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AQUATIC/WETLAND ASSESSMENT FOR THE PROPOSED 132KV POWERLINE FROM LEEUBOSCH TRACTION SUBSTATION TO THE VAAL REEF TEN SUBSTATION, MAQUASSI HILLS LOCAL MUNICIPALITY, NORTHWEST PROVINCE

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31 October 2022

Client
SiVEST Environmental

SPECIALIST ASSESSMENT DETAILS & DECLARATION OF INDEPENDENCE

Document Title	**AQUATIC/WETLAND ASSESSMENT FOR THE PROPOSED 132KV POWERLINE FROM LEEUBOSCH TRACTION SUBSTATION TO THE VAAL REEF TEN SUBSTATION, MAQUASSI HILLS LOCAL MUNICIPALITY, NORTHWEST PROVINCE**	
Report No.	**W72**	
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Date	**7 November 2022**	
Wetland Report completed by	**Wayne Jackson** *Cert.Sci.Nat. (119037)*	
Aquatic Report completed by	**Russell Tate** Pr. Sci. Nat. 400089/15	
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Fieldwork and Report Writing (Aquatics)	**Russell Tate** Pr. Sci. Nat. (400089/15)	

I, Wayne Jackson, hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Environmental Affairs.

Wayne Jackson

Wetland & Soils Specialist

Eco-Assist

7th November 2022

Specialist Team Details

Specialist	Role	Details
Wayne Jackson *Cert.Sci.Nat. (119037)*	**Field work and author (Wetlands)**	Wayne Jackson graduated from the University of KwaZulu-Natal, Pietermaritzburg, with a BSc. degree in Soil Science & Hydrology. Wayne is an experienced Wetlands & Soils Scientist with a demonstrated history of working in the environmental services industry (13 years). He is skilled in Soil Classification, Wetlands, Hydropedology, and Surface Water Hydrology. He has a strong Environmental mitigation and rehabilitation knowledge. He has also gained experience in large post-mining rehabilitation projects, providing specialist inputs on land capability and soil utilisation. He has extensive exposure to a wide range of projects in many sectors across South Africa, and parts of Africa. He is knowledgeable on how soils, wetlands, and hydrological systems are linked in the landscape and how activities could impact all these aspects. Wayne is a registered Natural Scientist with the South African Council for Natural Scientific Professionals (SACNASP) – Registration No. 119037.
Russell Tate *Pr. Sci. Nat. 400089/15*	**Field work and author (Aquatic Ecology)**	Russell Tate holds an MSc in aquatic health. Russell has 10 years of experience in the aquatic ecology field and has completed numerous water resource studies across much of Africa. Russell Tate is a registered Professional Natural Scientist (Pr. Sci. Nat.) in the Aquatic Science field with the South African Council for Natural Scientific Professions (SACNASP) and holds a valid SASS5 certification.

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized above. Curriculum Vitae of the specialist team are available on request.

COMPLIANCE WITH APPENDIX B.1 OF THE STANDARD AND EXPANSION OF POWER LINES AND SUBSTATIONS WITHIN IDENTIFIED GEOGRAPHICAL AREAS REVISION 2 (DFFE, 2022)

Reporting requirements of an Aquatic Ecology Confirming Statement	Section of specialist report addressing requirement
1. The confirming statement must be prepared by a specialist registered with the SACNASP with relevant expertise in aquatic ecology or similar	See table above
2. A statement on the duration, date and season of the site verification inspection and walkthrough as well as the relevance of the season to the outcome of the confirming statement;	Section 5.2, and Section 12.1
2. Confirmation that the aquatic ecology (flora and fauna) within the final pre-negotiated route and/or the substation location is low based on the most recently available desktop data, site verification inspection and walk through;	Section 8, Section 9, Section 12.1
3. Identification of aquatic ecological areas to be avoided within the final pre-negotiated route, including buffers and/or the substation location	Section 8.5.9, Section 9, Section 10, Section 11, and Section 12.1
4. An aquatic biodiversity sensitivity map, generated by the screening tool and enhanced by any relevant additional information including the walkthrough, overlaid with the proposed development footprint (i.e. pylon placement and power line route, as well as supporting infrastructure);	Section 5, Section 8
5. A description on how the identified environmental sensitivity, relating to aquatic ecology, has been considered in determining the final pre-negotiated route and/or the substation location;	Section 5, Section 7, Section 8, Section 9, Section 10, and Section 11
6. A description on how the identified engineering constraints, relating to aquatic ecology, have been considered in determining the preferred route	Section 9, Section 10, Section 11,
7. A description of the implementation of the mitigation hierarchy in order to determine the final pre-negotiated route and/or substation location;	Section 10.
8. How the comments from interested and affected parties on the proposed route and/or substation location were incorporated; and	No comments received on report.
9. A statement confirming that: a. impact management actions as contained in the pre-approved Generic EMPr template are sufficient for the avoidance, management and mitigation of impacts and risks; or b. where required, specific impact management outcomes and actions are required and have been provided as part of the site specific EMPr.	Section 9, Section 10, Section 11, and Section 12.1

Table of Contents

List of Figures

List of Tables

1 INTRODUCTION

Eco-Assist Environmental Consultants (Here After Eco-Assist) was appointed by SiVEST to conduct aquatic ecology and wetland specialist assessments for the proposed development of the Leeudoringstad 132kv powerline between Leeudoringstad and Orkney in the North West Province, South Africa.

The proposed project involves the construction and operation of electricity distribution infrastructure, to connect the proposed Leeudoringstad solar plants to the Vaal reef ten power station.

1.1 Background

A new switching station will be constructed next to the existing Leeubosch Traction Substation. A new IPP substation will be built adjacent to the new switching station to step up the voltage from 33kV to 132kV. From the new switching station a 132kV powerline will run to Orkney Solar Plant (Genesis). The line will connect to the Genesis switching station and share a 132kV powerline to Vaalreef Ten.

Please find an overview of the high-level scope below (subject to Eskom approval):

The scope of work in IPP substation:

- *Install a compact 132/33kV transformer substation with the associated protection equipment*
- *Install 2x33kV containerized switchgear*

The scope of work in the Leeubosch substation:

- *Install 1 x 132kV feeder bays at Leeubosch substation to accommodate the IPP compact 132/33kV substation*
- *Establish a completely new 132 kV single busbar*
- *Build approximately 32 km of a single circuit Tern line from Leeubosch substation to New 132kV Collector at Orkney Solar Farm*

The scope of work at the 132 kV Collector Station close to the Orkney Solar Farm:

- *Establish a new 132kV single busbar collector substation*
- *Build 2 x 132 kV feeder bays to connect the Leeudoringstad IPP and Orkney Solar Farm.*
- *Build approximately 10 km of double circuit Twin Tern line from the new collector station to the VaalReef Ten substation*

The scope of work at the VaalReef Ten substation:

- *Equip 1 x 132 kV feeder bay for a 10 km double circuit Twin Tern line*

1.2 Scope of Work

1.2.1 Wetland Assessment

- Provide an overview of relevant legislative requirements specifically relating to wetlands and watercourses.
- Delineate of all wetlands present in accordance with the DWS wetland delineation guideline – A practical field procedure for the identification and delineation of wetland and riparian areas. As part of the delineation, wetlands must be divided and classified into Hydrogeomorphic (HGM) units.
- Carry out a Level 2 Wetland Health and Functional Assessment of all systems identified.
- Recommend suitable project setback buffers.
- Assess the impact on the wetland and recommend mitigation measures (which may include offsets) for likely impacts.
- Provide a comprehensive report that includes the methodology and findings of the work undertaken.
- Produce a detailed map using recognised GIS software compatible with the ArcGIS program.
- Generate data that is compatible with existing Municipal GIS systems (ArcView) to allow the resulting data to be distributed and incorporated into other GIS data sets.
- Compile the findings of the Wetland Risk Assessment into a report.

1.2.2 Aquatic Ecology Assessment

- Comply with the Standards for the development and expansion of power lines within identified geographical areas (DFFE, 2022).
- Establish baseline ecological condition of riverine habitats.
- Delineate sensitive riverine habitats and provide buffer zones.
- Complete risk assessment for the proposed project.
- Provide recommendations regarding mitigation and avoidance actions.

2 KEY LEGISLATION

Relevant environmental legislation pertaining to the protection and use of water resources in South Africa has been included in Table 2-1.

Table 2-1: Relevant Legislation.

Legislation	Description of relevant portions
The National Water Act 36 of 1998.	This Act imposes 'duty of care' on all landowners, to ensure that water resources are not polluted. The following Clause in terms of the National Water Act is applicable in this case: **19 (1)** *"An owner of land, a person in control of land or a person who occupies or uses the land on which (a) any activity or process is or was performed or undertaken; which causes, has caused or likely to cause pollution of a water resource, must take all reasonable measures to prevent any such pollution from occurring, continuing or recurring"* Chapter 4 of the National Water Act is of particular relevance to wetlands and addresses the use of water and stipulates the various types of Licenced and unlicensed entitlements to the use water. Water use is defined very broadly in the Act and effectively requires that any activities with a potential impact on wetlands (within a distance of 500m upstream or downstream of a wetland) be authorized.
General Authorisations (GAs).	These have been promulgated under the National Water Act and were published under GNR 398 of 26 March 2004. Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a Licence which should be obtained from the Department of Water and Sanitation (DWS).
Environmental Impact Assessment (EIA) Regulations.	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 4 December 2014 in Government Notice No. R. 32828. In addition, listing notices (GN 983-985) lists activities which are subject to an environmental assessment.
National Environmental Management Act 107 of 1998.	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays', and requires responsibility for impacts to be taken throughout the life cycle of a project.
South African Constitution 108 of 1996.	This includes the right to have the environment protected through legislative or other means.
National Environmental Management: Biodiversity Act No. 10 of 2004.	The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed invasive alien plants.
Conservation of Agricultural Resources Act 43 of 1967.	The intention of this Act is to control the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

3 ASSUMPTIONS & LIMITATIONS

The following limitations are applicable to this project:

- *It has been assumed that the extent of the development area provided by the responsible party is accurate;*
- *Only wetlands that were likely to be impacted by proposed development activities were assessed in detail during the field survey. Wetlands located within a 500m radius of*

the sites but not in a position within the landscape to be measurably affected by the development were not considered as part of this assessment.

- *The GPS used for ground truthing is accurate to within five meters. Therefore, the observation site's delineation plotted digitally may be offset by up to five meters to either side.*
- *Some areas were not accessible due to locked farm gates and inaccessibility.*
- *The assessment of potential impacts was informed by site-specific environmental conditions at the time of the site visit and ecological concerns based on the investigator's working knowledge and experience with similar projects.*
- *Information used to inform the assessment was limited to data and GIS coverage's available for the province at the time of the assessment.*
- *Riverine habitat condition assessments were completed in the 3 riverine systems whilst SASS5 was completed in all open channeled watercourses.*
- *To address the limitations of inaccessibility, sampling points were selected up and downstream of anticipated areas of impacts to effectively establish baseline conditions.*
- *The risk assessment assumes that avoidance measures will be implemented.*
- *Only powerline and associated pylon structures were considered in this assessment, no substations were considered.*

4 PROJECT LOCALITY

4.1 Locality

The project site falls within the Maquassi Hills Local Municipality within the Dr Kenneth Kaunda District Municipality in the North West Province. The site is accessible via an existing gravel road which branches off the tarred R502 Provincial Road (see Figure 4-1 and Figure 4-2).

It is noted that the project area is located within an Electricity Grid Infrastructure (EGI) zone (DFFE, 2022). This project is therefore subject to the EGI best practice guidelines.

4.2 Terrain and Hydrological Context

The terrain analysis was conducted using the processing tools within the ArcGIS mapping software. The spatial analyst terrain analysis tools were used to determine the Digital Elevation Model (DEM) (see Figure 4-5).

The project area spans three quaternary catchments of the Vaal Water Management Area including the C24B, C24J and C25A. The associated Sub-Quaternary Reaches (SQR) applicable to the study includes the C24H-01979, C24J-01772, C24J-01861, C25A-02090 and C24J-02016. Details pertaining to the watercourses is provided in Table 8-2.

The project area extent is situated on the south-east facing slopes draining into the Vaal River. The slopes are predominantly flat (<5-10%). The overall topographical landscape features are shown in Figure 4-5.

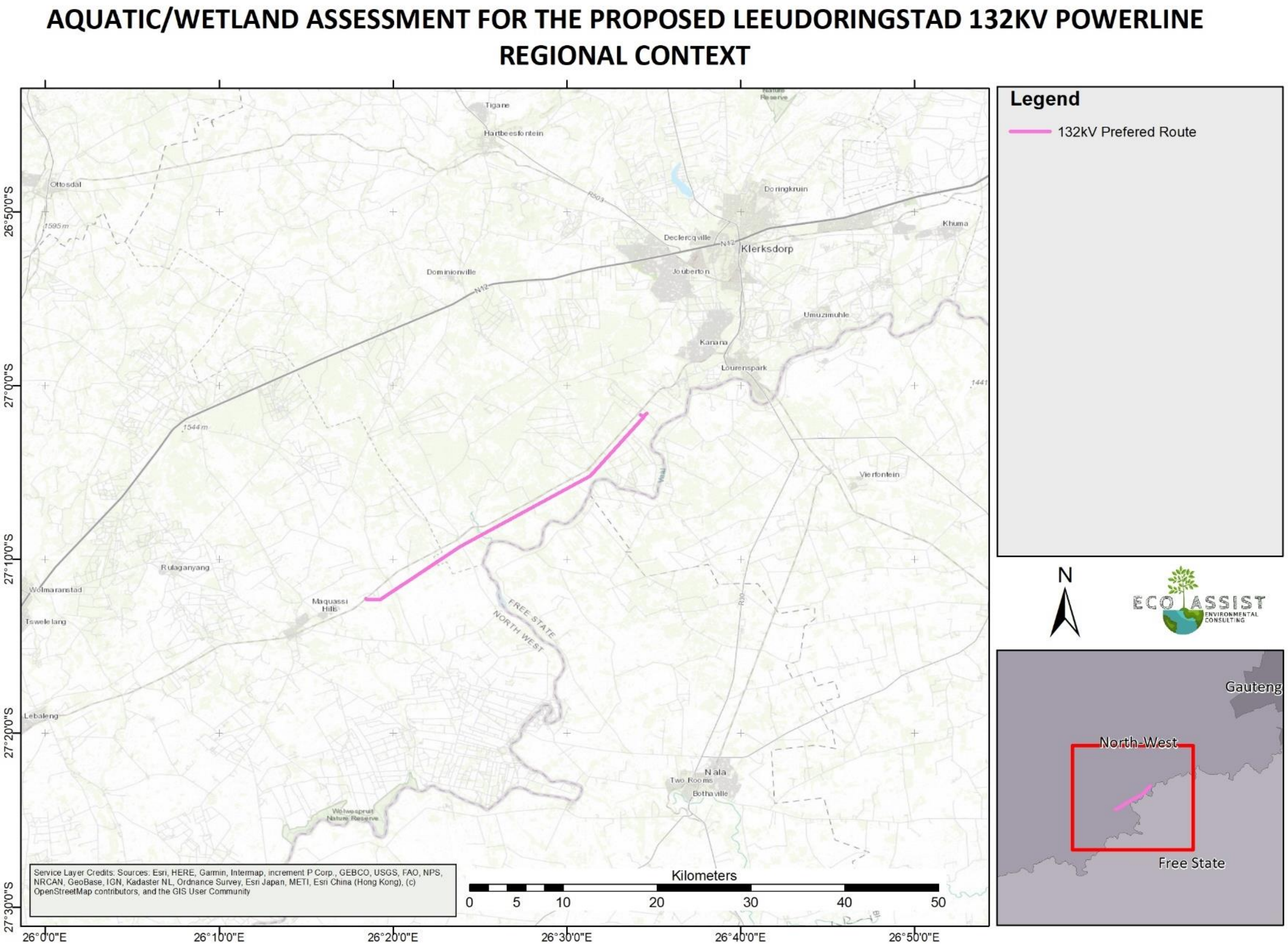

Figure 4-1: Map illustrating the regional context of the proposed project area.

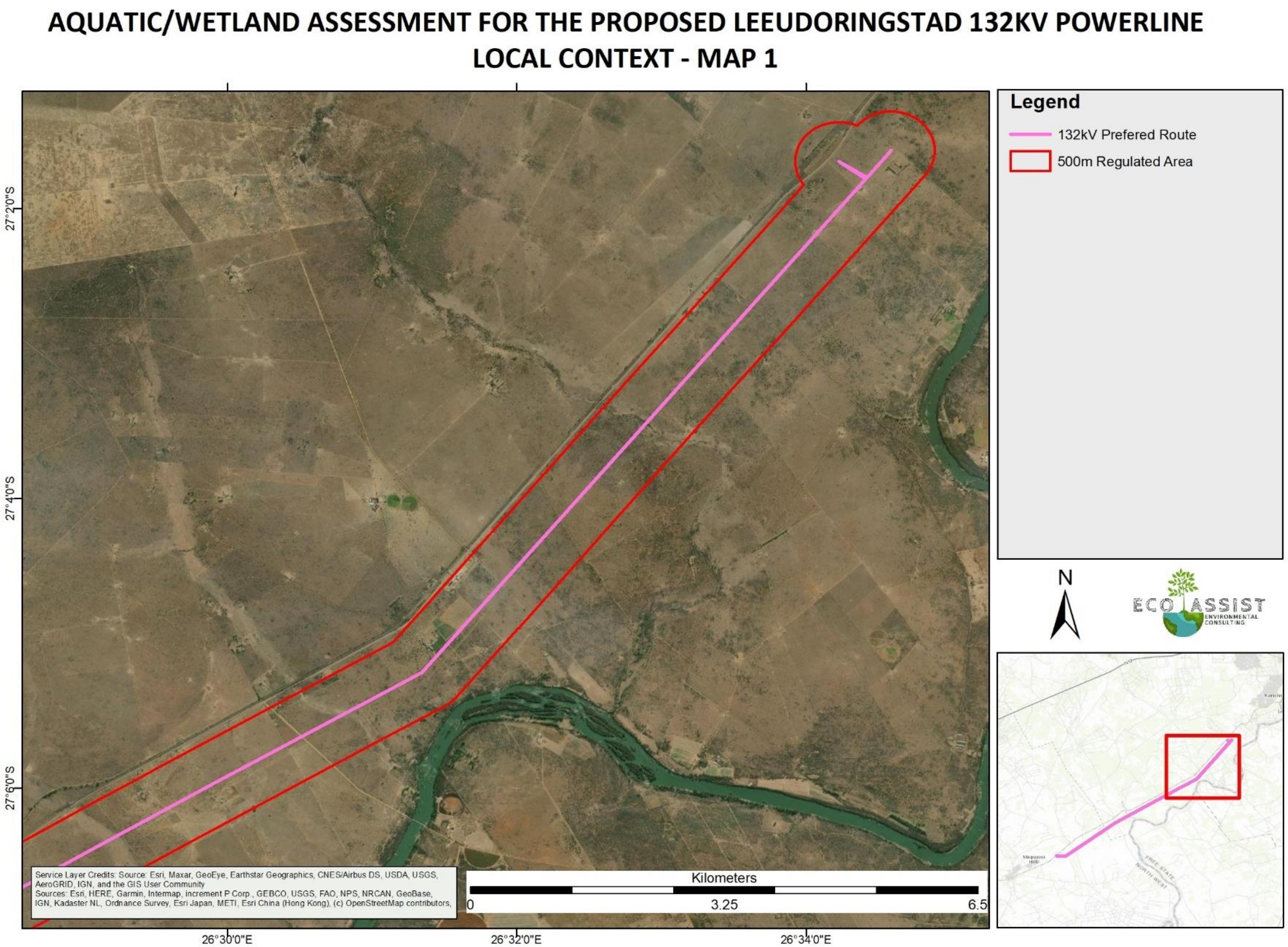

Figure 4-2: Local setting of the proposed project area (north-eastern section).

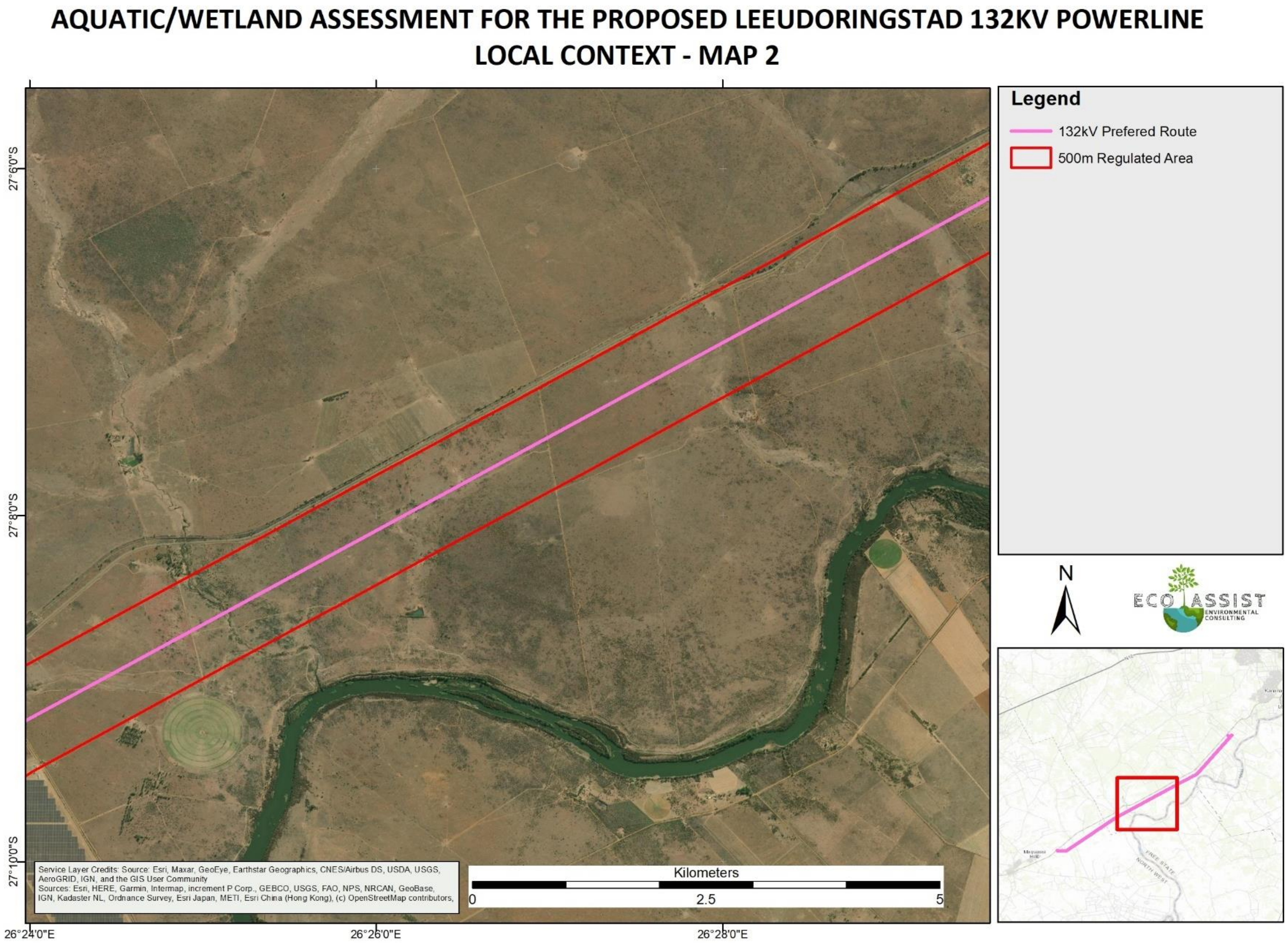

Figure 4-3: Local setting of the proposed project area (central section).

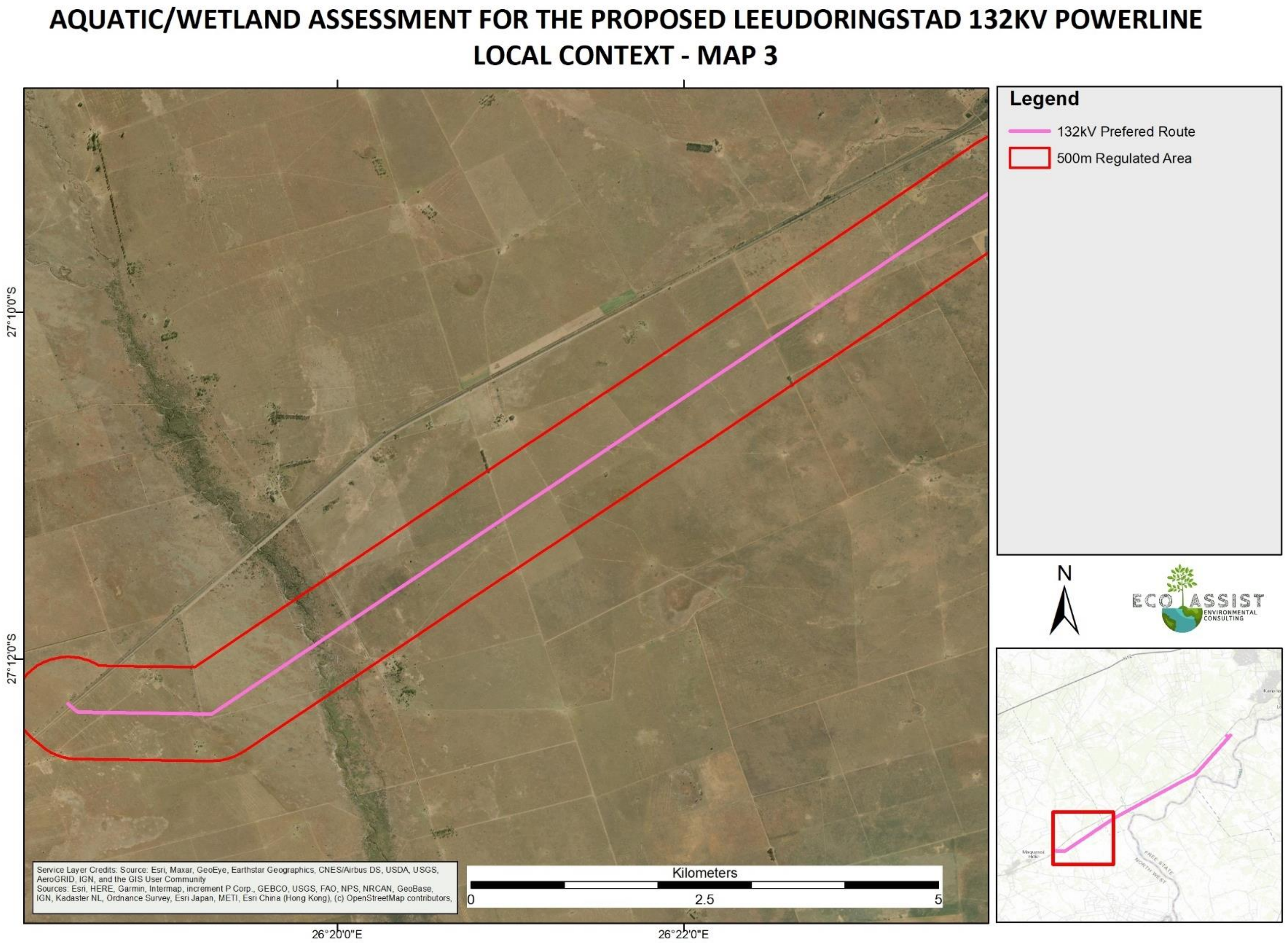

Figure 4-4: Local setting of the proposed project area (south-western section).

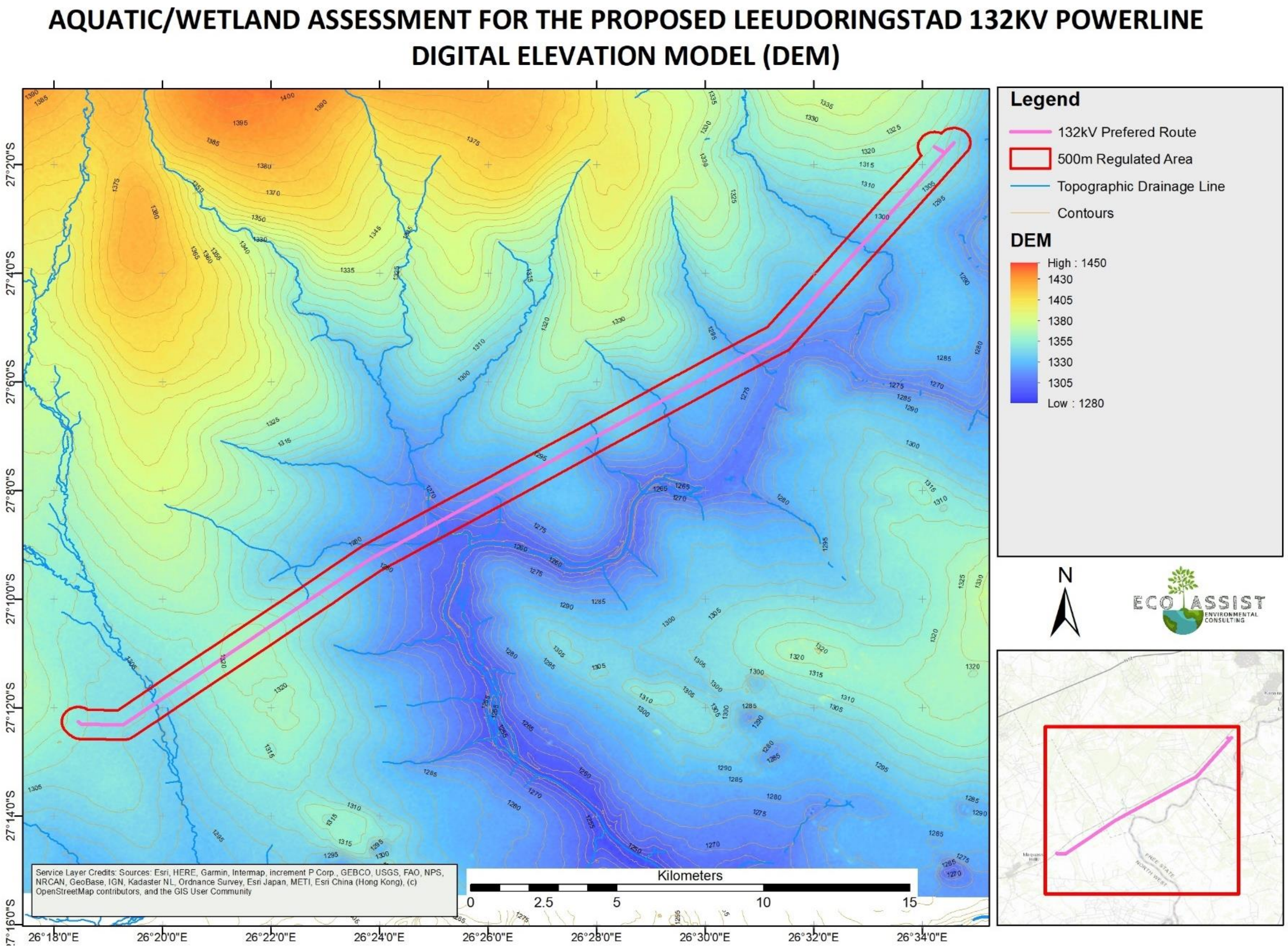

Figure 4-5: The DEM and drainage features and topographical features of the project area.

4.3 Climate

The climate of the vegetation unit is warm-temperate, with summer rainfall climate, with overall Mean Annual Precipitation (MAP) of 530mm. The area is characterised by high summer temperatures. Severe frost (37 days per year on average) occurs in winter (Mucina & Rutherford, 2006).

4.4 Regional Vegetation

The project area falls within the Dry Highveld Grassland bioregion of the Grassland Biome and was within the Vaal-Vet Sandy Grassland vegetation unit.

The vegetation and landscape features of the Vaal-Vet Sandy Grassland vegetation unit is characterised by a plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element. The dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally, the low cover of *T. triandra* and the associated increase in *Elionorus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing and/or erratic rainfall (Mucina & Rutherford, 2006).

4.5 Desktop Soils and Geology

Existing Land Type data was used to obtain generalised soil patterns and terrain types for the site. Land Type data exists in the form of published 1:250 000 maps. These maps indicate delineated areas of similar terrain types, pedosystems (uniform terrain and soil pattern) and climate (Land Type Survey Staff, 1972 - 2006).

The entire project extent falls within the Fb6 landtype (see Figure 4-7). The landtype landscape units are comprised of 20% crest positions, which are dominated by shallow Mispah and Glenrosa soil forms. 60% midslope positions, which are dominated by shallow Mispah and Glenrosa soil forms, but with some Arcadia and Westleigh soil forms also occurring. 15% footslopes positions, which are dominated by Arcadia, Valsrivier, and Westleigh soil forms, but with some shallow Mispah and Glenrosa soil forms also occurring. 5% valley bottom positions, which are dominated by Inhoek and Willowbrook soil forms as shown in Figure 4-6. The slopes in the land type range from 0% to 3% indicating a flat area.

The geology for this land type is mainly Andesitic to basaltic lavas of the Ventersdorp Supergroup (Land Type Survey Staff, 1972 - 2006).

According to Mucina and Rutherford, (2006) the geology and soils of the vegetation unit comprise Aeolian and colluvial sand overlying sandstone, mudstone, and shale of the Karroo Supergroup (mostly the Ecca Group) as well as older Ventersdorp Supergroup andesite and basement gneiss in the north (Mucina & Rutherford, 2006).

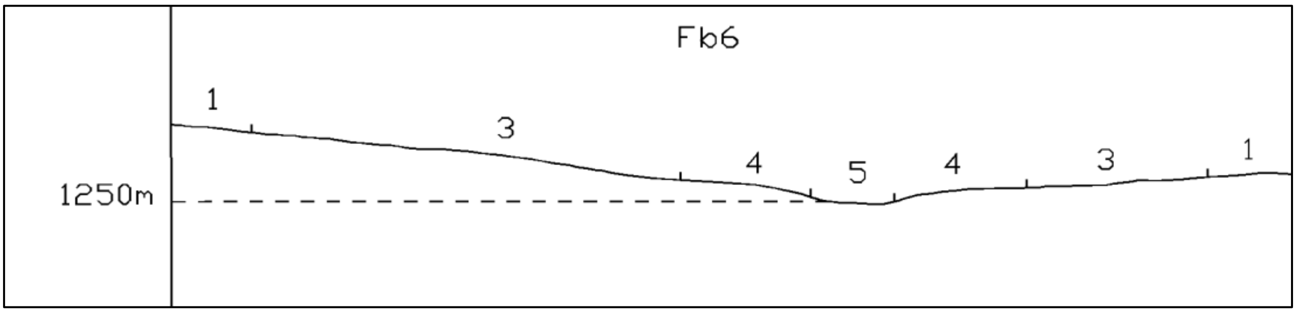

Figure 4-6: The hillslope catena of landtype Fb6.

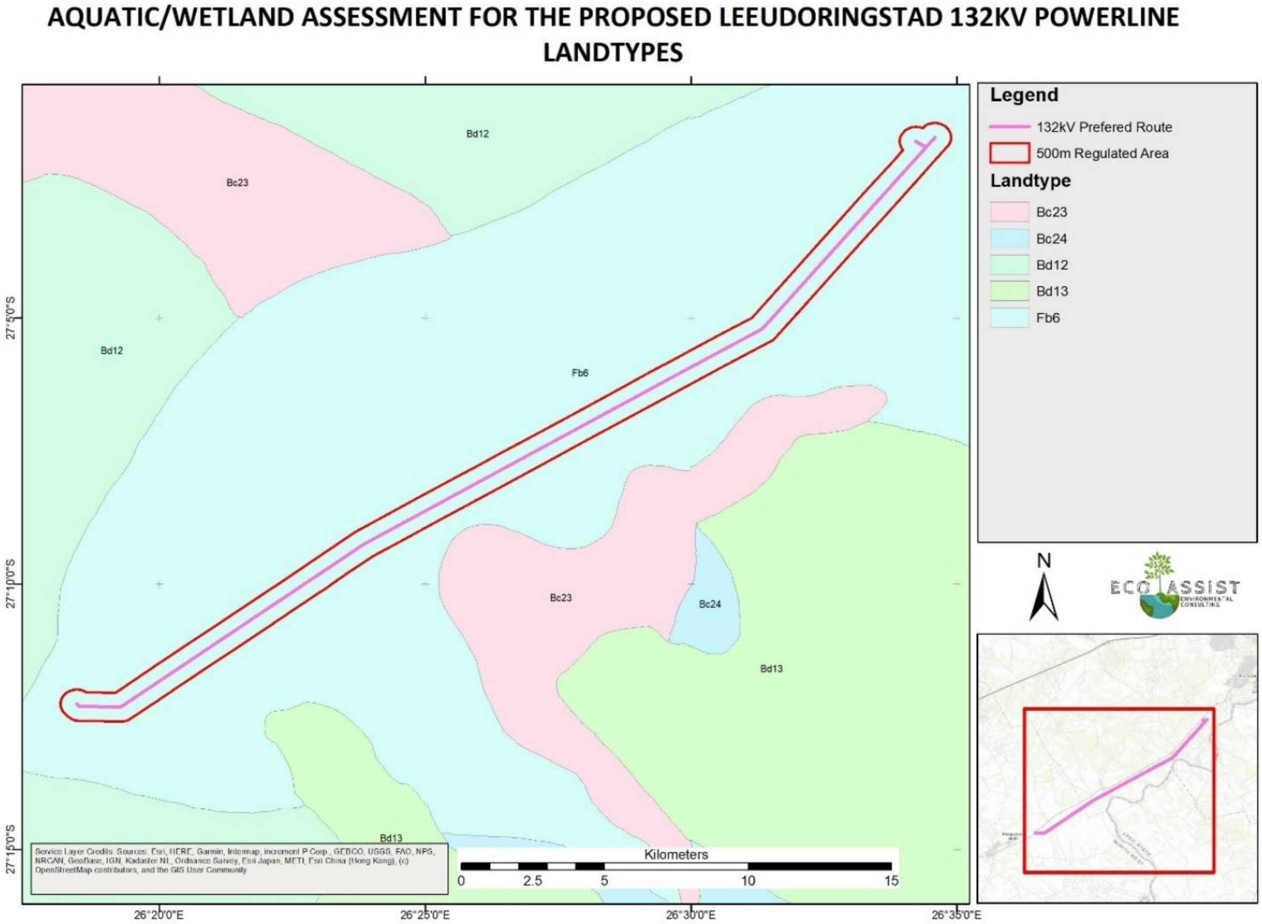

Figure 4-7: The landtypes associated with the project area.

5 SENSITIVITY ANALYSIS BASED ON THE ENVIRONMENTAL SCREENING TOOL AND LEVEL OF ASSESSMENT

5.1 Screening Assessment

The result of the Department of Forestry, Fisheries and the Environment (DFFE) screening tool for the Aquatic sensitivities for the proposed project is shown in Figure 5-1. The screening tool was accessed in the October 2022 by Wayne Jackson. The powerline was buffered by 500m to match the 500m regulated area as per the DWS guidelines.

The results show that the majority of the area is deemed as low sensitivity with the water course crossings and wetland zones showing a high sensitivity.

The DFFE screening tool must be used as a guideline, and it is up to the specialists to verify these results in the field. The screening tool is based on coarse datasets and at times may not be accurate.

5.2 Field Verification Assessment

During the field verification, on the 11th to 13th of October 2022 and the 27th to 29th of October 2022, of the proposed powerline the specialists took into account the various watercourse crossing locations and the PES of the freshwater ecosystems. The field verification and full assessment was conducted during the late dry season, but will not affect the findings of this assessment. It was noted that the systems were at a low risk if the prescribed construction methodologies which include avoidance and mitigation measures are applied. These interventions will reduce any potential risks by not allowing any alterations to these systems, which would follow the avoidance principle in the mitigation hierarchy.

Therefore, the assessment protocol would only require that the "Standard for the Development and Expansion of Power Lines and Substations within Identified Geographical Areas" (Department of Forestry, Fisheries and the Environment, 2022) be followed.

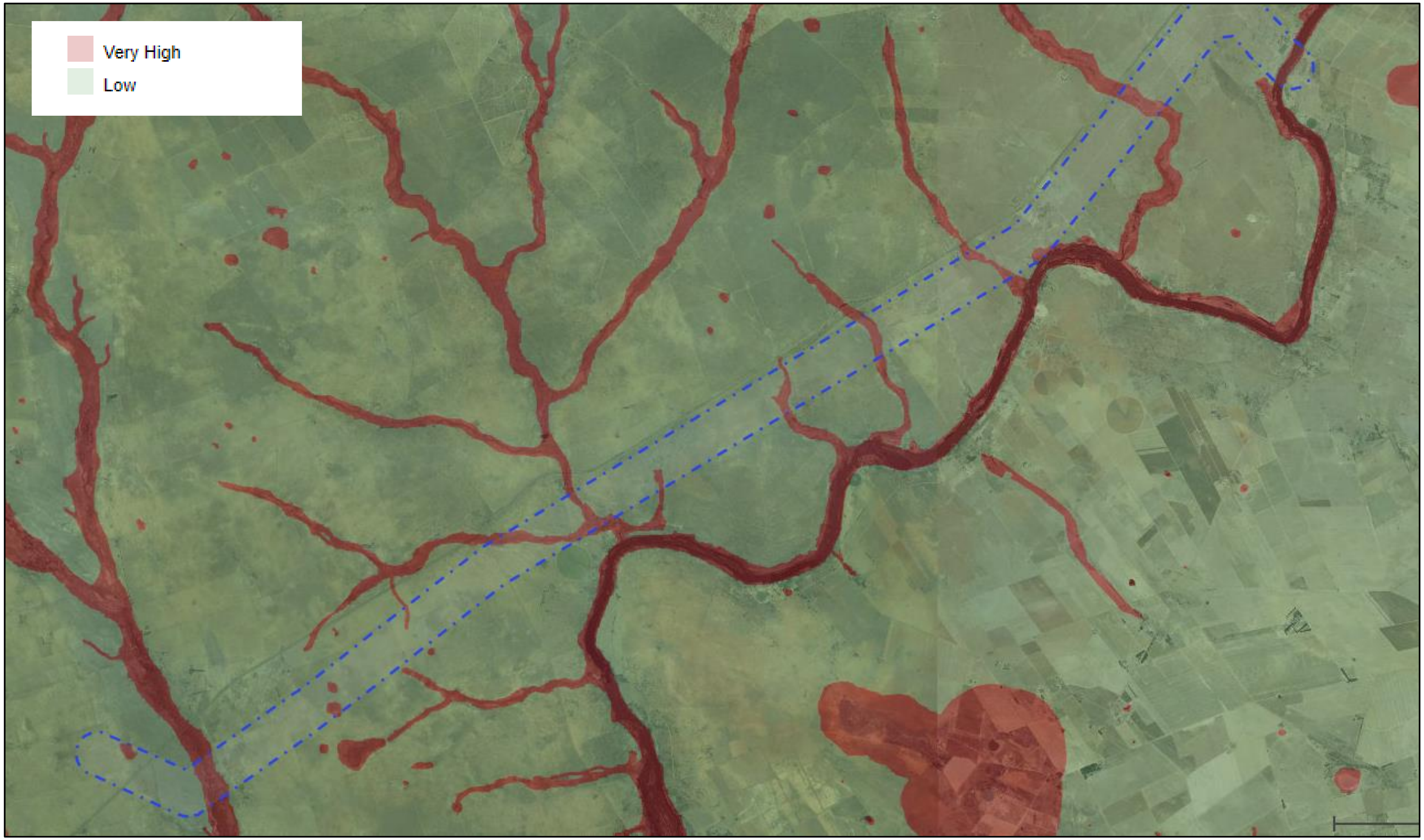

Figure 5-1: DFFE screening tool results for the aquatic biodiversity sensitivity theme for the project extent.

6 RESPONSES TO INTERESTED AND AFFECTED PARTIES

To this point no concerns have been raised as yet. If any concerns are raised with regards to this study, this report will be updated.

7 METHODOLOGY

7.1 Riverine Survey and Sample Points

A riverine survey was completed between the 28th and 30th of October 2022. A total of 8 aquatic sampling points were selected (Figure 7-1). Details pertaining to the sample points is provided in Table 7-1. It is noted that only directly impacted watercourses were considered. No direct impact to the Vaal or Skoonspruit Rivers are expected. The sampling points were however considered to address the 500m inclusion zone for watercourses as is standard practise for environmental assessments.

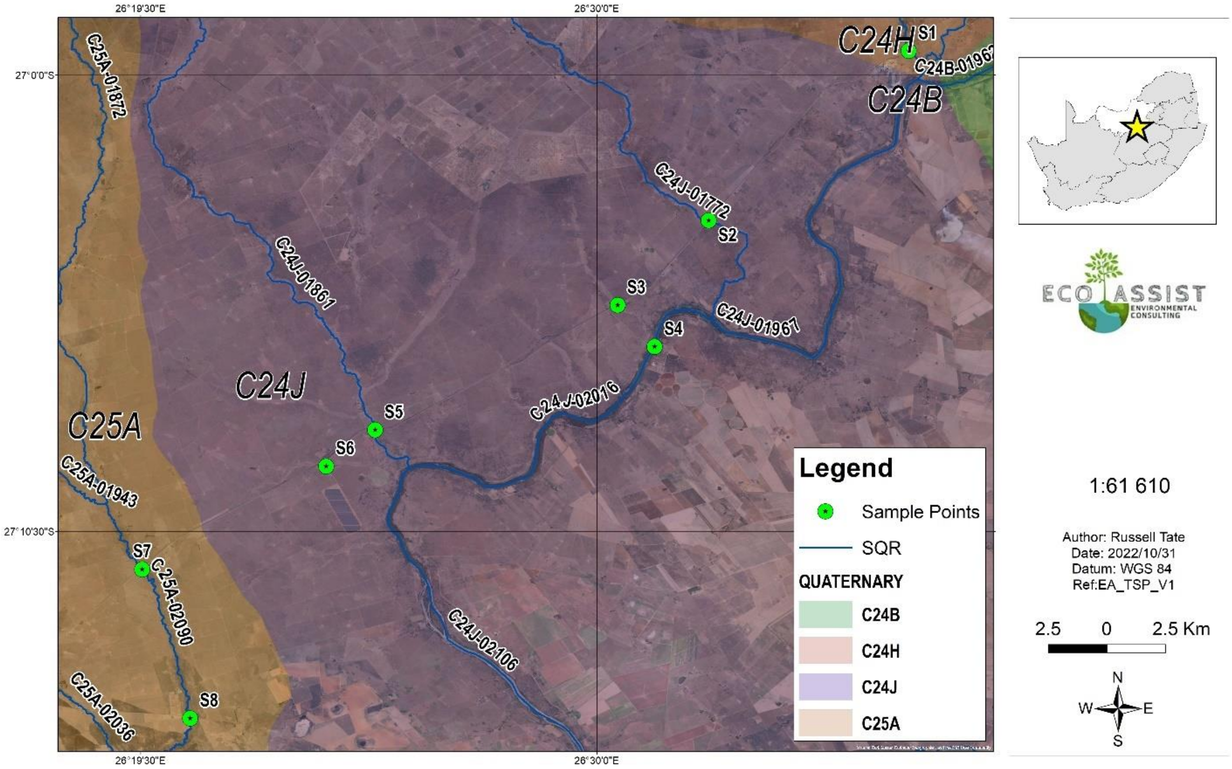

Figure 7-1: Location of the sampling points in respect to the project AoI

Table 7-1: Details pertaining to sampling points (October 2022)

Sample Point	X	Y	Photograph
S1	26.61957858	-26.99073944	
S2	26.54292876	-27.05579516	
S3	26.5080043	-27.08821125	

Sample Point	X	Y	Photograph
S4	26.52220777	-27.10420124	
S5	26.41500545	-27.13608926	
S6	26.39629268	-27.14999789	

Sample Point	X	Y	Photograph
S7	26.32567023	-27.18951202	
S8	26.34412664	-27.24666768	

7.2 Riverine Assessment

The riverine assessment methods were completed in watercourses with riverine features. To provide a comprehensive baseline, wetland systems with open channels were also considered for invertebrate and water quality assessment where instream conditions were assessed. Watercourses are dynamic systems and it is possible for a watercourse to possess both wetland and riparian features, this was the case for the Klipspruit.

7.2.1 Water Quality

In situ water quality was obtained at the sites (see Table 7-1) using a calibrated Extech DO-600 Multimeter. The following constituents included conductivity (mS/m), temperature (°C), pH and dissolved oxygen (mg/l).

7.2.2 Habitat Quality

The Intermediate Habitat Integrity Assessment (IHIA) as described by Kleynhans (1996) was used to define the ecological condition of the riparian habitat of the considered river reaches. The IHIA was informed by the results of the land cover assessments and direct observations of changes to the river system processes. The IHIA considers both the riparian and instream habitat condition but for this report only the riparian habitat was considered. The method relies on the study of reference condition or natural watercourses within a similar setting. The spatial framework of the assessment was within the 500m screening zone of the project.

Table 7-2: Intermediate habitat integrity categories (Kleynhans, 1996)

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

7.2.3 Aquatic Macroinvertebrates

Macroinvertebrate assemblages are indicators of localised conditions because many benthic macroinvertebrates have limited migration patterns or a sessile mode of life. They are particularly well-suited for assessing site-specific impacts (upstream and downstream studies) (Barbour et al., 1999). Benthic macroinvertebrate assemblages are made up of species that constitute a broad range of trophic levels and pollution tolerances, thus providing strong information for interpreting cumulative effects (Barbour et al., 1999). The assessment and monitoring of benthic macroinvertebrate communities forms an integral part of the monitoring of the health of an aquatic ecosystem.

7.2.3.1 South African Scoring System

The South African Scoring System version 5 (SASS5) is the current index being used to assess the status of riverine macroinvertebrates in South Africa. According to Dickens and Graham (2002), the index is based on the presence of aquatic invertebrate families and the perceived sensitivity to water quality changes of these families. Different families exhibit different sensitivities to pollution, these sensitivities range from highly tolerant families (e.g., Chironomidae) to highly sensitive families (e.g., Perlidae). SASS results are expressed both as an index score (SASS score) and the Average Score Per recorded Taxon (ASPT value).

Sampled invertebrates were identified using the “Aquatic Invertebrates of South African Rivers” Illustrations book, by Gerber and Gabriel (2002). Identification of organisms were made to family level (Dickens and Graham, 2002; Gerber and Gabriel, 2002). All SASS5 and ASPT scores were then compared with the SASS5 Data Interpretation Guidelines (Dallas, 2007) for the Highveld (Figure 7-2).

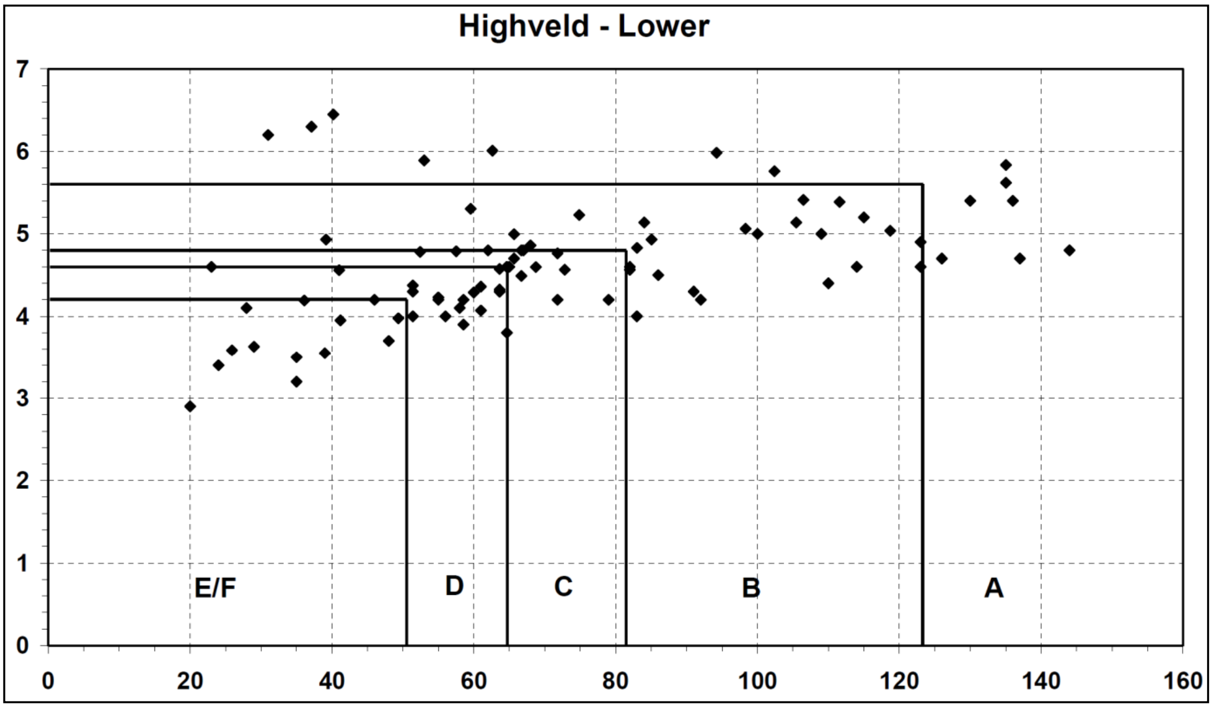

Figure 7-2: Highveld Lower Ecoregion Interpretation (Dallas, 2007)

7.2.4 Ecological Importance, Sensitivity and Services Analysis

The Ecological Importance and Sensitivity (EIS) of the riverine watercourses was investigated using Kleynhans (1999).

7.3 Wetland Assessment

7.3.1 Wetland Delineation

A wetland is defined 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 (from the South African National Water Act; Act No. 36 of 1998).

The **Hydrogeomorphic** (**HGM**) Classification identifies groups of wetlands that function similarly using three criteria that fundamentally influence how wetlands function. These criteria are geomorphic setting, water source, and hydrodynamics. Geomorphic setting refers to the landform in which the wetland occurs, its geologic evolution, and its topographic position in the landscape. Water source refers to the primary source of the water entering the wetland. The three primary water sources are precipitation, overbank surface flow, or groundwater. Hydrodynamics refers to the level of energy and the direction that water takes as it moves into and through the wetland.

The wetlands are delineated in accordance with the (Department of Water Affairs (DWAF), 2005) guidelines, a cross section is presented in Figure 7-3. The outer edges of the wetland areas were identified by considering the following four specific indicators:

- *The Terrain Unit Indicator helps to identify those parts of the landscape where wetlands are more likely to occur;*

- *The Soil Form Indicator identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;*
- *The soil forms (types of soil) found in the landscape were identified using the South African soil classification system namely; Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group 1991):*
- *The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and*
- *The Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.*

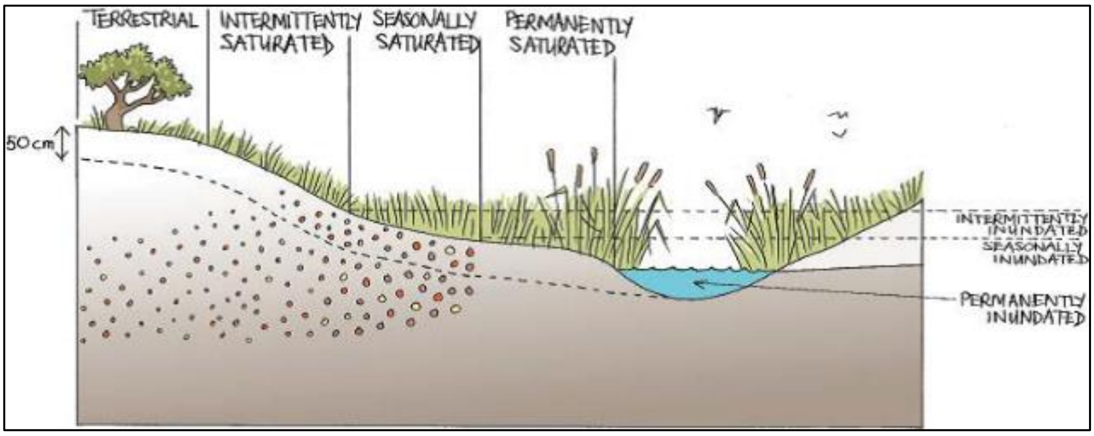

Figure 7-3: Cross section through a wetland, indicating how the soil wetness and vegetation indicators change (Ollis et al, 2013).

7.3.2 Present Ecological State

The Present Ecological State (PES) was determined by using the Wet-Health (Version 2.0) guidelines (Macfarlane, et al., 2020). WET-Health Version 2 consists of a series of three tools developed to assess the Present Ecological State (PES) or “ecological health” of wetland ecosystems of different hydrogeomorphic types at three different levels of detail/resolution.

PES is then assessed by evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four inter-related components of wetland health, as follows:

Hydrology is defined in this context as the distribution and movement of water through a wetland and its sediments. This component focuses on (i) changes in water inputs that result from human alterations to the catchment which affect water inflow quantity and pattern, and (ii) modifications within the wetland itself that alter the water distribution and retention patterns of the wetland (e.g., artificial drainage channels). These aspects are then integrated into a composite score that reflects the overall change in wetland hydrology.

Geomorphology in this context is assessed by assessing changes to (i) geomorphic processes and (ii) the geomorphic structure of the wetland. Geomorphic processes in this context, refers to those physical processes that are currently shaping and modifying wetland form and evolution, whilst geomorphic structure refers to the three-dimensional shape of sediment deposits on which wetland habitat is established. Whilst catchment drivers (similar to those assessed in the hydrology module) are integrated as part of the assessment, impacts are ultimately assessed based on an understanding of the degree to which within-wetland geomorphic processes and the associated structure of the wetland have been altered by anthropogenic activities. The component also accounts for differences in geomorphic processes in wetlands characterised by clastic (minerogenic) sedimentation and those characterised by organic sediment accumulation (peat).

Water quality is defined as the physico-chemical attributes of the water in a wetland. It is assessed based on considering both potential diffuse runoff from land uses within the wetland and from the areas surrounding the wetland, together with point-source discharges of pollution entering directly into the wetland and/or into streams that flow into that wetland.

Vegetation is defined in this context as the structural and compositional state of the vegetation within a wetland. This component evaluates changes in vegetation composition and structure as a consequence of current and historic on-site transformation and/or disturbance. Whilst the assessor needs to have some knowledge of vegetation in a particular region, the method does not require the assessor to be able to identify all wetland plant species. The emphasis is rather on identifying alien and ruderal (weedy) species that indicate disturbance and assessing their occurrence relative to common naturally occurring indigenous species, including those that are naturally dominant in the wetland.

The aim of WET-Health Version 2.0 is to facilitate the derivation of an Ecological Category for each of the four components of wetland PES and an overall Ecological Category for each wetland that is being assessed. A common suite of Ecological Categories (or Present State Categories), ranging from A to F, are typically used in PES assessments of inland aquatic ecosystems in South Africa (see Table 7-3).

Table 7-3: The Present Ecological State categories (Macfarlane, et al., 2020).

Impact Category	Ecological Category	Description	Impact Score	PES Score (%)
None	**A**	**Unmodified, natural.**	**0 to 0.9**	**90 - 100**
Small	**B**	**Largely Natural** with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	**1.0 to 1.9**	**80 - 89**
Moderate	**C**	**Moderately Modified.** A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	**2.0 to 3.9**	**60 - 79**
Large	**D**	**Largely Modified.** A large change in ecosystem processes and loss of natural habitat and biota has occurred.	**4.0 to 5.9**	**40 - 59**
Serious	**E**	**Seriously Modified.** The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognizable.	**6.0 to 7.9**	**20 - 39**
Critical	**F**	**Critical Modification.** The modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	**8.0 to 10**	**0 - 19**

7.3.3 Ecosystem Services

The assessment of the ecosystem services supplied by the identified wetlands was conducted per the guidelines as described in WET-EcoServices (Version 2) (Kotze, et al., 2020).

WET-EcoServices provides a set of indicators (e.g., slope of the wetland) rated on a five-point scale that reflect the supply/capability of a wetland for each of the 16 different ecosystem services. Indicator scores are then combined automatically in an algorithm that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators (Table 7-4). In addition, the extent of the wetland providing the service is recorded, and the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g., toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale.

Table 7-4: Classes for determining the likely extent to which a benefit is being supplied (Kotze, et al., 2020).

Importance Category		Description
Very Low	**0 - 0.79**	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	**0.8 – 1.29**	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately Low	**1.3 – 1.69**	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	**1.7 – 2.29**	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately High	**2.3 – 2.69**	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	**2.7 – 3.19**	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	**3.2 - 4.0**	The importance of services supplied is very high relative to that supplied by

7.3.4 Importance and Sensitivity

The method used for the Importance and Sensitivity (IS) determination was adapted from the method as provided by the then Department of Water and Sanitation (DWS) (1999) for floodplains by (Rountree & Kotze, 2013).

Ecological Importance (EI) is the expression of the importance of wetlands and rivers in terms of the maintenance of biological diversity and ecological functioning at a local and landscape level. Ecological Sensitivity (ES) refers to ecosystem fragility or the ability to resist or recover from disturbance (Rountree & Kotze, 2013). The purpose of assessing ecological importance and sensitivity of water resources like wetlands, and rivers is to be able to identify those systems that provide valuable biodiversity support functions, regulating ecosystem services, or are especially sensitive to impacts. Knowing what ecosystems are valuable enables the appropriate setting of management objectives (i.e., recommended ecological category - REC) and the prioritization of management actions and interventions to promote effective water resource management.

A series of variables for IS are assessed on a scale of 0 to 4, where 0 indicates Low importance and 4 indicates Very High importance. The mean of the variables is used to assign the Ecological Importance and Sensitivity (EIS) category as listed in Table 7-5.

Table 7-5: Description of EIS categories.

EIS Category	Range of Mean	Recommended Ecological Management Class
Very High	3.1 to 4.0	**A**
High	2.1 to 3.0	**B**
Moderate	1.1 to 2.0	**C**
Low Marginal	< 1.0	**D**

7.3.5 Recommended Ecological Category

The Recommended Ecological Category (REC) is determined by the PES of the water resource and the importance and/or sensitivity of the water resource.

Water resources which have Present Ecological State categories in an E or F ecological category are deemed unsustainable by the DWA. In such cases the REC must automatically be increased to a D (Rountree, et al., 2013).

The REC and associated management objective for the water resource is informed by an understanding of PES, EIS and social importance (where available). Trajectory of change should be considered here by selecting a PES that is attainable rather than using the current PES, which may be subject to rapid change in a high threat environment or to improvement through planned rehabilitation interventions (Macfarlane & Bredin, 2017). The default table used to inform this process is Table 7-6.

Table 7-6: Summary of selection criteria (Macfarlane & Bredin, 2017).

Attainable PES	Importance			
	Very High	High	Moderate	Low
A	A Maintain	A Maintain	A Maintain	A Maintain
B	A Improve	A/B Improve	B Maintain	B Maintain
C	B Improve	B/C Improve	C Maintain	C Maintain
D	C Improve	C/D Improve	D Maintain	D Maintain
< D	D Improve	D Improve	D Improve	D Improve

7.3.6 Buffer Determination

The “Buffer Zone Guidelines for Rivers, Wetlands, and Estuaries” (Macfarlane & Bredin, 2017) was used to determine the appropriate buffer zone for the proposed activity.

Buffer zones have been defined as a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another. Buffer zones are typically designed to act as barriers between human activities and sensitive water resources to protect them from adverse negative impacts.

7.4 Risk/Impact Assessment

The risk assessment was completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016). The significance of the impact is calculated according to Table 7-7.

Table 7-7: Risk Assessment Matrix.

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

7.5 Standard for the Development and Expansion of Power Lines and Substations within Identified Geographical Areas

The site sensitivity analysis indicated some areas of watercourse crossing were identified as very high by the DFFE screening tool, however the site verification assessment concluded that the risk to these features would be low if the prescribed construction methodology and mitigation measures are followed.

This Standard and exclusions do not apply in the following instances:

- *Where any part of the infrastructure occurs on an area for which the environmental sensitivity for a relevant environmental theme is identified as being very high or high by the screening tool and confirmed to be such by the EAP or the relevant specialist for the identified environmental theme;*
- *Where the site verification for a specific theme identifies that the low or medium sensitivity rating of the screening tool is in fact high or very high; or*
- *Where the greater part of the proposed infrastructure falls outside of any strategic transmission corridor.*

Once the decision has been made to continue with the standards as described above, the specialist is required to complete a confirmation statement. The overall aim of the confirming statement is to:

- *Confirm that the environmental sensitivity is low or medium as per the sensitivity identified by the screening tool;*
- *provide a brief elaboration on how the mitigation hierarchy was implemented for the theme;*
- *state whether identified route is considered to be optimal based on the specialist confirmation of low or medium environmental sensitivity and walkthrough.*

In the confirming statement the following information must be provided:

1. Contact details, relevant qualifications and curriculum vitae of the specialist or EAP, including a description of expertise in preparing the statement;
2. A signed declaration of independence by the specialist or EAP on the form contained in Appendix D or Appendix E of this Standard;

The confirming statement must be prepared by a specialist registered with the SACNASP with relevant expertise in aquatic ecology or similar, and must contain, as a minimum, the following information:

1. A statement on the duration, date and season of the site verification inspection and walkthrough as well as the relevance of the season to the outcome of the confirming statement;
2. Confirmation that the aquatic ecology (flora and fauna) and existing environmental impacts within the final pre-negotiated route and/or substation location is low, based on the most recently available desktop data, site verification inspection and walk through;
3. Identification of aquatic ecological areas to be avoided within the preliminary corridor, including buffers;
4. An aquatic biodiversity sensitivity map, generated by the screening tool and enhanced by any relevant additional information, overlaid with the proposed development footprint (i.e., pylon placement and power line route, as well as supporting infrastructure);
5. A description on how the identified environmental sensitivity, relating to aquatic ecology, has been considered in determining the proposed route;
6. A description on how the identified engineering constraints, relating to aquatic ecology, have been considered in determining the proposed route;
7. A description of the implementation of the mitigation hierarchy in order to determine the proposed route and/or substation location;
8. How the comments from interested and affected parties on the proposed route and/or substation location were incorporated; and
9. A statement confirming that:
    a. impact management actions as contained in the pre-approved Generic EMPr template are sufficient for the avoidance, management and mitigation of impacts and risks; or
    b. where required, specific impact management outcomes and actions are required and have been provided as part of the site specific EMPr;

8 FINDINGS

8.1 NFEPA Wetlands

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the NWA (Nel, et al., 2011).

In Figure 8-1 there are 2 bench flat wetland systems identified. These were classified as natural with a present ecological state of A/B. They are rated as important.

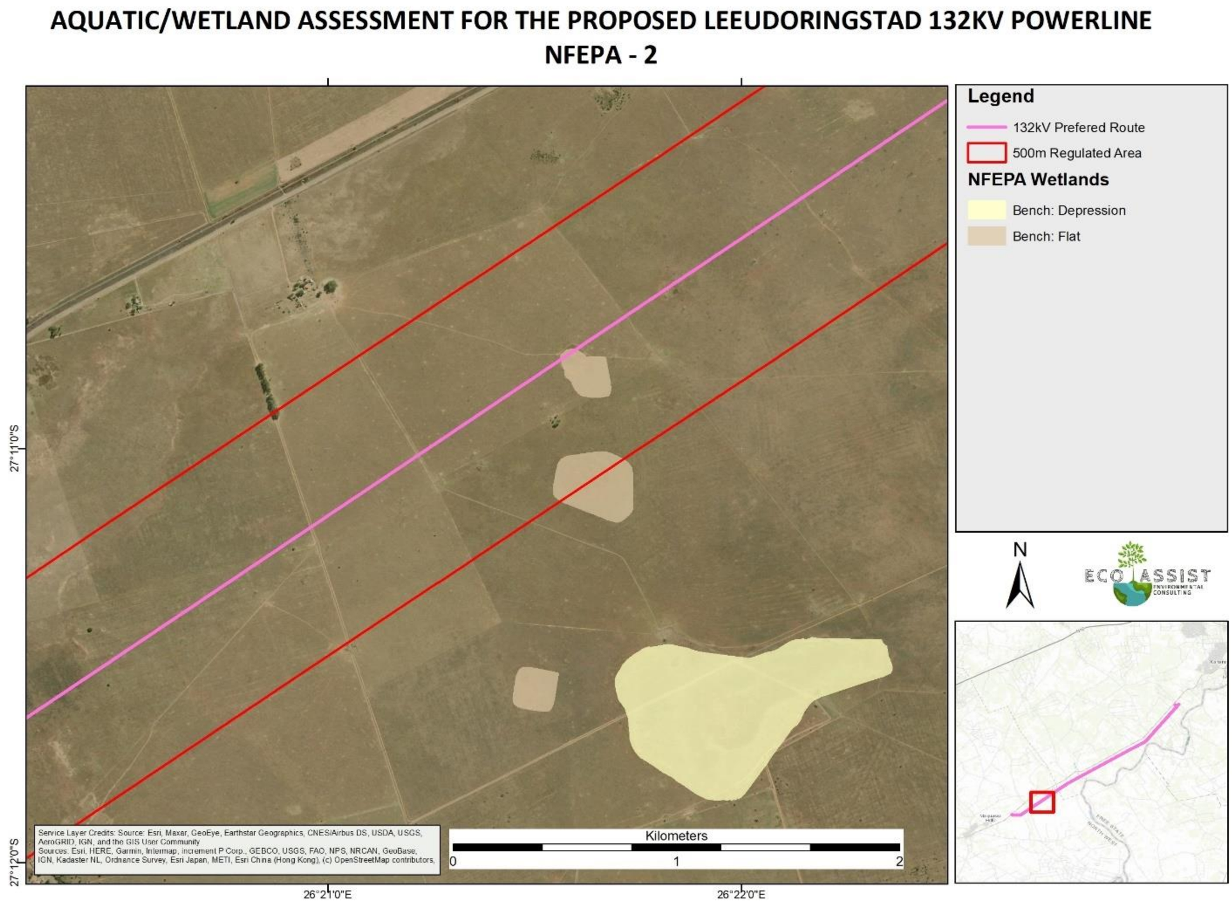

Figure 8-1: The NFEPA wetlands associated with the project area (map 1).

8.2 South African Inventory of Inland Aquatic Ecosystems (SAIIAE)

The South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Van Deventer, et al., 2018) has updated the previous NFEPA maps to give a more comprehensive desktop data set of the wetlands at a national level. The data has been called the National Wetland Map 5 layers (NWM5).

The powerline was separated into several sections and the SAIIAE wetlands are discussed as per the figures to follow.

In Figure 8-2 a channelled valley bottom system is crossed and is rated as moderately modified (class C).

In Figure 8-3 a channelled valley bottom system is crossed and is rated as largely to critically modified (class D/E/F). The channelled valley bottom is fed by a hillslope seep system from the west, which is also rated as largely to critically modified (class D/E/F).

In Figure 8-4 there are two depressions which could be at risk (southern depression is named the Graspan pan). These depressions are rated as largely natural (class A/B).

In Figure 8-5 a channelled valley bottom system is crossed and is rated as largely to critically modified (class D/E/F).

The wetlands in the region were critically endangered and poorly protected.

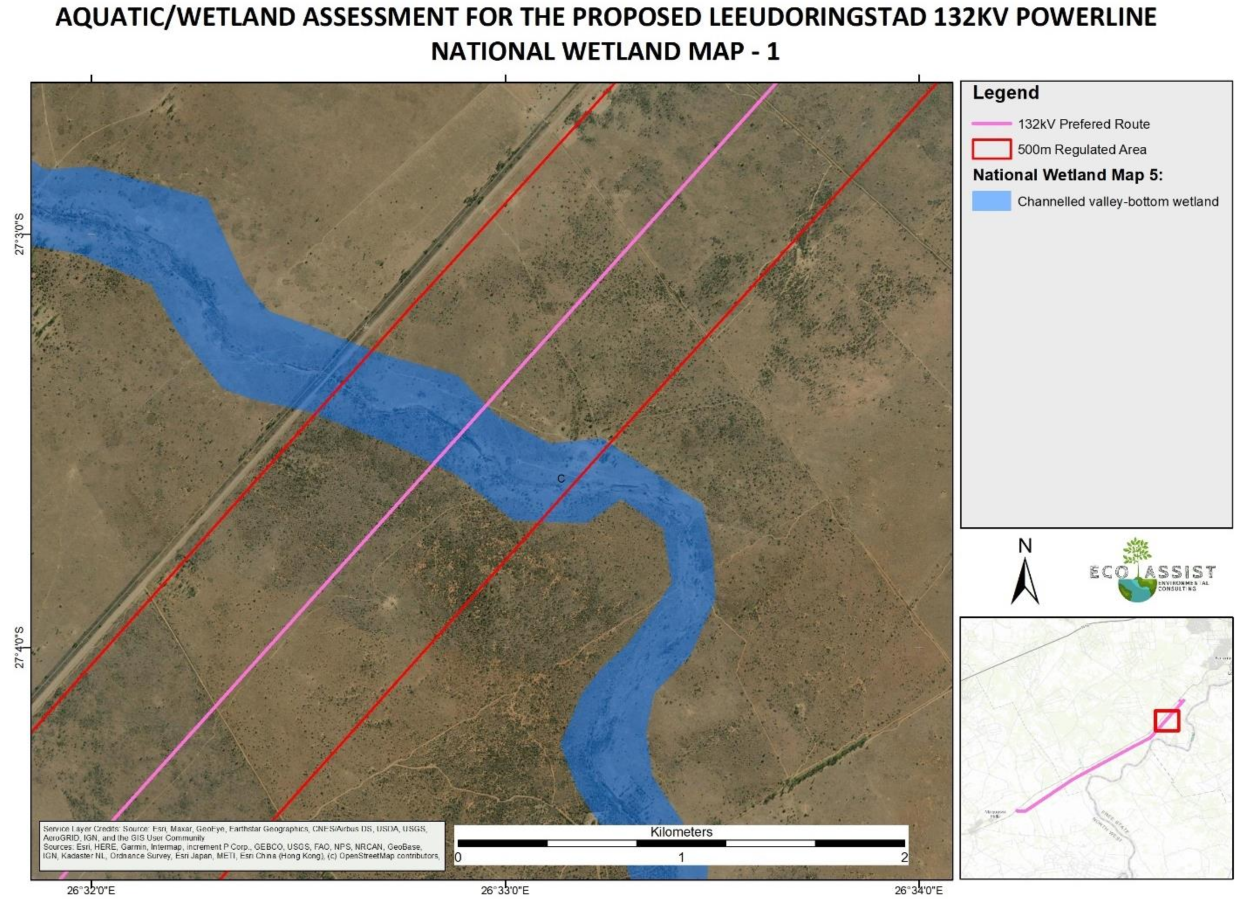

Figure 8-2: The SAIIAE wetlands associated with the project area (map 1).

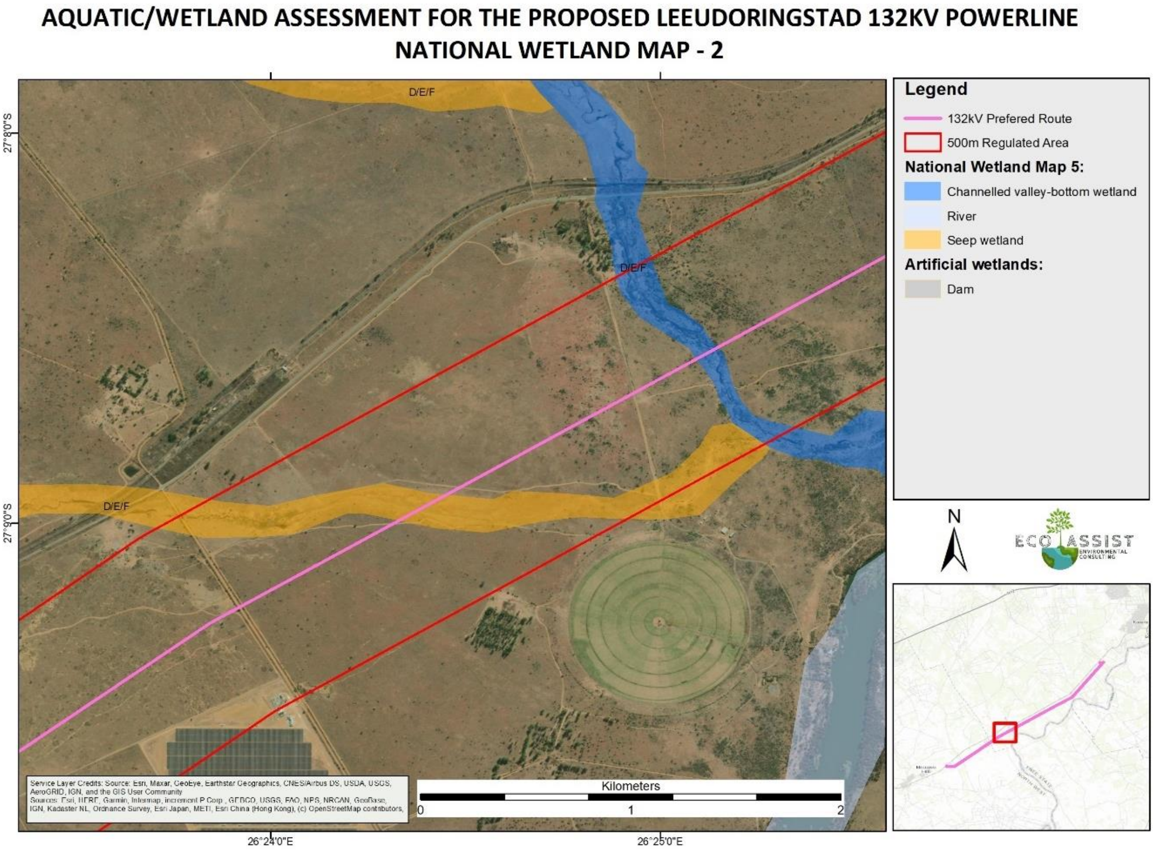

Figure 8-3: The SAIIAE wetlands associated with the project area (map 2).

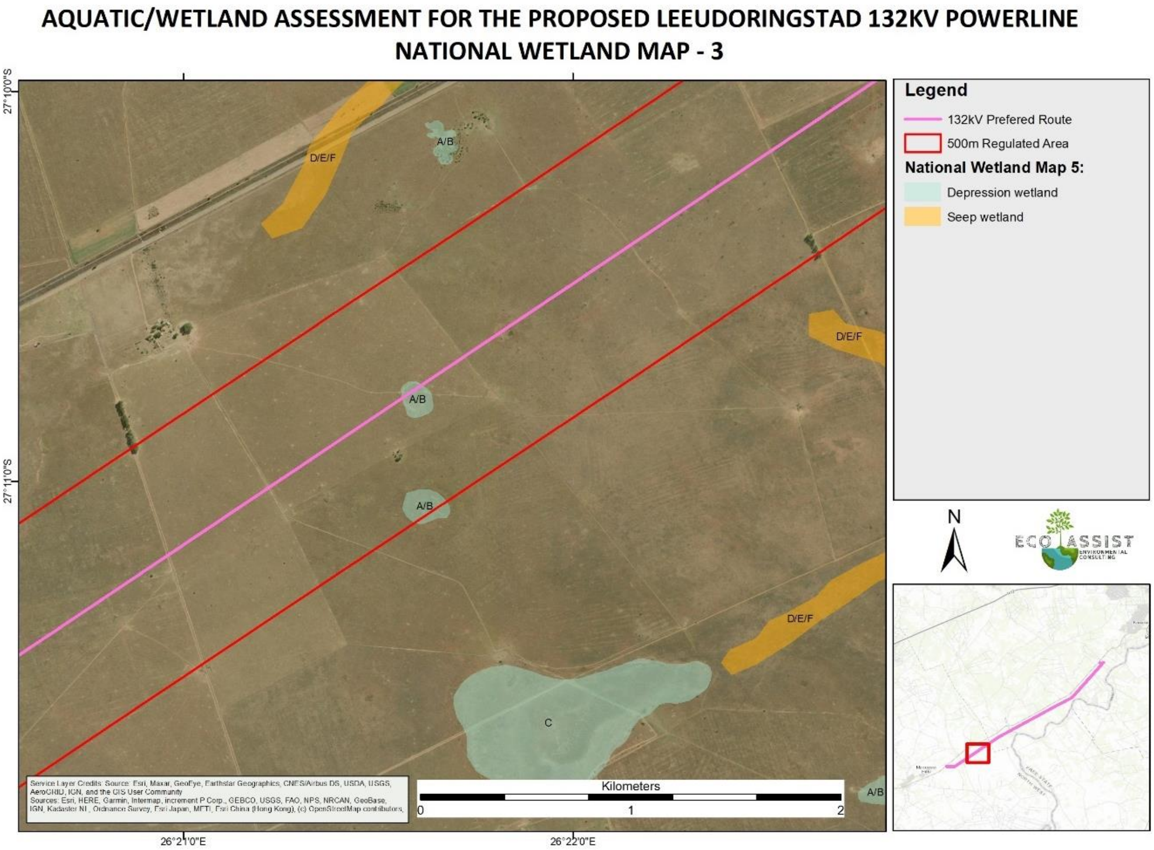

Figure 8-4: The SAIIAE wetlands associated with the project area (map 3).

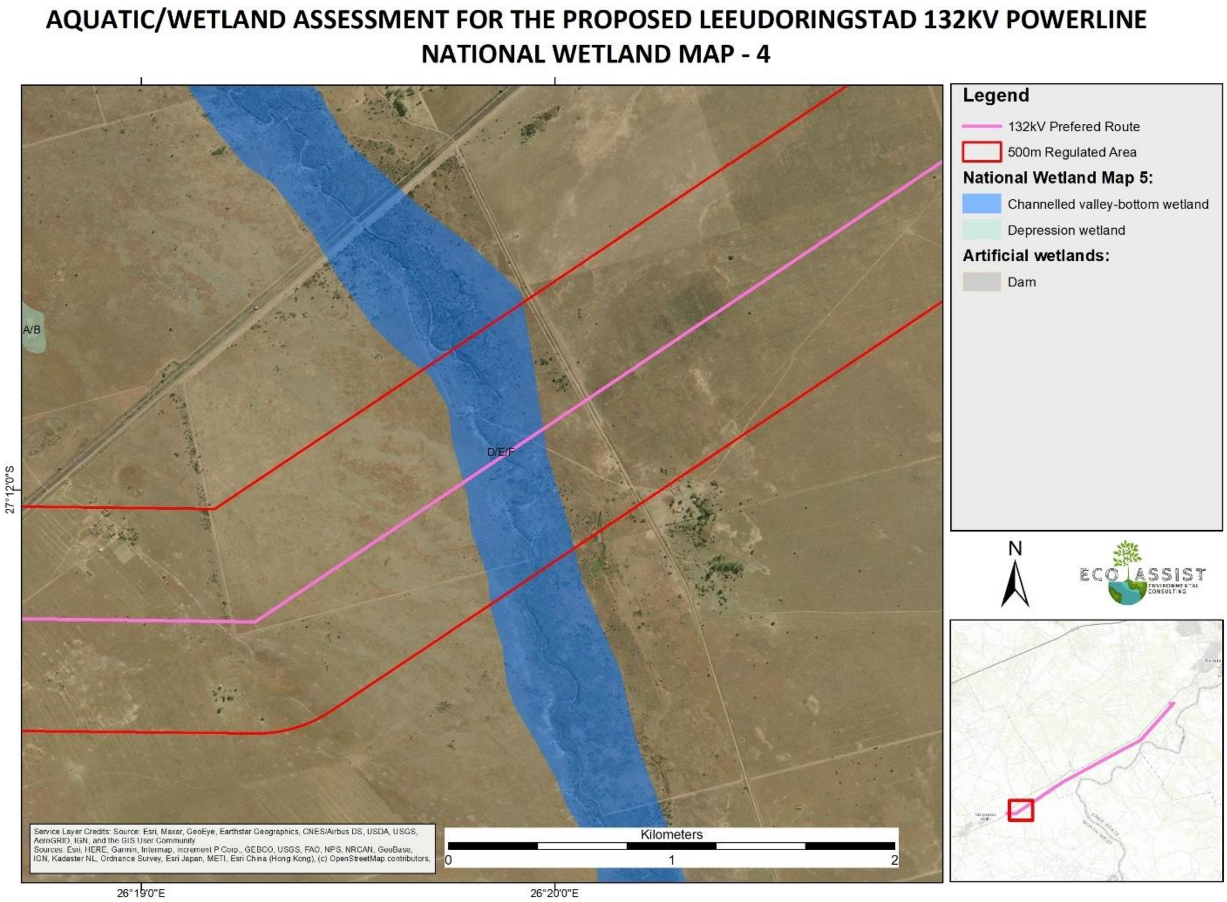

Figure 8-5: The SAIIAE wetlands associated with the project area (map 4).

8.3 Watercourse Delineation and Classification

The wetland survey was conducted in October 2022 which is within the beginning of the wet season. A hand-held auger and a GPS phone were used to log all information in the field. The wetlands within the 500m regulated area were identified in some areas and delineated in accordance with the DWAF (2005) guidelines. The wetland delineation for the 500m regulated area is shown in Figure 8-10 to Figure 8-18. The wetlands identified are listed in Table 8-1 and were categorised into 11 HGM units based on the similarities and impacts within these wetlands.

The wetland types were represented in the delineation which consisted of a riverine, channelled valley bottom, depression, and Hillslope Seep wetland types (Figure 8-6 to Figure 8-8).

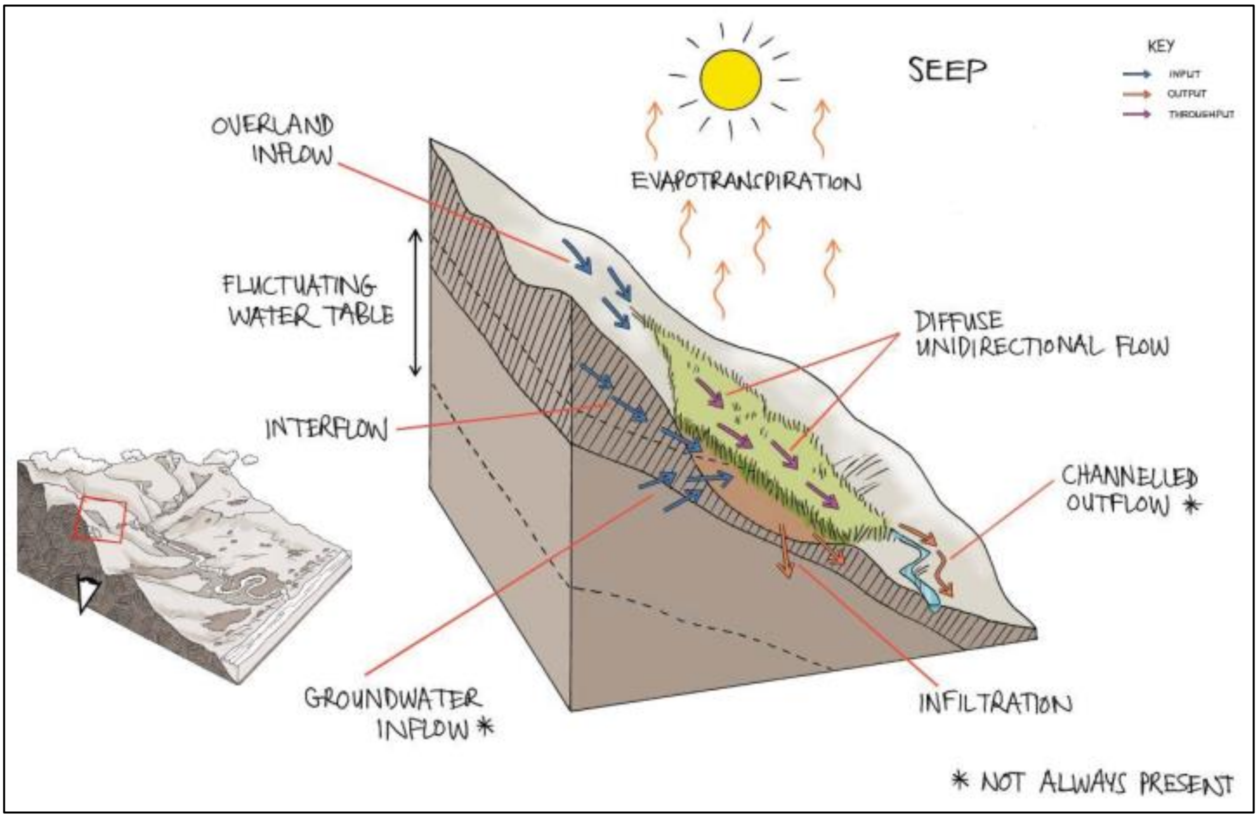

Figure 8-6: Seep Wetland Type (Ollis et al., 2013)

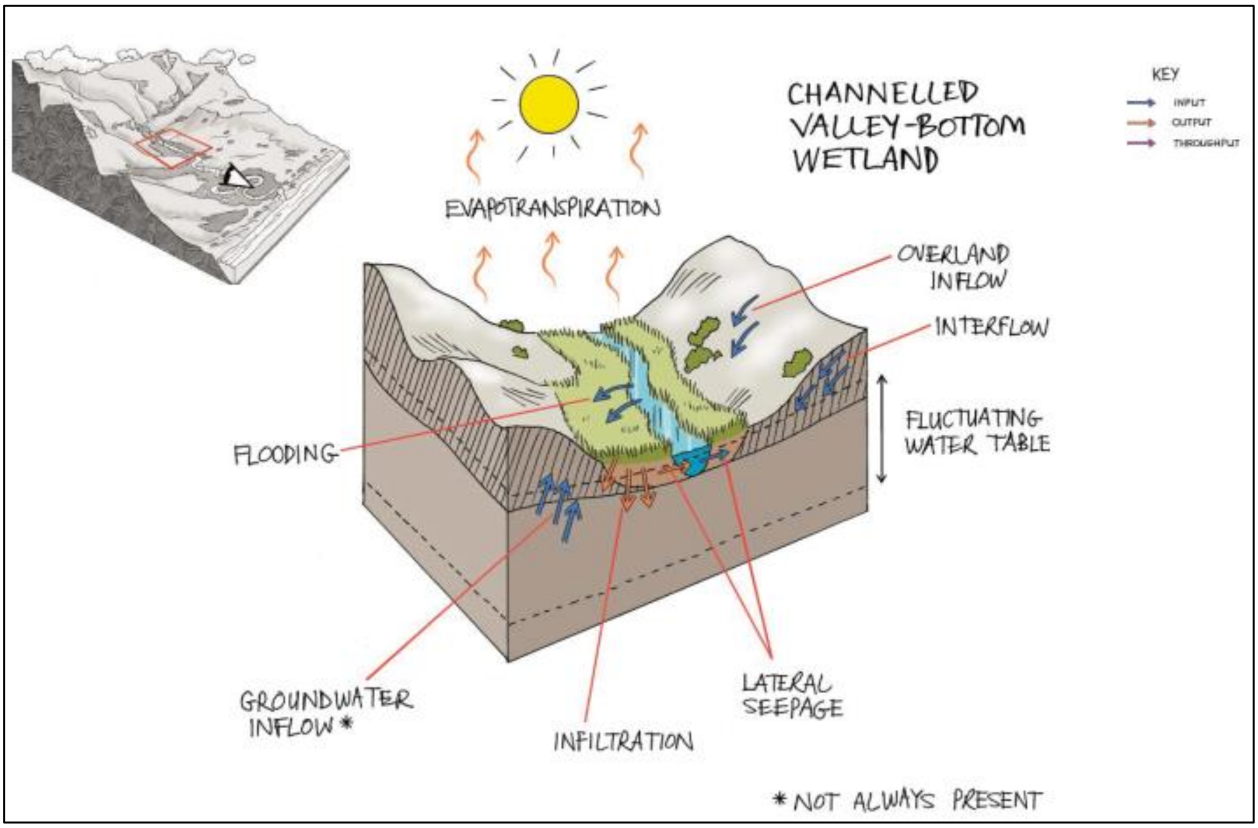

Figure 8-7: Channelled valley bottom Wetland Type (Ollis et al., 2013)

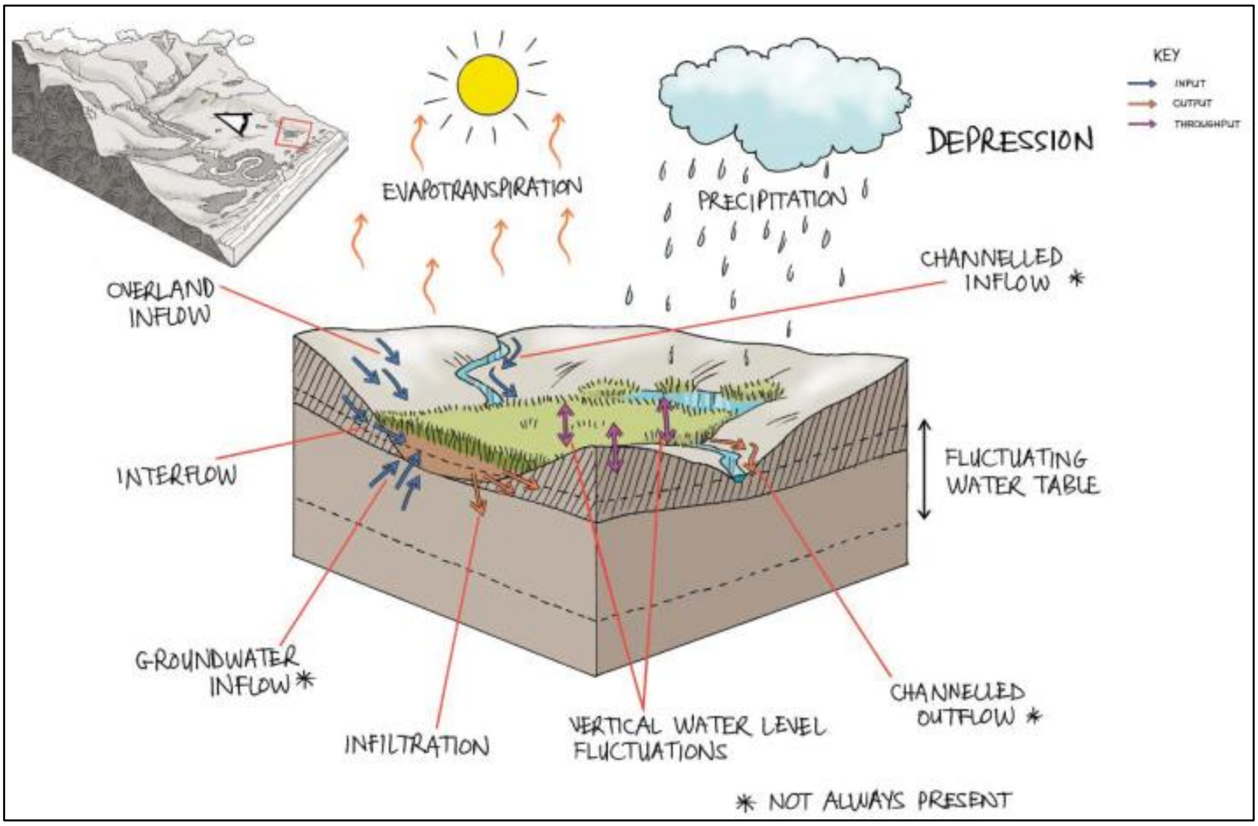

Figure 8-8: Depression Wetland Type (Ollis et al., 2013)

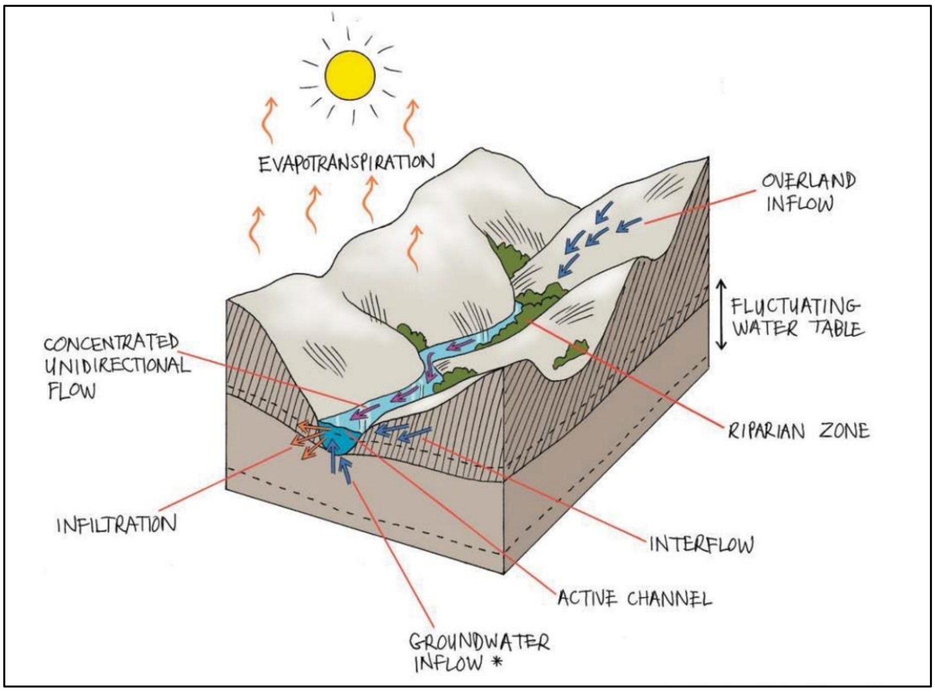

Figure 8-9: Riverine Watercourse Type (Ollis et al., 2013)

Table 8-1: Wetland Classification within 500m screening area

Wetland System Unit	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg Group/s	Landscape Unit	4A (HGM)	4B	4C
HGM 2	Inland	Highveld Ecoregion	Dry Highveld Grassland	Valley Bottom	Riverine	N/A	N/A
HGM 3	Inland			Valley Bottom	Channelled Valley Bottom	N/A	N/A
HGM 4	Inland			Valley Bottom	Channelled Valley Bottom	N/A	N/A
HGM 5	Inland			Valley Bottom	Channelled Valley Bottom	N/A	N/A
HGM 6	Inland			Valley Bottom	Channelled Valley Bottom	N/A	N/A
HGM 8	Inland			Bench	Depression	Exhoreic	Without channelled inflow
HGM 9	Inland			Bench	Depression	Exhoreic	Without channelled inflow
HGM 10	Inland			Bench	Depression	Exhoreic	Without channelled inflow
HGM 11	Inland			Slope	Seep	With channelled outflow	N/A
HGM 12	Inland			Slope	Seep	With channelled outflow	N/A
HGM 13	Inland			Slope	Seep	With channelled outflow	N/A

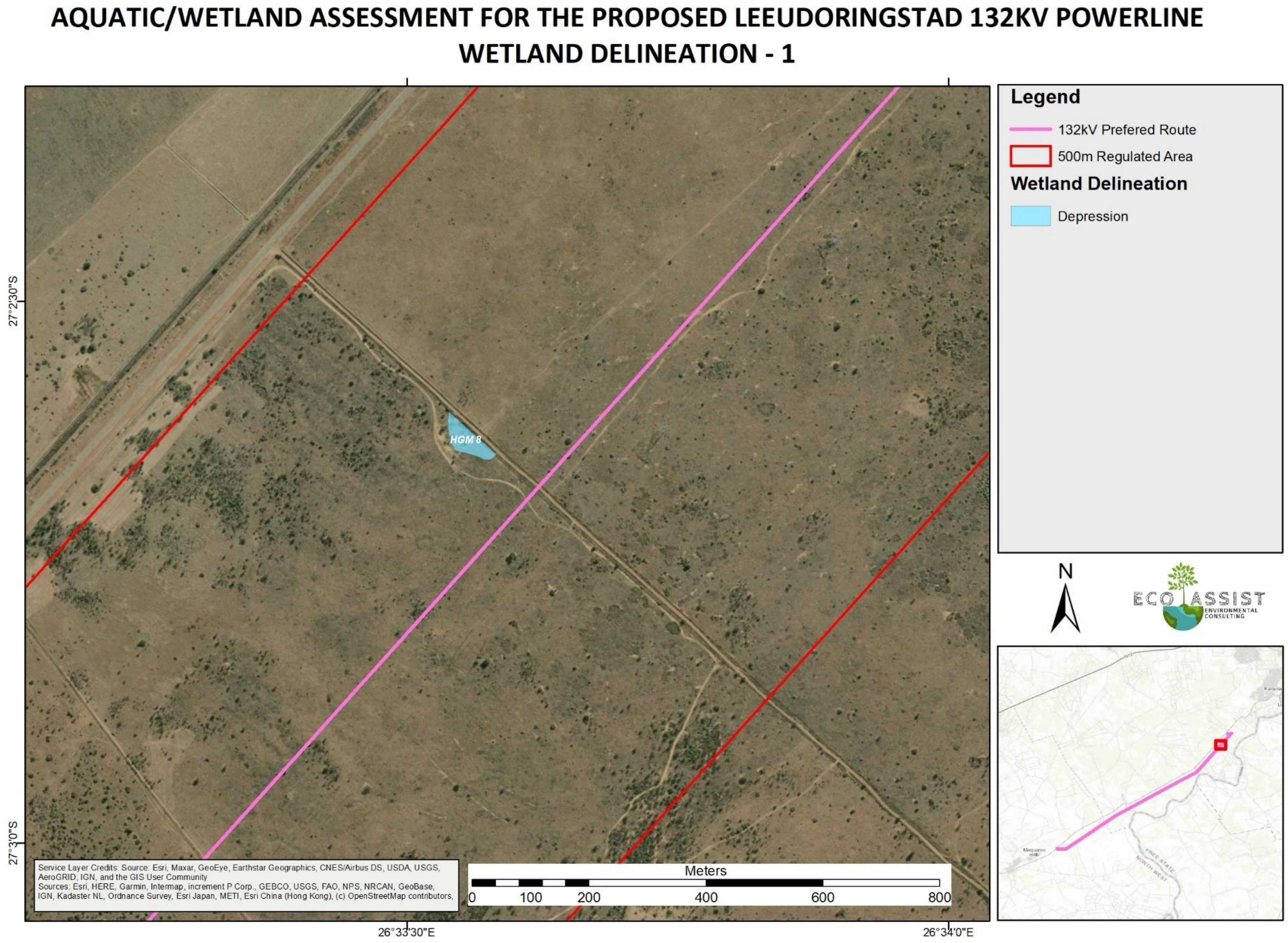

Figure 8-10: Wetland delineations for the proposed project area – Map 1.

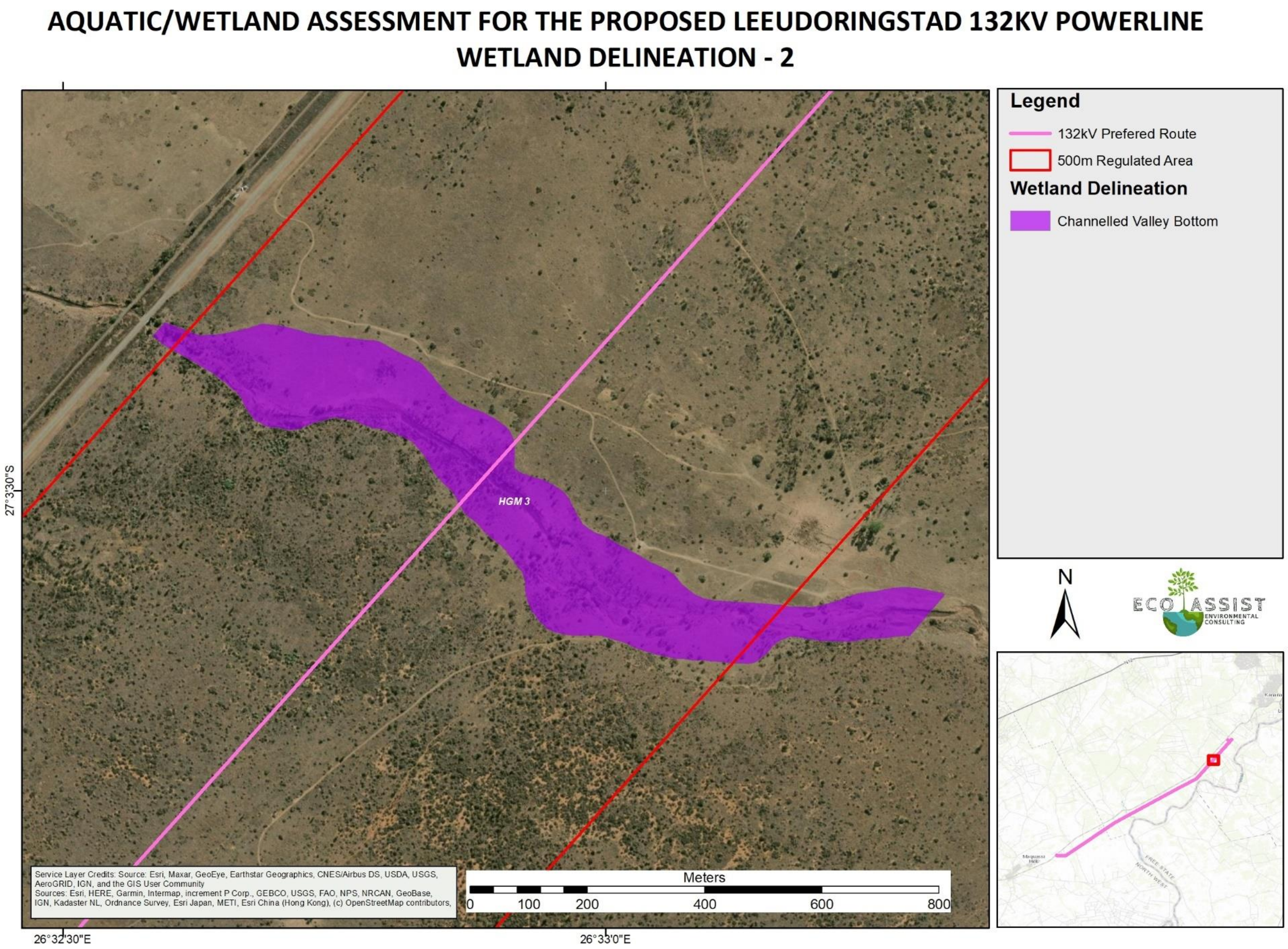

Figure 8-11: Wetland delineations for the proposed project area – Map 2.

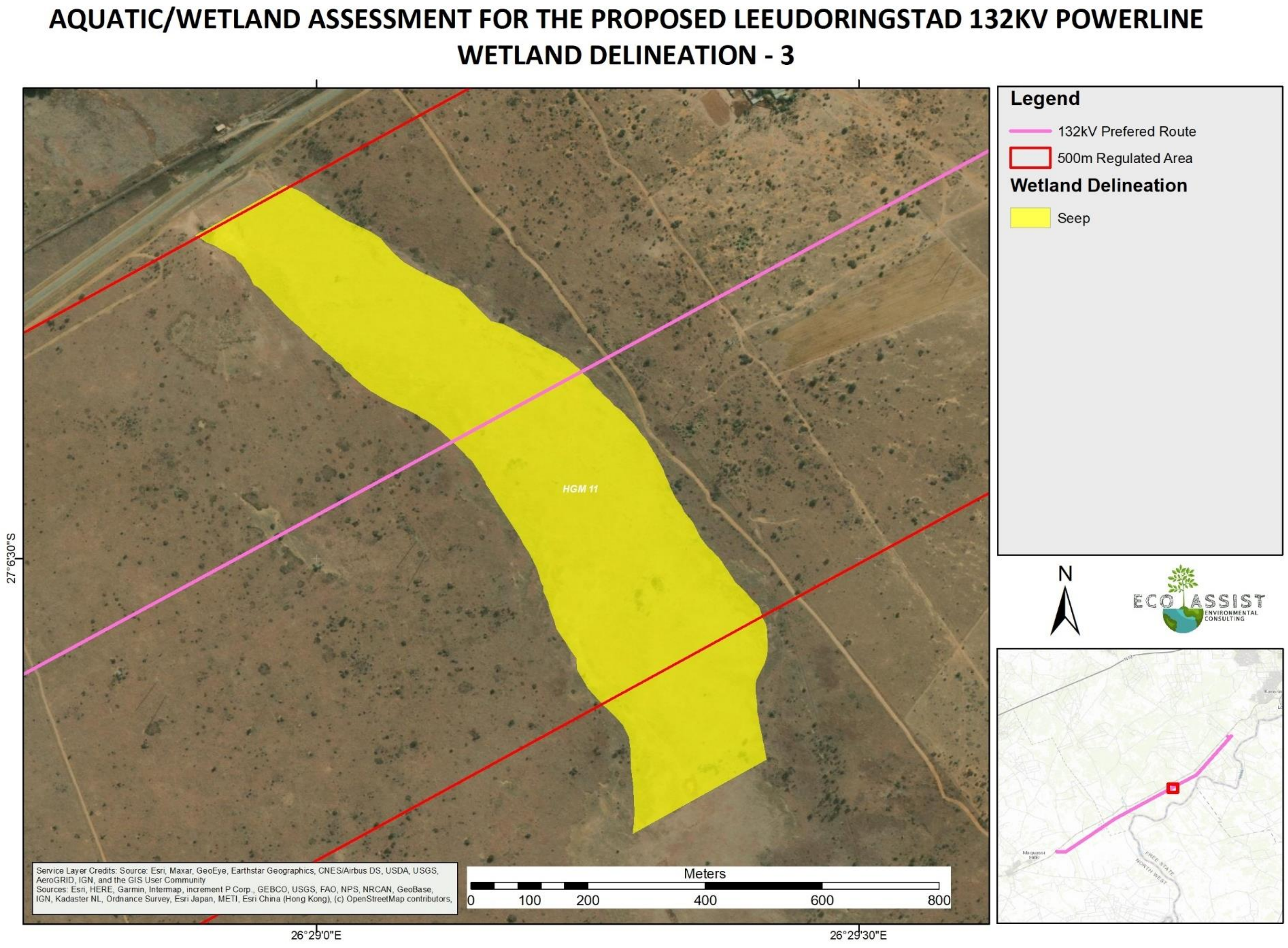

Figure 8-12: Wetland delineations for the proposed project area – Map 3.

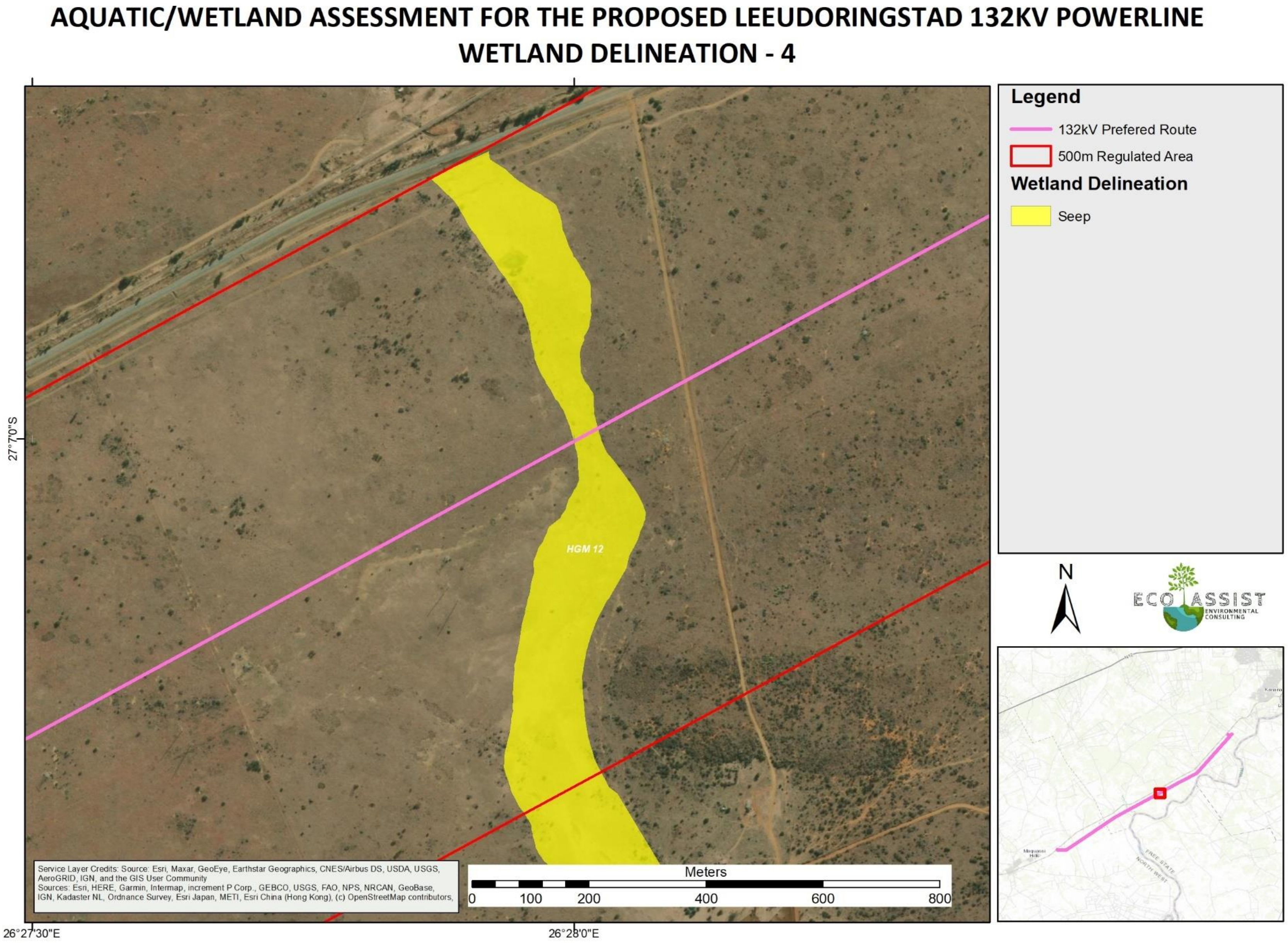

Figure 8-13: Wetland delineations for the proposed project area – Map 4.

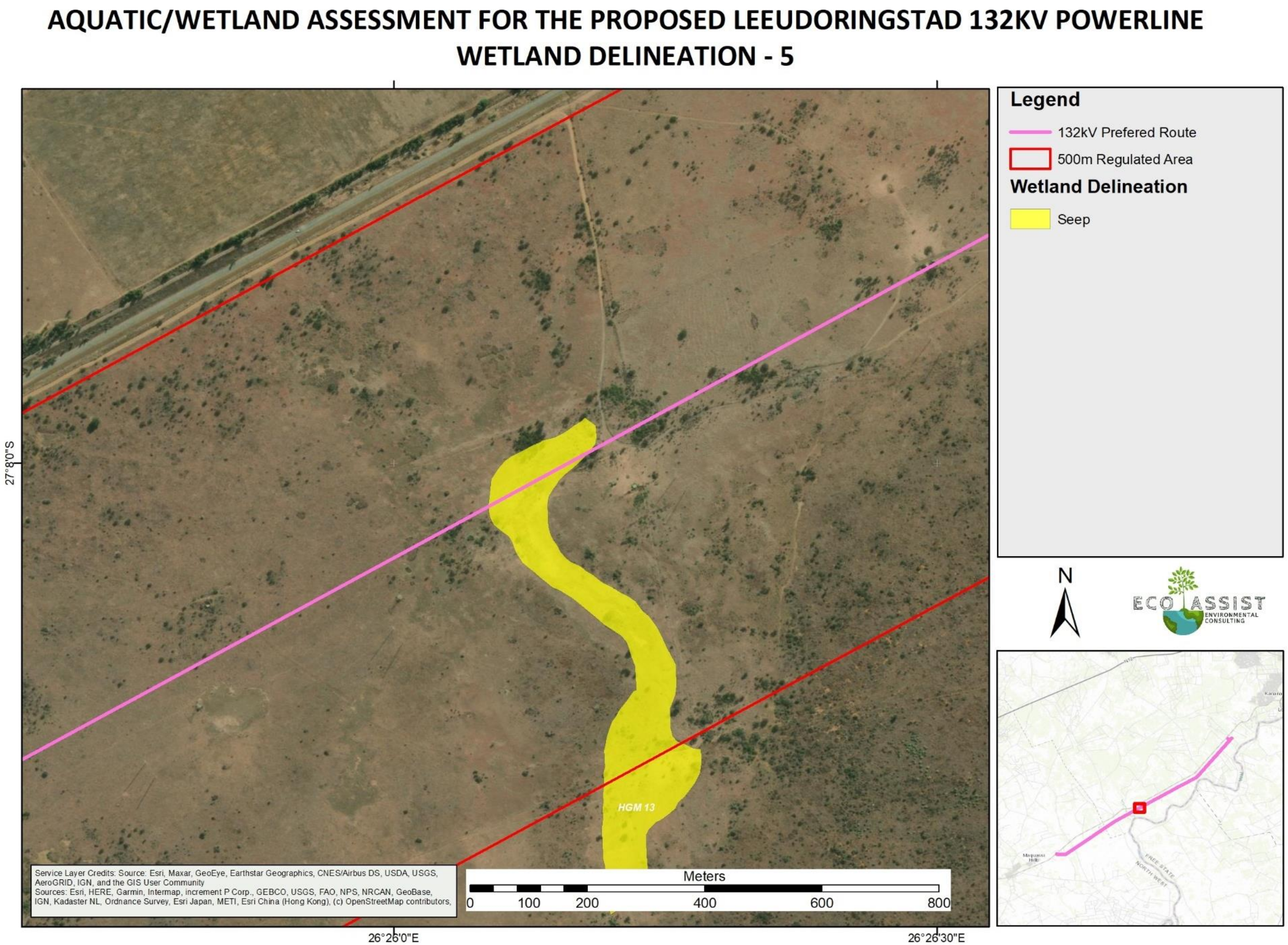

Figure 8-14: Wetland delineations for the proposed project area – Map 5.

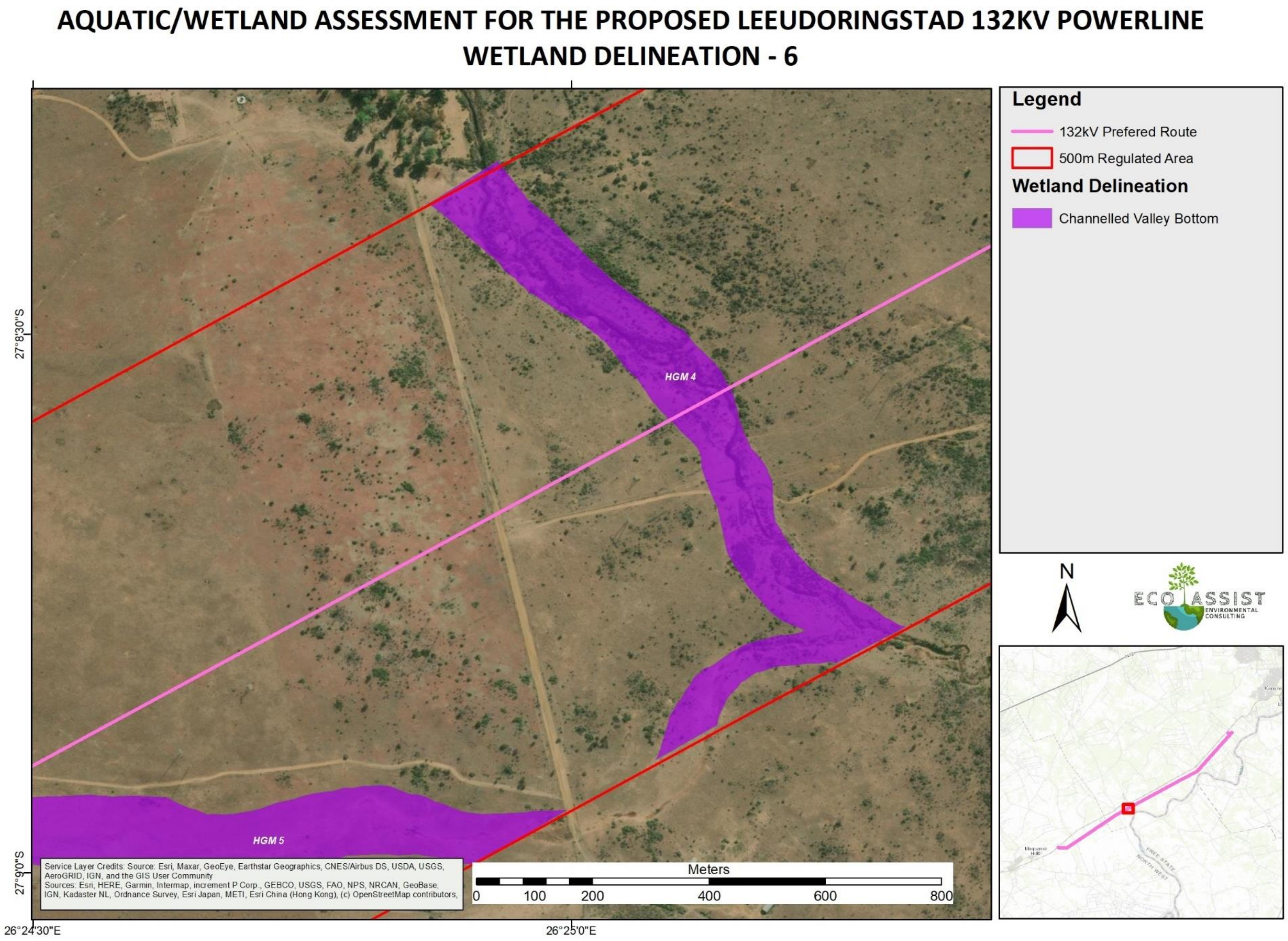

Figure 8-15: Wetland delineations for the proposed project area – Map 6.

AQUATIC/WETLAND ASSESSMENT FOR THE PROPOSED LEEUDORINGSTAD 132KV POWERLINE
WETLAND DELINEATION - 7

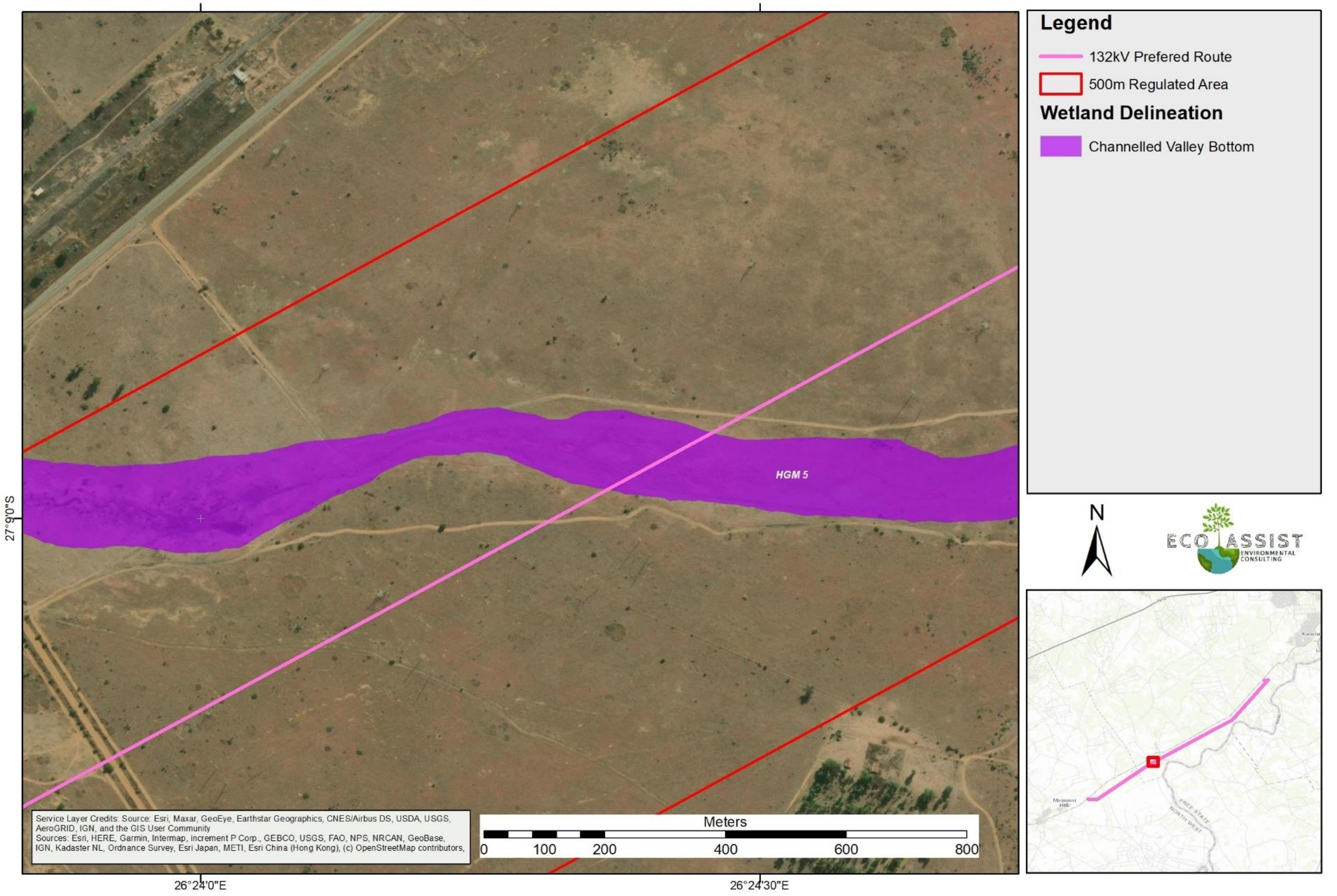

Figure 8-16: Wetland delineations for the proposed project area – Map 7.

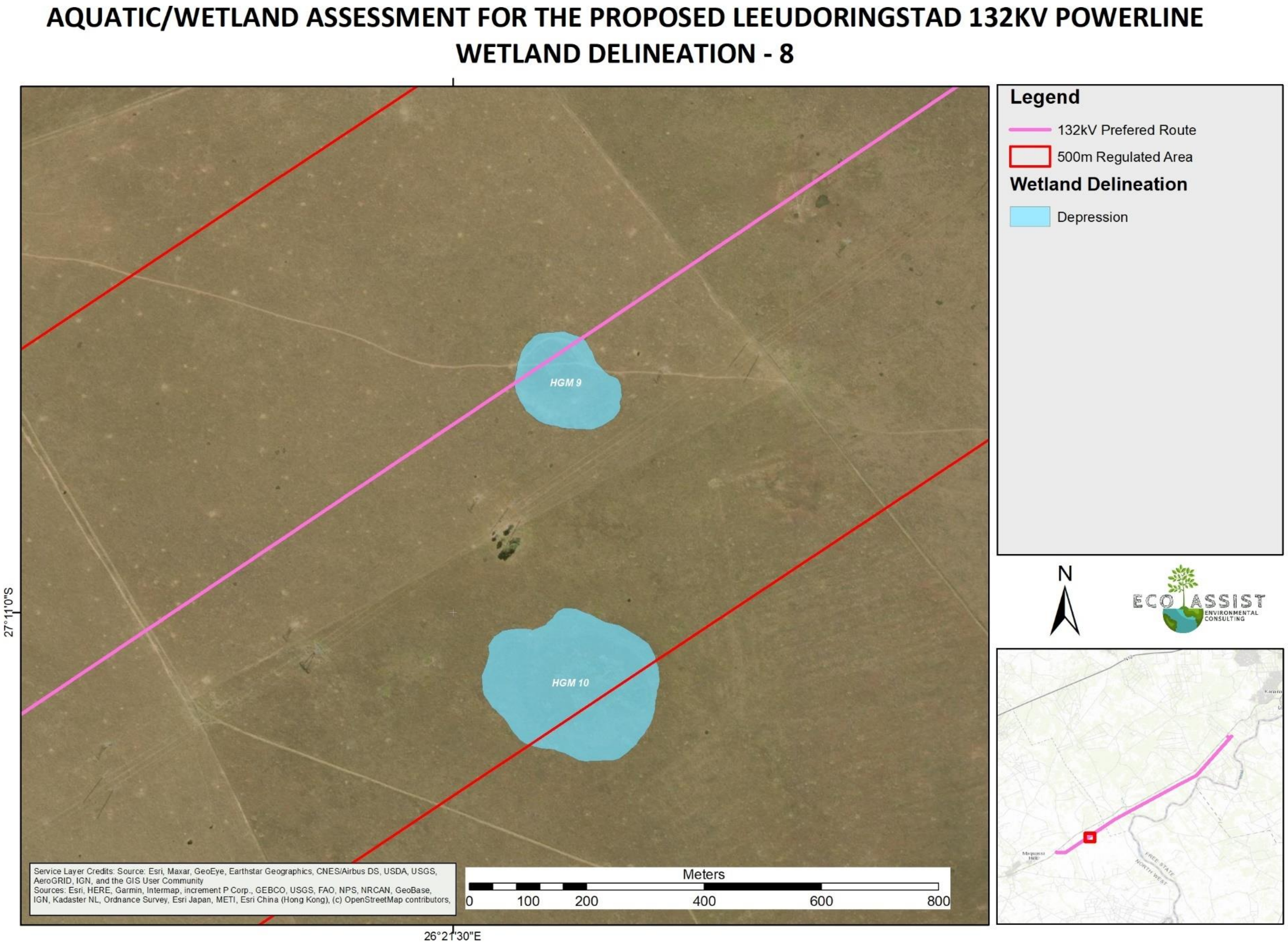

Figure 8-17: Wetland delineations for the proposed project area – Map 8.

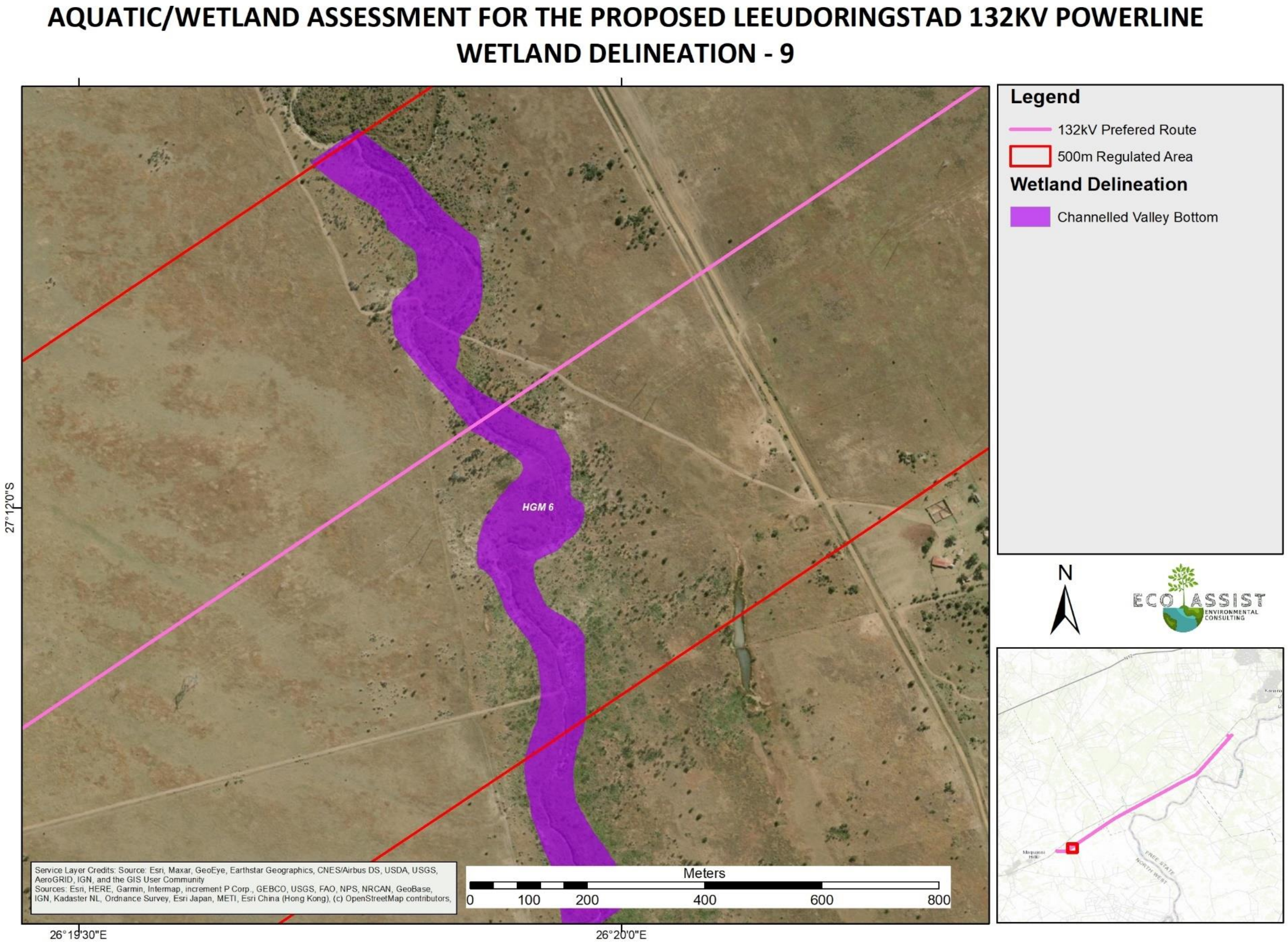

Figure 8-18: Wetland delineations for the proposed project area – Map 9.

8.4 Aquatic Ecology Findings

The desktop information relevant to the assessment is provided in Table 8-2.

Table 8-2: Relevant Desktop Information (DWS, 2019)

SQR	River Name	Ecological Status	Ecological Importance	Ecological Sensitivity
C24H-01979	Skoonspruit	Class D	Moderate	Low
C24J-01772	Ysterspruit	Class C	High	High
C24J-01861	Matjiespruit	Class C	High	High
C25A-02090	Klipspruit	Class C	Moderate	Moderate
C24J-02016	Vaal	Class C	High	High

8.4.1 Water Quality

The results of the water quality analysis are presented in Table 8-3.

Table 8-3: In situ water quality results (October 2022)

Site	pH	Conductivity (mS/m)	DO (mg/l)	Temperature (°C)
RQO/TWQR	**6.5-9.5****	**-**	**>5.00****	**5-30****
S1	8.4	76	5.2	19
S2	7.6	62	5.9	18
S3	7.2	49	5.3	18
S4	7.2	65	6.1	21
S5	7.1	53	5.8	19
S6	7.3	46	5.2	18
S7	7.9	63	5.1	19
S8	7.8	62	5.2	19
**Target Water Quality Guidelines (DWAF, 1996) Red shading indicates values exceeding thresholds				

The results of the water quality analysis show elevated pH in watercourses with urbanised catchments such as S1. The remaining pH levels were largely within the neutral range and not indicative of a pH which would negatively impact aquatic biota. The levels of conductivity ranged from 49 mS/m to 76 mS/m. Watersheds with high contributions of landcover to the urban and cultivated components typically had higher levels of dissolved solids, whilst more natural watersheds were comparably lower. The dissolved solid concentrations are however higher than what would have been expected under reference conditions. The concentrations of dissolved oxygen and water temperature were indicated to be natural.

Observations made during the survey indicated high levels of suspended solid runoff from recent rainfall in the systems assessed. The levels of turbidity in S1 are expected to be higher due to the presence of an urbanised watersheds. Furthermore, negative water quality conditions were also expected as a result of non-point and point source sewage contamination which is common in urbanised watersheds. Prior to the riverine survey in Late October, during the wetland survey, indications for eutrophication in the minor watercourses were also noted as presented in Figure 8-26.

In conclusion the water quality results indicate elevated dissolved solid concentrations where impacts from surrounding land use have altered the water quality condition from reference conditions.

Figure 8-19: High turbidity levels at S1 (October 2022)

8.4.2 Habitat Quality

To further characterise the condition of the instream and riparian habitat of the riverine watercourses the IHIA was completed. The results of the land cover analysis are presented in Figure 8-24. The habitat condition assessment is presented in Table 8-4 and Table 8-5.

As indicated in the landcover analysis, most of the watersheds conformed to the rural land cover classification, whilst natural areas were confined to the grassland landcover class, this landcover is utilised for livestock agriculture and therefore is considered to be semi-natural. Landcover within the HGM1 watershed was however found to consist of urbanised areas. Considering the modified nature of the landcover in the watersheds, modified runoff velocities and volumes were expected thus resulting in changes to riverbeds (substratum composition), channel morphology and natural flows (peak flow and frequency). The assessment revealed the moderately to largely modified nature of the instream and riparian habitats. This further confirms and supports the findings of the water quality and desktop assessment in that conditions are modified from reference conditions.

Examples of aspects negatively impacting the watercourses are provided in Figure 8-19, Figure 8-20, Figure 8-21, Figure 8-22, and Figure 8-23.

Table 8-4: Instream IHIA for the riverine systems (October 2022)

Criterion	Water loss	Flow mod	Bed mod	Channel mod	Water quality	Inundation	Exotic veg	Exotic fauna	Solid waste disposal	Condition
HGM1	5	12	10	13	15	5	12	0	15	60.68
HGM2	5	19	16	16	8	5	8	10	5	56.92

Criterion	Water loss	Flow mod	Bed mod	Channel mod	Water quality	Inundation	Exotic veg	Exotic fauna	Solid waste disposal	Condition
HGM6	5	10	8	12	6	5	0	0	5	75.04

Table 8-5: Riparian IHIA for the riverine systems (October 2022)

Criterion	Indigenous vegetation removal	Exotic vegetation encroachment	Bank erosion	Channel mod	Water loss	Inundation	Flow mod	Water quality	Condition
HGM1	15	12	8	13	5	5	12	10	59.96
HGM2	5	16	5	12	5	5	19	5	64.64
HGM6	12	5	8	12	5	5	9	5	69.4

Figure 8-20: Non-native vegetation in the Skoonspruit showing proliferation of Echorhina crassipes (October 2022)

Figure 8-21: Solid waste disposal in a minor watercourse

Figure 8-22: Typical riparian vegetation on the margins of minor watercourses (October 2022)

Figure 8-23: Typical riparian habitat in the Vaal River (October 2022)

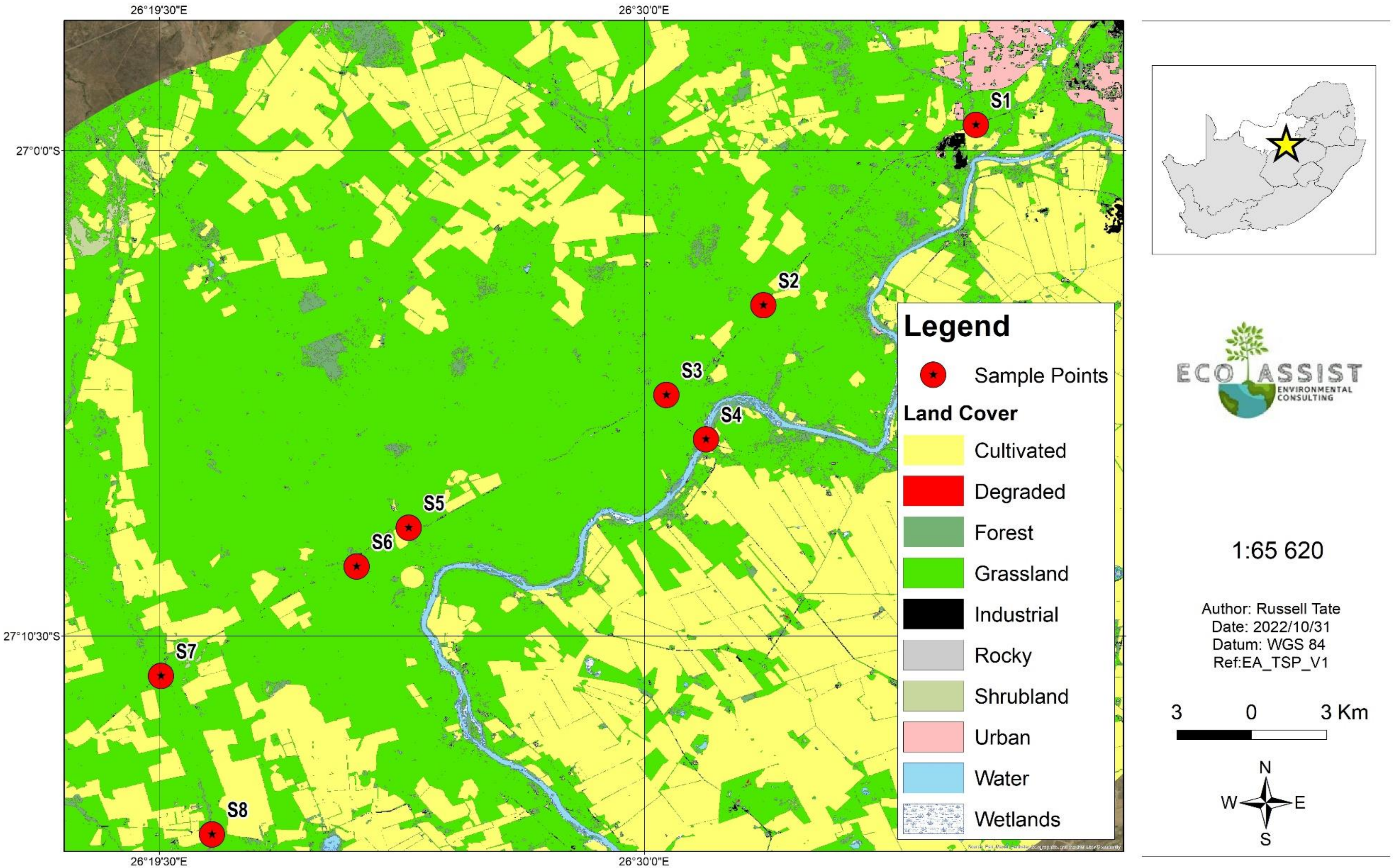

Figure 8-24: Landcover in the AoI

8.4.3 Aquatic Macroinvertebrates

The results of the biotope assessment are provided in Table 8-6. The invertebrate habitat present in the watercourses assessed typically consisted of the marginal vegetation biotope whereby rocky substrates were typically absent. Despite heavy precipitation prior to the survey most of the watercourses assessed did not have flowing water. The results of the biotope analysis indicate limited habitat availability for aquatic macroinvertebrates and will likely have an impact on the diversity of invertebrates within the sampling points. An example of the typical habitat type is presented in Figure 8-1. The results of the SASS5 assessment are presented in Table 8-7.

Figure 8-25: Stands of marginal vegetation serving as diverse habitats for aquatic macroinvertebrates (October 2022)

Table 8-6: Invertebrate Biotope Assessment Results (October 2022)

Biotope	S1	S2	S5	S6	S7	S8
Hydraulic Biotope	**Pool**	**Pool**	**Pool**	**CVB**	**Pool**	**Pool**
Stones in current	0	0	0	0	0	0
Stones out of current	0	2	0	0	0	0
Bedrock	0	1	0	0	0	0
Aquatic Vegetation	0	0	3	0	0	0
Marginal Vegetation in Current	1	1	1	0	1	1
Marginal Vegetation Out of Current	3	2	1	2	2	2
Gravel	0	0	0	0	0	0
Sand	1	2	0	0	0	1
Mud	2	2	3	2	2	1
Biotope Score	7	10	8	4	5	5
Weighted Biotope Score (%)	16	20	18	8	12	12

Biotope	S1	S2	S5	S6	S7	S8
Hydraulic Biotope	**Pool**	**Pool**	**Pool**	**CVB**	**Pool**	**Pool**
Biotope Category (Tate and Husted, 2015)	F	F	F	F	F	F

Table 8-7: SASS5 Score in the AoI (October 2022)

Site	SASS Score	No. of Taxa	ASPT*	Category (Dallas, 2007)**
S1	40	10	4.0	**E/F**
S2	53	14	3.7	**D**
S5	67	15	4.4	**C**
S6	23	7	3.2	**E/F**
S7	58	15	3.8	**D**
S8	56	14	4.0	**D**
*ASPT: Average score per taxon **Kalahari Ecoregion (Dallas, 2007)				

The results of the SASS5 assessment indicated varied invertebrate classifications from seriously modified (class E/F) to moderately modified (class D). The aquatic macroinvertebrate assemblage observed at the sampling points were typical of tolerant taxa where a complete absence of sensitive families was noted. Under reference conditions contributions to the assemblage by the orders Ephemeroptera and Trichoptera would usually be high, however under the observed conditions no Trichoptera and a depauperate Ephemeroptera community was observed. The results of the invertebrate assessment corroborate the habitat integrity assessments which indicate large scale watershed alteration.

8.4.4 Fish Community

The expected species list for the watercourse is provided in Table 8-8. It is noted that the expected species list provides taxa which commonly occur in the Vaal River system, this watercourse is not anticipated to be directly impacted. The fish community expected to be present in the minor watercourses, which made up the dominant habitat type of the AoI, is likely only to contain *Enteromius anoplus, Clarias gariepinus, Tilapia sparrmanii* and *Pseudocrenilabrus philander.* No listed fish species are expected to occur in the minor watercourses, with *Labeobarbus kimberleyensis* restricted to the Vaal River.

Table 8-8: Expected Fish Species (Skelton, 2001)

Species	IUCN Status (IUCN, 2022)
Enteromius anoplus	Least Concern
Enteromius paludinosus	Least Concern
Enteromius trimaculatus	Least Concern
Labeo capensis	Least Concern
Labeo umbratus	Least Concern
Labeobarbus aeneus	Least Concern
Labeobarbus kimberleyensis	Near Threatened
Clarias gariepinus	Least Concern
Austroglanis sclateri	Least Concern
Pseudocrenilabrus philander	Least Concern
Tilapia sparrmanii	Least Concern

8.4.5 Riverine Ecological Importance and Sensitivity

The results of the riverine ecological importance and sensitivity ratings is provided in Table 8-9. The results of the assessment largely conforms to the desktop information where moderate EIS was determined for the Vaal River and low EIS for the minor watercourses.

Table 8-9: Riverine Ecological Importance and Sensitivity

Biological determinants			
Determinant	**HGM1**	**HGM2**	**HGM6**
Rare and endangered biota	1	2	1
Unique biota	1	2	1
Intolerant biota	1	2	1
Species richness	1	2	1
Habitat determinants			
Diversity of aquatic habitat	1	2	1
Refuge value of habitat types	1	2	1
Sensitivity of habitat to flow modification	1	2	1
Sensitivity to flow related water quality changes	1	2	1
Migration route corridor for instream and riparian biota	1	2	1
National parks and wilderness areas	0	0	0
Mean	0.9	2.0	00.9
EIS class	Low	Moderate	Low

8.5 Wetland Findings

8.5.1 Wetland Survey Results

The wetland delineation identified eleven (11) wetland units and four (4) wetland types. These included;

- *One (1) riverine systems;*
- *Three (3) hillslope seeps;*
- *Three (3) Depressions; and*
- *Four (4) channelled valley bottom.*

Only the wetlands at risk were analysed during the functional assessment. This is determined on whether the wetlands will incur direct or indirect impacts. Therefore, wetlands that are a significant distance upstream, and/or away from the proposed activity, and/or are in a separate catchment will not be at risk. Also, only natural systems can be assessed (see Table 8-10).

Table 8-10: Wetlands with their associated HGM classifications for the proposed project area.

Wetland Type	HGM Unit	Potentially at Risk
Riverine (Vaal River)	HGM 2	No
Channelled Valley Bottom	HGM 3	Yes
Channelled Valley Bottom	HGM 4	Yes
Channelled Valley Bottom	HGM 5	Yes
Channelled Valley Bottom	HGM 6	Yes
Depression	HGM 8	No
Depression	HGM 9	Yes
Depression	HGM 10	Yes
Seep	HGM 11	Yes
Seep	HGM 12	Yes
Seep	HGM 13	Yes

HGM 3, 4, 5, 6, 9 ,10, 11, 12. And 13 were located within the potential risk zone. The remaining HGM units will not be at risk from the construction and operation of the proposed project.

8.5.2 Wetland Units at Risk

As described above, only some wetland units are at risk based on the inherent location of the powerline infrastructure in spatial relations to the water resources. These HGM units are described briefly below.

Channelled valley bottom (HGM 3):

HGM 3 is a relatively large system with cattle and wild life grazing as the main land use. The direction of flow is in the south-easterly direction with evidence of eutrophication within the watercourse (see Figure 8-26). Several alien vegetation species can be seen on the banks of the active channel. The existing powerline was constructed with the transmission towers outside of the water resource boundaries. The same principle must be followed.

Figure 8-26: Channelled valley bottom of HGM 3 (October 2022)

Channelled valley bottom (HGM 4 and HGM 5):

These two channelled valley bottom systems are smaller than HGM 3 but have similar properties. The catchment land use is still grazing for cattle and game farms. The direction of flow is in the easterly direction for HGM 4 and north-easterly for HGM 5, with evidence of eutrophication within the watercourse (see Figure 8-27). Several alien vegetation species can be seen on the banks of the active channel. The existing powerline was constructed with the transmission towers outside of the water resource boundaries. The same principle must be followed.

Figure 8-27: Channelled valley bottom of HGM 4 (October 2022)

Figure 8-28: Channelled valley bottom of HGM 5 (October 2022)

Channelled valley bottom (HGM 6):

HGM 6 is located at the south-western end of the transmission line and a clear change in geology and soil composition has occurred. The soils are darker at the surface with clear gleyed and bleached characteristics in the sub-horizons. The channel is also dry, but it is anticipated that flow occurs during the wet season (see Figure 8-29).

The existing powerline was constructed with the transmission towers outside of the water resource boundaries. The same principle must be followed.

Figure 8-29: Channelled valley bottom of HGM 6 (October 2022)

Depression (HGM 9 and HGM 10):

Two (2) small depressions were identified to be at risk. These systems appeared to be dry, however play an important role during the wet season. The soil depth and geology play a large role in the hydrological functioning as these depressions are formed on shallow soils with impermeable bedrock layer limiting infiltration.

The existing powerline was constructed with the transmission towers outside of the water resource boundaries. The same principle must be followed. Powerline 132kV alternative 2 is recommended as this will miss the depression wetland area, however if Alternative 1 is selected then the spanning with the powerline must be done during the dry season.

Figure 8-30: Depression systems present in the powerline servitude (October 2022)

Hillslope seeps (HGM 11 to HGM 13):

Three (3) hillslope seeps were identified to be at risk. These systems were wide, and the areas were used for grazing (see Figure 8-31). The soil depth and geology play a large role in the hydrological functioning as these seeps are formed on shallow soils with impermeable bedrock layer limiting infiltration. Due to the shallow slopes water moves slowly laterally along the lowest points in the landscape, creating hillslope seeps. The seeps all drain in and easterly direction.

The existing powerline was constructed with the transmission towers outside of the water resource boundaries. The same principle must be followed.

Figure 8-31: One of the wetlands seeps found on site (October 2022)

8.5.3 Hydric Soils Indicators

The prolonged waterlogging and saturation of soils results in the occurrence of anaerobic conditions (no molecular oxygen present) and the formation of distinct soil features like the loss of soil colour (called 'gleying') and mottles. The loss of soil colour is a result of the reduction of mineral oxides in the soil under saturated soil conditions and mottles are concentrated mineral oxide deposits that precipitate out of solution during the drying of the soil in the dry season. Soils characterized by these features are referred to as hydric soils (Edwards, et al., 2018).

The survey was conducted during the dry season in October 2022. This did not limit the use of vegetation as an indicator; however, the area is used for grazing of cattle, and this did pose a limitation in the identification of vegetation as an indicator in some areas. The soils were the dominant indicator in areas that were not yet disturbed. The geology is fairly impermeable limiting infiltration into groundwater zones, as a result of a thick hard plinthic layer which formed on sandstone (see C in Figure 8-32). Therefore, water predominantly moves along the soil/bedrock interface (interflow hydropedological class). This leads to the accumulation of water within the vadose zone and therefore the formation of hillslope seeps is evident. The permanent zones were classified by identifying the Katspruit soil forms (see A in Figure 8-32) and Westleigh soil forms where indicative of the seasonal/temporary zones (See B in Figure 8-32).

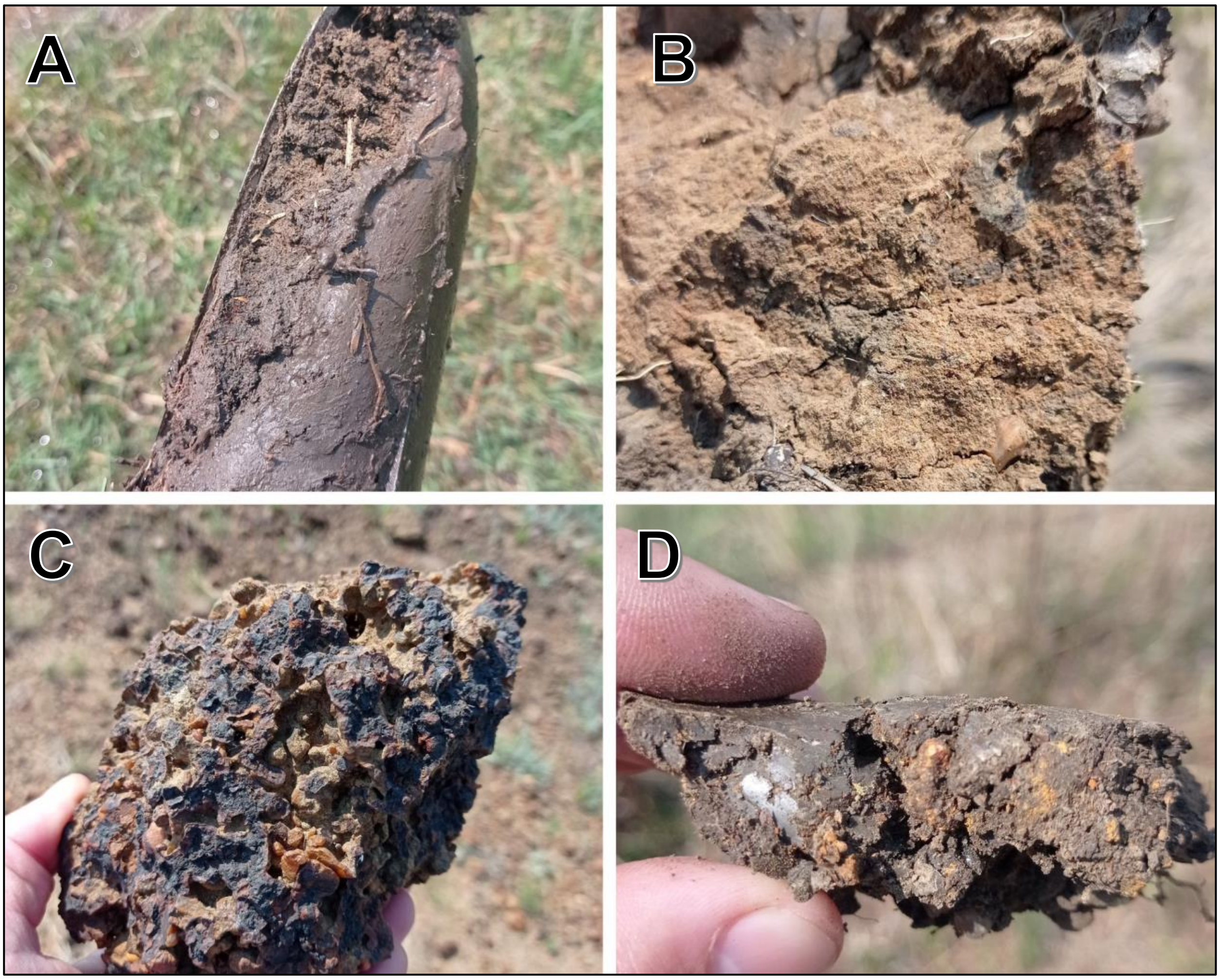

Figure 8-32: The soils within the project area. A) Katspruit soil, B) Mottled Westleigh soil, C) Hard Plinthite layer, D) Wet Glenrosa soil. (October 2022).

8.5.4 Hydromorphic Vegetation Indicators

Hydrophytes are plants that can survive and reproduce in anaerobic soil conditions. Plants require oxygen to live and typically take up oxygen from the soils via their roots. Such oxygen is absent for all, or part of the year, in hydric soils. Thus, hydrophytes have evolved special features/adaptations that enable oxygen to be taken from the atmosphere via their leaves and transported internally. For this reason, leaves and stems of wetland plants are often hollow and/or spongy (Edwards, et al., 2018).

The survey was conducted during the late dry season. The wetland vegetation identification was limited due to grazing of the project area. The wetland vegetation identified within the project area included;

- *Phragmites australis;*
- *Typha Capensis;*
- *Cyperus spp.;*
- *Persicaria spp.;*

- *Schoenoplectus decipiens;*
- *Agrostus lachnantha; and*
- *Schoenoplectus spp..*

The above list is by no means a comprehensive account of the wetland vegetation present on site, but merely a snapshot of the diversity that was identified.

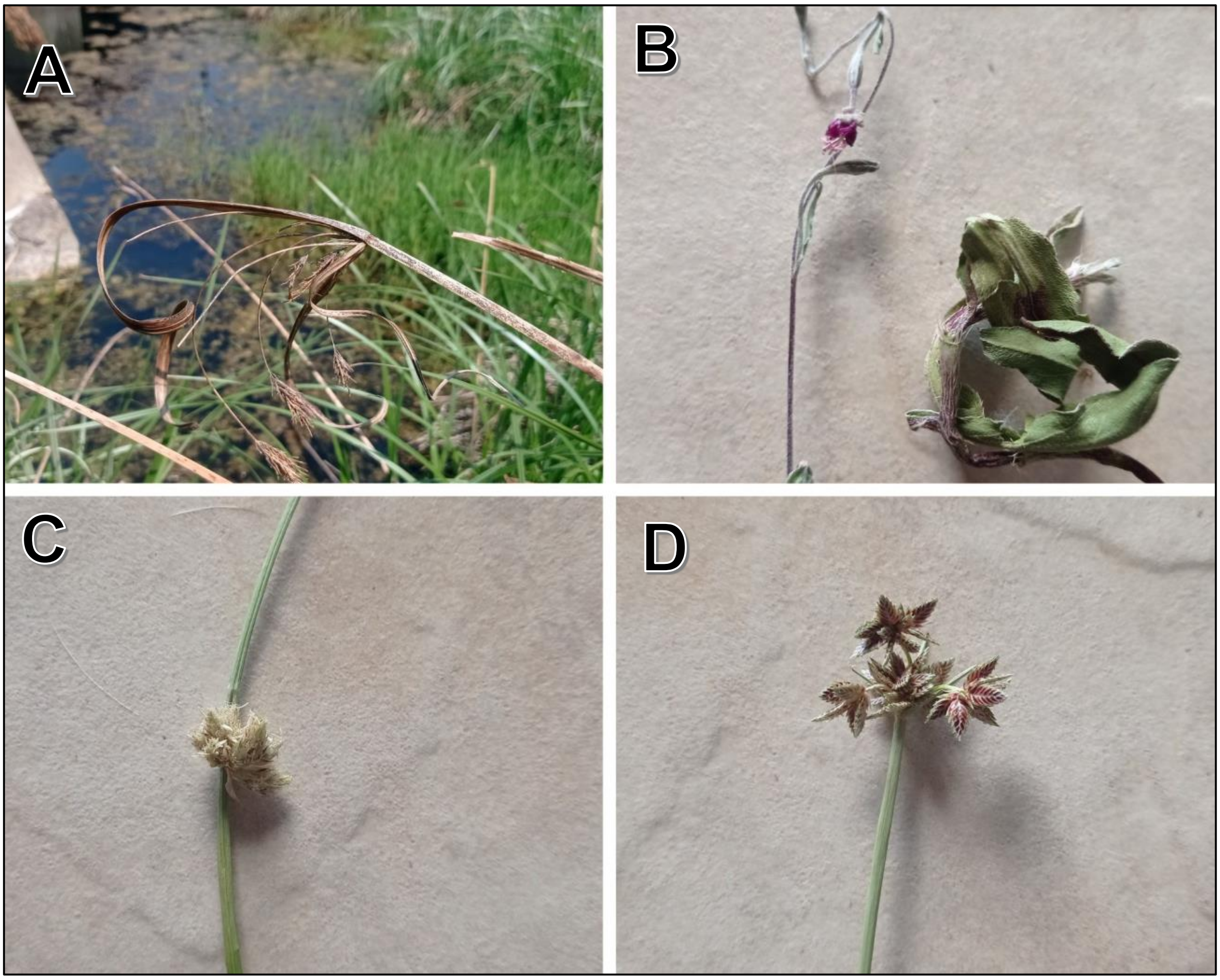

Figure 8-33: Some of the wetland vegetation within the project area. A) Cyperus spp., B) Persicaria spp., C) Schoenoplectus decipiens, D) Cyperus marginatus. (October 2022).

8.5.5 Present Ecological State

The PES is determined by using the WET-Health guidelines (version 2.0) set out by (Macfarlane, et al., 2020). The detailed PES ratings for HGM 3 to HGM 13 are shown in Table 8-11 to Table 8-15.

Overall Wetland Condition

The PES for all HGM units were assessed based on the current conditions of the wetland systems. All HGM units were calculated to be moderately modified (class C).

Hydrology

The hydrological component for all assessed HGM units was calculated to be moderately modified (class C).

The ratings can be attributed to the following:

- *Increased hydrological inputs from the surrounding catchment, through grazed areas with increased runoff potential.*
- *Altered inputs from topographical catchment through roads and culvert structures.*

Geomorphology

The geomorphological component for the HGM units ranged from largely natural (class B) for HGM 3, 9, 10, 11, 12, and 13, to moderately modified (class C) for HGM 4, 5, and 6. The ratings can be attributed to the following:

- *Change in sediment inputs through the altered landscape.*
- *Reduced surface roughness as a result of grazing.*
- *Artificial infilling of wetland portions through roads and culvert structures.*

Water Quality

The water quality component for the HGM units ranged from largely natural (class B) to moderately modified (class C).

Vegetation

The vegetation component for the HGM units ranged from moderately modified (class C) to seriously modified (class E). The ratings can be attributed to the following:

- *The surrounding land use and wetland zones have been altered by reduced vegetation cover as a result of livestock grazing practises.*
- *Areas of alien vegetation infestation.*
- *Increased nutrients alter the vegetation composition.*

Table 8-11: Summary of the Present Ecological State (PES) scores for HGM 3.

Wetland PES Summary				
Wetland name	Leeudoringstad			
Assessment Unit	HGM 3			
HGM type	Channelled VB wetland not laterally maintained			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.4	1.6	3.0	3.7
PES Score (%)	76%	84%	70%	63%
Ecological Category	C	B	C	C
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	2.6			
Combined PES Score (%)	74%			
Combined Ecological Category	C			

Table 8-12: Summary of the Present Ecological State (PES) scores for HGM 4 & 5.

Wetland PES Summary				
Wetland name	Leeudoringstad			
Assessment Unit	HGM 4 & 5			
HGM type	Channelled VB wetland not laterally maintained			
PES Assessment	Hydrology	Geomorphology	Water Quality	Vegetation
Impact Score	2.8	2.2	3.0	4.3
PES Score (%)	72%	78%	70%	57%
Ecological Category	C	C	C	D
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	3.1			
Combined PES Score (%)	69%			
Combined Ecological Category	C			

Table 8-13: Summary of the Present Ecological State (PES) scores for HGM 6.

Wetland PES Summary				
Wetland name	**Leeudoringstad**			
Assessment Unit	**HGM 6**			
HGM type	Channelled VB wetland not laterally maintained			
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	3.8	3.4	1.4	6.1
PES Score (%)	62%	66%	86%	39%
Ecological Category	**C**	**C**	**B**	**E**
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	3.7			
Combined PES Score (%)	63%			
Combined Ecological Category	**C**			

Table 8-14: Summary of the Present Ecological State (PES) scores for HGM 9 & 10.

Wetland PES Summary				
Wetland name	**Leeudoringstad**			
Assessment Unit	**HGM 9 & 10**			
HGM type	Depression without flushing			
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	2.3	1.8	1.8	4.6
PES Score (%)	77%	82%	82%	54%
Ecological Category	**C**	**B**	**B**	**D**
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	2.6			
Combined PES Score (%)	74%			
Combined Ecological Category	**C**			

Table 8-15: Summary of the Present Ecological State (PES) scores for HGM 11 to 13.

Wetland PES Summary				
Wetland name	**Leeudoringstad**			
Assessment Unit	**HGM 11 to 13**			
HGM type	Seep			
PES Assessment	**Hydrology**	**Geomorphology**	**Water Quality**	**Vegetation**
Impact Score	2.7	1.9	1.5	4.1
PES Score (%)	73%	81%	85%	59%
Ecological Category	**C**	**B**	**B**	**D**
Trajectory of change	↓	↓	↓	↓
Confidence (revised results)	Medium	Medium	Medium	Medium
Combined Impact Score	2.6			
Combined PES Score (%)	74%			
Combined Ecological Category	**C**			

8.5.6 Ecosystem Service Assessment

The assessment of the ecosystem services supplied for the HGM units was conducted per the guidelines as described in WET-EcoServices (Version 2) (Kotze, et al., 2020). The detailed results for the HGM units are shown in Table 8-16 to Table 8-20.

Site Specific services provided by HGM unit type.

The services provided by a wetland is grouped into two categories. These are what the wetland can ***supply*** and what the ***demand*** for a service is at the current state. These two categories are then combined to give an importance rating to a specified service.

The Eco-Services are also split into three benefit categories, namely:

- *Regulating and Supporting Services;*
- *Provisioning Services; and*
- *Cultural Services.*

Only services that have been rated as moderate or higher have been discussed.

Regulating and Supporting Services

The maintenance of biodiversity ids the only regulating service that was calculated to have a moderate to high rating. This is due to the areas of game farm and the relatively intact grassland areas, which create feeding and breeding sites for birds and other animals

Provisioning Services

HGM 3, 11, 12, and 13 have a moderate benefit to providing food for livestock and this benefit is being utilised. No other provisioning services were rated as having moderate or higher importance rating.

Cultural Services

No cultural services were rated as having moderate or higher importance rating.

Table 8-16: Summary of the Eco-Services being provided by HGM 3.

	ECOSYSTEM SERVICE	Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.5	0.0	0.0	Very Low
	Stream flow regulation	2.7	0.3	1.3	Moderately Low
	Sediment trapping	2.0	2.0	1.5	Moderately Low
	Erosion control	1.4	0.7	0.3	Very Low
	Phosphate assimilation	1.8	2.0	1.3	Low
	Nitrate assimilation	1.8	2.0	1.3	Moderately Low
	Toxicant assimilation	1.8	1.0	0.8	Very Low
	Carbon storage	1.3	2.7	1.1	Low
	Biodiversity maintenance	2.9	3.0	2.9	High
PROVISIONING SERVICES	Water for human use	1.6	0.0	0.1	Very Low
	Harvestable resources	1.5	1.0	0.5	Very Low
	Food for livestock	3.0	1.3	2.2	Moderate
	Cultivated foods	1.8	0.0	0.3	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.9	0.3	0.0	Very Low
	Education and Research	0.8	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

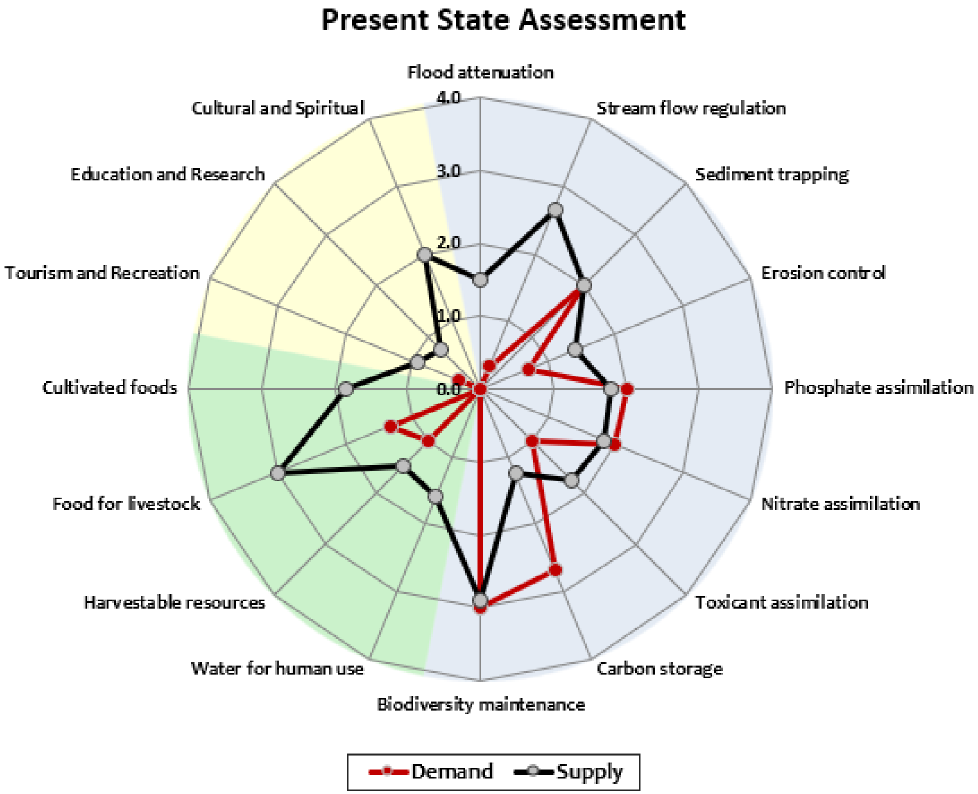

Figure 8-34: Spider diagram showing the Eco-Services for HGM 3

Table 8-17: Summary of the Eco-Services being provided by HGM 4 & 5.

ECOSYSTEM SERVICE		Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.3	0.0	0.0	Very Low
	Stream flow regulation	2.7	0.3	1.3	Moderately Low
	Sediment trapping	2.0	2.0	1.5	Moderately Low
	Erosion control	1.4	0.7	0.3	Very Low
	Phosphate assimilation	1.8	2.0	1.3	Low
	Nitrate assimilation	1.8	2.0	1.3	Moderately Low
	Toxicant assimilation	1.8	1.0	0.8	Very Low
	Carbon storage	1.3	2.7	1.1	Low
	Biodiversity maintenance	2.8	3.0	2.8	High
PROVISIONING SERVICES	Water for human use	1.0	0.0	0.0	Very Low
	Harvestable resources	1.5	1.0	0.5	Very Low
	Food for livestock	2.3	1.3	1.4	Moderately Low
	Cultivated foods	1.8	0.0	0.3	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.6	0.3	0.0	Very Low
	Education and Research	0.8	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

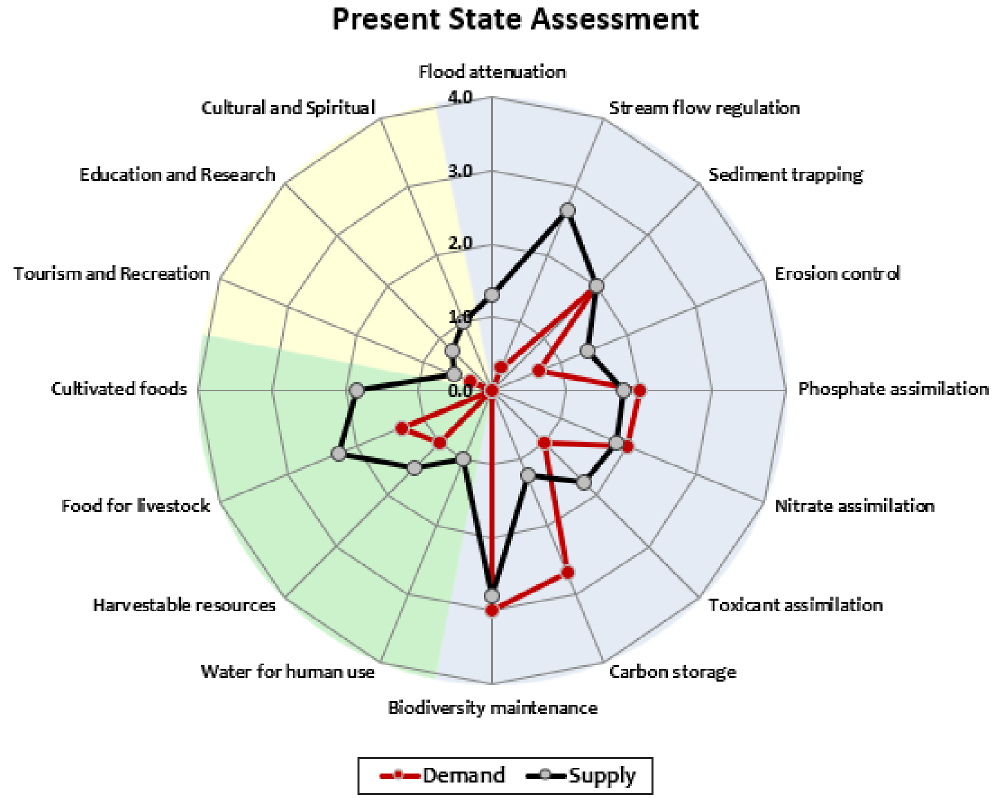

Figure 8-35: Spider diagram showing the Eco-Services for HGM 4 & 5

Table 8-18: Summary of the Eco-Services being provided by HGM 6.

ECOSYSTEM SERVICE		Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1.3	0.0	0.0	Very Low
	Stream flow regulation	2.7	0.3	1.3	Moderately Low
	Sediment trapping	2.0	2.0	1.5	Moderately Low
	Erosion control	1.4	0.7	0.3	Very Low
	Phosphate assimilation	1.8	2.0	1.3	Low
	Nitrate assimilation	1.8	2.0	1.3	Moderately Low
	Toxicant assimilation	1.8	1.0	0.8	Very Low
	Carbon storage	1.3	2.7	1.1	Low
	Biodiversity maintenance	2.8	3.0	2.8	High
PROVISIONING SERVICES	Water for human use	1.0	0.0	0.0	Very Low
	Harvestable resources	1.5	1.0	0.5	Very Low
	Food for livestock	2.3	1.3	1.4	Moderately Low
	Cultivated foods	1.8	0.0	0.3	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.6	0.3	0.0	Very Low
	Education and Research	0.8	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

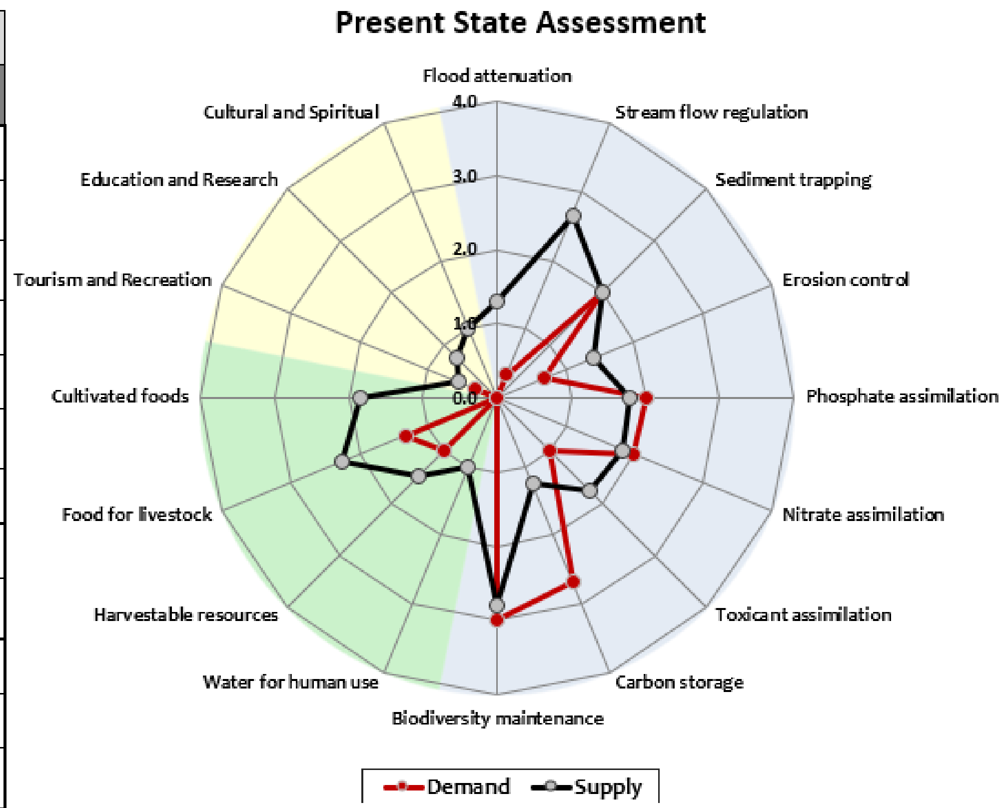

Figure 8-36: Spider diagram showing the Eco-Services for HGM 6

Table 8-19: Summary of the Eco-Services being provided by HGM 9 & 10.

ECOSYSTEM SERVICE		Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.0	0.0	0.0	Very Low
	Stream flow regulation	0.0	0.0	0.0	Very Low
	Sediment trapping	0.9	0.3	0.0	Very Low
	Erosion control	1.1	0.5	0.0	Very Low
	Phosphate assimilation	0.9	0.5	0.0	Very Low
	Nitrate assimilation	0.9	0.5	0.0	Very Low
	Toxicant assimilation	0.9	0.3	0.0	Very Low
	Carbon storage	1.3	2.7	1.1	Low
	Biodiversity maintenance	2.9	1.0	1.9	Moderate
PROVISIONING SERVICES	Water for human use	1.0	0.0	0.0	Very Low
	Harvestable resources	1.5	0.7	0.3	Very Low
	Food for livestock	2.3	0.7	1.1	Low
	Cultivated foods	2.0	0.0	0.5	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.5	0.3	0.0	Very Low
	Education and Research	0.5	0.0	0.0	Very Low
	Cultural and Spiritual	2.0	0.0	0.5	Very Low

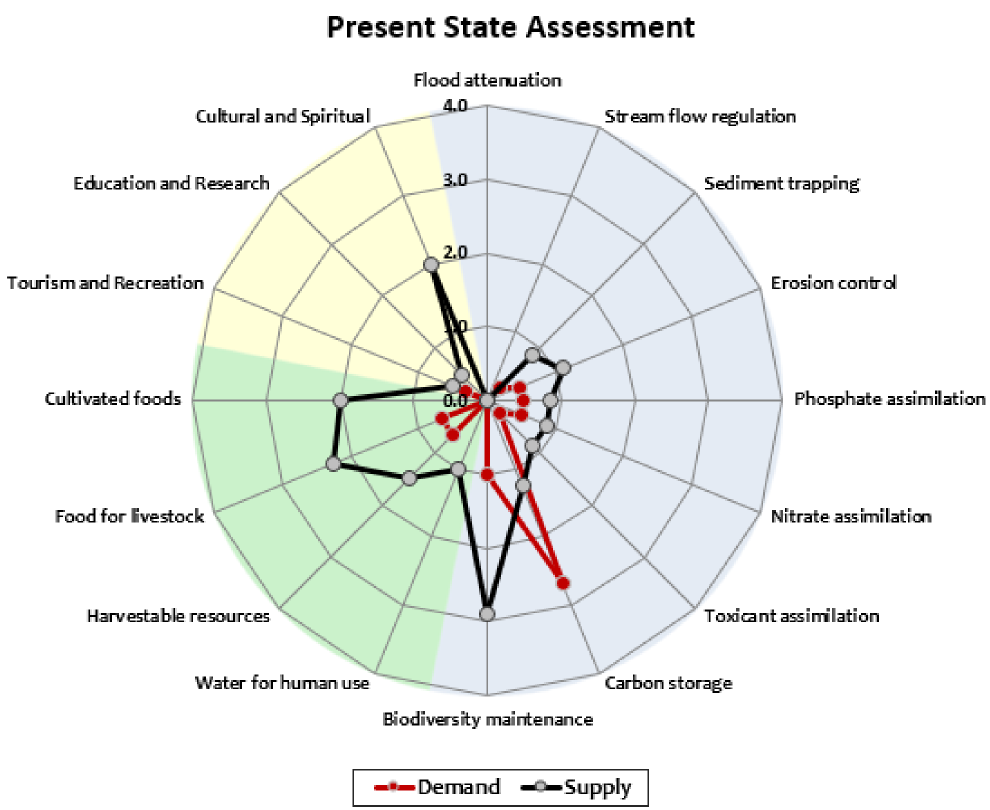

Figure 8-37: Spider diagram showing the Eco-Services for HGM 9 & 10

Table 8-20: Summary of the Eco-Services being provided by HGM 11 to 13.

ECOSYSTEM SERVICE		Present State			
		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.6	0.0	0.0	Very Low
	Stream flow regulation	2.3	0.0	0.8	Low
	Sediment trapping	2.1	0.5	0.8	Low
	Erosion control	0.4	0.7	0.0	Very Low
	Phosphate assimilation	2.0	1.0	1.0	Low
	Nitrate assimilation	1.9	1.0	0.9	Low
	Toxicant assimilation	2.0	0.5	0.8	Very Low
	Carbon storage	1.1	2.7	0.9	Low
	Biodiversity maintenance	2.9	3.0	2.9	High
PROVISIONING SERVICES	Water for human use	0.4	0.0	0.0	Very Low
	Harvestable resources	1.0	0.7	0.0	Very Low
	Food for livestock	3.0	1.0	2.0	Moderate
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	0.3	0.0	0.0	Very Low
	Education and Research	0.5	0.0	0.0	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

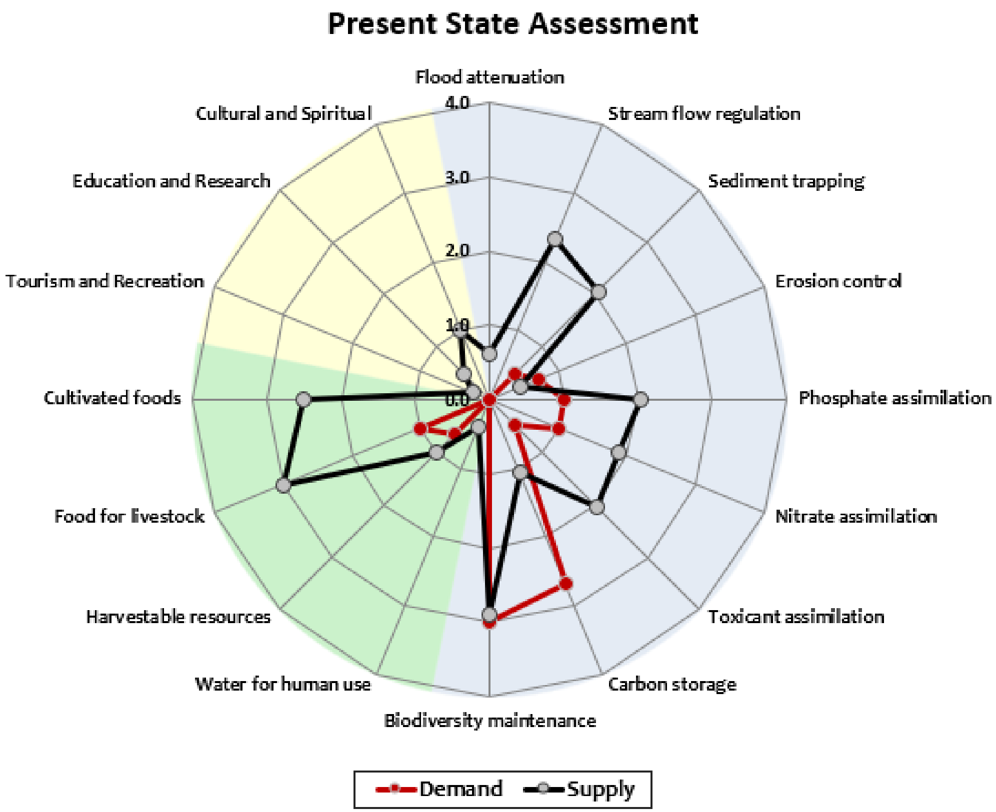

Figure 8-38: Spider diagram showing the Eco-Services for HGM 11 to 13

8.5.7 Ecological Importance and Sensitivity

The EIS assessment was applied to the HGM units described in the previous section to assess the levels of sensitivity and ecological importance of the wetlands. The results of the assessment are shown in Table 8-21.

The EIS for HGM 3, 4, 5, 11, 12, and 13 was rated as High (class B). HGM 6, 9, and 10 was rated as Moderate (class C). These rating can be attributed to the following:

- *The wetlands ecosystem protection level for this region is not protected (NP);*
- *The wetlands ecosystem threat level for this region is critically endangered (CR);*
- *The wetlands provide good habitat for biodiversity,*
- *Some protected species were identified in the area (Secretary Bird).*

The Hydrological Functionality for all HGM units were rated as Moderate (class C), with the exception of HGM 9 and 10, which was rated as Low (class D). These rating can be attributed to the following:

- *The flow regulatory benefits;*
- *The control of sediment; and*
- *The assimilation of some nutrients and toxicants from the landscape.*

The Direct Human Benefits were rated as Moderate (class C) for all HGM units. These rating can be attributed to the following:

- *Provisioning of grazing for livestock.*

Table 8-21: The Wetland Ecological Importance and Sensitivity (EIS) assessment results for the assessment area

Wetland Importance and Sensitivity	HGM 3	HGM 4 & 5	HGM 6	HGM 9 & 10	HGM 11 to 13
Ecological Importance & Sensitivity	B	B	C	C	B
Hydrological/Functional Importance	C	C	C	D	C
Direct Human Benefits	C	C	C	C	C

8.5.8 Recommended Ecological Category (REC)

The REC is set based on the combination of the PES and EIS values and is determined to set targets for the ecological state of the identified wetlands during and after the project has occurred. Table 8-22 shows the PES, EIS as well as the determined REC for the project area.

The REC for the HGM units has been set to maintain the current state of moderately modified (class C).

Table 8-22: Recommended ecological categories of wetlands within the assessment area of the project based on the PES and EIS results.

HGM	Wetland Type	Overall PES	Overall EIS	REC
3	Channelled valley bottom	C	B	C (Maintain)
4 & 5	Channelled valley bottom	C	B	C (Maintain)
6	Channelled valley bottom	C	C	C (Maintain)
9 & 10	Depression	C	C	C (Maintain)
11 to 13	Seep	C	B	C (Maintain)

8.5.9 Buffer Zone Determination

The wetland buffer zone tool (Macfarlane & Bredin, 2017) was used to calculate the appropriate buffer required for the project area prior to the construction of the development. The model shows that during construction phase the largest threat (High, pre-mitigation, but Low, Post-mitigation) is that of increased sediment inputs and turbidity. The operational phase showed only Low risks (Table 8-23).

According to the buffer guideline (Macfarlane & Bredin, 2017) a high-risk activity would require a buffer that is 95% effective to reduce the risk of the impact to an acceptable level.

The risks were then reduced with the prescribed mitigation measures and therefore the recommended buffer was calculated to be 10m for the construction and operational phases. This buffer is calculated assuming mitigation measures are applied.

Table 8-23: The risk results from the wetland buffer model for the project.

Threat Posed by the proposed land use / activity		Specialist Threat Rating	Description of any additional mitigation measures	Refined Threat Class
Construction Phase	1. Alteration to flow volumes	N/A		N/A
	2. Alteration of patterns of flows (increased flood peaks)	Very Low		Very Low
	3. Increase in sediment inputs & turbidity	High	See mitigation measures in Section 10.	Low
	4. Increased nutrient inputs	N/A		N/A
	5. Inputs of toxic organic contaminants	Very Low		Very Low
	6. Inputs of toxic heavy metal contaminants	Low		Low
	7. Alteration of acidity (pH)	Low		Low
	8. Increased inputs of salts (salinization)	N/A		N/A
	9. Change (elevation) of water temperature	N/A		N/A
	10. Pathogen inputs (i.e., disease-causing organisms)	Very Low		Very Low
Operational Phase	1. Alteration to flow volumes	Low		Low
	2. Alteration of patterns of flows (increased flood peaks)	Very Low		Very Low
	3. Increase in sediment inputs & turbidity	Very Low		Very Low
	4. Increased nutrient inputs	Very Low		Very Low
	5. Inputs of toxic organic contaminants	Very Low		Very Low
	6. Inputs of toxic heavy metal contaminants	Low		Low
	7. Alteration of acidity (pH)	Very Low		Very Low
	8. Increased inputs of salts (salinization)	Very Low		Very Low
	9. Change (elevation) of water temperature	Very Low		Very Low
	10. Pathogen inputs (i.e., disease-causing organisms)	Very Low		Very Low

9 RISK/IMPACT ASSESSMENT

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines.

9.1 Wetland/Aquatic Risk Assessment

The risk assessment was conducted in accordance with the DWS risk-based water use authorisation approach and delegation guidelines. The risk matrix interpretation is shown in Table 7-7.

9.1.1 Existing Activities – no-go Situation

Existing activities within the project area include livestock and cultivated agriculture, road infrastructure and existing powerline servitudes (Figure 9-1). These activities have had an impact on the status of the watercourses. The no-go situation indicates the long-term maintenance and slight deterioration of the assessed watercourses.

Figure 9-1: Existing powerline servitude in the AoI (October 2022)

9.1.2 Proposed Activities

No specific project activities were provided for this assessment. The expected activities that will be completed for the proposed turbine and grid connection projects are summarised below:

- Site access and clearing of vegetation in working areas;
- Establishment of laydown yard/construction camps;
- Earthworks for infrastructure setting;

- Stockpiling and movement of soils and construction materials;
- Manual crossing of watercourses;

Construction Phase:

During the construction phase the existing roadways accessing the existing servitude will be utilised. The clearing of vegetation and preparation of the earth for the installation of the pylons will than take place. This activity will be limited to the immediate footprint of the proposed pylon and therefore of inconsequential scale for hydrological alteration. The crossing of the cables across the watercourses will be done manually where no-diversion, impedance or disturbance of the watercourse banks are expected to occur. The risk of the construction phase was therefore derived to be low

Operational Phase:

During the operational phase, maintenance activities which involve the clearing/maintenance of vegetation will take place. This will occur in existing servitudes and therefore is unlikely to have a significant impact on watercourse vegetation structures. During the operational phase, land which was disturbed can become infested with non-native vegetation. The removal of this vegetation prior to the construction phase is therefore required. The risk of the operational phase to the physical and biological functioning of the watercourse was derived to be low.

Table 9-1: Department of Water and Sanitation Risk Assessment Compiled by Russell Tate (Pr. Sci. Nat.) – Powerline Construction and Operation

Aspect	Flow Regime	Water Quality	Habitat	Biota	Severity	Spatial scale	Duration	Consequence
Construction Phase								
Operation of equipment and machinery	1	1	2	1	1.25	1	3	5.25
Clearing vegetation	1	1	2	1	1.25	1	3	5.25
Excavating/shaping landscape	2	1	2	2	1.75	1	1	3.75
Final installation and post construction rehabilitation	2	1	2	2	1.75	1	1	3.75
Operational Phase								
Alteration of drainage	1	1	1	1	1	1	1	3
Alteration of surface water flow dynamics	1	1	1	1	1	1	1	3
Establishment of alien plants on disturbed areas	1	1	1	1	1	1	1	3

Table 9-2: Department of Water and Sanitation Risk Assessment Compiled by Russell Tate (Pr. Sci. Nat.) – Powerline Construction and Operation

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Construction Phase								
Operation of equipment and machinery	2	2	0	3	7	36.75	Low	Low
Clearing vegetation	2	2	0	3	7	36.75	Low	Low
Excavating/shaping landscape	2	2	0	3	7	36.75	Low	Low
Final installation and post construction rehabilitation	2	2	0	3	7	36.75	Low	Low

Aspect	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Sig.	Without Mitigation	With Mitigation
Operation Phase								
Alteration of drainage	3	2	0	3	8	24	**Low**	**Low**
Alteration of surface water flow dynamics	3	2	0	3	8	24	**Low**	**Low**
Establishment of alien plants on disturbed areas	3	2	0	3	8	24	**Low**	**Low**
In accordance with General Notice 509 “Risk is determined after considering all listed control / mitigation measures. Borderline Low / Moderate risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to listing of additional mitigation measures detailed below								

10 MITIGATION MEASURES

The mitigation hierarchy is regarded internationally as the best practice framework for environmental planning and managing environmental impacts. It is a set of prioritized, sequential steps that are applied to anticipate, avoid, and reduce the potential negative impacts of project activities on the natural environment. It involves a sequence of four key components: avoidance, minimization, remediation, and offset as illustrated in (Edwards, et al., 2018).

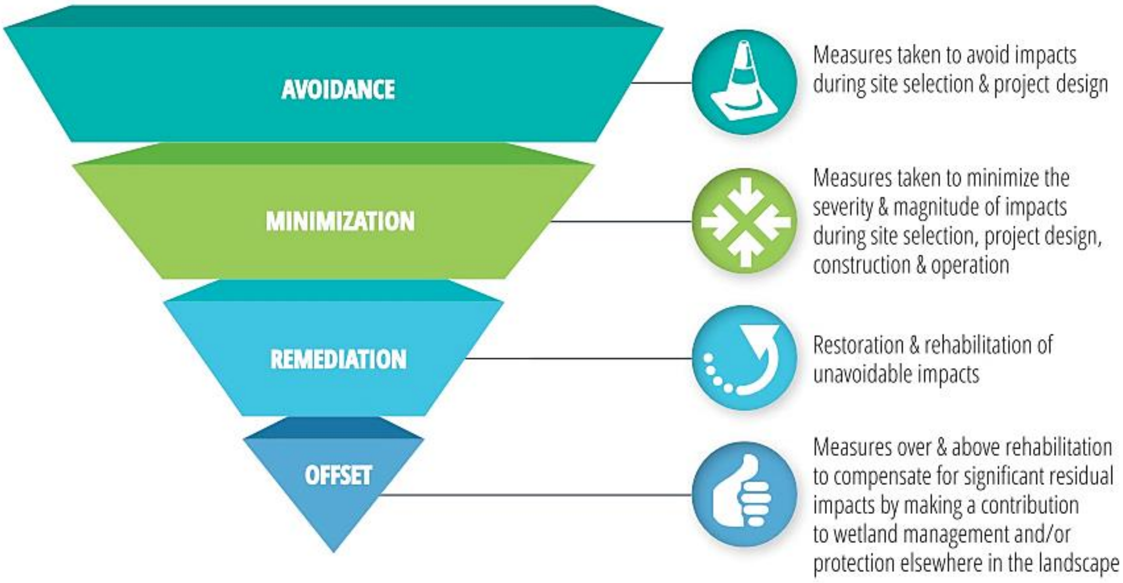

Figure 10-1: The mitigation hierarchy (Edwards, et al., 2018)

The focus of mitigation measures is to follow the mitigation hierarchy where possible. The activities that are not required within the water resource and its associated buffer zone will follow the avoidance principles and as a result impacts/risk are expected to be low for these activities. The aspects that occur within the water resource will follow the minimization and remediating principles to reduce the significance of potential impacts associated with the proposed activity. The prescribed mitigation measures for the proposed activity are provided in the respective sections below.

10.1 Site Planning

Every effort must be made to avoid potential impacts from the outset of a project (e.g., through careful spatial or temporal placement of elements of infrastructure) to prevent or limit impacts to water resources.

The most important aspect to keep risks or the potential impacts to a Low, is to ensure that the placement of the powerline tower structures are located as far from the wetland zones as possible.

The above is further advocated in DFFE (2022) whereby the following is quoted:

"Wetlands must be avoided or, where wetland crossing is unavoidable, the power line should be routed over the narrowest part of the wetland. For the most part, wetlands and rivers can be traversed by the power line with little to no impact by placing the pylons outside of the wetland."

Various aspects will contribute to the risks described above, and as a result the mitigation measures for these aspects are listed below.

10.2 Site Clearing

During site clearing the vegetation and topsoil is removed, increasing the runoff and erosion potential of flowing water. to mitigate these impacts the following measures must be followed:

- *Minimise the area of soil disturbance to reduce the impact of sedimentation into waterbodies.*
- *Clearing and grading must occur only where necessary to build and provide access to structures and infrastructure. Clearing must be done immediately before construction, rather than leaving soils exposed for months or years.*
- *Where possible, plants should be cut down to ground level instead of being removed completely to stabilise the soil during land-clearing operations.*
- *The proposed limits of land disturbance must be physically marked off to ensure that only the land area required for the development is cleared.*
- *When excavated areas are backfilled the surface must be level with the surrounding land surface, to minimise soil erosion from the areas when the excavation is complete.*
- *The most efficient approach to control erosion is to minimise the area of land disturbed as well as the duration for which it is exposed.*
- *Once surfaces have been exposed, they must immediately be protected from erosion, so limiting the source of the sediment.*
- *During the excavation of pits, roads, construction sites etc. the removed topsoil must be stored and appropriately protected so that it does not wash into waterbodies, causing sedimentation and nutrient loading. This is then used to backfill the area so that it can be effectively rehabilitated.*
- *Topsoil that is removed during excavation must NEVER be buried or rendered unusable in any way (such as mixing it with spoils or being compacted by machinery).*
- *During excavation soil must be excavated one layer at a time and stored in separate stockpiles so they can be returned in their natural order when the area is backfilled. This improves soil functions and improves the template for plant growth.*

10.3 Access Control

- *Water resources must be well fenced and sign-posted, to keep machinery, people, and livestock away from the water body as well as vegetated areas to reduce the soil disturbance, soil compaction and vegetation destruction, which thus reduces the amount of erosion and habitat loss.*
- ***No vehicles will be allowed to cross any wetland or rivers to span the powerline.***

10.4 Erosion & Sedimentation Control

- *Sediment traps are small impoundments that allow sediment to settle out of runoff. They are usually installed in a drainageway or other point of discharge from a disturbed area. Temporary diversions can be used to direct runoff to the sediment trap. Sediment traps detain sediments in stormwater runoff to protect receiving water bodies, and the surrounding area. The traps are formed by excavating an area or by placing an earthen embankment across a* *low area or drainage swale. An outlet or spillway is often constructed using large stones or aggregate to slow the release of runoff.*

10.5 Soil Stabilisation

- *Stabilization practices (e.g., revegetation) must occur as soon as possible after grading. In colder climates, a mulch cover is needed to stabilize the soil during the winter months when grass does not grow or grows poorly.*
- *The following measures can be used to stabilize soils for site preparation and construction: hydro mulch, straw (placed evenly on slope), crimping (rolling the placed straw with a sheep-foot roller), seeding, fertiliser, transplanting and net (jute netting pinned onto the slope).*

10.6 Stockpile management

- *Unprotected stockpiles are very prone to erosion and therefore must be protected. Small stockpiles can be covered with a tarp to prevent erosion. Large stockpiles must be stabilized by erosion blankets, seeding, and/or mulching.*

10.7 Pollution Control

- *If soil contamination occurs (such as due to a spill) the soil must be removed from the site and disposed of appropriately.*
- *Prevention of spills eliminates or minimizes the discharge of pollutants to water bodies.*
- *Handle hazardous and non-hazardous materials, such as concrete, solvents, asphalt, sealants, and fuels, as infrequently as possible and observe all national and local regulations when using, handling, or disposing of these materials.*
- *An effective response plan must be in place and personnel must be ready to mobilise in the event of a spillage to reduce the environmental effects of an oil or chemical spill.*
- *Spill control devices such as absorbent snakes and mats must be placed around chemical storage areas, and they can be used in an emergency to contain a spill.*
- *Implement preventative maintenance system to ensure that work vehicles are maintained in an acceptable condition. This would involve routinely checking vehicles for leaks before construction begins; and not allowing vehicles with significant leaks to operate or be repaired within the construction site. Ideally, vehicle maintenance and washing occurs in garages and wash facilities, not on active construction sites.*
- *Before an operation occurs near a waterbody, vehicles must be checked for leaks, to reduce soil and water contamination from vehicle fluids.*
- *Old engine oil must NOT be thrown on the ground or down a stormwater drains but rather collected in containers and recycled.*
- *Ensure that appropriate solid waste disposal facilities are provided, and adequate signage is provided for all solid, liquid, and hazardous waste types. These must contain waste products in a weatherproof manner and to prevent any airborne litter, access to scavengers or loss of food residues that may be washed into surface or ground waters. Collected waste needs to be disposed of at a registered landfill site/hazardous waste facility.*
- *Re-fuelling areas for vehicles must be bunded and located away from water resources and sensitive environments to prevent any accidental spillage contaminating soil or seeping into*

groundwater aquifers. All servicing area run-off must be directed towards a fully contained collection sump for recovery and appropriate disposal.

- *There must be no standing water at a stockpile site, to reduce erosion as well as the contamination of the water by nutrients/ toxics.*

10.8 Runoff Control

- *Runoff from disturbed areas (such as landing/depot areas, extraction routes, gravel pits, temporary and unpaved roads) must be directed to silt traps (silt fences, sandbags, etc) to remove sediment and reduce the sedimentation of the water bodies.*
- ***Check dams** are small, temporary dams constructed across a swale or channel. They can be constructed using gravel, rock, gabions, or straw bales. They are used to reduce the velocity of concentrated flow and, therefore, to reduce erosion in a swale or channel.*

10.9 Sediment Controls

- *Sediment basins and rock dams can be used to capture sediment from stormwater runoff before it leaves a site. Both structures allow a pool to form in an excavated or natural depression, where sediment can settle. The pool is dewatered through a single riser and drainage hole leading to a suitable outlet on the downstream side of the embankment or through the gravel of the rock dam. The water is released more slowly than it would be without the control structure.*

10.10 Sanitation

- *Portable toilets must be provided where work is being done and must be located a considerable distance away from water resources and riparian areas.*

10.11 Site Management

- *Alien and invasive vegetation have several detrimental effects on water quality, from nutrient enrichment to increased erosion and excessive water use, which is especially relevant in dry areas or in important catchments. Invasive species are highly likely to colonise disturbed areas, even after rehabilitation and follow-up clearing must be done until healthy vegetation returns to the site.*
- *Areas (away from surface water bodies and outside of the riparian zone) must be designated for the storage of materials and mixing of materials (such as concrete or chemicals). This reduces contamination of water resources from these materials/ activities.*
- *To ensure that it reaches most people signs must be written in the languages of the area (NOT just English). This ensures that non-English speakers can understand and will hopefully cooperate in reducing water pollution by the measures indicated on the sign.*
- *Within a construction site, vehicle access must be strictly controlled (i.e., there must be set parking, turning areas, set routes and no access to undisturbed areas.) This minimises soil disturbance and compaction and pollution from fluids leaking onto the ground as well as the disturbance of aquatic organisms.*

11 RECOMMENDATIONS

The following recommendations have been made to minimise threats to sensitive receptors (sub-surface flow paths) and wetland functioning;

- It is recommended that an alien invasive management programme is implemented.
- No vehicles will be allowed to cross any wetland or rivers to span the powerline.
- Powerline sections crossing wetlands/rivers will by strung by manually without the need to alter the beds and banks of the watercourses.
- Powerline pylon infrastructure must be located outside of the derived buffer zones provided in this study.
- Alternative 1 spanning of the powerline across HGM 9 must be done during the dry season.

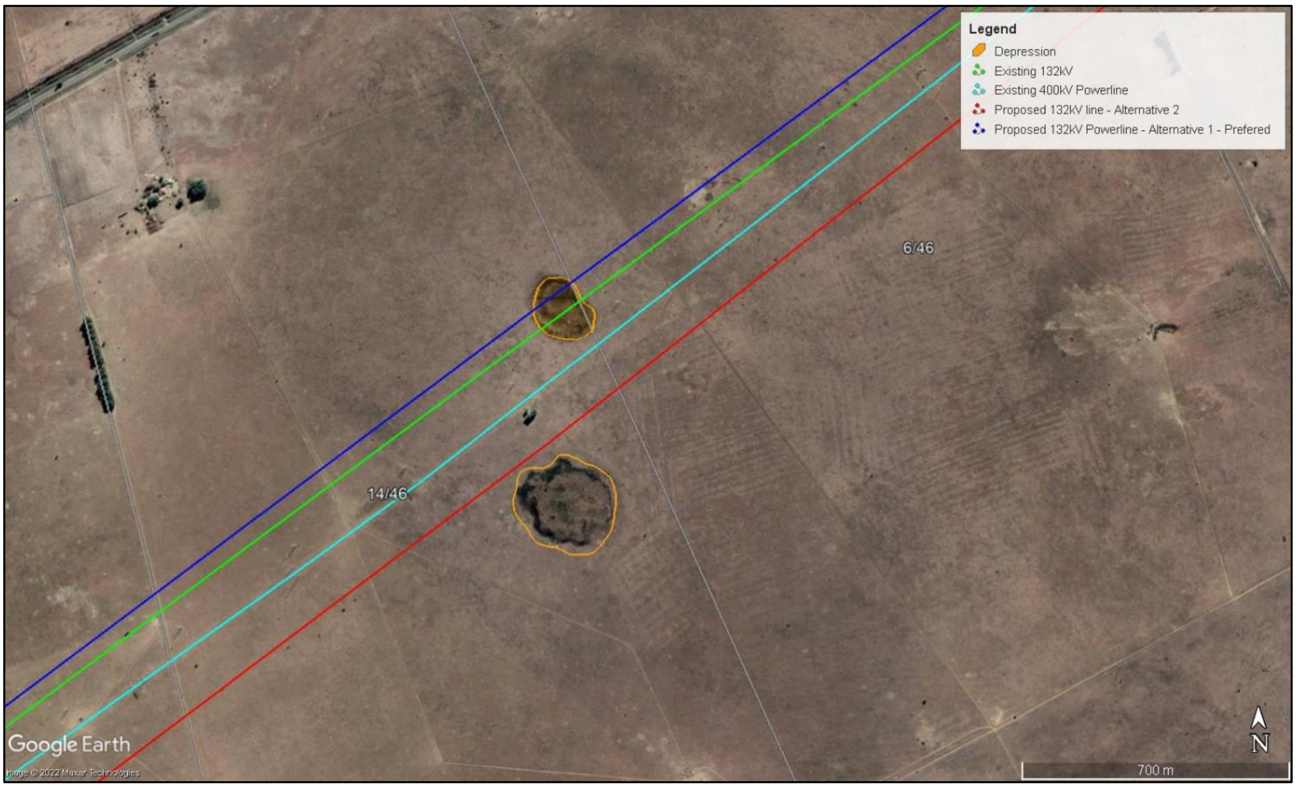

Figure 11-1: Preferred 132kv transmission line at HGM 9 and HGM 10.

12 CONCLUSION

The results of the watercourse assessment indicate the presence of both riverine and wetland ecosystems which are associated with the proposed development. The ecological status of the watercourses was assessed where modified ecosystems were derived to be present. The ecological importance and sensitivity of the watercourses were also investigated where moderate and low ratings were derived.

Using the standardised risk assessment approach, the risk of the proposed project was determined to be low, where negligible impacts to watercourses can be expected. Important recommendations provided in this report include the avoidance buffers.

It is the opinion of the Specialist that the proposed development may proceed and that a General Authorisation will be sufficient, this is based on the above findings and recommendations.

12.1 CONFIRMING STATEMENT

The specialists have assessed the project area according to the national norms and best practise guidelines. The following is the required information for the confirming statement;

1. The project area was assessed by Mr. Wayne Jackson (wetland specialist) on the 11th to 13th of October 2022. The aquatic specialist Mr. Russell Tate assessed the project area on the 28th and 30th of October 2022. The assessment falls within the wet season.
2. The full assessment of the health and functionality of the watercourses indicated ecological conditions which were modified from reference (I.E non-natural systems).
3. In field assessments were completed to delineate the watercourse extents and sensitive freshwater habitats which are provided in this report (see Section 8.3).
4. The ecological importance and sensitivity of the watercourses were derived to be predominantly low, with the highest rating being moderate. No high or very high ecological importance and sensitivity ratings were obtained.
5. Using the present ecological status and ecological importance and sensitivity, the required buffer zones for the proposed project were derived, this provided information to inform pylon placement.
6. The risk assessment completed for the proposed powerline project was confirmed to be low risk.
7. Avoidance recommendations for freshwater resources were recommended.
8. Standard impact management guidance by the EGI guidelines is recommended. However, the following specific recommendations were also made:
    a. Alternative 1 spanning of the powerline across HGM 9 must be done during the dry season.
    b. The placement of pylons must occur outside of the delineated buffer zones.
    c. No disturbance to wetland habitats, river banks or beds can occur, where powerline setting must occur without diverting or impeding watercourses.

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