan_C2.

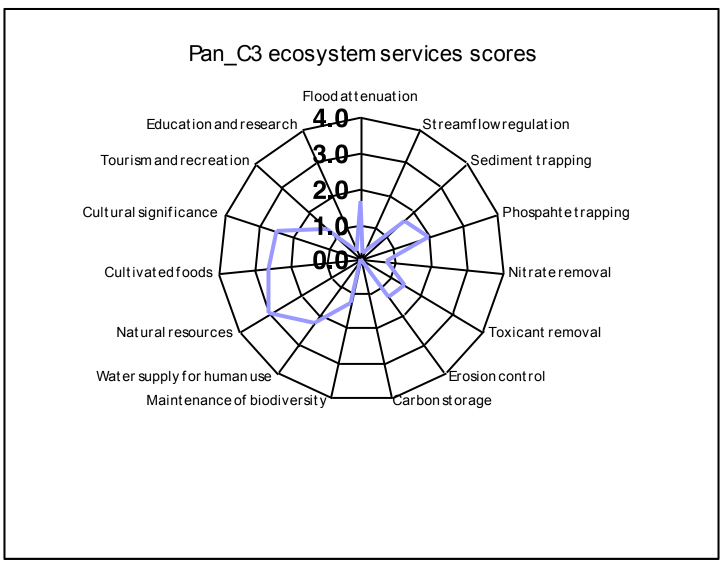

Figure 26. Eco-services provided by wetland unit Pan_C3.

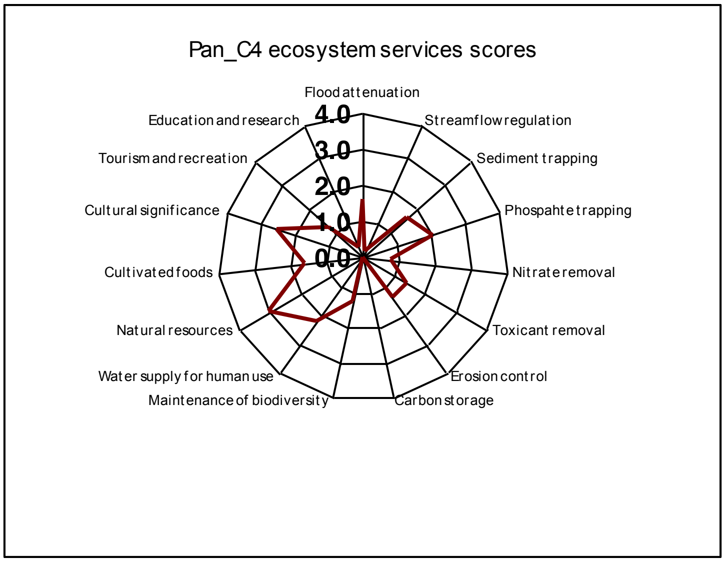

Figure 27. Eco-services provided by wetland unit Pan_C4.

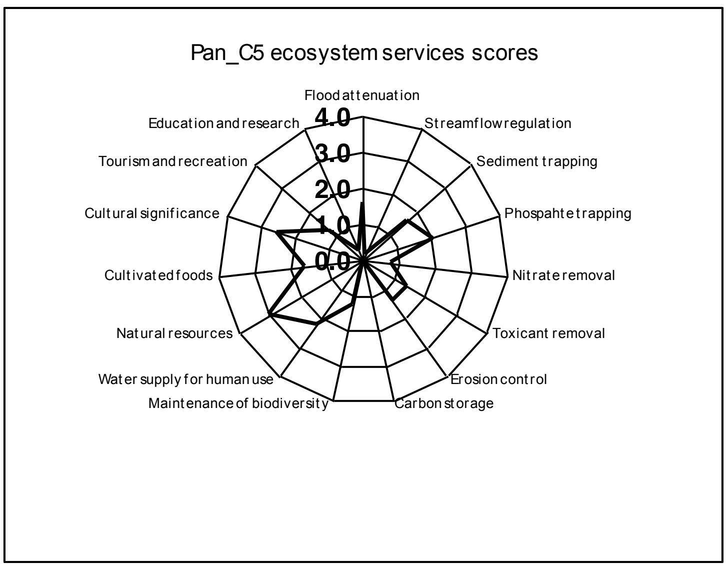

Figure 28. Eco-services provided by wetland unit Pan_C5.

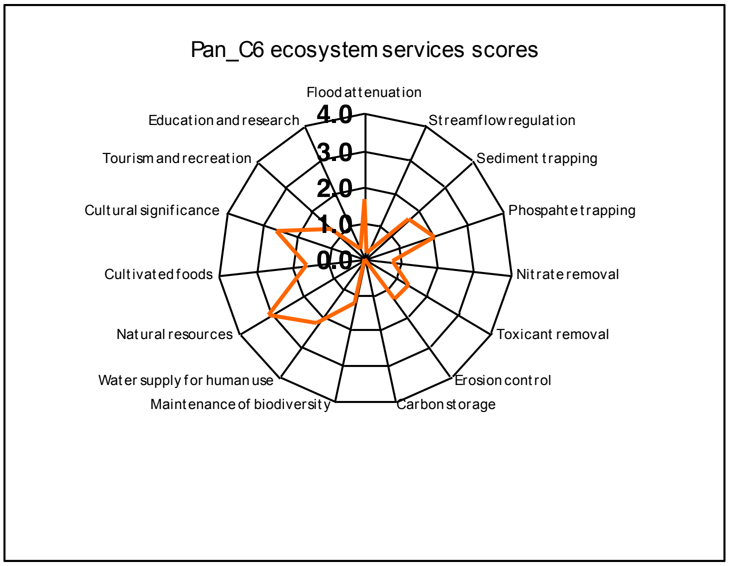

Figure 29. Eco-services provided by wetland unit Pan_C6.

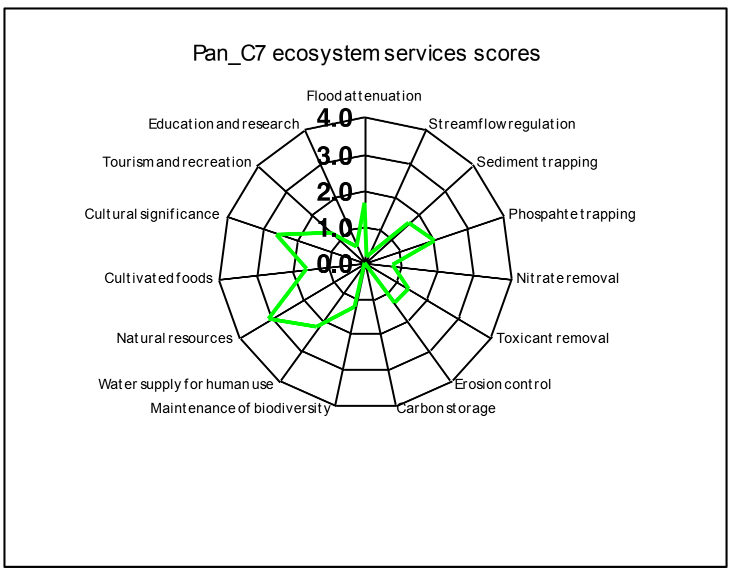

Figure 30. Eco-services provided by wetland unit Pan_C7.

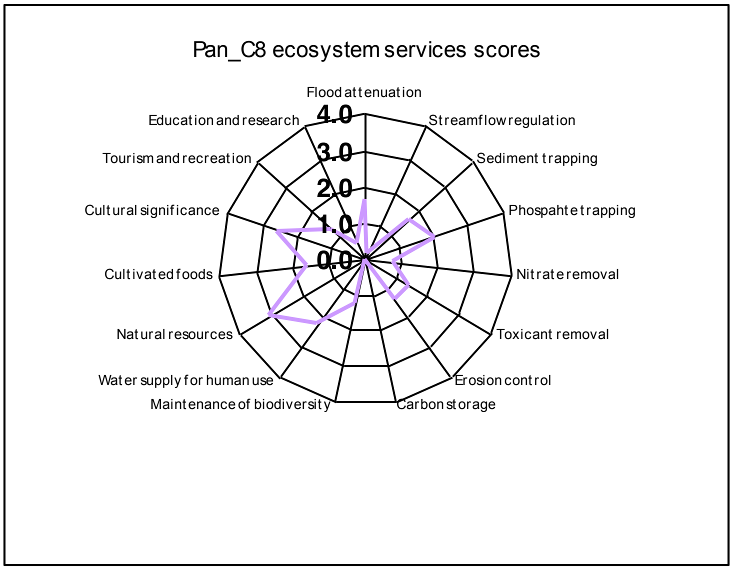

Figure 31. Eco-services provided by wetland unit Pan_C8.

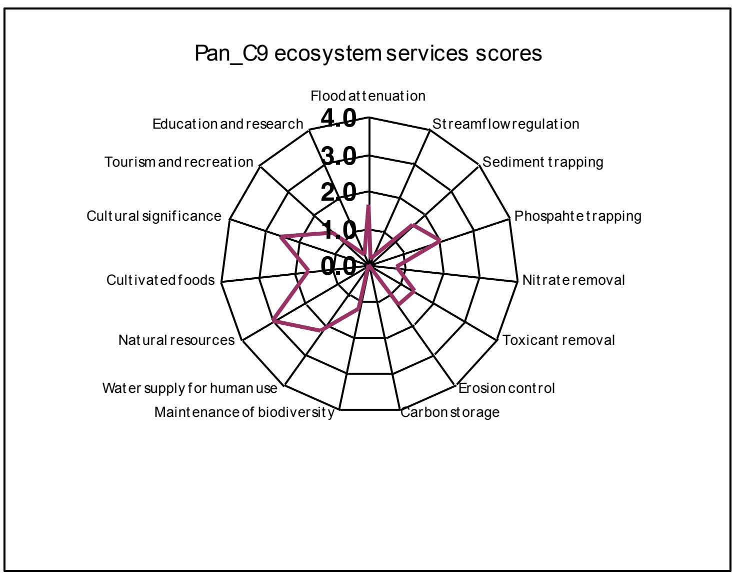

Figure 32. Eco-services provided by wetland unit Pan_C9.

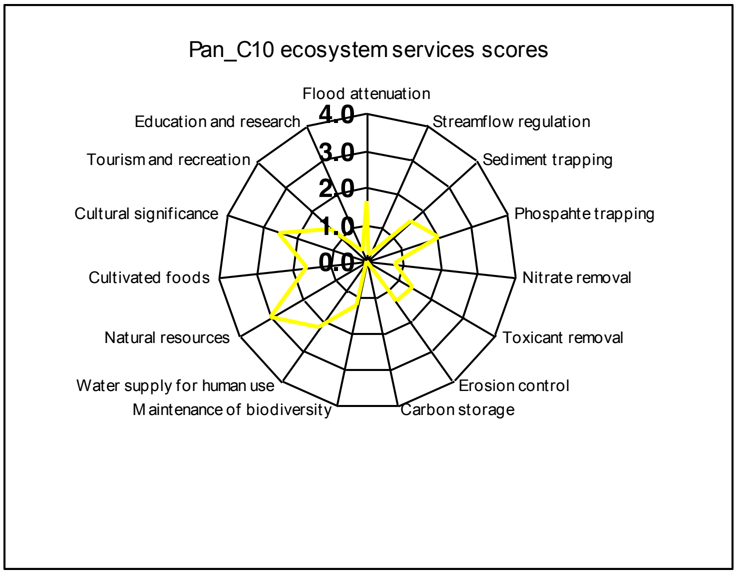

Figure 33. Eco-services provided by wetland unit Pan_C10.

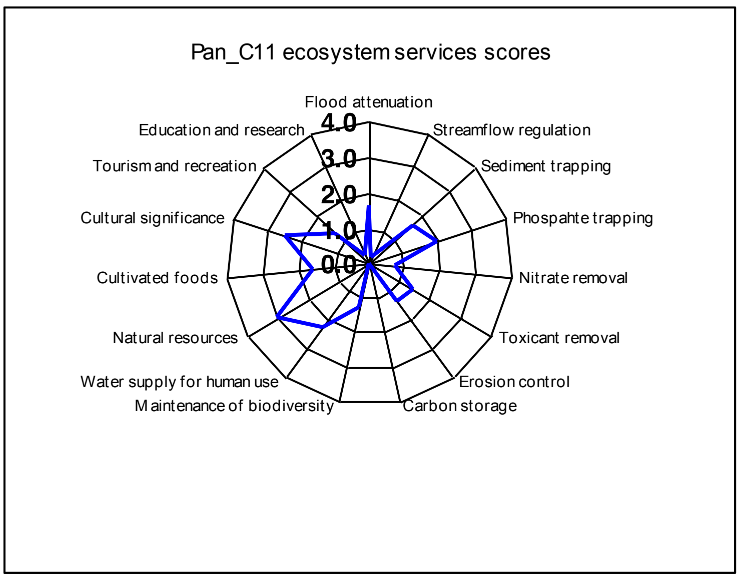

Figure 34. Eco-services provided by wetland unit Pan_C11.

The pan wetlands within the Central Corridor Alternative share many of the same characteristics of pan wetlands identified in the Western Corridor Alternative as a result of their relative close proximity to each other (located in the Polokwane Plain). Accordingly, these environmental features essentially share the same characteristics and functional aspects. The general baseline of the surrounding environment is likewise similar for the pan wetlands of the Central Corridor Alternative with natural bushveld in the upland terrestrial areas but with a relatively strong presence of subsistence agriculture (cattle farming and crop cultivation). The functional aspects are relatively similar for the pan wetlands in the Central Corridor Alternative with variable degrees of significance between the ecosystem services offered with the pan wetlands scoring low to moderate on sediment trapping, phosphate trapping, flood attenuation, toxicant removal and erosion control. Equally however, the pan wetlands of the Central Corridor Alternative were found to provide a higher degree of significance on water supply for human use, cultural significance, cultural resources and natural resources. The general characteristics of the individual pan wetlands are provided below.

Table 12. General characteristics of wetland unit Pan_C1.

Wetland unit size (Ha)	2.31
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 13. General characteristics of wetland unit Pan_C2.

Wetland unit size (Ha)	1.2
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Crop cultivation encroachment. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 14. General characteristics of wetland unit Pan_C3.

Wetland unit size (Ha)	1.81
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Crop cultivation encroachment. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock.

	▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 15. General characteristics of wetland unit Pan_C4.

Wetland unit size (Ha)	1.41
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Crop cultivation encroachment. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent

	terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 16. General characteristics of wetland unit Pan_C5.

Wetland unit size (Ha)	0.61
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Crop cultivation encroachment. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 17. General characteristics of wetland unit Pan_C6.

Wetland unit size (Ha)	0.84
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the	▪ Livestock movement and trampling in

wetland unit)	the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 18. General characteristics of wetland unit Pan_C7.

Wetland unit size (Ha)	0.94
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.

Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 19. General characteristics of wetland unit Pan_C8.

Wetland unit size (Ha)	0.71
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 20. General characteristics of wetland unit Pan_C9.

Wetland unit size (Ha)	0.95
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 21. General characteristics of wetland unit Pan_C10.

Wetland unit size (Ha)	2.69
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent

	agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.
Wetland Unit Sensitivity	Moderate.

Table 22. General characteristics of wetland unit Pan_C11.

Wetland unit size (Ha)	1.33
Terrain unit (HGM unit)	Pan Wetland
Underlying Geology	Granite/Gneiss
Land uses in catchment	Subsistence crop cultivation and cattle livestock farming
Threats / pressures (problem areas in the wetland unit)	▪ Livestock movement and trampling in the wetland. ▪ Threat of gully erosion and physical degradation exists. ▪ Grazing pressure from livestock. ▪ Potential chemical (biocides and fertilizers) leaching from adjacent agricultural fields.
Main aspects of wetland functionality	▪ Water supply for human use. ▪ Cultural significance. ▪ Cultural resources. ▪ Natural resources.
Overall State of Wetland	Largely Natural / Unmodified.
Overall Degree of Functionality of Wetland	Moderate.
Important biodiversity features in the wetland unit	▪ Unique habitat in the context of the landscape and prevailing climate. ▪ Ecological linkages to the adjacent terrestrial environment. ▪ Aquatic habitat for wetland faunal species.

Wetland Unit Sensitivity	Moderate.

In consideration of the various factors and low current impacts to the wetland units, the *overall functional class* of the pan wetlands in the Central Corridor Alternative is **moderate**. Much like the pan wetlands of the Western Corridor Alternative, the pan wetlands of the Central Corridor Alternative are not especially biodiverse in terms of overall vegetation composition but may provide habitat to charismatic and possibly sensitive species. The principal role of the wetlands in supplying water, offering cultural significance, cultural resources and natural resources for the immediate catchment and the relative size of the wetland in relation to the catchment contributes to the *sensitivity* of the wetland unit being classified as **moderate**.

8 COMPARATIVE ALTERNATIVES ASSESSMENT

A comparative assessment of the three alternative corridors for the proposed development is provided in **Table 23** below.

Since the average spanning distance for a 400kV power line is approximately 430 metres, surface water resources (perennial and non-perennial hydrological systems) that exceed this distance were accounted for to identify where development within surface water resources are likely to be required. A worst-case scenario approach was undertaken whereby the widest part of the surface water resources was recorded (even though there might be narrower areas where the power line is more likely to follow). Importantly, all surface water resources in the Central and Eastern Alternative Corridors were assessed in conjunction to the surface water resources that occur in the Western Alternative Corridor up to where it meets with the Eastern Alternative Corridor. This information formed the primary basis for the comparative assessment in assessing the alternative corridor that could be associated with the least likelihood of development impact within surface water resources.

It has been assumed here that pan wetlands should not be affected since these sensitive hydrological systems can be avoided (circumvented or at least spanned if required) due to their relatively limited size (0.61 to 3.75 hectares).

Table 23. Comparative assessment of the three alternative corridors for the proposed development in terms of surface water occurrence.

Alternative	Preference	Reasons
BORUTHO-NZHLELE POWER LINE ROUTES		
Western Corridor Alternative (Bor-Nzh1)	**Not preferred**	Several areas are likely to result in the proposed power line crossing through delineated watercourses. These areas range from a maximum width of 485m to 2.5km for 8 watercourses. Of the 8 watercourses, 5 are particularly wide which range from a maximum width of between1.7 to 2.5km. Given that the average spanning length for a 400kV power line is approximately 430m, it is likely that several monopole structures will need to be placed in watercourses. As a result, and this alternative corridor is therefore not preferred.
Eastern Corridor Alternative (Bor-Nzh2)	**Favourable**	Several areas are likely to result in the proposed power line crossing through delineated watercourses. These areas range from a maximum width of 520m to 1.3km for 7 watercourses. The majority of watercourses that will need to be crossed are mainly concentrated to the south of the alternative Corridor. Given that the average spanning length for a 400kV power line is approximately 430m, it is likely that several monopole structures will need to be placed in watercourses. However, the nature of the watercourses in the alternative Corridor are such that the predominantly linear shape of the delineated features will mean that there is a greater chance for spanning these features at narrower areas. As a result, this alternative Corridor is therefore favourable.
Central Corridor Alternative (Bor-Nzh3)	**Favourable**	Several areas are likely to result in the proposed power line crossing through delineated watercourses. These areas range from a maximum width of 485m to 1.2km for 4 watercourses. The nature of the watercourses in the alternative Corridor are such that the predominantly linear shape of the delineated features will mean that there is a greater chance for spanning these features at narrower areas. As a result, this alternative Corridor is therefore

Alternative	Preference	Reasons
		favourable.

Preferred	The alternative will result in a low impact / reduce the impact
Not Preferred	The alternative will result in a high impact / increase the impact
Favourable	The impact will be relatively insignificant in the context of the proposed development

From **Table 23** above, the Central and Eastern Alternative Corridors are viewed as favourable for the establishment of the proposed power line due to the number, type and nature of watercourses that are envisaged to be affected by the proposed development.

9 IMPLICATIONS OF THE PROPOSED DEVELOPMENT

In the context of NEMA (1998) and the EIA Regulations (2010), the proposed development is highly likely to traverse a number of delineated surface water resources depending on which alternative and final alignment is finally selected. Additionally, it is likely that the placement of the power line towers / pylons structures inside surface water resources will be required since the spanning length is shorter than the crossing distance for several delineated surface water resources. As a result, Activity 11 and 18 as identified below stipulated in Government Notice R. 544 Listing Notice 1 of the EIA Regulations (2010) are expected to be triggered and are highly likely to require environmental authorization:

Activity 11 *- The construction of:*

xix. infrastructure or structures covering 50 square metres or more

where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

and

Activity 18 *- The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock from*

i. a watercourse;

In the context of the NWA (1998) and the proposed development, a “water use” is required where construction activities will impact on a water resource. In this light, “water use” is defined *inter alia* as follows:

a) *Taking water from a water resource;*
b) *Storing water;*
c) *Impeding or diverting the flow of water in a watercourse;*
d) *Engaging in stream flow reduction activity contemplated in Section 36 of the NWA;*
e) *Engaging in a controlled activity identified as such in Section 37 (1) or declared under Section 38(1) of the NWA;*
f) *Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;*
g) *Disposing of waster in a manner which may detrimentally impact on a water resource;*
h) *Disposing of waste in a manner of water which contains waste from, or which has been heated in any industrial or power generation process;*
i) *Altering the bed, banks, course or characteristics of a watercourse;*
j) *Removing, discharging or disposing of water found underground if it is necessary for efficient continuation of an activity or for the safety of people; and*
k) *Using water for recreational purposes.*

In light of the above, it is anticipated (but not limited to) that water uses (c) and (i) are likely to be required for the proposed development.

Furthermore, where the proposed development will impact directly on or within 500m of any delineated wetland areas, the proposed development will also be subject to a water use license under **Section 21** of the NWA read with Government Notice 1199 (Replacement of General Authorisation in Terms of Section 39 of the NWA in terms of water uses 21 (c) and 21 (i).

Overall, the proposed development is anticipated to trigger a water use license in terms of **Section 21** of the NWA as well as Government Notice 1199. Furthermore, the proposed development is anticipated to trigger Activity 11 and 18 contained in Listing Notice 1 of the EIA Regulations (2010) read in terms of NEMA and is therefore highly likely to require environmental authorisation. Importantly however, all of the above information must not be deemed final but rather brought to the attention of the relevant determining authorities to assess their final applicability to the proposed development.

Figure 35 to **Figure 40** illustrates the various threshold boundaries applicable to the delineated surface water resources that are likely to trigger either a water use license or environmental authorisation process.

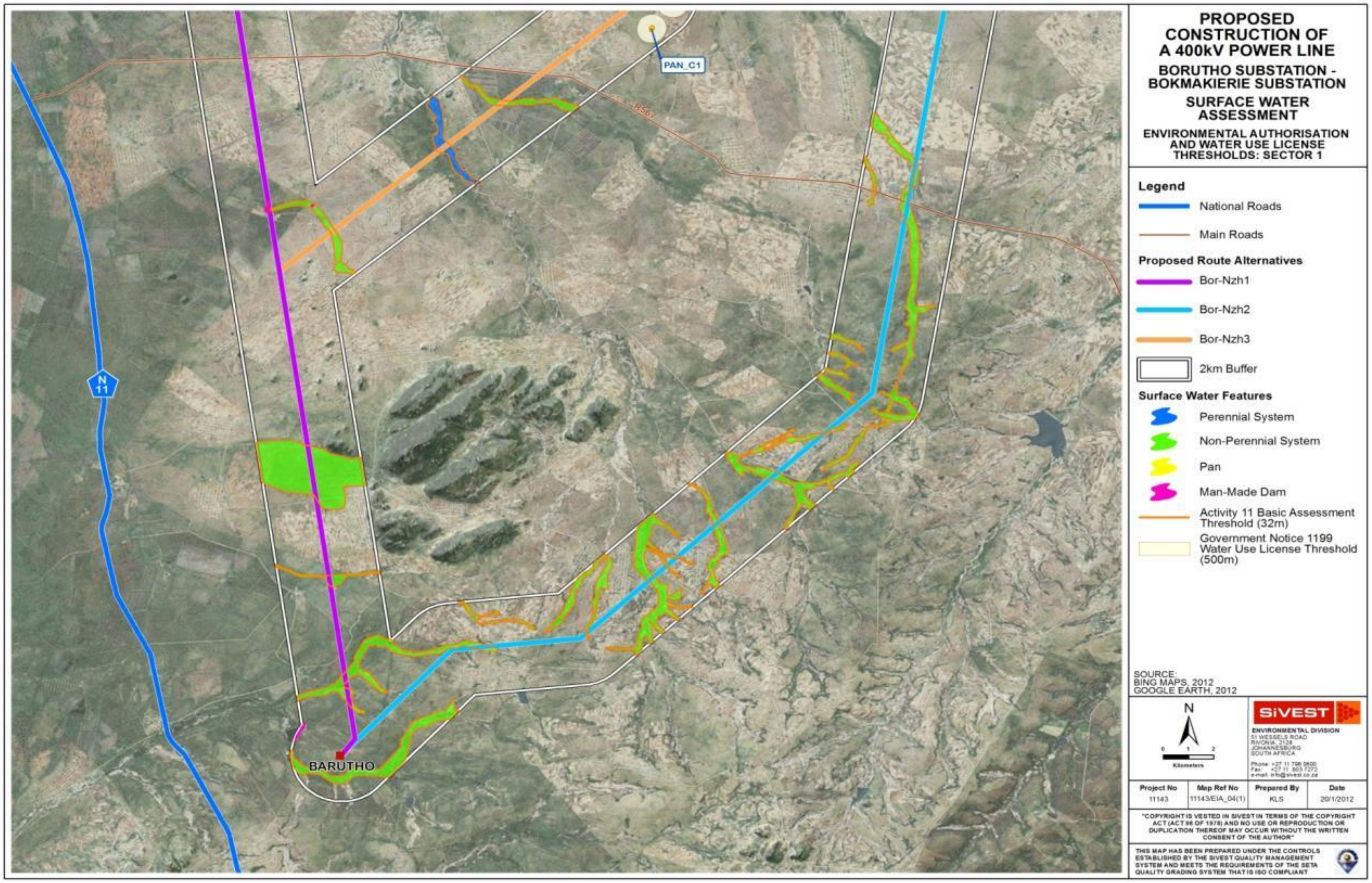

Figure 35. Surface water environmental and water legislation thresholds map – Sector one.

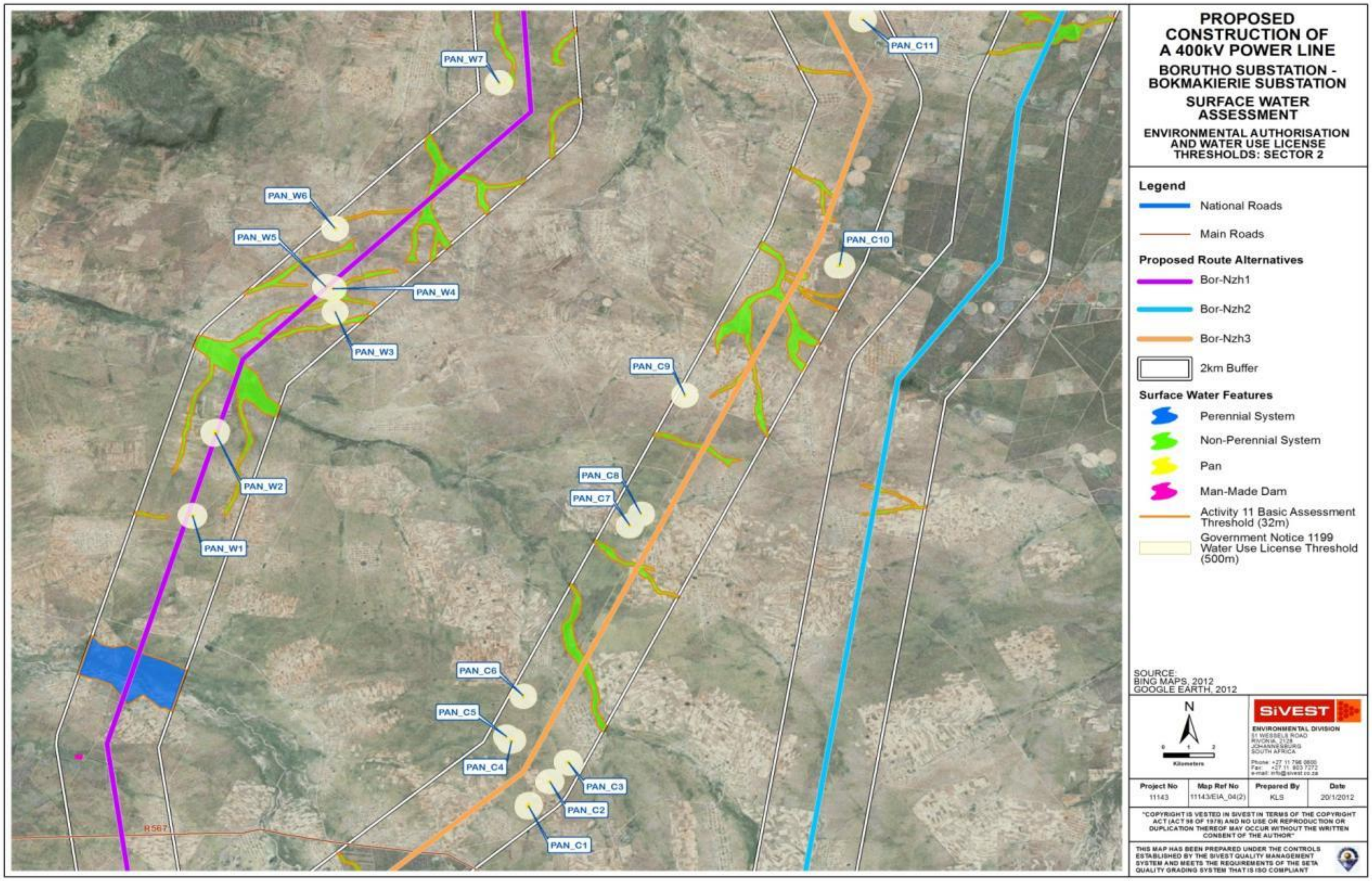

Figure 36. Surface water environmental and water legislation thresholds map – Sector two.

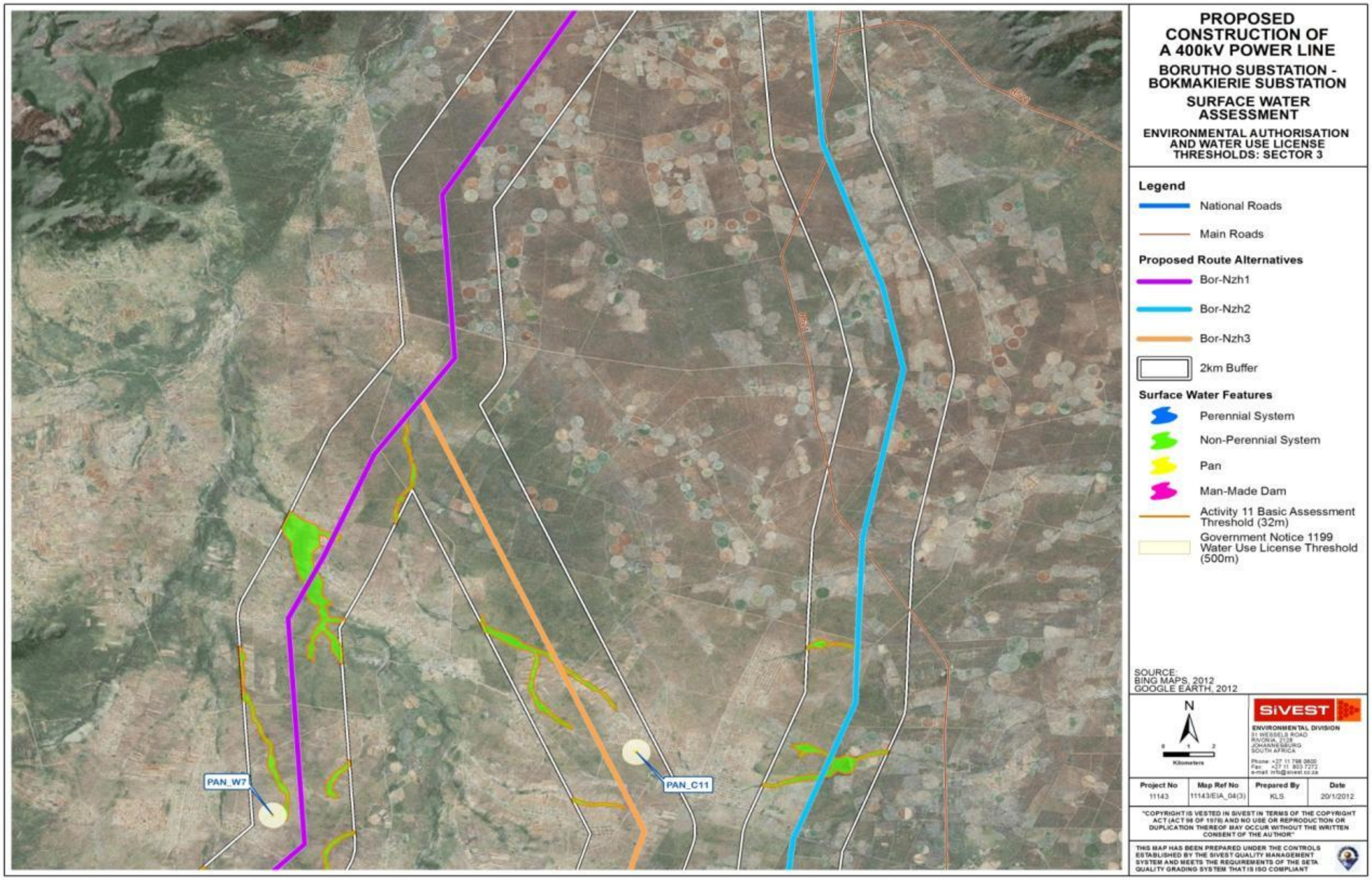

Figure 37. Surface water environmental and water legislation thresholds map – Sector three.

Figure 38. Surface water environmental and water legislation thresholds map – Sector four.

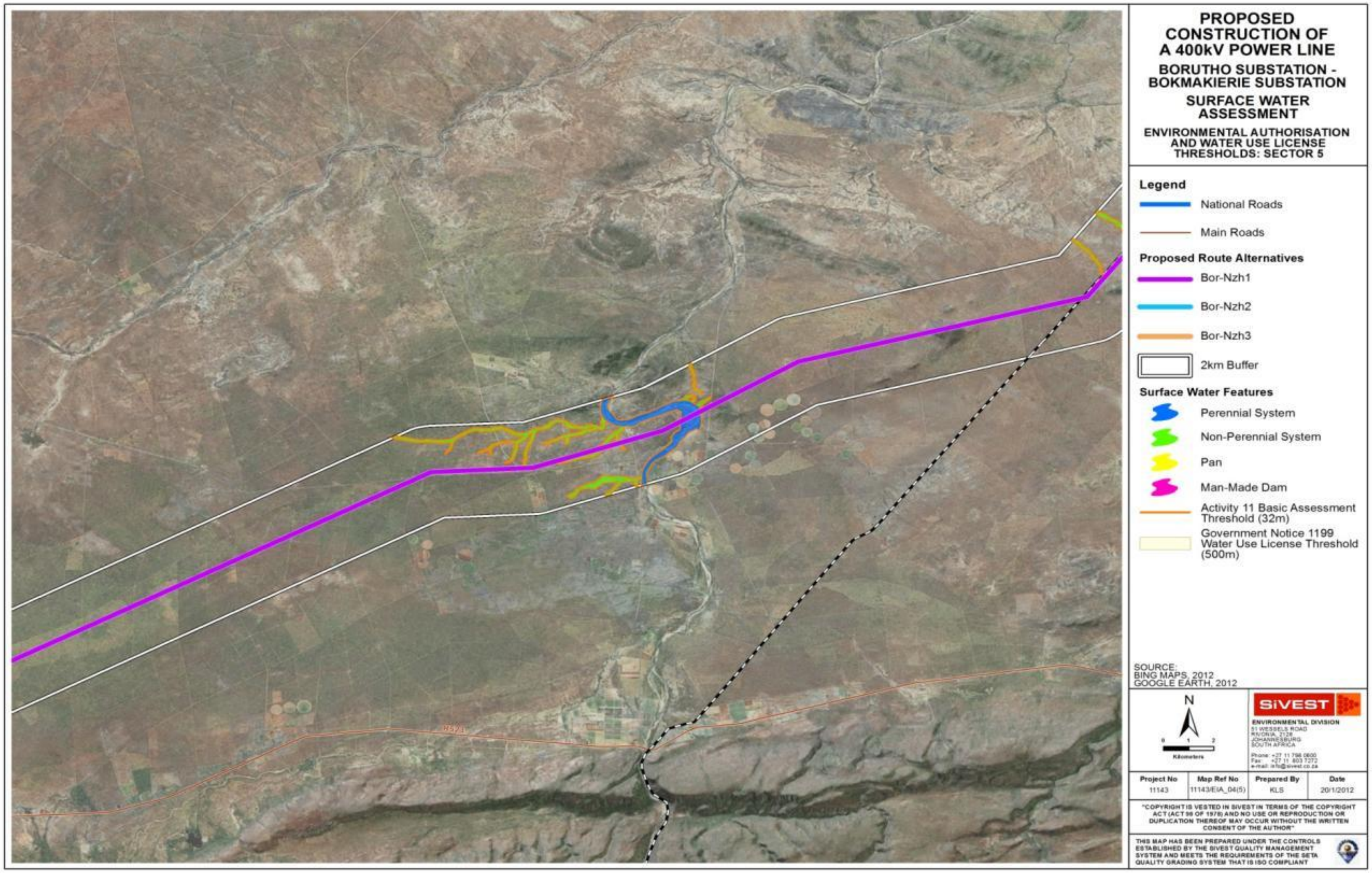

Figure 39. Surface water environmental and water legislation thresholds map – Sector five.

Figure 40. Surface water environmental and water legislation thresholds map – Sector six.

10 NATURE OF THE POTENTIAL AND ANTICIPATED IMPACTS ASSOCIATED WITH THE PROPOSED DEVELOPMENT

Several impacts can be anticipated to potentially take place as a result of the proposed development. This section will identify and contextualise each of the anticipated potential impacts in relation to the delineated surface water resources, rate these impacts according to an impact rating system (see **Appendix B** for a full methodology and description of the impact rating system), determine the effect of the environmental impact and provide recommendations towards mitigating the impact.

10.1 Construction Phase Potential Impacts

10.1.1 Impact – Placing Towers / Electricity Pylon Structures in Surface Water Resources

Towers / electricity pylons are relatively large structures that require foundations in order for the structures to retain their prescribed position. The process of excavating the foundations would disturb the substrate and entail the removal of soil and vegetation within the tower footprint, as well as the potential damage to vegetation and soils in the nearby area due to the movement of construction machinery in the vicinity. Moreover, sedimentation (as a result of excavated and exposed stockpiled soils resulting in consequent erosion and deposition via surface run-off into nearby wetlands and watercourses) can affect the functioning of a wetland by causing pollution (sediment). Furthermore, exposed excavations are susceptible to erosion inside wetlands and watercourses if left bare for long periods and where no mitigation measures are implemented.

Further impacts that are associated with the placing of towers near or in surface water resources include the presence and movement of vehicles as well as the use of machinery near or in surface water resources. The use of vehicles and machinery may result in accidental leakages (fuel, oils and cement) and the consequent introduction of pollutants and/or toxicants into these sensitive hydrological systems.

Additionally, the movement of heavy construction vehicles and machinery into surface water resources could likely result in the physical degradation of soils by means of compaction or destruction of sensitive vegetation. Moreover, vehicle movement can potentially result in faunal fatalities.

Power lines are well known for bird injuries and fatalities as a result of birds colliding with the lines. Hence, flight deviators or anti-collision devices are usually fitted to power lines in order to prevent collisions. However, when fitting the various devices or deviators to the power line above surface water resources, physical damage and compaction impacts can be caused by the vehicles that may be used for the fitment process.

Finally, workers entering and using wetlands and watercourse areas for inappropriate activities (dumping materials, depositing human faecal and urine waste etc.) may impact on the surface water resources. It is important that these anticipated potential impacts are mitigated. Generic impact mitigation measures are provided below. Importantly, site specific mitigation measures will need to be devised in the final walk-through surface water resources report and construction EMPr.

Table 24 below outlines the identified anticipated potential construction phase related impacts assessed in terms of the proposed development.

Table 24. Impact rating for placing towers in surface water resources.

IMPACT TABLE		
Environmental Parameter	*Wetlands and Watercourses*	
Issue/Impact/Environmental Effect/Nature	Placing tower structures in surface water resources	
Extent	*Local*	
Probability	*Probable*	
Reversibility	*Barely reversible*	
Irreplaceable loss of resources	*Marginal loss of resource*	
Duration	*Long term*	
Cumulative effect	*High cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the post mitigation impact rating can be reduced to a more acceptable level.*	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	3	3
Reversibility	3	1
Irreplaceable loss	2	2
Duration	4	1

Cumulative effect	4	1
Intensity/magnitude	2	1
Significance rating	- 36 (medium negative)	- 10 (low negative)
Mitigation measures	*A final walk-through surface water study is required to identify wetlands that are at risk to damage during the construction process and will require site specific mitigation measures. These site specific mitigation measures must be included in the construction EMPr for the proposed development and monitored during the construction phase.* *A construction method statement must be supplied by a suitably qualified surface water specialist in order for suitable site specific mitigation measures to be devised for the construction phase in addition to the measures specified here. Monitoring of surface water resources that will be at risk to damage during the construction process will be required during construction (this can be undertaken by a suitably qualified Environmental Control Officer).* *Vehicle access into surface water resources is not allowed unless the requisite environmental authorisation and water use licence have been obtained.* *Vehicles must be restricted to smaller vehicles where possible.* *In order to limit the amount of damage caused by vehicles, activity must be restricted to a narrow track or "Right of Way" (RoW) only.* *Heavy machinery and vehicles must be checked for oil leaks before operating in the surface water resources and the associated buffer zones. Additionally, no fuelling or re-fuelling is allowed to take place in the construction area around the towers.*	

	The removal of excavated sub-soils for the foundations of the towers must take place only if completely necessary (i.e. if the excavated soil cannot be re-instated due to it being an unsuitable grade of backfill for the foundation of the structure etc.). Removed excavated soils will need to be dumped at a registered landfill that has sufficient capacity. *Soil stockpiles should separate topsoils from sub-surface soils. Where excavated soils can be re-instated, the order of soils horizons should be backfilled correctly (i.e. sub-surface soils first, topsoil last).* *All stockpiled soils should preferably be placed outside the identified surface water resources. However, for excavations in the surface water resources, it may be advisable for soils to be stockpiled adjacent to the excavation pit to limit the amount of vehicular movement in and out of the surface water resources. The stockpiles must be bunded by suitable material that can resist heavy rains to prevent increased run-off (e.g. fixed wide wooden planks or several layers of bricks stacked on top of each other). This will prevent erosion and sedimentation of the nearby sensitive hydrological systems.* *Any mixing of cement must either only take place on a covered surface nearby or beside the excavation pit. Cement mixing can take place in the load bin of a vehicle. It is important that no cement spills unnecessarily in the area around the tower construction area for risk of entering surface water resources.* *Sanitary facilities must be available for workers (at a ratio of 1 toilet to 15 workers) to use to prevent urine and faecal waste entering the surface water resources and the associated buffer zones. The sanitary facilities must be placed at least 100m*

	outside of the delineated surface water resources. Surface water resources and the RoW's must be cordoned off at construction areas to prevent any unnecessary access by unauthorised personnel or vehicles. These areas must be identified as "no-go" zones. *Vegetation must not to be damaged or removed unless they are located within the footprint of the towers. Where sensitive vegetation is identified in the foot print of a tower, the relevant authority must be contacted and must advise on the most appropriate plan of action (i.e. removal and / or translocation). Sensitive wetland vegetation must be identified in the final walk-through study.* *Where ever possible, stringing operations of the power lines should be undertaken by hand through surface water resources and not vehicles to limit ingress and associated damage. The fitment of bird anti-collision devices should take place on the ground preferably prior to stringing to prevent the need for vehicles to undertake operations in problematic areas (i.e. watercourses or pan wetlands).* *A site-specific post-construction surface water rehabilitation plan compiled by a suitably qualified surface water specialist will be required to rehabilitate and monitor the affected surface water resources where construction impacts have been caused.*

10.2 Operation Phase Anticipated Potential Impacts

10.2.1 Impact – Vehicle damage to surface water resources during maintenance

Maintenance activities will need to be carried out on the power lines and the tower / pylon structures to ensure continued supply of electricity. Access will therefore be required in order for Eskom personnel to conduct maintenance activities. Access will most likely be required by means of vehicles. Access will also presumably be restricted to the power line servitude. As mentioned previously, vehicular activity into surface water resources can physical cause damage not only to the vegetation, but also to the soils. These two components are critical components of surface water resources; each component depends on the unique properties or characteristics of each other for functionality. Once the properties and characteristics of the surface water resources components are compromised or changed (for example compaction caused by vehicle movement), this can change the natural dynamics and functioning of a surface resource. Mitigation measures are provided below to minimise anticipated damage and degradation during the operational phase.

Table 25 below outlines the identified potential operation phase related impacts assessed in terms of the proposed development.

Table 25. Impact rating for vehicle damage in surface water resources during maintenance.

IMPACT TABLE		
Environmental Parameter	*Wetlands and Watercourses*	
Issue/Impact/Environmental Effect/Nature	Vehicle damage to surface water resources during maintenance	
Extent	*Local*	
Probability	*Probable*	
Reversibility	*Partly reversible*	
Irreplaceable loss of resources	*Marginal loss of resource*	
Duration	*Long term*	
Cumulative effect	*High cumulative Impact*	
Intensity/magnitude	*Medium*	
Significance Rating	*Pre-mitigation significance rating is medium and negative. With appropriate mitigation measures, the post mitigation impact rating can be limited.*	
	Pre-mitigation impact	Post mitigation impact

	rating	rating
Extent	2	2
Probability	2	2
Reversibility	3	3
Irreplaceable loss	2	2
Duration	3	3
Cumulative effect	4	2
Intensity/magnitude	2	1
Significance rating	- 32 (medium negative)	- 14 (low negative)
Mitigation measures	*It is imperative that existing roads are used where prevalent so that damage is limited and no new impacts are created. Where new access roads are required and the necessary authorisations and licences are obtained (i.e. water use licence and environmental authorisation), these roads must be limited in extent (i.e. go directly to the desired tower) and will need to be continuously maintained.* *Ideally, if access roads are required inside or through any surface water resources, coarse gravel should be used. This material will not erode away after rainfall events and will provide a relatively solid foundation where surface water accumulates.* *If dirt roads will be the means of access, these will have to be regularly checked for erosion from road storm water or other potential sources. This includes on a weekly to monthly basis and after short or long periods of heavy rainfall or after long periods of sustained rainfall.* *Where erosion begins to take place, this must be dealt with immediately to prevent severe erosion damage to the wetlands. Should large scale erosion occur, the erosion features must be rehabilitated immediately? In this regard, a rehabilitation measures must be provided by a suitably qualified wetland specialist..*	

11 SPECIALIST RECOMMENDATIONS

All of the proposed Corridor Alternatives will likely need to cross one or more surface water resources with a strong possibility of the placement of electricity towers / pylons in surface water resources (mainly watercourses). Therefore, it is imperative that when selecting a final route, the presence of the delineated surface water resources as identified in the report are incorporated into the alignment and location of the powerlines and routing around surface water resources must be undertaken as far as possible. Should it be required that watercourses will need to be spanned, the crossing point should be at the narrowest part of the linear watercourse to avoid the placement of electricity towers / pylons. Pan wetlands are not to be spanned. Given the relatively small size of these surface water resources, these can be circumvented by the final proposed power line. Accordingly, no electricity towers / pylons are to be placed in the delineated pan wetlands. As evaluated in the comparative alternatives assessment section of the report, either the Central or Eastern Corridor Alternatives were identified as favourable for the proposed development. However, given the linear nature of the watercourses and the potential ability of the surface water resources to be spanned at narrower sections, thereby reducing the possibility of the placement of electricity towers / pylons, **the Eastern Corridor Alternative is recommended as the more favourable option for the final routing of the proposed power line**. Finally, since the delineation exercise took place primarily at a desktop level, a final surface water walk-down study will be required once the route has been finalised to inform the final placement of electricity towers / pylons near outside of any surface water resources where possible, identify suitable crossing points over watercourses, inform routing of the proposed power lines around pan wetlands, to identify high risk areas where the placement of electricity towers / pylons will be required and stipulate site specific mitigation measures for minimising impacts where this is required.

12 CONCLUSION

A surface water delineation and impact assessment is provided in this report for three power line Corridor Alternatives including the Western Corridor Alternative, the Central Corridor Alternative and the Eastern Corridor Alternative. Following a desktop assessment of surface water resources in the three proposed Corridor Alternatives, groundtruthing and in-field assessment was undertaken which resulted in a major refinement of the initial desktop study. The in-field surface water resources delineation results were based on the DWAF (2005) methodology using soil wetness, soil from, terrain and vegetation indicators.

In the Western Corridor Alternative (Bor-Nzh1), thirty (30) non-perennial watercourses; two (2) perennial watercourses; ten (10) pan wetlands and four (4) man-made dams (artificial wetlands) were found. In the Eastern Corridor Alternative (Bor-Nzh2), it eighteen (18) non-perennial watercourses were found. Lastly, in the Central Corridor Alternative (Bor-Nzh3), nine (9) non-perennial watercourses; one (1) perennial watercourse and eleven (11) pan wetlands were found. All surface water resources were designated as highly sensitive. A buffer zone of 50m for wetlands and 100m for watercourses was applied to the delineated systems as per the Gauteng Minimum Requirements for Biodiversity Studies (2009).

In terms of preferred alternative corridors, either the Central or Eastern Corridor Alternatives were identified as favourable for the proposed development. However, given the linear nature of the watercourses and the potential ability of the surface water resources to be spanned at narrower sections, thereby reducing the possibility of the placement of electricity towers / pylons, **the Eastern Corridor Alternative is recommended as the more favourable option for the final routing of the proposed power line**. It is also recommended that since the delineation exercise took place primarily at a desktop level, a final surface water walk-down study will be required once the route has been finalised to:

- inform the final placement of electricity towers / pylons near outside of any surface water resources where possible;
- identify suitable crossing points over watercourses;
- inform routing of the proposed power lines around pan wetlands;
- identify high risk areas where the placement of electricity towers / pylons will be required; and
- stipulate site specific mitigation measures for minimising impacts where this is required.

In terms of the legislative implications of the proposed development, it was established that environmental authorisation is likely to be required in terms of Activity 11 and 18 of Listing Notice 1 of the EIA Regulations as well as a water use licence in terms of the NWA should construction need to take place inside or through any of the surface water resources.

Anticipated potential construction and operation related impacts were identified and evaluated. The primary construction related impact for the proposed development is related to the placing of towers in the wetlands whilst the main operation related impact concerns vehicle damage to wetlands during maintenance. It is critical that the generic mitigation measures supplied in this report are implemented and included in the EMPr in order to mitigate any potential impacts that may be caused by the proposed development.

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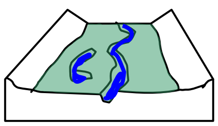
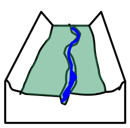
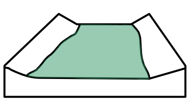
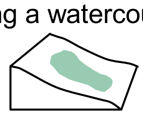
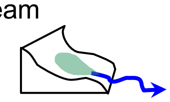
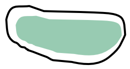
Appendix A:

HYDROGEOMORPHIC FORMS

The table below is adapted from a table in **Kotze *et al.*, 2005**. Each hydrogeomorphic form is contained below with a representative sketch of type as well as a description of each.

Hydro-geomorphic types	**Description**
Floodplain 	Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel 	Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the alluvial transport and deposition of material by water or may have steeper slopes and characterized by the loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel 	Valley bottom areas with no clearly defined stream channel usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Hillslope seepage not feeding a watercourse 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a watercourse.
Hillslope seepage feeding a stream 	Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from subsurface flow and outflow via a well defined stream channel

Depression (includes Pans) 	A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.

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