AQUATIC ECOLOGICAL IMPACT ASSESSMENT REPORT

THE PROPOSED CONSTRUCTION OF 132KV POWERLINE AND THE NEW MUTSHIKILI SUBSTATION WITHIN THENGWE IN THE LIMPOPO PROVINCE

PREPARED FOR:

DIGES GROUP

PREPARED BY:

NALEDZANI ENVIRONMENTAL SERVICES

DATE:

14 JULY 2023

078 901 4833
076 388 7203
ramalivhanam@gmail.com
ramalivhanam@naledzanies.co.za
www.naledzanies.co.za
Suite 211, Elephant House
107 Albertina Sisulu Street
Johannesburg
2107

PROJECT DETAILS	
Project Title	Tshilamba 132KV powerline
Client	Diges Group
Description	The proposed construction of a 132kv powerline and the new Mutshikili substation within Thengwe in the Vhembe District of the Limpopo Province
Document Status	Rev 3.0
Prepared by	Mpho Ramalivhana
	Mpho Ramalivhana Pri Sci. Nat (Hons. Bot.; SAAB; SACNASP)
Approved by	
Date	14 July 2023

DECLARATION OF INDEPENDENCE

I, Mpho Ramalivhana, declare that I:

- I consider myself bound to the rules and ethics of the South African Council for Natural Scientific Professions (SACNASP).
- At the time of conducting the study and compiling this report I did not have any interest, hidden or otherwise, in the proposed development that this study has reference to, except for financial compensation for work done in professional capacity.
- Work performed for this study was done in an objective manner. Even if this study results in views and findings that are not favourable to the client/applicant, I will not be affected in any manner by the outcome of any environmental process of which this report may form a part, other than being a member of the public.
- I declare that there are no circumstances that may compromise my objectivity in performing this specialist investigation. I do not necessarily object to or endorse the proposed development, but aim to present facts, findings and recommendations based on relevant professional experience and scientific data.
- I do not have any influence over decisions made by the governing authorities.
- I undertake to disclose 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 a competent authority to such a relevant authority and the applicant.
- I have expertise and experience in conducting specialist reports relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity.
- This document and all information contained herein is and will remain the intellectual property of Naledzani Environmental Services and the specialist investigator responsible for conducting the study. This document, in its entirety or any portion thereof, may not be altered in any manner or form, for any purpose without the specific and written consent of the specialist investigator.
- I will comply with the Act, regulations and all other applicable legislation.
- I realize that a false declaration is an offence in terms of Regulation 71 of NEMA and is punishable in terms of section 24F of the Act.

Mpho Ramalivhana Pri Sci. Nat (Hons. Bot.; SAAB; SACNASP, EAPASA)

SPECIALIST INFORMATION

Mpho Ramalivhana of Naledzani Environmental Consultant holds an Honours Degree in Botany from the University of Limpopo (Turfloop Campus) and has 12 years' professional experience in biodiversity assessment & management, and aquatic assessment. He is a registered member for South African Council for Natural Scientist Professions (**400395/14**), Environmental Assessment Practitioner Association of South Africa.

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1. INTRODUCTION

1.1. Background

Eskom proposes to construct a new 132kv powerline and the new Mutshikili substation within Thengwe in the Limpopo Province. An EIA process must be undertaken in terms of the Environmental Impact Assessment (EIA) Regulations of the National Environmental Management Act (Act No. 107 of 1998) (NEMA), and Diges Group has been appointed as the independent Environmental Assessment Practitioner to undertake this environmental assessment process. The Naledzani Environmental Services (NES) was, in turn, appointed to provide freshwater ecological input into the EIA process. Two powerline routes (Alt 1 and alt 2) as well as four station sites have been assessment as shown on figure 1 and 2 below.

1.2. Terms of reference

The terms of reference for the freshwater ecological input into this project were understood by Naledzani Environmental Services are to be as follows:

- Conduct a desktop review and situation assessment based on existing information for the study scope, site and area.
- Identify and map the freshwater ecosystems (rivers and wetlands) within the proposed powerline corridors and substation sites that could be affected by the proposed activities.
- Assess the ecological condition and importance of potentially impacted freshwater ecosystems.
- Assess the significance of the identified potential impacts on freshwater ecosystems that could result from the proposed activities.
- Provide recommendations to mitigate the potentially negative impacts to freshwater ecosystems that could result from the proposed activities; Identify the legal requirements in terms of the National Water Act (Act No. 36 of 1998) that could be triggered by the proposed activities; and
- Provide a summary of the findings in a Freshwater Ecosystems Impact Assessment Report.

1.3. Assumptions and limitations

The following assumptions have been made in conducting the specialist study of freshwater ecosystems for the proposed project:

- Analysis of the freshwater ecosystems was undertaken according to nationally developed methodologies as defined by DWS (Department of Water and Sanitation).
- That construction activities associated with the establishment of the power line will be restricted to a corridor 60 m or less in width along the centreline of the proposed routes.
- That pylon structures of some sort would need to be erected every few hundred metres along the power line route that is selected, to support the distribution cables.
- That a continuous access road would be established along the centreline of the proposed route between towers, unless alternative existing access roads are identified or there are areas where it is not possible to establish such an access road.
- The application of the recommended buffer areas to these freshwater ecosystems does compensate for inaccuracies in the delineation of these features; and

- That there will be further opportunity for freshwater ecological input into the selection of specific positions for pylon structures before they are erected and the final routing of access roads to and between pylons.
- Recommendations are based on professional opinion and best practise guidelines within South Africa.
- Should the client undertake the proposed development activities within the identified surface water resources banks and beds, then a Section 21 c and i Water Use Application and Authorisation will be needed from the Department of Water and Sanitation (DWS).

2. RELEVANT LEGISLATION

2.1. The Constitution of the Republic of South Africa Act (Act No. 108 of 1996) – Section 24

The Constitution is South Africa's overarching law. It prescribes minimum standards with which existing and new laws must comply. Chapter 2 of the Constitution contains the Bill of Rights in which basic human rights are enshrined. Government's commitment to give effect to the environmental rights enshrined in the Constitution is evident from the enactment of various pieces of environmental legislation since 1996, including the National Water Act, the National Environmental Management Act, etc.

2.2. National Environmental Management Act (Act No. 107 of 1998) (NEMA), as amended.

NEMA replaces a number of the provisions of the Environment Conservation Act, 1989 (Act No. 73 of 1989). The Act provides for cooperative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for coordinating environmental functions. The principles enshrined in NEMA guide the interpretation, administration and implementation of the Act with regards to the protection and / or management of the environment. These principles serve as a framework within which environmental management must be formulated. Section 2(4) specifies that "sustainable development requires the consideration of all relevant factors including aspects specifically relevant to biodiversity":

2.3. National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEMBA)

NEMBA provides for the management and conservation of biological diversity and components thereof; the use of indigenous biological resources in a sustainable manner; the fair and equitable sharing of benefits rising from bioprospecting of biological resources; and cooperative governance in biodiversity management and conservation within the framework of NEMA.

2.4. National Water Act (Act No. 36 of 1998) (NWA)

The National Water Act (NWA) is a legal framework for the effective and sustainable management of water resources in South Africa. Central to the NWA is recognition that water is a scarce resource in the country which belongs to all the people of South Africa and needs to be managed in a sustainable manner to benefit all members of society. The NWA places a strong emphasis on the protection of water resources in South Africa, especially against its exploitation, and the insurance that there is water for social and economic development in the country for present and future generations.

The National Water Act, requires any development to secure Water Use Licences with the following activities:

Section 21 (c) and (i) use, i.e., river or wetland crossings, which includes any drainage lines by any infrastructure.

In terms of the definitions provided, activities included under Sections 21(c) and 21(i) are (amongst others) the construction of roads, bridges, pipelines, culverts and structures for slope stabilisation and erosion protection. DWS will however need to be approached to provide guidance on whether approval for Section 21 (c) and (i) water uses would be required.

2.5. CMS

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned 22 with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory to this convention.

2.6. AEWA

The African-Eurasian Waterbird Agreement. The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The agreement covers 119 countries and the European Union (EU) from Europe, parts of Asia and Canada, the Middle East and Africa.

2.7. Other Relevant Legislations and Guidelines

- Environmental Impact Assessment Guidelines 2017 as amended.
- DWS Wetlands Delineation and Riparian area determination Guideline, 2005.
- Biodiversity management plans (BMP).
- National biodiversity assessment (NBA); and
- Integrated Development Plan (IDP).

3. DESCRIPTION OF THE RECEIVING ENVIRONMENT

3.1. Identification of the SAMPLING POINTS

The identified sampling points are indicated in Figure 2 and described in Table 1 below. Sampling points were selected to obtain baseline data representative of the conditions in relation to the proposed activity.

Sampling point	Description	Latitude	Longitude
Point A	Situated within the Mutale River	S 22º 43' 07.00"	E 30 35' 13.00"
Point B	Situated within the unmade tributary of Mutale River	S 22º 44' 48.31"	E 30 36' 45.73"
Point A	Situated within the Mutale River	S 22º 45' 02.76"	E 30 35' 32.54"

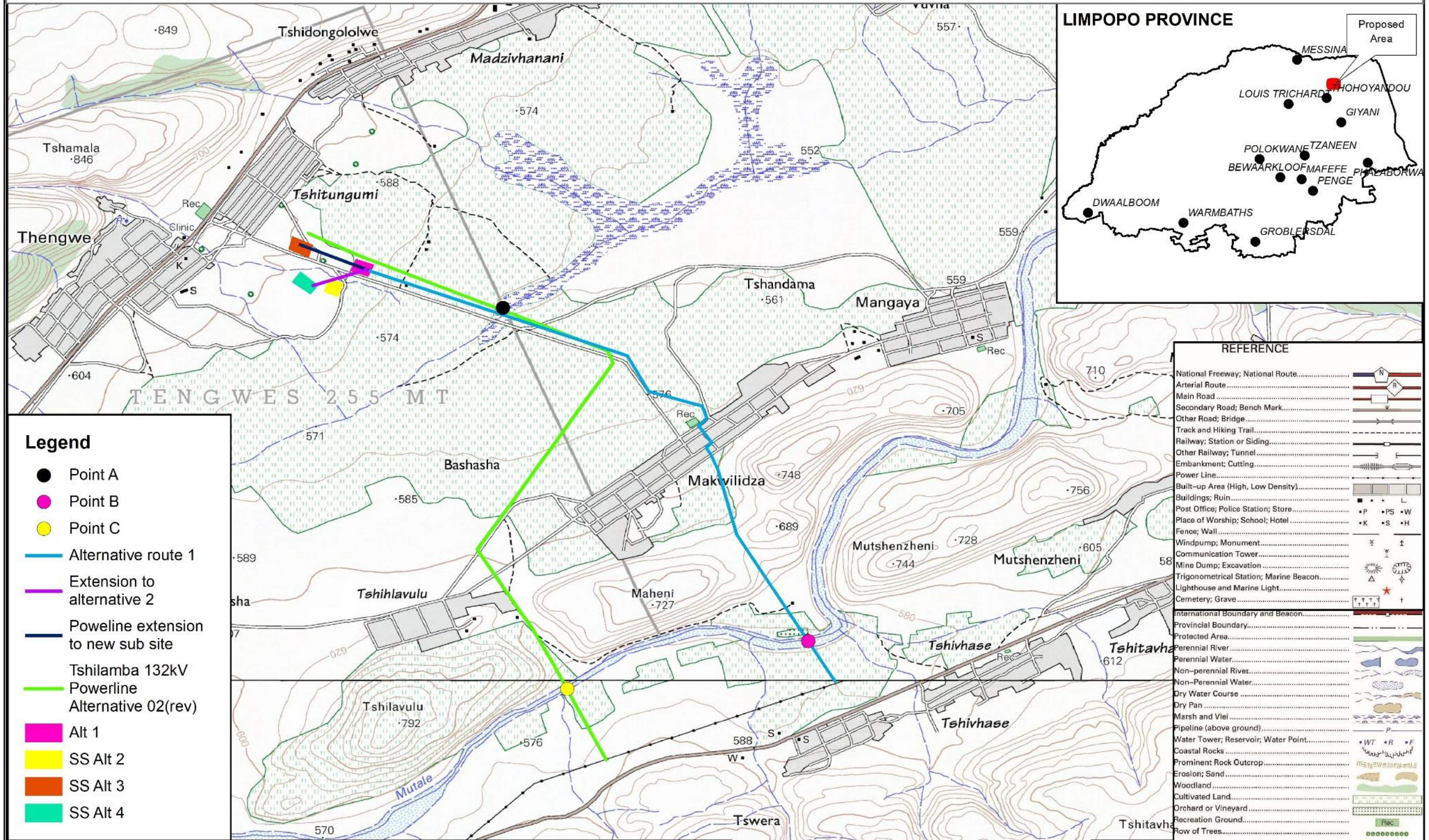
Figure 1: Sampling point A

Figure 2: View of point B

Figure 3: Sampling point C

Figure 4: Wetland area on point A

The proposed 132kv powerline and the new Mutshikili substation within Thengwe in the Limpopo Province



GPS COORDINATES

Name	Latitude	Longitude
Point A	22°43'07.00"S	30°35'13.00"E
Point B	22°44'48.31"S	30°36'45.73"E
Point C	22°45'02.76"S	30°35'32.54"E

Locality Map

Data Source: NGI

Date: 14 JULY 2023

Projection: Transverse Mercator

Datum: WGS 84

Scale: 1:50 000

0 0,5 1 2 3 Km

Naledzani Environmental Services
Fax: 086 606 4760 Cell: 076 388 7203
Email: ramalivhanam@gamial.com/info@naledzanies.co.za
Suite 211, Elaphant House
107 Albertina Sisulu Street; Johannesburg, 2107

Figure 5: Locality map for the sampled points

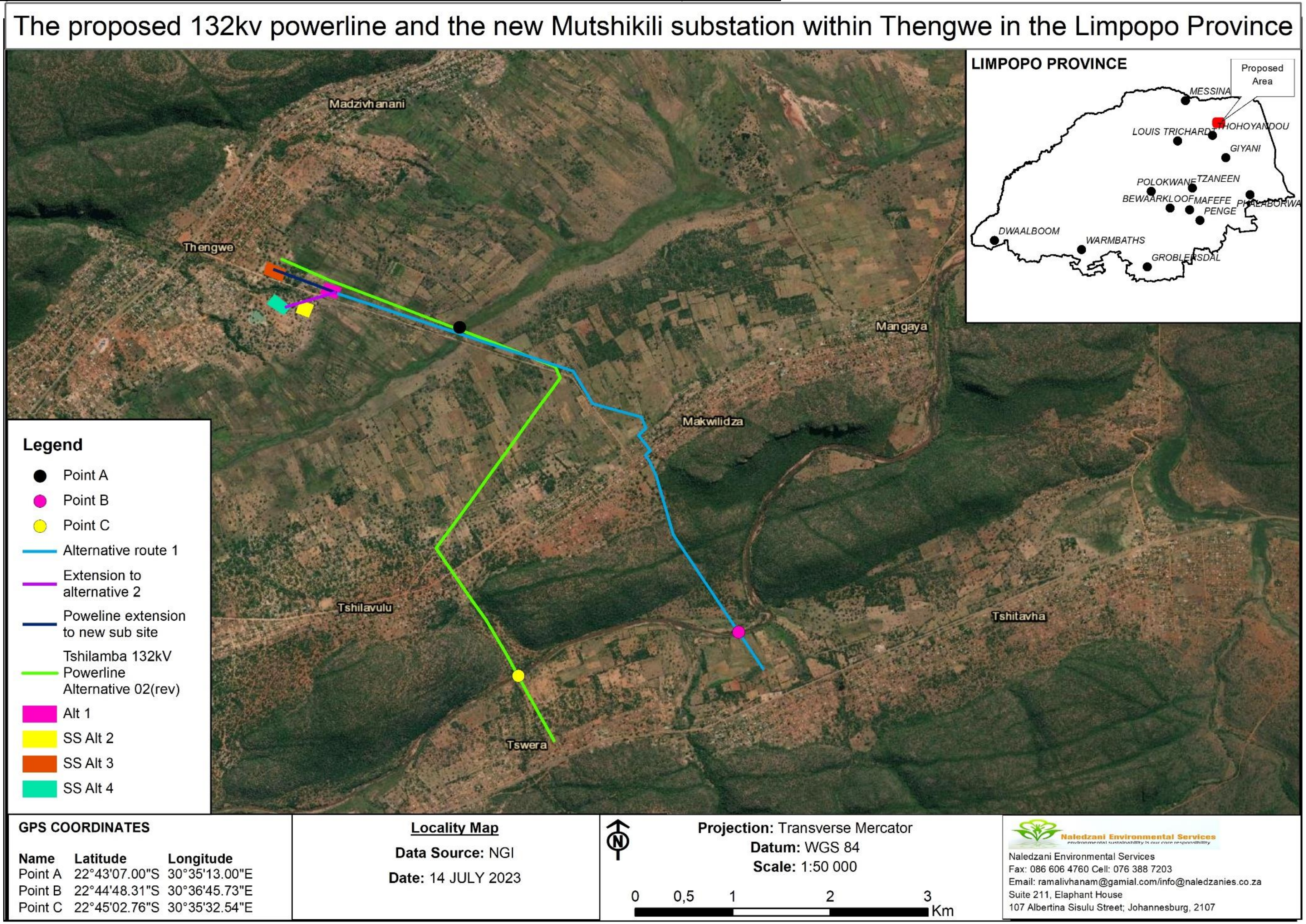


Figure 6: Google-earth view of the sampled points

3.2. Regional and catchment description

The proposed development is situated within the Limpopo Water Management Area and the quaternary drainage region applicable to the proposed development is the A92B quaternary drainage region. Ecoregions are regions that share similar ecological characteristics and according to Ferrar and Lötter (2007) this characterization is "based on the understanding that ecosystems and their biota display regional patterns that mirror causal factors such as climate, soils, geology, physical land surface and vegetation."

An Ecoregion is an area with similar physical characteristics and is expected to support a unique combination of flora and fauna (Kleynhans et al, 2007). The study area is located within Level 1 Ecoregion (Limpopo Plain). This Ecoregion is characterized by plains and lowlands with a low moderate relief and vegetation consisting mostly of Bushveld types and Mopane veld. Generally, this is a low laying, dry to arid, hot region with no perennial streams originating in the area itself.

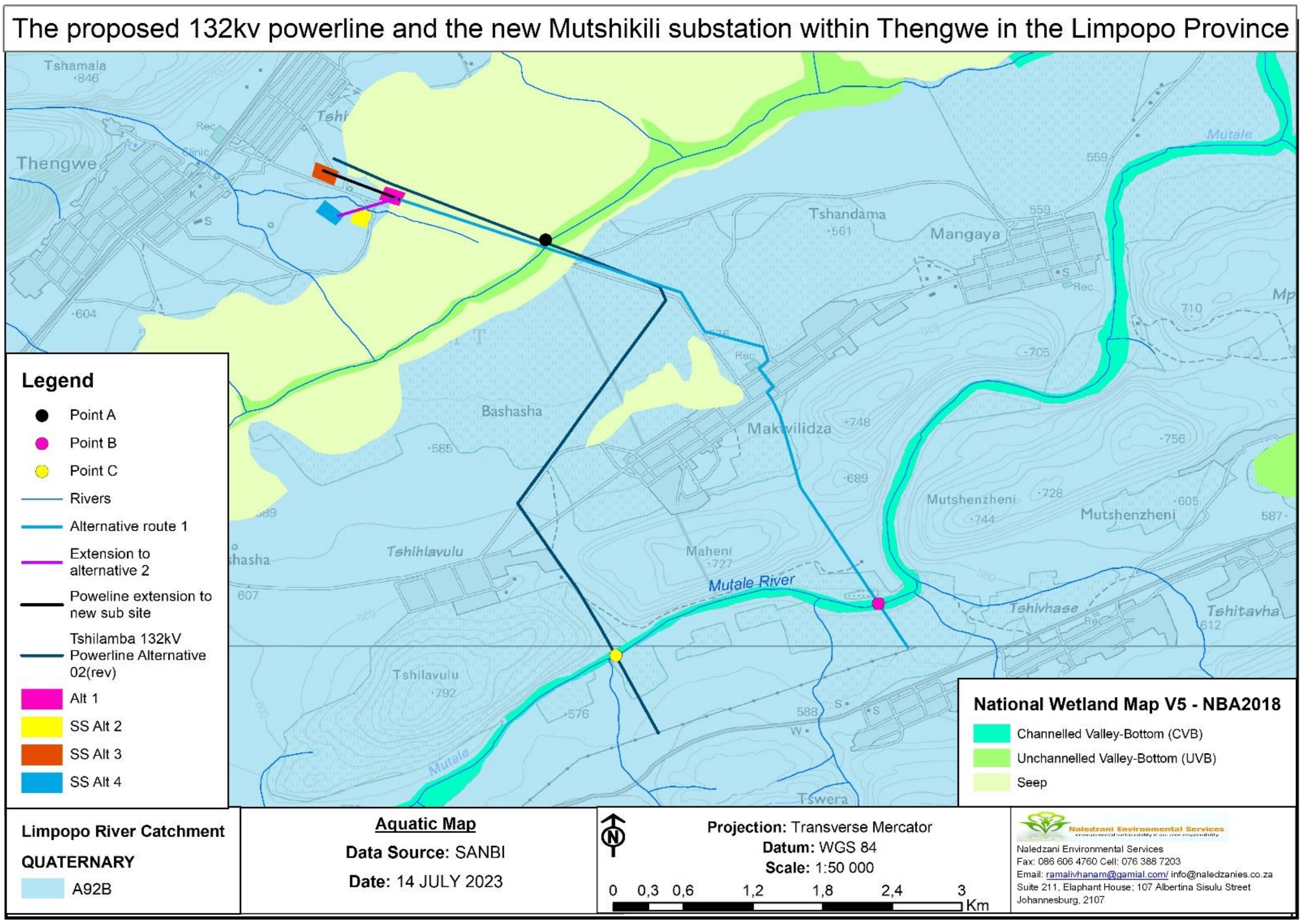


Figure 7: Aquatic map for the site

3.3. Climatic conditions

The region is hot and humid with a summer rainfall. The average summer temperature is 23°C, and the average winter temperature is 17°C. The mean annual precipitation follows the same pattern as the topography ranging from 2000mm/annum in the mountainous areas of the northwest to 440mm/annum at the Limpopo River confluence, with a catchment average of 800mm/annum. The prevailing wind direction is east to southeast in both the summer and the winter months. The average wind speed is 11km/h in the summer and 15km/hr in the winter.

3.4. Vegetation

According to the Mucina and Rutherford (2006) classified the study area as falls **Makuleke Sandy Bushveld**. This vegetation is distributed in the Limpopo and (very slightly into) Mpumalanga Provinces. It occurs in the flats and hills east of the Soutpansberg, south of Klein Tshipise and Masisi, along the valleys of the Mutale River and mid- to lower Levuvhu River; the Maseya Sandveld and Punda Maria areas of the northern Kruger National Park and as few isolated patches in the park, for example Dzundwini Mountain in the north and a narrow sandstone belt sandwiched between the granite and the basalt reaching the Timbavati Picnic Area in the south. The Makuleke Sandy Bushveld is considered as Vulnerable with a conservation target of 19%. About 32% statutorily conserved in the Kruger National Park. 27% has been transformed, mostly through cultivation. Erosion is moderate to high in places.

4. METHODOLOGY

4.1. Water quality

All water samples collected were analysed by SANAS accredited testing laboratories. All water quality and sediment samples were analysed by Waterlab. The quality certificate for the laboratory is attached in Appendix 1.

4.2. Habitat assessments

An evaluation of habitat quality and availability to biota is critical to any assessment of ecological integrity and was conducted at each site at the time of biological sampling. On site habitat assessments were conducted using the habitat evaluation indices of McMillan (IHAS, 1998).

Habitat assessments are critical since changes in habitat can be responsible for changes in SASS5 scores. The use of a SASS orientated habitat assessment index, namely the Invertebrate Habitat Assessment System (IHAS), is therefore important to determine the relative “health” or “availability” of sufficient habitat for the establishment or maintenance of viable biological communities.

The IHAS index was specifically designed to assess habitat and to form a significant part of the final biological assessment of rivers. The system was developed in a way that allows different operators to obtain the same or very similar scores to ensure for replication. The version used during this assessment was version 2.0e of the IHAS system. The system is an improvement on the (HAM), (HAI) and (HQI) indices by McMillan (1998), because it allows for less subjectivity according to the assessor’s interpretation. According to the River Health Program (www.csir.co.za/rhp), this system can be used with confidence throughout South Africa.

The habitat scoring system is based on a scoring system out of 100. It is described in terms of percentages. The assessment is divided into two sections. The first makes up 55 points of the scoring system and is directly related to the SASS5 sampling habitat.

The second section consisting of 45 points is based on physical features such as stream make up, average width, and depth. Other features such as colour, human disturbances and riparian vegetation are also investigated (McMillan, 1998).

For each parameter, there are up to six possible answers that can be obtained. Each of these answers has a score with a value between zero and five (0–5). Generally, a higher value would indicate a better habitat condition.

4.3. Aquatic invertebrate assessment: SASS, Version 5

Benthic macro-invertebrate communities of the selected sites were investigated according to the South African Scoring System, version 5 (SASS5). This method is based on the British Biological Monitoring Working Party (BMWP) method and has been adapted for South African conditions by Dr. F. M. Chutter. The SASS method is a rapid, simple and cost-effective method that has progressed through four different upgrades/versions. The current upgrade is Version 5, which is specifically designed to comply with international accreditation protocols.

Interpretation of the results of biological monitoring depends, to a certain extent, on interpretation of site-specific conditions (Thirion, et al., 1995). In the context of this investigation, it would imply not to use SASS scores in isolation, but rather in comparison with relevant habitat scores.

4.3.1. Sample collection

An invertebrate net (30 x 30cm square with 0.5 mm mesh netting) was used for the collection of the organisms. Various different biotopes should be sampled, and each of the biotopes should be sampled with different methods. The biotypes sampled at the monitoring points were Vegetation (VG) Biotopes, Stone and Rock (S) Biotopes and Gravel, Sand and Mud (GSM) Biotopes.

Stone (S) Biotopes:

Stones in current (SIC) or any solid object: Movable stones of at least cobble size (≥3 cm diameter) to approximately 25 cm in diameter, within the fast and slow flowing sections of the river.

Kick sampling is used to collect organisms in this biotope. This is done by putting the net on the bottom of the river, just downstream of the stones to be kicked, in a position where the current will carry the dislodged organisms into the net. The stones are then kicked over and against each other to dislodge the invertebrates (kick sampling) for ± 2 minutes.

Stones out of current (SOOC), bedrock or any solid object out of the current: Movable stones of at least cobble size (2 cm diameter) to approximately 25 cm in diameter that are out of current where fine sediments are able to settle on their surfaces. The stones are then kicked over and against each other to dislodge the invertebrates (kick sampling) for ± 1min.

Both SIC and SOOC samples are combined into a single Stones sample.

Vegetation (VG) Biotopes:

Marginal vegetation (MV): This is the overhanging grasses, bushes, twigs and reeds growing on the edge of the stream, often emergent, both in current (MvegIC) and out of current (MvegOOC). Sampling is conducted by holding the net perpendicular to the vegetation (below the surface) and sweeping back and forth through the vegetation (± 2 m of vegetation). This sampling is spread over a stretch of the river. Dominant plant species may be recorded.

Submerged vegetation (AQV): This vegetation is totally submerged and includes filamentous algae and the roots of floating aquatics such as water hyacinth. This is sampled by pushing the net (under the water) against and through the vegetation in an area of approximately one square meter.

Gravel, Sand and Mud (GSM) Biotopes:

Sand: This includes sandbanks within the river, small patches of sand in hollows at the side of the river or sand between the stones at the side of the river. These biotopes were sampled by stirring the substrate by shuffling or scraping of the feet.

Gravel: Gravel typically consists of smaller stones (2-3 mm up to 3 cm). Sampling was similar to that of sand.

Mud: It consists of very fine particles, usually as dark-coloured sediment. Mud usually settles to the bottom in still or slow flowing areas of the river. Sampling was similar to that of sand. All three biotopes are sampled for a collective total of 1min and then combined into a single GSM (Gravel, Sand and Mud) sample.

Hand picking and visual observation:

Before, during and after sampling the site, approximately 1 minute of “hand-picking” for specimens that may have been missed by the sampling procedures is carried out. Visual observation is also carried out during sampling.

4.3.2. Sample preparation

The organisms sampled in each biotope group were identified and their relative abundance noted on the SASS5 datasheet. The scoring system consists of a checklist on which the different invertebrate family has a value between 1 and 15 varying from the least intolerant to the most intolerant. The families collected at the site were identified and checked off against the list. Values according to the checklist were allocated to the families, which allow for the summation of each sample to provide a sample score. The number of families was summed as the number of taxa present. Subsequently the number of taxa to provide the Average Score Per Taxon commonly referred to as ASPT divided the sample score.

5. RESULTS AND FINDINGS

The findings are based on the assessment as conducted the 14th October 2022 in the Mutale River and its Tributary (Point B and A respectively) and an assessment done on the 30th May 2023 on Point C. There is more reference for a previous assessment done in this stream but not at the specific powerline crossing and therefore these results will be used to set the baseline.

5.1. Water Quality

According to the South African Quality Guideline, water quality describes the physical, chemical, biological, and aesthetic properties of water which determine its fitness for a variety of uses and for protecting the health and integrity of aquatic ecosystems. Many of these properties are controlled or influenced by constituents which are either dissolved or suspended in water.

The following water quality variables were analysed in a SANAS accredited laboratory.

- pH: At pH less than 7 water is acidic, while at pH greater than 7 water is alkaline.

- The geology and geochemistry of the rocks and soils of a particular catchment area affect the pH and alkalinity of the water. The pH of rawest waters lies in the range of 6.5 - 8.5.

Biological and anthropogenic activities such as nutrient cycling and industrial effluent discharge respectively can give rise to pH fluctuations. Notably, acid mine drainage can have a marked effect on the pH. Further, acid-forming substances, such as oxides of sulphur and nitrogen released into the atmosphere may ultimately alter the acid-base equilibria in natural waters and result in a reduced acid-neutralising capacity and, hence lowering the pH.

Electrical conductivity (EC): is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence of ions in water such as carbonate, bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium and magnesium, all of which carry an electrical charge. Most organic compounds dissolved in water do not dissociate into ions, consequently they do not affect the EC.

Chloride: is a common constituent in water, is highly soluble, and once in solution tends to accumulate. Typically, concentrations of chloride in fresh water range from a few to several hundred mg/R. In sea water the concentration is approximately 19800 mg/R. Chloride inputs to surface waters can arise from irrigation return flows, sewage effluent discharges and various industrial processes. Chloride can only be removed from water by energy-intensive processes or ion exchange.

Sulphate: is a common constituent of water and arises from the dissolution of mineral sulphates in soil and rock, particularly calcium sulphate (gypsum) and other partially soluble sulphate minerals. Since most sulphates are soluble in water, and calcium sulphate relatively soluble, sulphates when added to water tend to accumulate to progressively increasing concentrations. Typically, the concentration of sulphate in:

- surface water is 5 mg/R, although concentrations of several 100 mg/R may occur where dissolution of sulphate minerals or discharge of sulphate rich effluents from acid mine drainage takes place; and
- sea water is just over 900 mg/R.

Sulphates are discharged from acid mine wastes and many other industrial processes such as tanneries, textile mills and processes using sulphuric acid or sulphates. Sulphates can be removed or added to water by ion exchange processes, and microbiological reduction or oxidation can interconvert sulphur and sulphate. The microbiological processes tend to be slow and require anaerobic conditions usually only found in sediments and soils. Atmospheric sulphur dioxide, discharged on combustion of fossil fuels, can give rise to sulphuric acid in rainwater (acid-rain) and as such, this results in the return of sulphate to surface waters in the environment.

Nitrate: Mineral deposits of nitrates are rare due to the high-water solubility of nitrates, although large deposits of sodium nitrate (saltpetre) occur in the desert regions of Chile. Nitrates are ubiquitous in soils and in the aquatic environment, particularly in association with the breakdown of organic matter and eutrophic conditions.

Concentrations of nitrate in water are typically less than 5 mg/R of nitrate-nitrogen (or, alternatively, 22 mg/R nitrate). A significant source of nitrates in natural water results from the oxidation of vegetable and animal debris and of animal and human excrement. Treated sewage wastes also contain elevated concentrations of nitrate. Nitrate tends to increase in shallow ground water sources in association with agricultural and urban runoff, especially in densely populated areas. Nitrate together with phosphates stimulate plant growth.

In aquatic systems elevated concentrations generally give rise to the accelerated growth of algae and the occurrence of algal blooms. Algal blooms may subsequently because problems associated with malodours and tastes in water and the possible occurrence of toxicity.

Sodium: is ubiquitous in the environment and usually occurs as sodium chloride, but sometimes as sodium sulphate, bicarbonate or even nitrate. Sodium is found as solid sodium chloride (rock salt) in areas where geological deposits occur. The levels of sodium in surface waters are generally low in areas of high rainfall and high in arid areas with low mean annual precipitation. Sodium is highly soluble in water and does not precipitate when water evaporates, unless saturation occurs. Hence, water in arid areas often contains elevated concentrations of sodium. High concentrations also occur in sea water, at approximately 11 g/R.

Industrial wastes, especially processes that give rise to brines, contain elevated concentrations of sodium. Sodium is also present at high concentrations in domestic wastewater; this is in part due to the addition of table salt (sodium chloride) to foods. Furthermore, with re-use or recycling of water, the sodium concentration will tend to increase with each cycle or addition of sodium to the water. For this reason, sodium concentrations are elevated in runoffs or leachates from irrigated soils.

Total Suspended Solids: are solids in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage. High concentrations of suspended solids can cause many problems for stream health and aquatic life.

Table 1: Water sample analysis.

Date sampled		**14th October 2022**	**14th October 2022**	**30th May 2023**
Locality		**Tributary of Mutale**	**Mutale River**	**Mutale River**
	Unit	**Point A**	**Point B**	**Point C**
pH @ 25°C	pH	7.76	7.66	8.1
Electrical conductivity 25°C	mS/m	59.9	74.2	56
Chloride	Mg/l	89.9	143	51
Sulphate	Mg/l	16.8	13.1	53
Nitrate	Mg/l	0.361	4.66	2.8
Sodium	Mg/l	57.9	34.8	54
Chemical Oxygen Demand	Mg/l	59.3	27.3	31
Total suspended Solids (TSS)	Mg/l	6.0	<4.5	<4.2

5.2. Specific aquatic water quality constituent

Water quality is compared against the General Authorisation Limit, as well as the Quality of Domestic Water Use limit, should the water accidently be ingested.

Water quality is further classified according to the DWAF et al (1998) domestic use standard classification system (see Table 2). When comparing the data to the guidelines the worst substance class will determine the overall class of the water supply. Results are presented in Table 3.

Table 2: DWAF (1998) Quality of Domestic Water Supplies-colour classification system (condensed).

CLASS/COLOUR	**DESCRIPTION**	**EFFECTS**
Class 0	Ideal water quality	No effects, suitable for many generations.
Class 1	Good water quality	Suitable for lifetime use. Rare instances of sub-clinical effects.
Class 2	Marginal water quality	May cause some effects in sensitive users. Some effects possible after a lifetime of use. Aesthetic effects.
Class 3	Poor water quality	Poses risk of chronic health effects, especially in babies, children and the elderly. Poor aesthetics.
Class 4	Unacceptable water quality	Severe acute health effects, even with short-term use. Taste and appearance will lead to rejection of the water.

Table 3: Water quality results of the representative samples analysed.

Date sampled:				**14th October 2022**	**14th October 2022**	**30th May 2023**
Locality				**Pont A**	**Point B**	**Point C**
	Unit	**General Authorisation Limit, Section 21f and h, 2013**	**Quality of Domestic Water Supplies: Drinking Class 1**	**Sampled readings**	**Sampled readings**	**Sampled readings**
pH @ 25°C	pH	5.5/9.5	4.5/10.0	7.76	7.66	8.1

Electrical conductivity (EC) @ 25°C	mS/m	150	150	59.9	74.2	56
Chloride (Cl)	mg/l	-	200	89.9	143	51
Sulphate (SO_4)	mg/l	-	400	16.8	13.1	53
Nitrate (NO_3) as N	mg/l	15	10	0.361	4.66	2.8
Sodium (Na)	mg/l	-	200	57.9	34.8	54
Chemical Oxygen Demand (COD)	mg/l	75	-	59.3	27.3	31
Total suspended solids (TSS)	mg/l	25	-	6.0	<4.5	<4.2

The physical characteristic of the Control sample can be described as neutral (pH 6.0 - 8.5). although the ph at point C is highly it can be seen that it is still within the specified limits

Based on the presented variables in Table 3 none of the samples exceeded the general authorisation limits. Based on the results of variables analysed, the water quality of the submitted samples can be classified according to the WRC Domestic Use standard classification as follows:

- Point A....................... Ideal (Class 1) water quality
- Point B...................... Good (Class 1) water quality
- Point C……………… Good (Class 1) water quality

5.3. Aquatic invertebrate assessment

The South African Scoring System (Version 5) is a site-specific index, which, together with associated habitat indices (Habitat suitability scores and IHAS) gives a general perspective of the biotic integrity (based on macro-invertebrates) and the impact of water quality on the biotic integrity of the specific sites (Thirion et.al., 1995; Dickens & Graham, 2001). The IHAS scores were used during this biomonitoring survey to provide an indication of the habitat availability and condition for invertebrates and was applied to determine the comparability of SASS scores between different sites and not to classify the sites into specific habitat categories. Suitability scores, ranging between 0 (unsuitable) to 5 (highly suitable) were also given to the different biotopes (stones-in-current, stones-out-of-current, bedrock, aquatic vegetation, marginal vegetation in-current and out-of-current, gravel, sand and mud) to assist in the habitat evaluation process for each site.

The IHI results revealed that the sites were in largely modified condition. The SASS5 protocol indicated a lower habitat suitability and availability. This may have resulted from the observed sand mining upstream of Point B and C as well as ploughing upstream of point A.

6. COMPARISON OF THE POWERLINE AND SUBSTSATIONS

6.1. Comparison of the powerline route

When assessing the powerline routes the was no difference in terms of order of preferences. Both powerline routes (Alt 1 and 2) cuts through the Mutale River which is regarded as an NFEPA. Although there were differences in the chemical properties of the water samples (point B and C), this might be due to differences in the time for sampling. Both line routes, are still to impact the wetland up on point A. As such, in terms of aquatic assessment, any powerline route can be the preferred. As the impacts will be the same on the aquatic resources.

6.2. Comparison of the substations

When it comes to the substation areas. **<u>The preferred substation location is alternative 3</u>** since substation is situated outside water resources and also the powerline that connect to it transverses less streams/water resources as compared to other substations.

Table 4: Comparison of the substation areas

Substation	Sensitive area	Explanation	Order of preference
Alternative Sub-1	According to the sensitivity map the site is situated within what is categorised as a wetland	The site is within what is classified as wetland	**<u>Least preferred</u>** and not supported.
Alternative Sub-2	Stream (which the powerline to the substation will transverse) and an open water body (dam) west of the site	The substation is situated close to an open water body which is located approximately 320 meters west of the proposed substation but very close to the area classified as a wetland although it has been ploughed. Also there will be a need to construct a powerline, which will cut through a stream, to connect to the substation. This will lead to more contamination of the water resources within the site	**<u>Least preferred</u>** due to the powerline passing through a stream as well having an open water body close to it

Alternative Sub-3	N/A	The substation is situated outside water resources and the powerline that connect to it transverses less streams/water resources as compared to other substations.	**Preferred** as the line runs through an existing line and there are more existing access roads that covers a large extent within this corridor
Alternative Sub-4	Stream (which the powerline to the substation will transverse) and an open water body (dam) west of the site	The substation is situated close to an open water body which is located approximately 220 meters west of the proposed substation. Also there will be a need to construct a powerline, which will cut through a stream, to connect to the substation. This will lead to more contamination of the water resources within the site	**Least preferred** due to the powerline passing through a stream as well having an open water body close to it

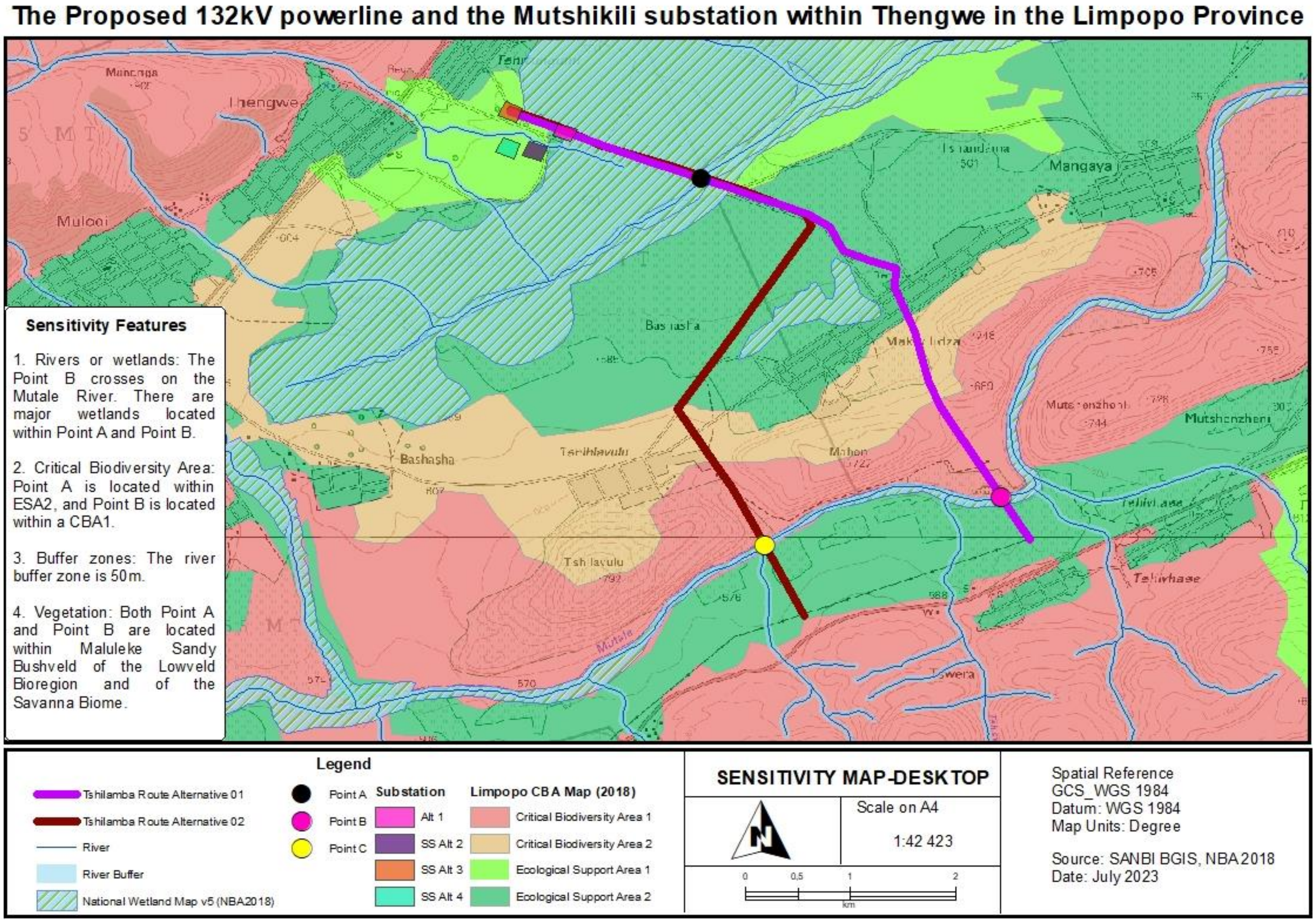


Figure 8: Sensitivity map for the powerline routes as well as substations

7. ASSESSMENT OF POTENTIAL IMPACTS

The current status quo of the proposed power line routes and of the potentially affected freshwater ecosystems is the baseline against which the significance of potential impacts on freshwater ecosystems was assessed (below). In other words, the significance of potential impacts associated with the proposed power line routes has been determined by comparison with the "no-go alternative" of not undertaking the proposed activities as opposed to comparison against the presumed pristine state of the study area in the absence of existing impacts.

The potential impacts of the proposed distribution line and associated infrastructure on freshwater ecosystems were assessed separately for design-phase impacts, construction-phase impacts, operational-phase impacts and decommissioning-phase impacts.

7.1. Design phase impacts

Two streams have been, and wetlands have been identified within corridor along the proposed power line route. As such, one of the main potential impacts of the proposed power line on freshwater ecosystems is the placement of power line pylons within or near freshwater ecosystems. Another, related, potentially negative impact is the construction of new access roads through freshwater ecosystems located between pylons. Both footprint-related issues, which can only be addressed during the design phase, could potentially result in the infilling of wetlands and other freshwater ecosystems, the loss of vegetation (and subsequent erosion) in or adjacent to freshwater ecosystems, and the possible fragmentation of habitats associated with freshwater ecosystems. These impacts would also result in the need for a "water use" authorisation to be obtained from the Department of Water and Sanitation in terms of Sections 21 and 22 of the National Water Act (Act No. 36 of 1998) for all pylons and access roads that encroach into any freshwater ecosystems.

The recommended mitigation measure for the negative footprint-related impacts potentially associated with the power line would be to avoid the impacts by ensuring that no infrastructure (such as pylon structures and new access roads) is established within the recommended buffer areas for the freshwater ecosystems mapped along the proposed routes. If this mitigation measure was to be effectively implemented in the final design stages of the power line project, it is predicted that the potential footprint-related impacts on freshwater ecosystems could be reduced to a low level of significance. Therefore, unless it is possible to avoid the establishment of distribution line pylons and new access roads in freshwater ecosystems along this route or within the recommended buffer areas for the freshwater.

Impact	Nature	Intensity	Extent	Duration	Consequence	Probability	Significance	Confidence
Impact 1: Encroachment of infrastructure into freshwater ecosystems	Negative	Medium-High	Local	Long-term	Medium-High	Highly probable	MEDIUM-HIGH	Low-Medium
With Mitigation*	Negative	Low	Local	Long-term	Low	Probable*	LOW	Medium

7.2. Construction-phase impacts

Due to the proximity of the proposed power line routes to numerous drainage lines and some wetlands, potential impacts on freshwater ecosystems associated with the construction of the proposed power line and associated infrastructure could include:

- Physical destruction or damage of freshwater ecosystems by workers and machinery operating within or near wetlands or drainage lines, and through the establishment of construction camps or temporary laydown areas within or in close proximity to wetlands or drainage lines.
- Pollution of freshwater ecosystems through the runoff of contaminants such as fuel, oil, concrete, wash-water, sediment and sewage into these ecosystems.
- Increased disturbance of aquatic and semi-aquatic fauna, because of the noise from construction teams and their machinery working within or in close proximity to wetlands and rivers.

The following mitigation measures, which should be included in the Environmental Management Programme (EMP) for the project, are recommended to reduce the severity of the above-mentioned construction-phase impacts:

- All wetlands and drainage lines should generally be treated as “no-go” areas and appropriately demarcated as such. No vehicles, machinery, personnel, construction materials, cement, fuel, oil or waste should be allowed into these areas without the express permission of and supervision by the ECO.
- Construction activities associated with the establishment access roads through wetlands or drainage lines (if unavoidable) should be restricted to a working area 10 m in width either side of the road, and these working areas should be clearly demarcated. No vehicles, machinery, personnel, construction material, cement, fuel, oil or waste should be allowed outside of the demarcated working areas.
- There should be as little disturbance to surrounding vegetation as possible when construction activities are undertaken, as intact vegetation adjacent to construction areas will assist in the control of sediment dispersal from exposed areas.
- Construction camps, toilets and temporary laydown areas should be located at least 30 m from the edge of any wetlands and drainage lines.
- No fuel storage, refuelling, vehicle maintenance or vehicle depots should be allowed within 30 m of the edge of any wetlands or drainage lines.
- Refuelling and fuel storage areas, and areas used for the servicing or parking of vehicles and machinery, should be located on impervious bases and should have bunds around them. Bunds should be sufficiently high to ensure that all the fuel kept in the area will be captured in the event of a major spillage.
- Vehicles and machinery should not be washed within 30 m of the edge of any wetland or drainage line.
- No effluents or polluted water should be allowed to discharge into any drainage lines or wetland areas.
- If construction areas are to be pumped of water (e.g., after rains), this water should be pumped into an appropriate settlement area, and not allowed to flow straight into any drainage lines or wetland areas.
- No spoil material, including stripped topsoil, should be temporarily stockpiled within 30 m of the edge of any wetland or drainage line.
- Freshwater ecosystems located in close proximity to construction areas (i.e., within ~30 m) should be inspected on a regular basis by the ECO for signs of disturbance from construction activities, and for signs of sedimentation or pollution. If signs of

disturbance, sedimentation or pollution are noted, immediate action should be taken to remedy the situation and, if necessary, a freshwater ecologist should be consulted for advice on the most suitable remediation measures.

- Workers should be made aware of the importance of not destroying or damaging the vegetation along drainage lines and in wetland areas, of not undertaking activities that could result in the pollution of drainage lines or wetlands, and of not killing or harming any animals that they encounter. This awareness should be promoted throughout the construction phase (and decommissioning phase, if this takes place).

Table 5: Summary of assessment of potential construction-phase impacts on freshwater ecosystems

Impact	Nature	Intensity	Extent	Duration	Consequence	Probability	Significance	Confidence
Impact 2: Physical destruction or damage of wetlands and drainage lines	Negative	Medium	Local	Short-term	Low	Highly probable	LOW	Medium
With Mitigation*	Negative	Low	Local	Short-term	Very low	Probable	VERY LOW	Medium
Impact 3: Pollution of freshwater ecosystems	Negative	Medium	Local	Short-term	Low	Highly probable	LOW	Medium
With Mitigation*	Negative	Low	Local	Short-term	Very low	Probable	VERY LOW	Medium
Impact 4: Disturbance to aquatic and semi-aquatic fauna	Negative	Medium	Local	Short-term	Low	Highly probable	LOW	Medium
With Mitigation*	Negative	Low	Local	Short-term	Very low	Probable	VERY LOW	Medium

7.3. Operational-phase impacts

The main potential impacts to freshwater ecosystems that have been identified for the operational phase of the proposed power line development are as follows:

- Increased erosion and alteration of the hydrology of drainage lines and wetlands, as a result of the establishment of distribution line towers within or immediately adjacent to these freshwater ecosystems.
- Increased erosion and alteration of the hydrology of drainage lines and wetlands, as a result of the establishment of access roads through these freshwater ecosystems.
- Clearing or trimming of natural vegetation in and around wetlands and drainage lines located within the servitude of the power line, as part of the routine maintenance operations.
- Disturbance to aquatic and semi-aquatic fauna associated with freshwater ecosystems located below or in close proximity to the power line, through the noise and electromagnetic field (EMF) that would result from the operation of the high-voltage distribution line3. There is also the possibility of noise- and lighting-related disturbance to aquatic and semi-aquatic fauna associated with freshwater ecosystems located in close proximity to the proposed substation/s.

The only way to effectively mitigate the first of the potential operational-phase impacts listed above would be to ensure that none of the pylons for the distribution line are located within any drainage lines or wetlands, and preferably that no pylons are located within the recommended buffer areas for these freshwater ecosystems.

For access road construction, the best way to mitigate this impact would also be to avoid it by, for example, using existing access roads wherever possible. In situations where the impact is unavoidable, it can be mitigated to some degree by formalising road crossings over drainage lines and using properly designed structures that minimise the alteration of flows. For wetlands, the impact can be mitigated to some extent by installing adequate sub-surface drainage under any access roads for which the crossing of wetland areas is unavoidable.

The clearing or trimming of natural vegetation in and around wetlands and drainage lines located within the servitude of the proposed power line is a potentially negative operational-phase impact rated to be of medium to high intensity, local to regional extent and medium to high significance without mitigation. The regional extent of this impact, in certain cases, is due to the relatively high number of threatened or near threatened plant species that could occur in natural habitats in the study area (as highlighted by Hoare 2013), including vegetated wetlands and drainage lines. It is strongly recommended that the vegetation maintenance protocol generally followed by Eskom should be re-evaluated for the sections of the proposed power line that traverse natural areas, including wetlands and drainage lines, in consultation with relevant conservation agencies for the region. One of the options that could be explored to mitigate against the potential vegetation clearing/trimming impacts would be to consider constructing taller pylons in certain areas that are high enough to allow for the growth of relatively tall vegetation. In addition, as recommended by Hoare (2013), where the proposed power line traverses' areas of natural vegetation (including wetlands and vegetated drainage lines), a detailed threatened plant species assessment should be undertaken by a suitably qualified botanical specialist during an appropriate season and possibly at different times of the year. This specialist assessment should be used to guide the final positioning of the infrastructure (including pylons and access roads) associated with the proposed power line, so as to avoid disturbance of plant species of conservation importance.

Table 6: Summary of assessment of potential operational-phase impacts on freshwater ecosystems

Impact	Nature	Intensity	Extent	Duration	Consequence	Probability	Significance	Confidence
Impact 5: Increased erosion and alteration of hydrology of freshwater ecosystems due to the placement of pylons	Negative	Medium	Local	Long-term	Medium	Highly probable	MEDIUM	Low-Medium
With Mitigation*	Negative	Low#	Local	Long-term	Low#	Probable	LOW	Medium
Impact 6: Increased erosion and alteration of hydrology of freshwater ecosystems due to the placement of access roads	Negative	Medium	Local	Long-term	Medium	Highly probable	MEDIUM	Low-Medium
With Mitigation*	Negative	Low	Local	Long-term	Low	Probable	LOW	Medium
Impact 7: Clearing and/or trimming of natural vegetation in and around freshwater ecosystems within servitude	Negative	Medium-High	Local-Regional	Long-term	Medium-High	Highly probable	MEDIUM-HIGH	Low-Medium
With Mitigation*	Negative	Low	Local-Regional	Long-term	Low	Probable	LOW	Medium

Impact 8: Ongoing disturbance to aquatic and semi-aquatic fauna	Negative	Low	Local	Long-term	Low	Probable	LOW	Low

7.4. Decommissioning-phase impacts

The potential impacts on freshwater ecosystems that are likely to be associated with the decommissioning the proposed power line would be very similar to the construction-phase impacts. The recommended mitigation measures for the decommissioning phase are, therefore, the same as those for the construction phase and the significance of the potential impacts on freshwater ecosystems is likely to be similar. No potential cumulative impacts of major significance to freshwater ecosystems were identified for the decommissioning phase of the proposed project.

8. CONCLUSIONS AND RECOMMENDATIONS

8.1. Conclusions

Two major freshwater ecosystems were identified along the proposed route for the 132kv Tshilamba powerline routes (*i.e., Alt 1 and alt2*). The Assessed points were assessed to be in good condition most were rated to be of moderate conservation importance. The potential for the encroachment of infrastructure associated with the proposed powerline routes (especially pylons and access roads) into freshwater ecosystems is Minimal as the powerline (be alternative 1 or alternative 2) only crosses two points but point A has a widespread wetland in which the line may need to be adjusted.

From the aquatic assessment there is no difference in terms of order of preferences of the powerline route. Both powerline routes (Alt 1 and 2) cuts through the Mutale River which is regarded as an NFEPA. Although there were differences in the chemical properties of the water samples (point B and C), this might be due to differences in the time for sampling. Both line routes, are still to impact the wetland up on point A. As such, in terms of aquatic assessment, any powerline route can be the preferred. As the impacts will be the same on the aquatic resources. The physical characteristic of the Control sample can be described as neutral (pH 6.0 - 8.5). Although the ph at point C is highly it can be seen that it is still within the specified limits.

As it has been described on table 4 above, the preferred substation is alternative 4 as it situated at least 170 meters way from water a stream and the powerline to be connect to it does not transverse any stream.

The significance of most of the potentially negative construction-, operational- and decommissioning-phase impacts is dependent on the degree to which the encroachment into freshwater ecosystems can be avoided during the design phase to affect the construction phase. If the encroachment of power line pylons and access roads into freshwater ecosystems can be avoided, then it is predicted that most of the potential negative impacts to freshwater ecosystems would be reduced to low levels of significance, if all the other mitigation measures recommended in the current report are also properly implemented. The avoidance of encroachment into freshwater ecosystems would also reduce the likelihood that a water use authorisation would be required from DWS in terms of the National Water Act (Act No. 36 of 1998).

8.2. Recommendations

The maps of freshwater ecosystems along the proposed power line routes that have been compiled as part of this specialist study and of the recommended buffer areas for the freshwater ecosystems, should be used to guide the further planning of the proposed infrastructure development. In particular, distribution line pylons should be positioned outside of the recommended buffer areas for freshwater ecosystems and access roads should be routed in such a way as to avoid the crossing of freshwater ecosystems or encroachment into the recommended buffer areas for freshwater ecosystems.

Assuming that the encroachment of infrastructure associated with the proposed power line into freshwater ecosystems can be avoided or reduced to very low levels during the final design stages of the project, then the recommended mitigation measures for the protection of freshwater ecosystems during the construction and operational phases provided in the current report should be written into the EMP and implemented under the guidance of a suitably experienced ECO.

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