SCIENTIFIC AQUATIC SERVICES

Freshwater Assessment

AS PART OF THE ENVIRONMENTAL AUTHORISATION AND WATER USE LICENCE APPLICATION PROCESSES FOR THE PROPOSED HENDRINA NORTH 132KV OVERHEAD POWERLINE, HENDRINA, MPUMALANGA PROVINCE.

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Hendrina North 132KV overhead powerline and proposed substation (hereafter referred to respectively as the 'proposed powerline' or collectively with the proposed substation, the 'study area'), located near Hendrina, Mpumalanga province. The proposed powerline consists of two alternatives (Alternative 1 and Alternative 2) which will connect from the existing Eskom Hendrina power station, near Pullens Hope, to a proposed substation situated approximately 17 km south of the power station, near Meerlus.

A freshwater ecosystem assessment was undertaken on the 19th of August 2022 during which eight (8) valley bottom wetlands, three (3) depression wetlands, and one (1) seep wetland were identified in the study and investigation areas (defined as a 500m radius around the study area). As the valley bottom wetlands form part of larger drainage systems, the freshwater ecosystems were grouped for the purposes of presenting a concise discussion although the valley bottom hydrogeomorphic (HGM) units were individually assessed. The results of the field assessment are as follows:

Freshwater ecosystem	PES	Ecoservices	EIS	REC / RMO / BAS
Valley Bottom wetlands (Group 1)	E	Moderately Low-Very low	Moderate	D/Improve/D
Depression wetland (Group 2)	C	Low-Very low	Moderate	C/Maintain/C
Depression wetlands (Group 3)	C	Very Low-low	Moderate	C/Maintain/C
Seep wetland (Group 4)	D	Very Low-Low	Low/Marginal	D/Maintain/D

Based on the outcome of the DWS approved Risk Assessment Matrix and provided that all mitigation measures provided in this report are adhered to throughout the life of the proposed development, in particular that the supporting structures are placed outside the 32m ZoR of the freshwater ecosystems, the activities associated with the construction and operation of both alternatives 1 and 2 of the proposed powerline pose a "low" risk significance to the freshwater ecosystems within the study and investigation areas. However, the construction phase of the proposed substation poses a "high" risk significance to the valley bottom wetland (in which the substation is located), whilst the operational phase of the proposed substation poses a "low" risk significance to the freshwater environment. Since the proposed substation will result in the loss of approximately 2,50 ha of valley bottom wetland, it is advised that the layout footprint of the substation be revised so as to avoid the freshwater ecosystems and the NEMA 32m ZoR associated with the study and investigation areas. All mitigation measures as stipulated in Section 6 and Appendix G of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

Alternative 1 of the proposed powerline is the preferred alternative from a freshwater ecological management perspective. Alternative 1 traverses fewer freshwater ecosystems and thus poses a lower risk to the freshwater environment. Sections of Alternative 1 is also located along an existing powerline. As such, if the existing supporting structures are upgraded or new pylons erected adjacent to existing ones, the potential risks associated with the construction of supporting structures will be significantly reduced.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Hendrina North 132KV overhead powerline and a proposed substation (hereafter referred to respectively as the 'proposed powerline' and collectively with the proposed substation is referred to as the 'study area'), located near Hendrina, Mpumalanga province. The proposed powerline will connect to a proposed Wind Energy Facility (WEF). The proposed Hendrina North WEF (DFFE Reference No. 14/2/16/3/3/2/2130) is subject to a separate EIA process as contemplated in terms of the EIA Regulations 2014 (as amended), which is currently being undertaken. The proposed powerline will connect from the existing Eskom Hendrina Power Station near Pullens Hope, to a proposed substation situated approximately 17 km south of the power station, near Meerlus. The proposed powerline comprises two alternatives. Alternative 1 consists of a 17km 132KV overhead powerline which runs along an informal gravel road and crosses numerous farm portions. Alternative 1 is a shorter route (approximately 17 km) and is the preferred alternative. Alternative 2 consist of a 20km 132KV overhead powerline which is located adjacent to an informal gravel road and to the west of alternative 1. The two powerline route alternatives join further south and run adjacent to an informal gravel road to the proposed substation. The proposed powerline alternatives are situated in the boundary of the Steve Tshwete Local Municipality within the jurisdiction of the Nkangala District Municipality.

The purpose of this report is to define the ecology of the freshwater ecosystems associated with the study and associated investigation area (defined as a 500 m radius around the various components that form part of the study area, in line with GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) in terms of freshwater characteristics, including mapping of the freshwater ecosystems, defining areas of increased Ecological Importance and Sensitivity (EIS) and defining the Present Ecological State (PES) of the freshwater ecosystems associated with the study area. The report also aims to define the socio-cultural and ecological service provision of the freshwater ecosystems and additionally outlines the Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) for the freshwater ecosystems. The assessment took the following approach:

- A desktop study was conducted, in which possible freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted;
- The field assessment took place on the 29th of August 2022 during which the following freshwater ecosystems were identified:
  - Eight (8) valley bottom wetlands (includes channelled valley bottom and unchannelled valley bottom hydrogeomorphic (HGM) units);
  - Three (3) depression wetlands; and
  - One (1) seep wetland.

The results of the field assessment are presented in Section 4 of this report, and are summarised in the table below:

Table A: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	PES	Ecoservices	EIS	REC / RMO / BAS
Valley Bottom wetlands (Group 1)	E	Moderately Low-Very low	Moderate	D/Improve/D
Depression wetland (Group 2)	C	Low-Very low	Moderate	C/Maintain/C
Depression wetlands (Group 3)	C	Very Low-low	Moderate	C/Maintain/C
Seep wetland (Group 4)	D	Very Low-Low	Low/Marginal	D/Maintain/D

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2016) was applied to determine the significance of impacts of the proposed development on the receiving freshwater environment. The activities associated with the construction and operation of the proposed powerline alternative 1 and 2 pose a "low" risk significance to the freshwater ecosystems within the study and investigation areas, provided that the supporting structures are placed outside the 32m NEMA ZoR of the freshwater ecosystems. However, the construction phase of the proposed substation poses a "high" risk significance to the valley bottom wetland (associated with the substation), whilst the operational phase of the proposed substation poses a "low" risk significance, as the majority of impacts are likely

to have occurred during the construction phase. Since the proposed substation will result in the loss of approximately 2,50 ha of valley bottom wetland habitat (associated with the substation), it is advised that the layout footprint of the substation be revised so as to avoid the freshwater ecosystems and 32m NEMA ZoR associated with the study and investigation areas. All mitigation measures as stipulated in Section 6 and Appendix G of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

The outcome of the DWS Risk Assessment is summarised in the table below.

Table B: Summary of DWS Risk Assessment applied to the proposed powerline and substation.

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Risk Rating
1	Construction Phase	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials).	• Loss of freshwater ecosystem vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from potentially spilled oils and hydrocarbons originating from construction vehicles.	Powerline Alternative 1 and 2.	L
					Proposed substation located within a valley bottom wetland.	H
2			Removal of vegetation and associated disturbances to soil, and access to the site, including grading of existing informal farm roads (access roads will be maintained as informal gravel roads, or a typical jeep track type road).	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream freshwater ecosystem areas; • Exposure of soil, leading to increased runoff, and erosion, and thus increased sedimentation of the freshwater ecosystems ; • Increased sedimentation of the freshwater ecosystems , leading to smothering of vegetation associated in the freshwater ecosystems ; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Powerline Alternative 1 and 2.	L
					Proposed substation located within a valley bottom wetland.	H
3		Installation of the support structures (outside the 32 m ZoR of the delineated extent of the freshwater ecosystems and spanning of the proposed powerline.	• Excavation of pits for the support structures leading to stockpiling of soil; • Potential movement of construction equipment and personnel in the areas surrounding freshwater ecosystems .	• Disturbances of soil leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems .	Powerline Alternative 1 and 2.	L
4			• Mixing and casting of concrete for foundations.	• Potential contamination of surface water (when present).	Powerline Alternative 1 and 2 and the proposed substation	L

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Risk Rating
5		Construction of the proposed substation and associated infrastructure within a valley bottom wetland.	• Excavation of soil within the valley bottom wetland; Mixing and casting of concrete; and • Movement of construction vehicles and personnel within the valley bottom wetland.	• Loss of approximately 2, 50 ha of valley bottom wetland and indirect impacts; • Disturbance to soil, vegetation, biota and potentially water quality as a result of construction activities; • Altered runoff patterns as a result of excavation and casting of concrete within the valley bottom wetland, leading to increased erosion and sedimentation of the wetland; • Removal of freshwater ecosystem vegetation;*Potential spillage and ingress of hydrocarbons from maintenance vehicles into the valley bottom wetland.	Proposed substation located within a valley bottom wetland.	H
6	**Operational Phase**	Operation and maintenance of the proposed powerline.	• Potential indiscriminate movement of maintenance vehicles within the freshwater ecosystems or within close proximity to the freshwater ecosystems ; and • Increased risk of sedimentation and/or hydrocarbons entering the freshwater ecosystems via stormwater runoff from the access roads.	• Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	Powerline Alternative 1 and 2 and the Proposed substation located within a valley bottom wetland.	L

Alternative 1 of the proposed powerline is the preferred alternative from a freshwater ecological management perspective. Alternative 1 traverses fewer freshwater ecosystems and thus poses a lower risk to the freshwater environment. Sections of Alternative 1 are also located along an existing powerline. As such, if the existing supporting structures are upgraded or new pylons erected adjacent to existing pylons, the potential risks associated with the construction of supporting structures will be significantly reduced.

DOCUMENT GUIDE

The table below provides the specialist report requirements for the assessment and reporting of impacts on aquatic biodiversity in terms of Government Notice 320 as promulgated in Government Gazette 43110 of 20 March 2020 in line with the Department of Environmental Affairs screening tool requirements, as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998).

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Appendix G
2.2	Description of the preferred development site, including the following aspects-	Section 1
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 4.3
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 3.1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3.1 and 3.2
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 4.3
2.3	Identify any alternative development footprints within the preferred development site which would be of a “low” sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	Section 6 and 7
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 6
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Section 4.3 and Section 6
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Section 4.3
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	Section 4.3
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river);	Section 4.3

	c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	
2.4.5	How will the development impact on the functionality of the aquatic feature including: a. water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river) b. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). c. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); d. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); e. The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc.) associated with or within the aquatic ecosystem.	Section 4.3
2.4.6	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Section 4.3
2.4.7	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Section 4.3
2.4.9	A motivation must be provided if there were development footprints identified as per paragraph 2.3 above that were identified as having a “low” biodiversity sensitivity and were not considered appropriate.	Section 7
3.	The report must contain as a minimum the following information:	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Appendix A and H
3.2	A signed statement of independence by the specialist;	Appendix A
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 1 and 4.3
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Appendix C
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 6 and 7
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Section 6
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 5
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 6
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Section 7

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status according to the International Union for Conservation of Nature (IUCN) Classification.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50 cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50 cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
CSIR	Council of Scientific and Industrial Research
CVB	Channelled Valley Bottom
UCVB	Unchannelled Valley Bottom
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EPL	Ecosystem Protection Level
ES	Ecological Sensitivity
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HD	High Definition
HGM	Hydrogeomorphic
IAIA	International Association of Impact Assessors
IUCN	International Union for Conservation of Nature
mm	Millimetre
m.a.m.s.l	Metres above mean sea level
MAP	Mean Annual Precipitation
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South Africa Institute of Aquatic Biodiversity
SAIIAE	South Africa Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SASSO	South African Soil Surveyors Association
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WEF	Wind Energy Facility
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WUA	Water Use Authorisation

1 INTRODUCTION

1.1 *Background*

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Hendrina North High Definition (HD) 132KV overhead powerline and (hereafter referred to respectively as the 'proposed powerline' or collectively with the proposed substation, the 'study area'), located near Hendrina, Mpumalanga province. The proposed powerline will connect to the proposed Hendrina North Wind Energy Facility (WEF). The proposed Hendrina North WEF (DFFE Reference No. 14/2/16/3/3/2/2130) is subject to a separate EIA process as contemplated in terms of the EIA Regulations 2014 (as amended), which is currently being undertaken separately from this Basic Assessment (BA) by another consultant. The proposed powerline will connect from the existing Eskom Hendrina Power Station near Pullens Hope, to a proposed substation situated approximately 17 km south of the power station, near Meerlus. The proposed powerline comprises two alternatives. Alternative 1 consists of a 20km 132KV overhead powerline which runs along an informal gravel road and crosses numerous farm portions. Alternative 1 is a shorter route (approximately 17 km) and is the preferred alternative. Alternative 2 is a 132KV overhead powerline (approximately 20 km) which is located adjacent to an informal gravel road and to the west of alternative 1. The two powerline route alternatives join further south and run adjacent to an informal gravel road to the proposed substation. The proposed powerline alternatives are situated in the boundary of the Steve Tshwete Local Municipality within the jurisdiction of the Nkangala District Municipality.

The site visit for the freshwater ecosystem assessment was undertaken on the 29th of August 2022. Fieldwork was undertaken to obtain accurate ground-truthed results so as to guide the planning and construction of the proposed powerline and substation in relation to any potential freshwater ecosystems that may be affected directly or indirectly by the activities undertaken as part of the proposed activities. To identify all possible freshwater ecosystems that may potentially be impacted, a 500 m "zone of investigation" around the footprint of the proposed development, in accordance with Government Notice 509 (GN 509) of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA) (as amended), was used as a guide to assess possible sensitivities of the receiving environment. This area – i.e. the 500 m zone of investigation around the footprint of the proposed powerline- will henceforth be referred to as the "investigation area".

This study aims to provide information to guide the proposed activities associated with the proposed powerline and substation development in the vicinity of any freshwater ecosystems that may be traversed by the proposed powerline, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported, while considering the need for sustainable economic development. This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP) and proponent on the routing of the proposed powerline and positioning of the proposed substation from a freshwater management perspective and indicate any development constraints that should be considered in line with the principles of sustainable development and Integrated Environmental Management.

1.1.1 Project description

Two alternatives are proposed for the powerline route:

- Alternative 1 is a 17km HD 132 KV overhead powerline and largely follows the same route as an existing powerline; and
- Alternative 2 is a 20km HD 132KV overhead powerline.

Alternative 1 and 2 connect from the existing Eskom Hendrina Power Station, located in the small town of Pullens Hope. From the power station, the powerline runs adjacent to Pullens Hope road in a westerly direction. The powerline then runs along an informal road for approximately 3.68 km, where alternative 1 splits, west of alternative 2. Alternative 1 and 2 join just after crossing an unnamed formal road and then runs parallel to an informal road for approximately 7.87 km to the proposed substation.

The proposed substation consists of:

- Feeder bays, transformers, switching station electrical equipment (bus bars, metering equipment, switchgear, etc.), control building, workshop, telecommunication infrastructure, and access roads; and
- An area with a subterranean earthing mat onto which a concrete plinth will be constructed.

The locality of the proposed powerline alternatives and substation are depicted in Figure 1 and 2 below.

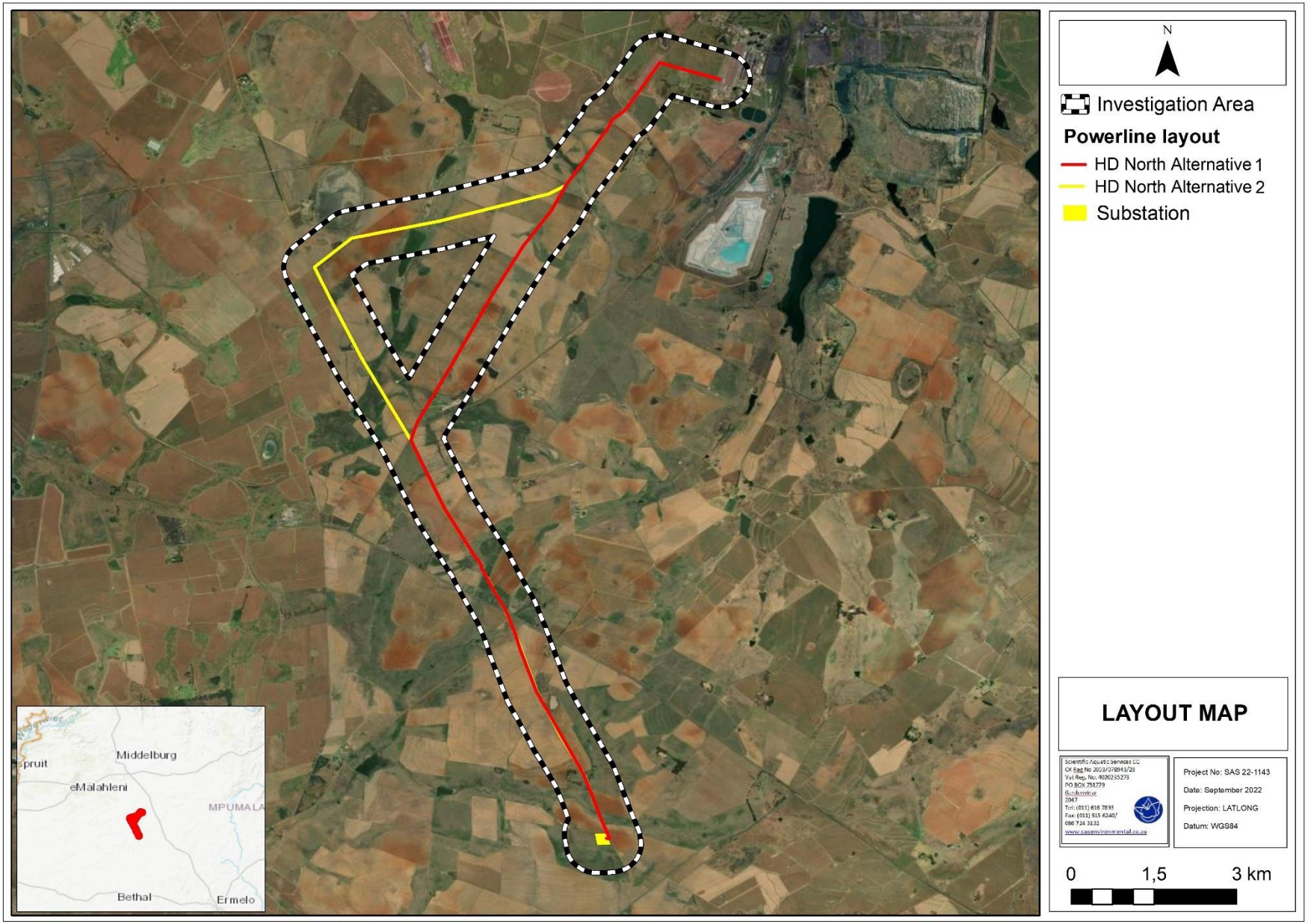

Figure 1: A digital satellite image depicting the location of the proposed powerline and associated investigation area in relation to the surrounding area.

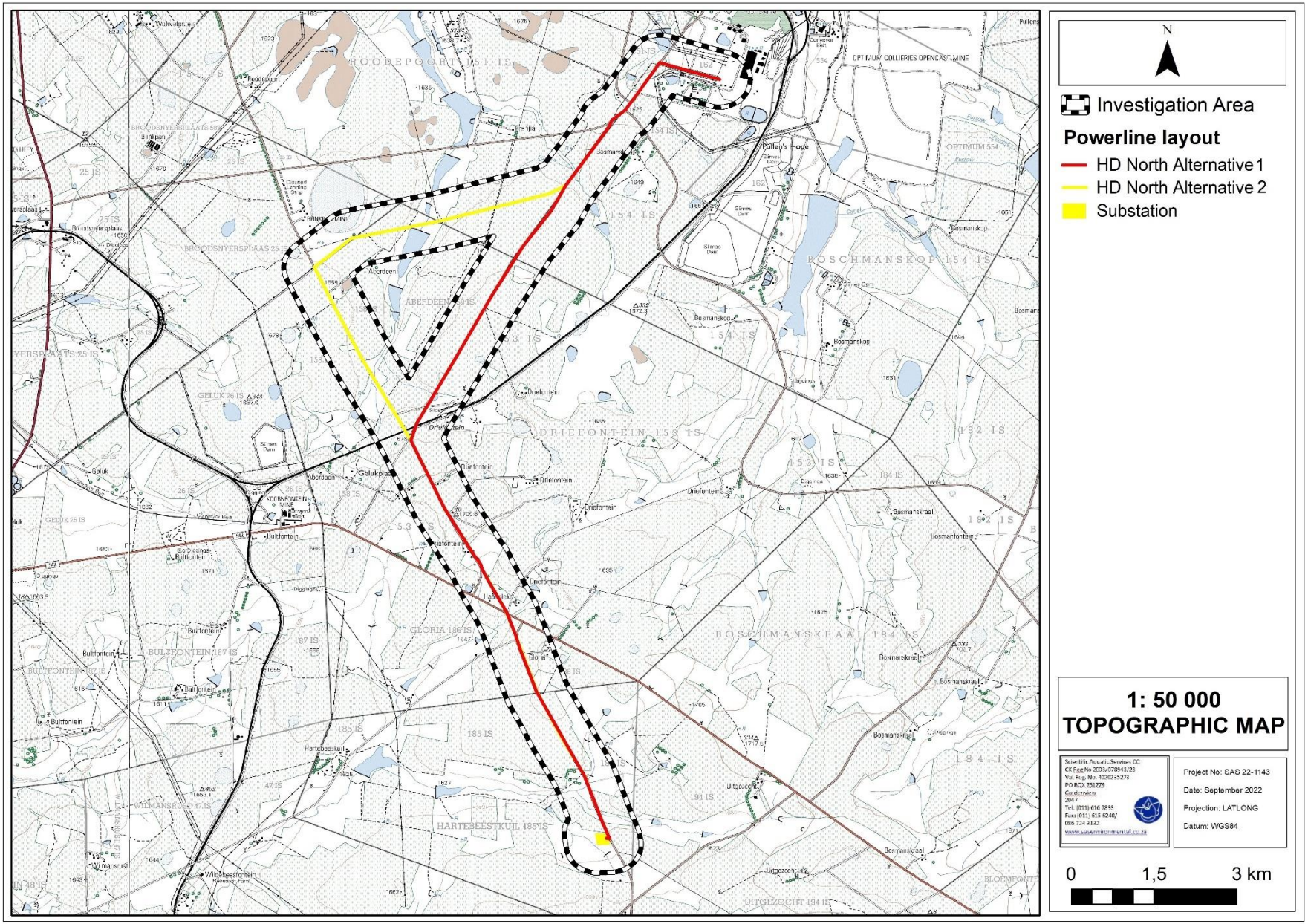

Figure 2: The proposed powerline and investigation area depicted on a 1:50 000 topographic map in relation to the surrounding area.

1.2 *Scope of Work*

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], (2014) database, National Biodiversity Assessment (NBA) (2018), and the Mpumalanga Biodiversity Spatial Plan (2014), were undertaken to aid in defining the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems;
- All freshwater ecosystems associated with the footprint of the proposed powerline, substation and associated investigation area were delineated using desktop methods in accordance with GN 509 of 2016 as it relates to activities as stipulated in the National Water Act, 1998 (Act No. 36 of 1998) and verified according to the "Department of Water Affairs and Forestry (DWAF)[1] (2008)[2]: A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics and wetness along with vegetation types were used to verify the freshwater ecosystems;
- The freshwater ecosystem classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The Present Ecological State (PES) of the freshwater ecosystems were assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.* (2008);
- The Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems were determined according to the method described by Rountree and Kotze*,* (2013);
- The Ecoservices of the freshwater ecosystems were assessed according to "A technique for rapidly assessing ecosystem services supplied by wetlands" (Kotze *et al.,* 2020);
- The freshwater ecosystem boundaries, and legislated zones of regulation were depicted for the freshwater ecosystems, where applicable;
- Allocation of a suitable Recommended Management Objective (RMO), Recommended Ecological Category (REC) and Best Attainable State (BAS) of the freshwater

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA) and subsequently as the Department of Water and Sanitation (DWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.
[2] Even though an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas), this is still considered a draft document currently under review.

ecosystems were assigned based on the results obtained from the PES and EIS assessments;

- The Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the freshwater ecosystems as a result of the proposed development, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact of the proposed development on the receiving environment.

1.3 *Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- Where access was possible, the freshwater ecosystems associated with the study area, were ground-truthed, however freshwater ecosystems within 500 m of the study area (within the investigation area) were delineated in fulfilment of GN509 of the NWA using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. Desktop delineations were ground-truthed where feasible. The delineations of freshwater ecosystems outside the study area must not be utilised for any purpose, other than planning within the study area the data in this study pertains to. Any areas that may have additionally been mapped will require field-based delineation and ground-truthing as directed by applicable legislation and best practice methods;
- Access to certain areas within the study area were restricted due to security risks and land ownership associated with the area. Certain portions along the proposed powerline where also burnt recently and therefore delineation utilising digital satellite imagery was deemed necessary;
- Various areas within the investigation area displayed transformed topography, soil profiles and runoff patterns within the landscape. As such, these disturbances have likely resulted in alterations to the hydroperiod of the identified freshwater ecosystems;
- It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics within the study area at the scale required to inform the EA process. However, this information is considered to be useful as background information to the study;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more

accurate assessments are required, the freshwater ecosystems will need to be surveyed and pegged according to surveying principles and with surveying equipment;

- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundaries may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. It is, however, expected that the freshwater ecosystems that may be affected by the proposed activities have been accurately assessed and considered, based on the site observations undertaken in terms of freshwater ecosystem ecology.

2 ASSESSMENT APPROACH

2.1 *Freshwater Ecosystem definition*

The National Water Act, 1998 (Act No. 36 of 1998) is aimed at the protection of the country's water resources, defined in the Act as "a watercourse, surface water, estuary or aquifer". According to the National Water Act, 1998 (Act No. 36 of 1998) a **watercourse** means:
(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare a watercourse.

The Act further provides definitions of wetland and riparian habitats as follows:
Wetland habitat is "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."

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas.

Thus, for the purposes of this investigation the definition of a freshwater ecosystem is considered to be synonymous with the definition of a watercourse as per the National Water Act, 1998 (Act No. 36 of 1998).

2.2 *Freshwater Ecosystem Field verification*

Where limitations to on-site delineations were experienced, use was made of historical and current digital satellite imagery, topographic maps and available provincial and national databases to aid in the delineation of the freshwater ecosystems following the site assessment. The following were taken into consideration when utilising the above desktop methods:

- Linear features: since water flows/moves through the landscape, freshwater ecosystems often have a distinct linear element to their signature which makes them discernible on aerial photography or satellite imagery;
- Vegetation associated with freshwater ecosystems: a distinct increase in density as well as shrub size near flow paths;
- Hue: with water flow paths often showing as white/grey or black and outcrops or bare soils displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation, with watercourse vegetation often indicated on black and white images as areas of darker hue (dark grey and black). In colour imagery, these areas mostly show up as darker green and olive colours or brighter green colours in relation to adjacent areas, where there is less soil moisture or surface water present; and
- Texture: with areas displaying various textures which are distinct from the adjacent terrestrial areas, created by varying vegetation cover and soil conditions within the freshwater ecosystems.

The site assessment was undertaken in August 2022 (late dry winter season), to delineate the freshwater ecosystems and undertake a detailed freshwater ecosystem assessment. The delineation of the freshwater ecosystems took place as far as possible, according to the method presented in the “Updated manual for the identification and delineation of wetland and riparian resources” (DWAF, 2008). The foundation of the method is based on the fact that freshwater ecosystems have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soil;

- Vegetation adapted to saturated soil; and
- The presence of alluvial soil in stream systems.

In addition to the delineation process, a detailed assessment of the delineated freshwater ecosystems was undertaken. Factors affecting the integrity of the freshwater ecosystems were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystems. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 *Analyses of Relevant Databases*

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided, and information that was considered of importance was emboldened.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study areas actual site characteristics at the scale required to inform the EA/ WUA processes. Nevertheless, this information is considered useful as background information to the study, is important in legislative contextualisation of risk and impact, and was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance. It must, however, be noted that site assessment of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. The information contained in the dashboard report below is intended to provide background to the landscape of the study area. Actual site conditions at the time of the assessment may differ to the background information provided by various datasets. Please refer to Section 4 for details pertaining to the site investigation.

Table 1: Desktop data indicating the characteristics of the freshwater ecosystems associated with the study and investigation areas.

Aquatic ecoregion and sub-regions in which the study and investigation areas are located.	
Ecoregion	Highveld
Catchment	Olifants-North
Quaternary Catchment (Figure 3)	B12B (northern portion) and B11A (southern portion)
WMA	Olifants
subWMA	Upper Olifants
Dominant characteristics of the Highveld (11.02) Ecoregion Level 2 (Kleynhans *et al.*, 2007).	
Dominant primary terrain morphology	Plains: low relief. Plains; moderate relief
Dominant primary vegetation types	Moist Sandy Highveld Grassland.
Altitude (m a.m.s.l)	1300 to 1900
MAP (mm)	500 to 800
Coefficient of Variation (% of MAP)	20 to 29
Rainfall concentration index	55 to 64
Mean annual temp. (°C)	12 to 18
Winter temperature (July)	0 to 20
Summer temperature (Feb)	10 to 26
Median annual simulated runoff (mm)	20 to 80
Mpumalanga Highveld Wetlands (MHW), (2014) (Figure 3 & 4).	
According to the MHW (2014) database, five CVB wetlands are indicated in the study and investigation areas. The three (3) CVB wetlands in the north are indicated to be in a moderately modified (WETCON C) ecological condition, whilst the two (2) CVB wetlands in the south, are in a largely modified (WETCON D) ecological condition. A total of five (5) depression wetlands are indicated within the investigation area, of which only one is within the northern portion of the study area as well. The depression wetland within the study area is indicated to be in a moderately modified (WETCON C) ecological condition. Two of the depression wetlands in the north west are indicated to be in a heavily to critically modified (WETCON Z) ecological condition. The other two depression wetlands in the north west are in a natural/good (WETCON A/B) to moderately modified (WETCON C) ecological condition. The depression wetland in the west is indicated to be in a heavily to critically modified (WETCON Z) ecological condition. Lastly, seven (7) seep wetlands are indicated in the study and investigation areas. Majority of the seep wetlands in the northern portion of the study and investigation areas are within a moderately modified (WETCON C) ecological condition. One small seep wetland is however in a natural/good (WETCON A/B) ecological condition. The	

Details of the study and investigation areas in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database.	
FEPACODE	The study and investigation areas fall within a sub quaternary catchment currently not considered important in terms of fish and freshwater conservation.
NFEPA Wetlands (Figure 5 & 6)	According to the NFEPA (2011) database, there are three channelled valley bottom (CVB) wetlands within the northern portion of the study and investigation areas. Two CVB wetlands are classified as being in a moderately modified (WETCON C) ecological condition and one is in a heavily to critically modified (WETCON Z3) ecological condition. Wetlands that have a Z3 ecological condition have <25% natural cover. One 'wetland flat' is indicated in the western portion of the investigation area and is in a moderately modified (WETCON C) ecological condition. An unchanneled valley bottom (UCVB) wetland is indicated in the northern portion of the investigation area and is in a moderately modified (WETCON C) ecological condition. Seven (7) seep wetlands are indicated across the majority of the study and investigation areas and are within a moderately modified (WETCON C) ecological condition. A total of three depression wetlands were identified within the northern (2) and south western (1) portions of the investigation area. These depression wetlands are indicated to be in a heavily to critically modified (WETCON Z1) ecological condition. Wetlands that have a Z1 ecological condition overlaps with an "artificial" inland waterbody.
Wetland Vegetation Type	The study and investigation areas fall within the Mesic Highveld Grassland Group 4. This vegetation group is considered to be least threatened according to Mbona *et al.* (2015).
NFEPA Rivers (Figure 5)	According to the NFEPA (2011) database two rivers occur within the study and investigation areas. The Woes-Alleenspruit is located within the northern portion of the study and investigation areas and is indicated to be in a largely modified (Class D) ecological condition (PES 1999). The Leeufonteinspruit. Is located within the southern portion of the study and investigation areas and is indicated to be in a moderately modified (Class D) ecological condition (PES 1999). Based on the site assessment these rivers were characterised as valley bottom wetlands and assessed as such (refer to Section 4).
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 7).	
According to the NBA database (2018), a total of seven (7) CVB wetlands, five (5) depression wetlands and four (4) seep wetlands are indicated within the study and investigation areas. The identified wetlands are all in a Largely to Critically Modified (WETCON D/E/F) ecological condition according to the NBA (2018). The ecosystem threat status (ETS) of all the identified wetlands is critically endangered (**CR**) and the Ecosystem protection level (EPL) of the identified depression and seep wetlands is classified as "poorly protected" (**PP**) whilst the CVB wetlands are "not protected" (**NP**).	
Mpumalanga Biodiversity Sector Plan (MBSP, 2019) (Figure 8).	
Ecological Support Area (ESA)	ESAs are areas that are not essential for meeting targets, but that play an important role in supporting the functioning of CBAs and that deliver important ecosystem services. According to the MBSP Aquatics database (2019), numerous ESAs are present within the study and investigation areas, The ESAs correspond to the freshwater ecosystems identified by the NFEPA (2011) database.

seep wetlands in the southern and western portion of the study and investigation areas are all in a largely modified (WETCON D) ecological condition.	Other Natural Areas (ONA)	ONAs are areas that have been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. A large portion of the study and investigation areas are classified as ONAs.
National Web Based Environmental Screening Tool (Accessed 2022) (Figure 9).		
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	Moderately or Heavily Modified	Majority of the study and investigation areas are identified as Moderately or Heavily Modified. These are areas in which significant or complete loss of natural habitat and ecological functioning has taken place which is largely due to agricultural activities within the area.
The wetland features identified by the NFEPA (2011), MBSP (2019 and NBA (2018) databases have a **very high** sensitivity for wetlands. The remaining portions of the study and investigation areas has a **low** sensitivity for aquatic biodiversity.		

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014).		
Sub-quaternary reach	B11A- 01331	B12B-01223
Proximity to study area	4,33 km	5,93 km
Assessed by expert?	Yes	Yes
PES Category Median	Largely modification (Class D)	Serious Modification (Class E)
Mean Ecological Importance (EI) Class	Moderate	Moderate
Mean Ecological Sensitivity (ES) Class	High	High
Stream Order	1	1
Default Ecological Class (based on median PES and highest EI or ES mean)	B (High)	B (High)

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South African Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area

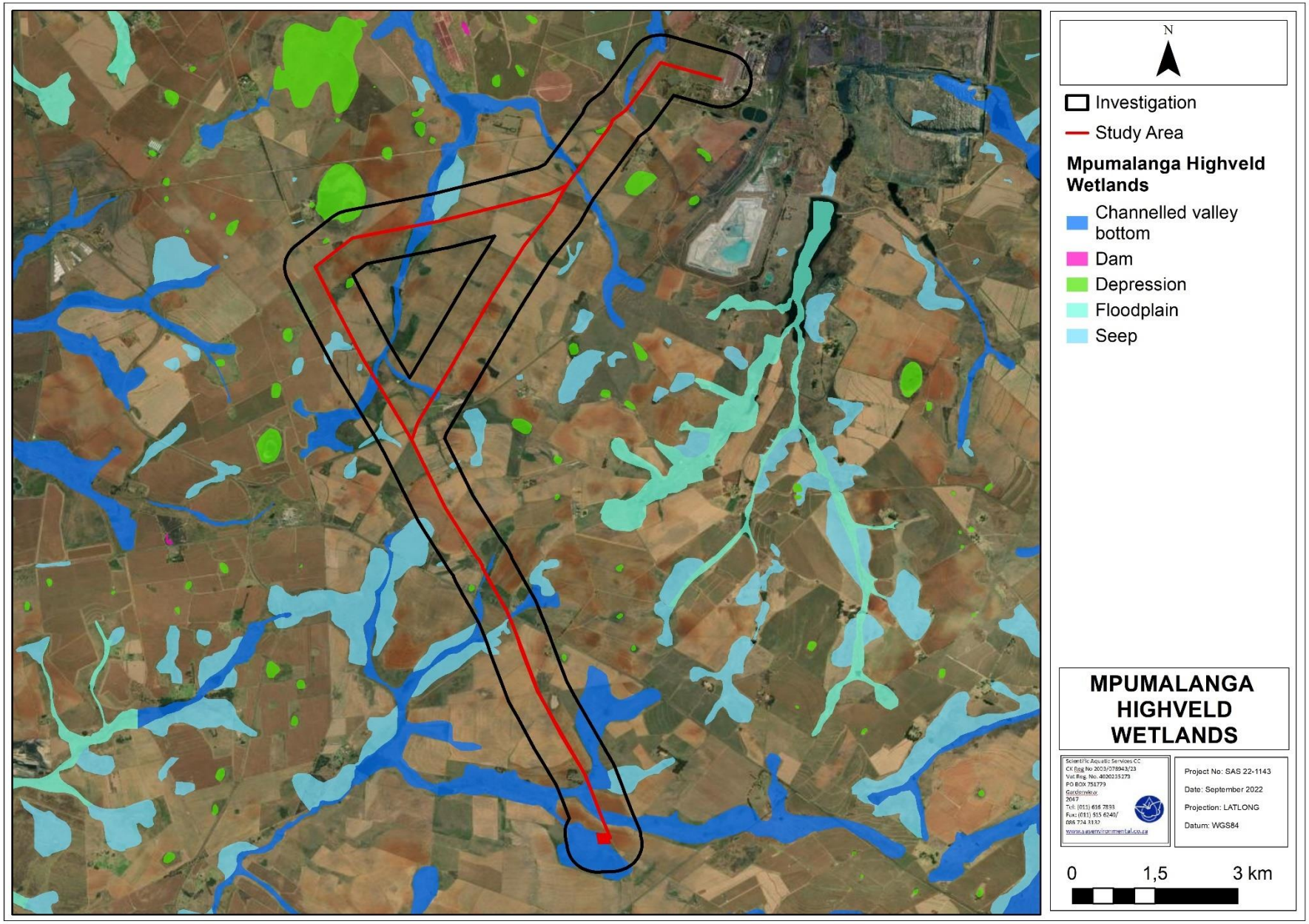

Figure 3: Wetlands associated with the study and investigation areas according to the Mpumalanga Highveld Wetlands database (2014).

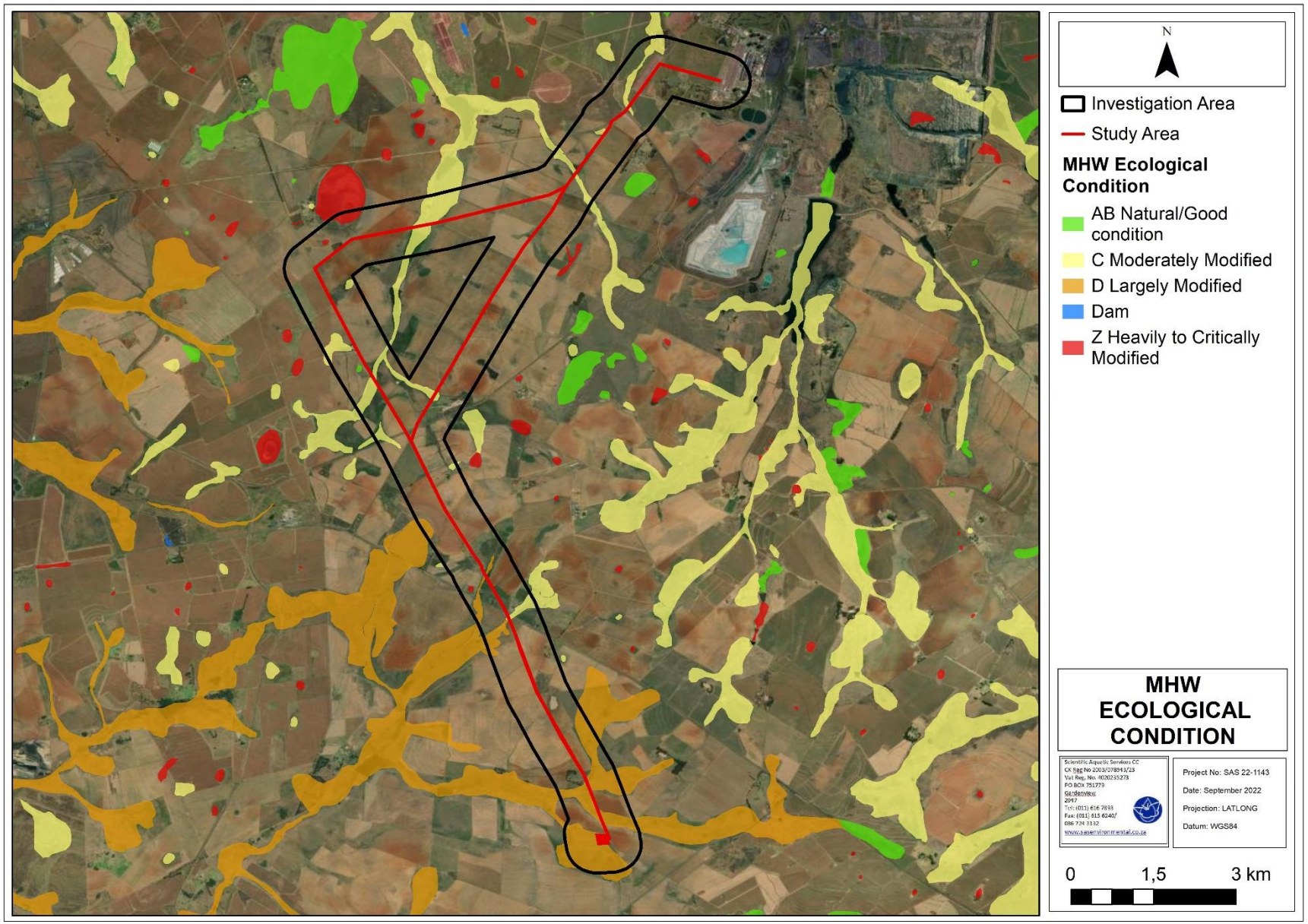

Figure 4: Ecological condition of the wetlands associated with the study and investigation areas according to the Mpumalanga Highveld Wetlands database (2014).

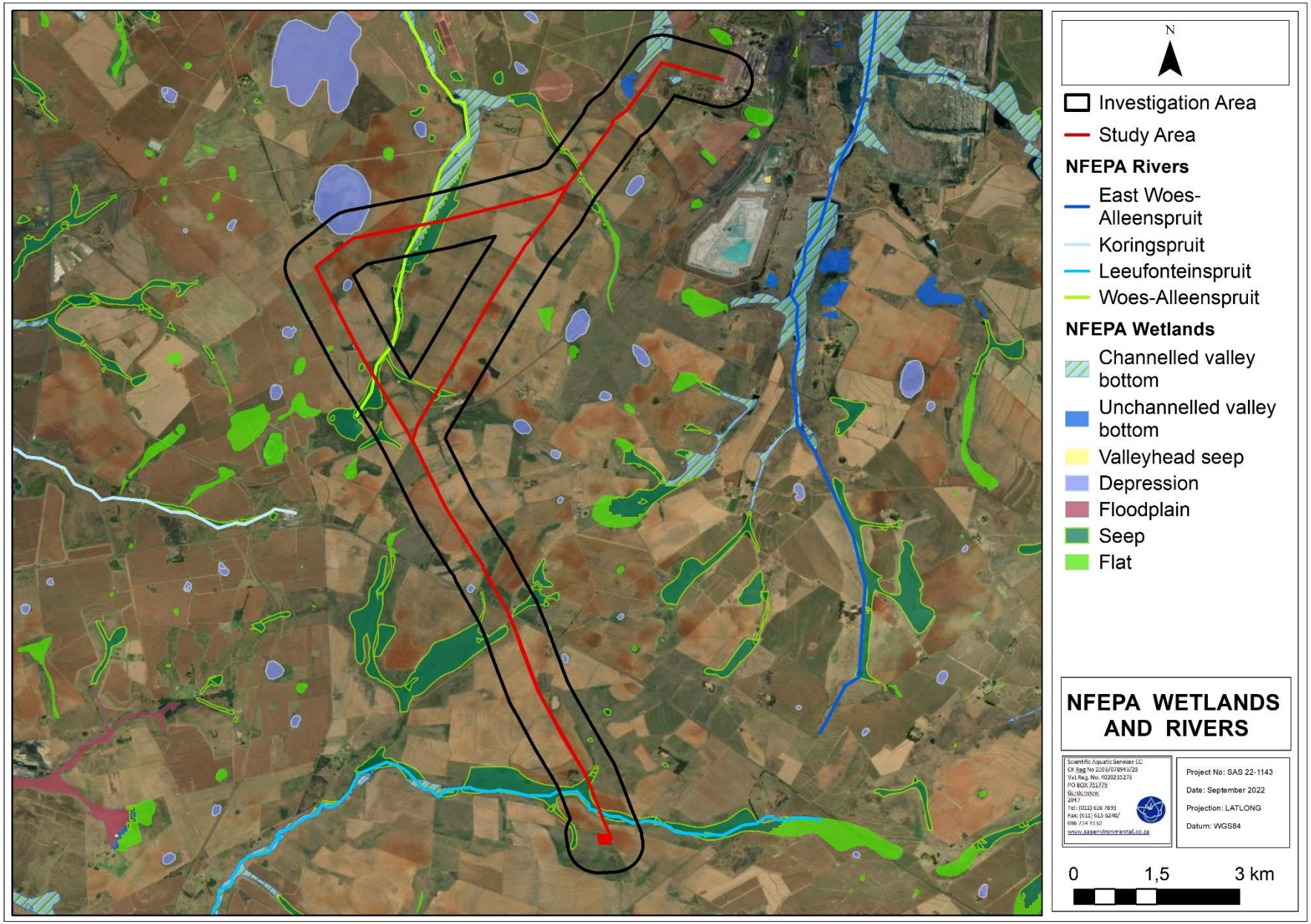

Figure 5: Wetlands and Rivers associated with the study and investigation areas according to the NFEPA database (2011).

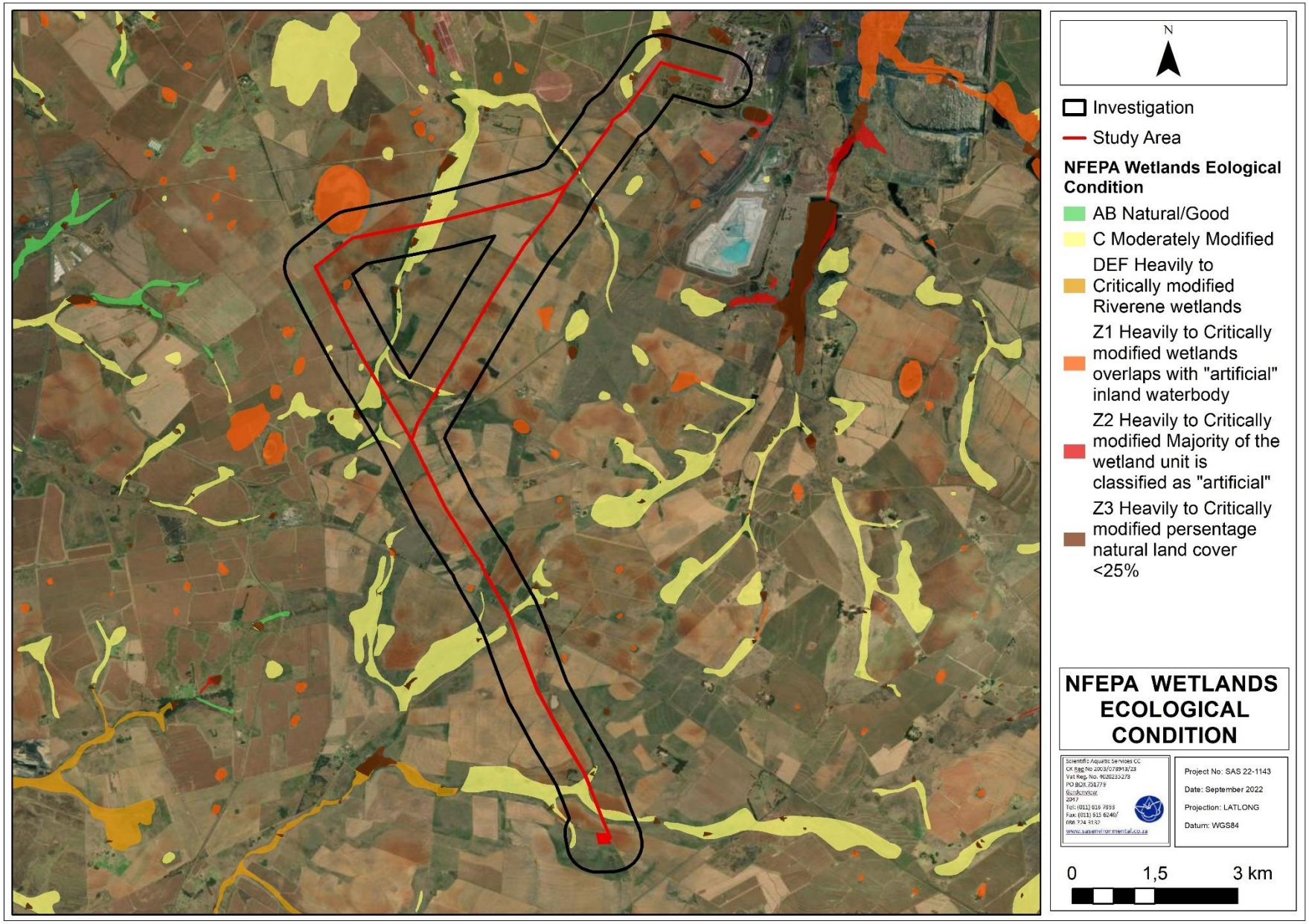

Figure 6: Ecological condition of the wetlands associated with the study and investigation areas according to the NFEPA database (2011).

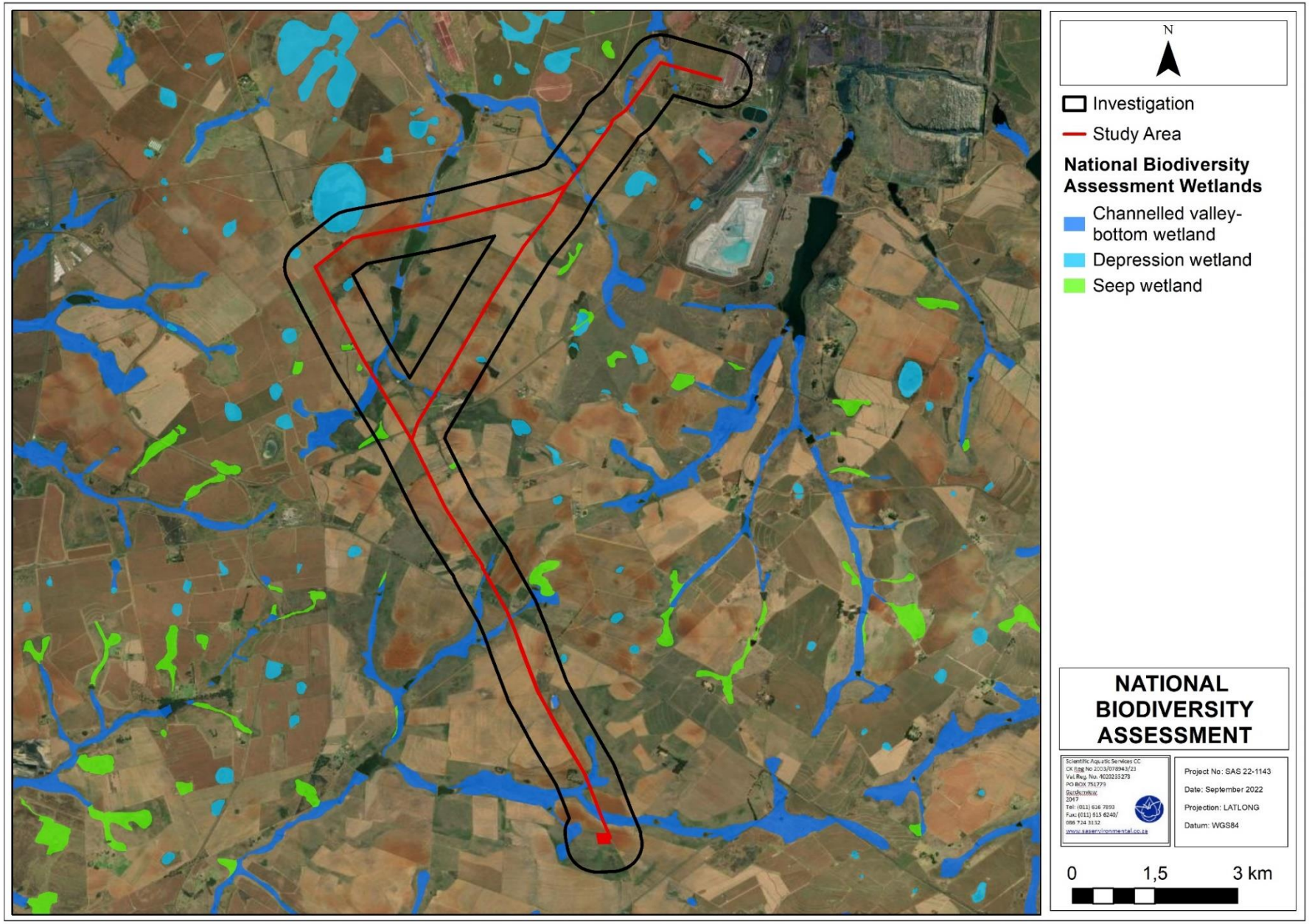

Figure 7: Wetlands associated with the study and investigation areas according to the National Biodiversity Assessment database (2018).

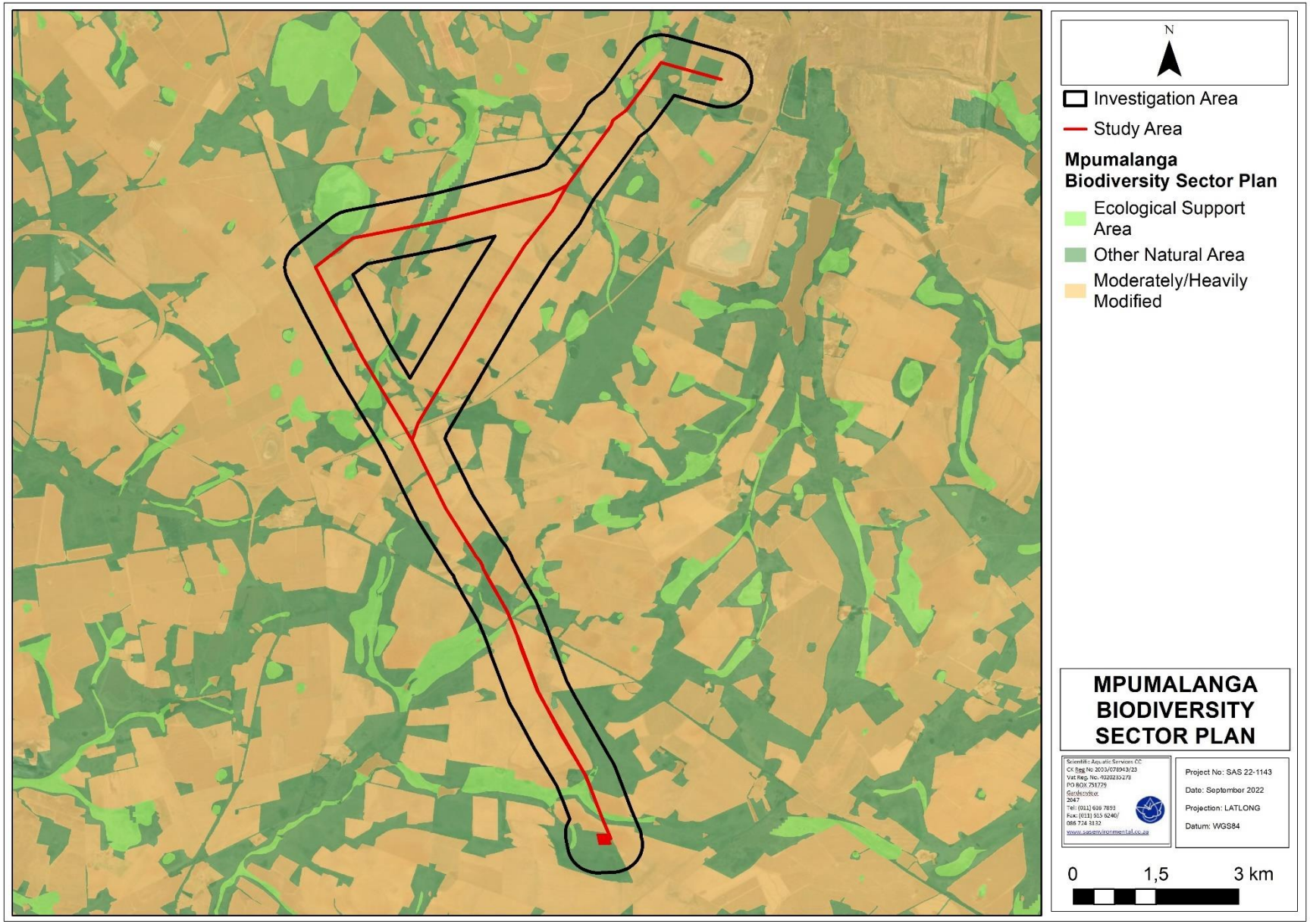

Figure 8: Ecologically important areas associated with the study and investigation areas according to the Mpumalanga Biodiversity Sector Plan database (2019).

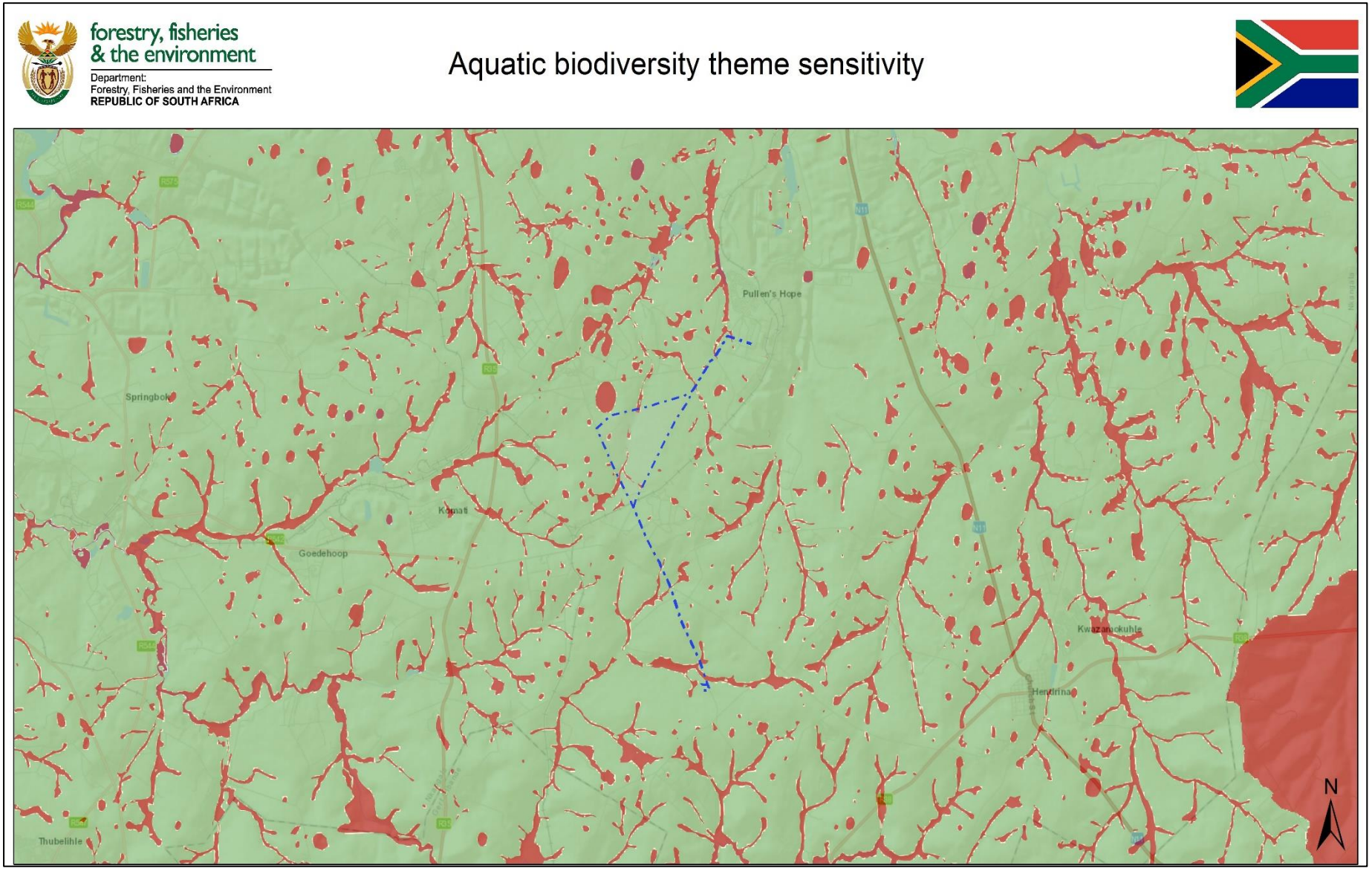

Figure 9: Map of relative aquatic biodiversity theme sensitivity for the study area according to the National Web Based Environmental Screening Tool (Accessed 2022).

3.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database*

The study area falls within the Highveld Aquatic Ecoregion and within the B11A and B12B quaternary catchments. According to the PES/EIS database, as developed by the DWS RQIS department, the following sub-quaternary catchment reaches (SQR) are applicable. The SQR monitoring points (B11A-01331) and (B12B-01223) are located approximately 4,33km and 5,9km southwest and north of the proposed powerline, respectively (Figure 10). The following macro-invertebrate taxa has previously been reported from SQR B11A-01331(Leeufonteinspruit) and B12B-01223 (Woes-Alleenspruit) (Table 2):

Table 2: Macro-invertebrate families recorded at SQR B11A-01331 (Leeufonteinspruit) and B12B-01223 (Woes-Alleenspruit):

Macro-Invertebrates	B11A-01331 (Leeufonteinspruit)	B12B-01223 (Woes-Alleenspruit)
Aeshnidae	X	X
Ancylidae	X	
Baetidae 1 Sp.		X
Baetidae 2 Sp.	X	
Belostomatidae	X	X
Bulininae	X	
Caenidae	X	X
Ceratopogonidae	X	
Chironomidae	X	
Coenagrionidae	X	X
Corbiculidae	X	
Corixidae	X	X
Crambidae	X	
Culicidae	X	
Dixidae	X	
Dytiscidae	X	X
Gerridae	X	X
Gomphidae	X	
Gyrinidae	X	
Hirudinea	X	X
Hydracarina	X	
Hydraenidae	X	
Hydrometridae	X	X
Hydrophilidae	X	
Hydropsychidae 1 sp.		X
Leptoceridae	X	X
Lymnaeidae	X	
Muscidae	X	
Naucoridae	X	
Nepidae	X	X
Notonectidae	X	X
Oligochaeta	X	X
Physidae	X	

Macro-Invertebrates	B11A-01331 (Leeufonteinspruit)	B12B-01223 (Woes-Alleenspruit)
Planorbinae	X	
Pleidae	X	
Potamonautidae	X	X
Psychodidae	X	
Sphaeridae	X	
Tabanidae	X	
Tipulidae	X	
Turbellaria	X	X
Veliidae/Mesoveliidae	X	X

The following fish species has previously been reported from SQR B11A-01331(Leeufonteinspruit) and B12B-01223 (Woes-Alleenspruit) (Table 3):

Table 3: Fish species recorded at the SQR B11A-01331 (Leeufonteinspruit) and B12B-01223 (Woes-Alleenspruit):

Fish species	B11A-01331 (Leeufonteinspruit)	B12B-01223 (Woes-Alleenspruit)
Clarias gariepinus	X	X
Enteromius anoplus	X	X
Enteromius neefi	X	X
Enteromius paludinosus	X	X
Pseudocrenilabrus philander	X	X
Tilapia sparrmanii	X	X

The ecological status of SQR B11A-01331(Leeufonteinspruit) and B12B-01223 (Woes-Alleenspruit) are indicated in Table 4 below:

Table 4: Summary of the ecological status of the SQR B11A-01331 (Leeufonteinspruit) and SQR B12B-01223 (Woes-Alleenspruit) according to the DWS RQS PES/EIS database.

PESEIS Data	B11A-01331 (Leeufonteinspruit)	B12B-01223 (Woes-Alleenspruit)
Synopsis		
PES Category Median	(D) Largely modified	(E) Serious modification
Mean EI class	Moderate	Moderate
Mean ES class	High	High
Length	19.00	21.00
Stream order	1	1
Default EC[4]	B	B
PES Details		
Instream habitat continuity MOD	Large	Serious
RIP/wetland zone continuity MOD	Moderate	Moderate
Potential instream habitat MOD activities	Large	Serious
Riparian/wetland zone MOD	Small	Large
Potential flow MOD activities	Large	Serious
Potential physico-chemical MOD activities	Moderate	Serious
EI Details		
Fish spp/SQ	6	6
Fish average confidence	2.33	2.67
Fish representivity per secondary class	Low	Low
Fish rarity per secondary class	Low	Low
Invertebrate taxa/SQ	42	30
Invertebrate average confidence	2.62	1.73
Invertebrate representivity per secondary class	High	Moderate
Invertebrate rarity per secondary class	Very High	High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Very Low
Habitat diversity class	Low	Low
Habitat size (length) class	Low	Low
Instream migration link class	Moderate	Low
Riparian-wetland zone migration link	High	High
Riparian-wetland zone habitat integrity class	Very High	Moderate
Instream habitat integrity class	Moderate	Low
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500 m	High	High
Riparian-wetland natural vegetation rating based on expert rating	High	High
ES Details		
Fish physical-chemical sensitivity description	High	High
Fish no-flow sensitivity	High	High
Invertebrates physical-chemical sensitivity description	Very High	Moderate
Invertebrate velocity sensitivity	Very High	Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	Very Low
Stream size sensitivity to modified flow/water level changes description	Very High	Very High
Riparian-wetland vegetation intolerance to water level changes description	High	High

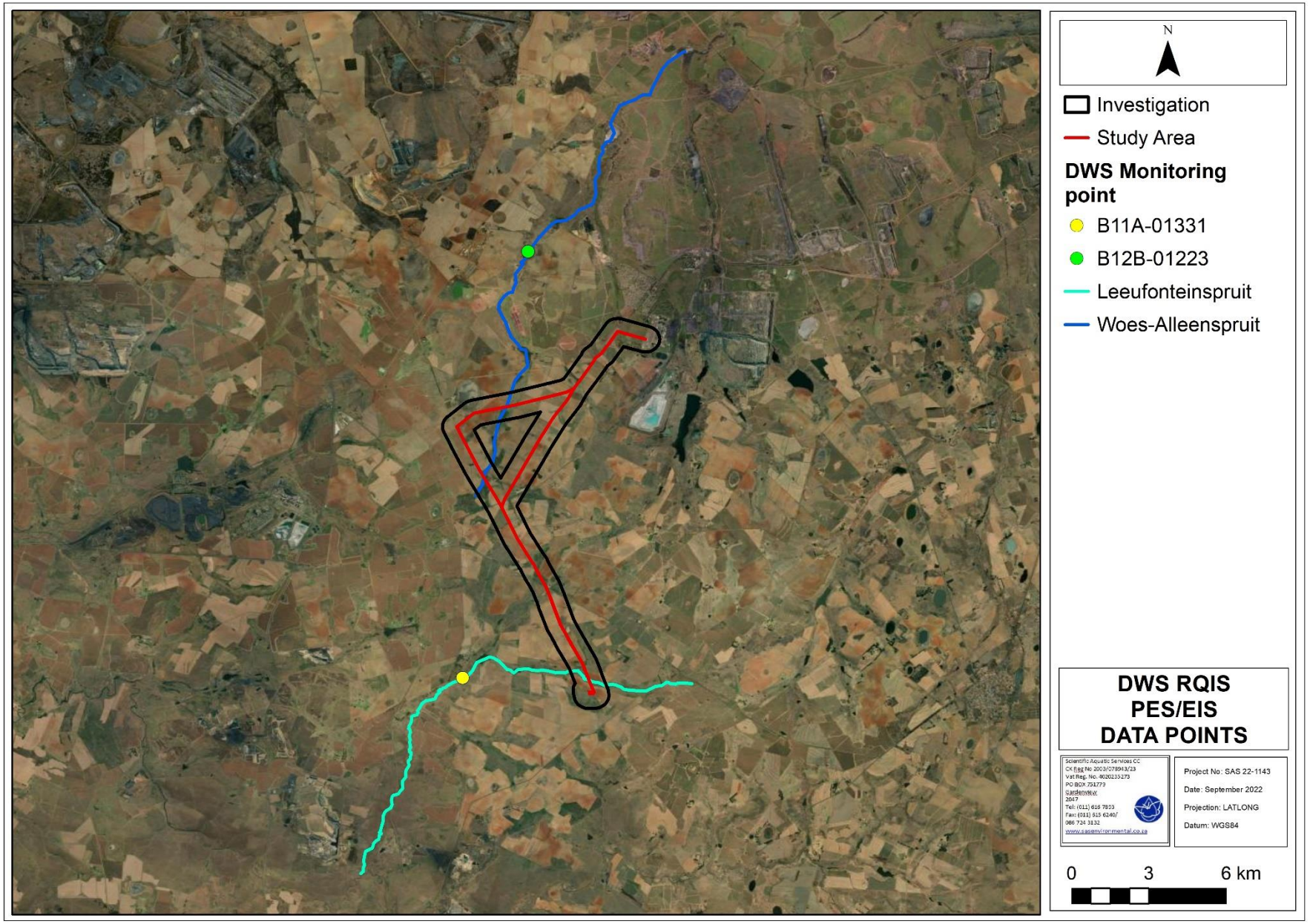

Figure 10: The DWS RQIS PES/EIS monitoring points associated with the study and investigation areas.

4 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 *Freshwater Ecosystem Characterisation*

The site assessment confirmed the presence of numerous Hydrogeomorphic (HGM) units, and were classified as follows:

- Eight (8) valley bottom wetlands (includes channelled valley bottom HGM units and unchannelled valley bottom HGM units);
- Three (3) depression wetlands; and
- One (1) seep wetland.

The freshwater ecosystems identified within the study and investigation areas were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems. The wetlands fall within the Highveld Aquatic Ecoregion and the Mesic Highveld Grassland Group 4 WetVeg (wetland vegetation) group, classified by Mbona *et al.* (2015) as "Least Threatened". At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 5, below.

Table 5: Characterisation at Levels 3 and 4 of the Classification System (Ollis *et al*., 2013) of the freshwater ecosystems associated with the study and investigation areas.

Freshwater ecosystems	Level 3: Landscape unit	Level 4: HGM Type
Eight (8) valley bottom wetlands (includes channelled and unchannelled valley bottom HGM units) are traversed by the proposed powerline (Alternative 1 and 2) and are located throughout the investigation area.	Valley floor: The base of a valley, situated between two distinct valley side-slopes.	**Unchannelled valley bottom**: A valley bottom wetland without a river channel running through it. **Channelled valley bottom:** A valley bottom wetland with a river channel running through it.
One depression wetland in the northern portion of the study area is traversed by the proposed powerline (Alternative 1). Two depression wetlands are located in the eastern portion of the investigation area.	Plain: an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	**Depression:** A wetland or aquatic ecosystem with closed (or near closed) elevation contours which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
One seep wetland is adjacent to the proposed powerline (Alternative 1 and 2) and is located in the south eastern portion of the investigation area.	Slope: an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley	**Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The delineated freshwater ecosystems are conceptually depicted in Figures 11 below.

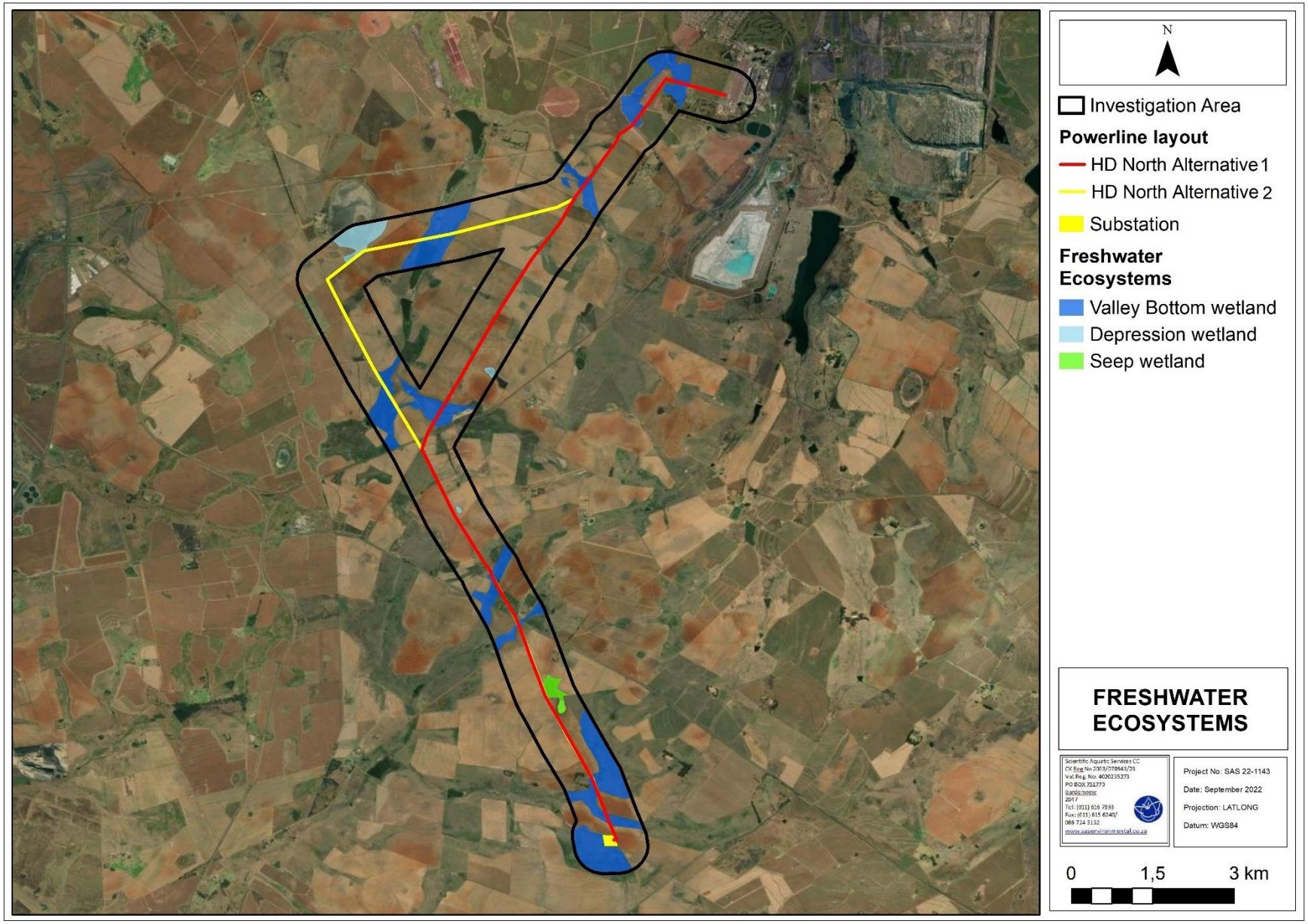

Figure 11: Location of the freshwater ecosystems associated with the proposed powerline and associated investigation area.

4.2 *Freshwater Ecosystem Delineation*

As noted in Section 1.2, the freshwater ecosystem assessment was limited to the proposed powerline and substation footprint and associated investigation area as provided by the proponent. It was noted during the site assessment that historical and ongoing agricultural activities have occurred within the proposed powerline and substation footprint, investigation area and immediate surrounds. As a result, changes to the topography, soil and vegetation profiles were evident. The delineations as presented in this report, are nevertheless deemed the best estimate of the freshwater ecosystem boundaries based on site conditions present at the time of the assessment and are considered sufficiently adequate to allow for informed decision-making.

During the site assessment, the following indicators were used to delineate the boundaries of the freshwater ecosystems:

- Soil wetness indicator, duration and frequency of saturation in the soil profile is a diagnostic indicator since it influences the colour change in the soil. Low chroma (grey and muted colours) as well as mottles are more prominent in soil which have higher saturation frequency. Soils displaying signs of hydromorphism also indicates an increased hydroperiod and thus the potential presence of hydromorphic characteristics (Figure 12);
- Vegetation was utilised in conjunction with the soil indicators associated with the freshwater ecosystems, where feasible. The distinction between obligate, facultative, and terrestrial vegetation was relatively discernible;
- Soil morphological characteristics typically associated with freshwater ecosystem conditions, such as gleying or mottling were utilised in conjunction with saturation as the secondary indicator; and
- Despite transformation of the landscape associated with the investigation area, the terrain provided an indication of low-lying areas where water is likely to collect and/or move through the landscape.

Figure 12: Representation of the soil of the freshwater ecosystems identified in the study and investigation areas, indicating soil saturation, gleyed soil and mottling which serve as key indicators of a fluctuating water table.

4.3 *Site Verification Results*

Following the site assessment, the assessments outlined in Section 1.2 were applied. The results of the assessments are discussed in the dashboard style reports which follow and the details thereof are presented in Appendix E.

The freshwater ecosystems identified in the study and investigation areas have undergone similar historic and current anthropogenic changes. As such, although the HGM units were individually assessed, for the purposes of presenting a concise discussion, the freshwater ecosystems were grouped (refer to Figure 13) according to HGM units and ecological condition and discussed as such:

- Eight (8) valley bottom wetlands (Group 1);
- Southern depression wetland (Group 2);
- Two (2) Eastern depression wetlands (Group 3); and
- Seep wetland (Group 4).

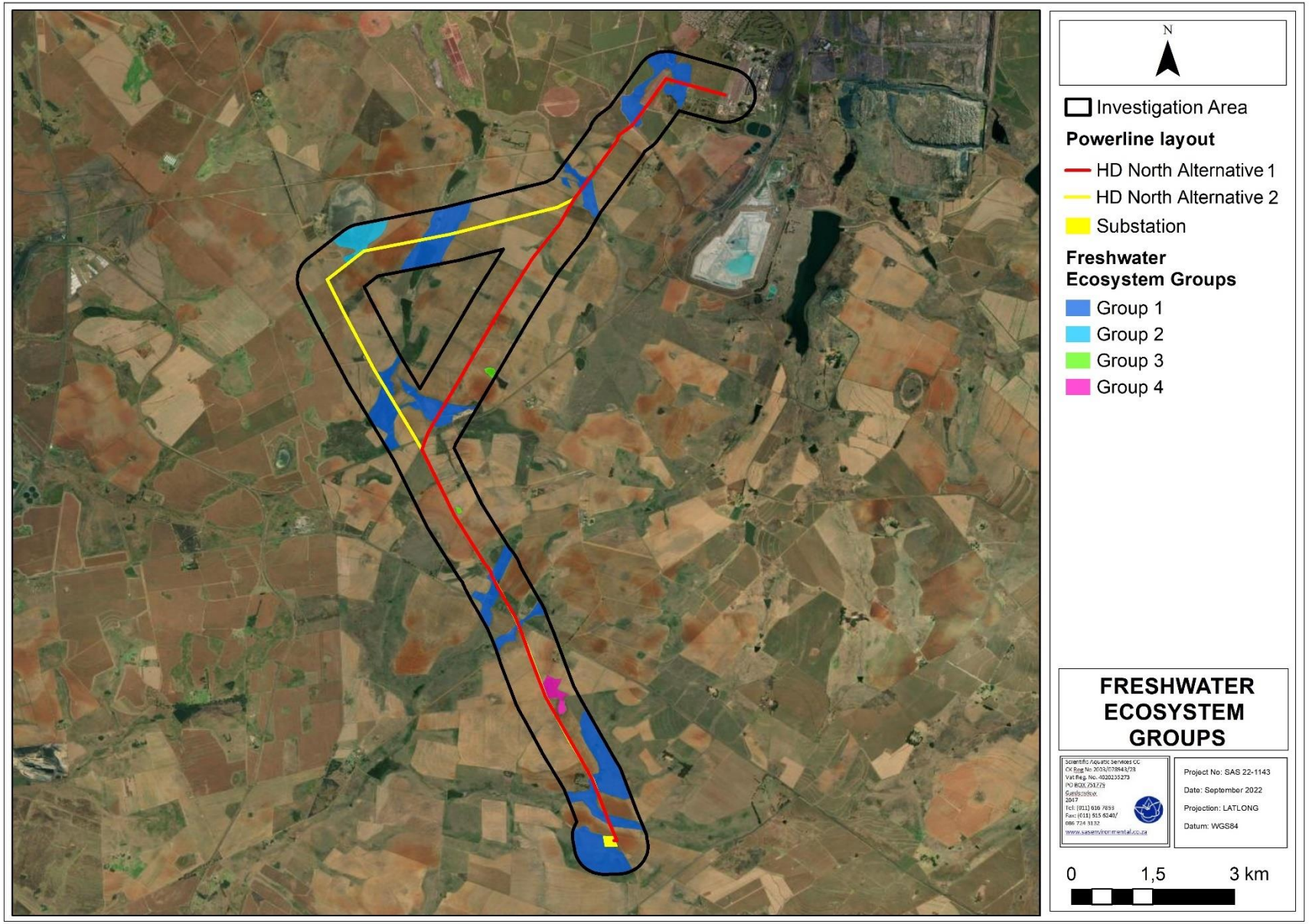

Figure 13: Visual representation of the grouping of the freshwater ecosystems associated with the proposed powerline and investigation area.

Table 6: Summary of the assessment of Group 1 (valley bottom wetlands) that will be traversed by the proposed powerline Alternative 1 and 2.

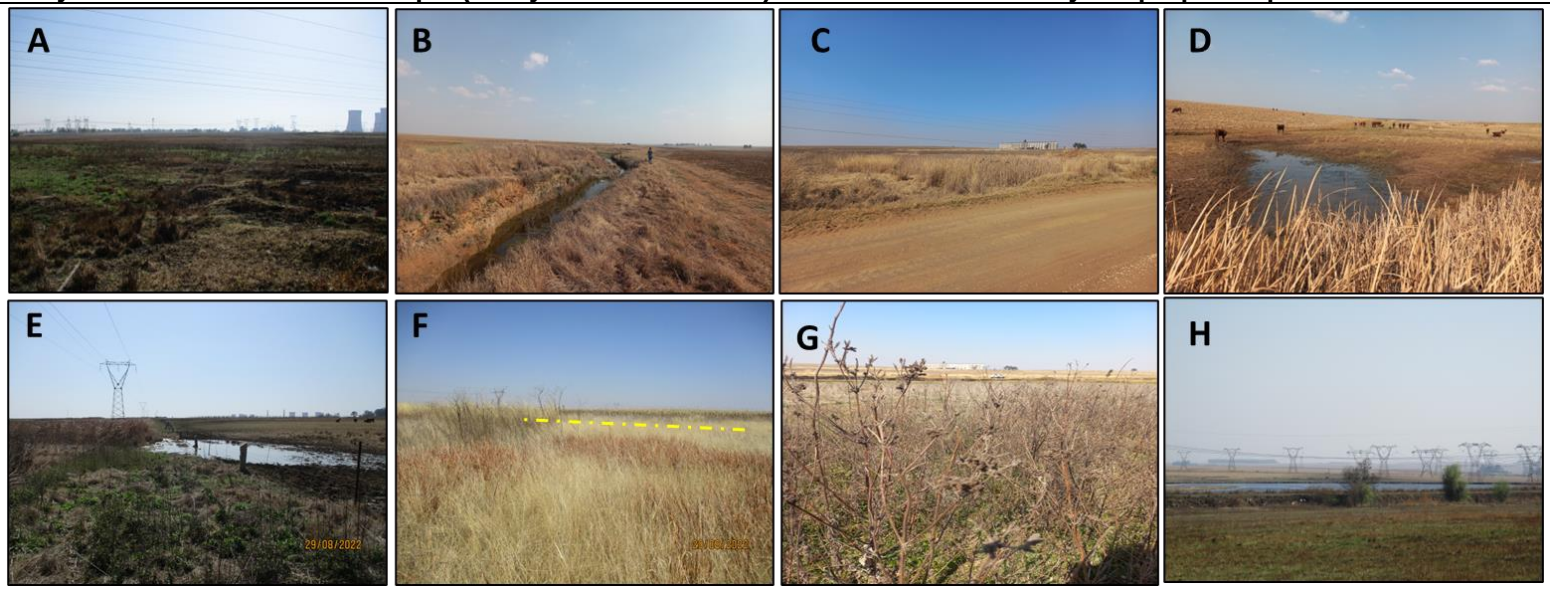

Figure 14: Representative photographs of the valley bottom wetlands. A- areas within the valley bottom wetlands were burnt at the time of assessment. B- channelisation of the wetlands. C- informal roads have been constructed through the wetlands. D- livestock grazing and trampling. E- an existing powerline is located along portions of the proposed powerline Alternative 2. F- agricultural activities which infringe on the boundary of the wetlands. G- dense Alien Invasive Plants (AIP's). H- numerous dams have been constructed in the wetlands.

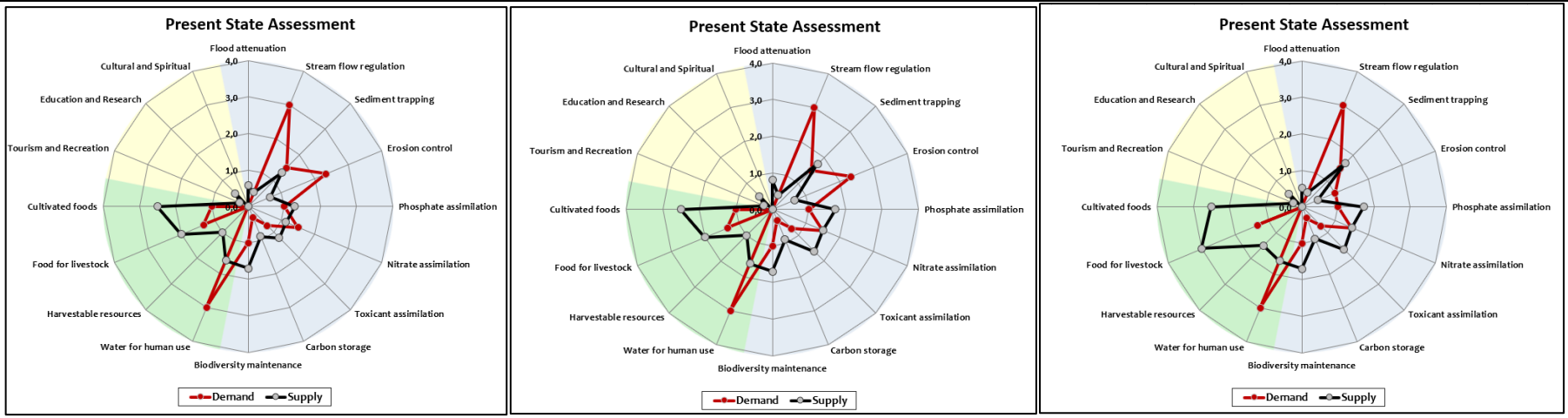

Figure 15: Representation of the ecological & socio-cultural provision graphs for the Valley Bottom wetlands that will be traversed by the proposed powerline (Alternative 1 and 2). The Ecoservice provision calculations were undertaken on a systems level.

PES Discussion (WET-Health)	**PES Category: E (Seriously Modified)** The valley bottom wetlands were classified as being in a seriously modified (Category E) ecological condition. The primary impacts affecting the wetlands' hydrology and geomorphology stem from the surrounding agricultural practices, increased catchment wide runoff, altered flood peaks, and the presence of numerous dams and informal roads which bisect the wetlands at numerous locations. The wetlands have been infringed on by cultivated fields which have reduced the overall extent of the wetlands in some areas. The vegetation of the wetlands has been intensively grazed and trampled by livestock and remaining vegetation is primarily grasses and Alien Invasive Plants (AIPs).	**Ecoservice provision**	**Ecoservices category: Very low to Moderate** The valley bottom wetlands provide a very low to moderate degree of ecological service provisioning with services such as sediment trapping, phosphate, nitrate and toxicant assimilation, food for livestock and cultivated foods considered the primary services supplied. There is a high demand for stream flow regulation, erosion control and water for human use, which is attributed to the surrounding agricultural activities which rely heavily on the wetlands in provisioning of these services.
EIS discussion	**EIS Category: Moderate** The EIS of the wetlands was defined as moderate. This was attributed to the sensitivity of the wetlands to changes in floods, low flows and water quality. The wetlands are also considered ecologically important for biodiversity maintenance due to the surrounding agricultural activities which decrease natural areas used as habitat for numerous faunal, avifaunal and floral species.	**REC, RMO & BAS Category**	**REC: D/ BAS: D (Improve) /RMO : E (Maintain)** Strictly speaking, according to the method of determining the Recommended Management Objective (RMO), the RMO is to maintain the PES, seriously modified ecological condition (Category E). However, since a PES Category E/F is considered ecologically unacceptable (Malan and Day, 2012), the recommended Ecological Category (REC) is Category D and therefore, efforts should be made to improve the Ecostatus of the wetlands accordingly. Please refer to the discussion below pertaining to impacts and mitigation measures.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

Alterations to the natural hydraulic regime and geomorphological processes of the valley bottom wetlands have occurred. These impacts include, road crossings, dams, increased runoff and changes to the natural flood peaks due to catchment wide agricultural activities, increased erosion and sediment laden runoff. These impacts alter the natural flow path, velocity of flow and sediment balance within the wetlands which can negatively impact habitat and ecoservice provision of the wetlands. Historical and recent cultivation which infringe on the temporary zone of the wetlands, and dense alien vegetation patches within the catchment have reduced infiltration rates and increased the volume of sediment laden runoff entering the wetlands.

Basic water quality parameters (pH, Temperature and Electrical Conductivity (EC)) were measured *in situ* during the site assessment . A total of four (4) water quality samples were taken where surface water was present at the time of assessment.
Sample 1: (northern valley bottom wetland adjacent to the Eskom Hendrina Power Station)
The pH was measured as 9.1 (exceeds the acceptable range limit >8.0), Temperature of 14.98° C (which is acceptable for the time of day (early morning) and season) and EC of 109.8 mS/m (exceeds the acceptable range limit (>85 mS/m) according to the Research Water Quality objectives (RWQO) of South Africa (DWA, 2011).

Sample 2: (northern valley bottom wetland, north of where Alternative 1 and 2 split)
The pH was measured as 7.74 (within the ideal range limit ≥6.5 - ≤8.0), Temperature of 13.28° C (which is acceptable for the time of day (early morning) and season) and EC of 177.8 mS/m (exceeds the acceptable range limit (>85 mS/m) according to the Research Water Quality objectives (RWQO) of South Africa (DWA, 2011).

Sample 3: (western valley bottom wetland, Alternative 2)
The pH was measured as 7.53-9.1 (within the ideal range limit ≥6.5 - ≤8.0), Temperature of 20° C (which is acceptable for the time of day and season) and EC of 214.1 mS/m (exceeds the acceptable range limit (>85 mS/m) according to the Research Water Quality objectives (RWQO) of South Africa (DWA, 2011).

Sample 4: (western valley bottom wetland, north of the substation)
The pH was measured as 7.53 (within the ideal range limit ≥6.5 - ≤8.0), Temperature of 20° C (which is acceptable for the time of day (late afternoon) and season) and EC of 177.8 mS/m (exceeds the acceptable range limit (>85 mS/m) according to the Research Water Quality objectives (RWQO) of South Africa (DWA, 2011).

Impacts such as agricultural activities and associated return flows can alter the water quality by altering the natural sediment balance and nutrient inputs from the use of herbicides, pesticides and fertilisers during cultivation as well as livestock grazing.

Due to the seasonality of the assessment, intense trampling and grazing of livestock, and surrounding cultivation activities, the accurate identification of certain plant species within the wetlands was not possible. The vegetation of the wetlands was dominated by grasses ,a few sedge species and AIPs. The plant species identified include, but not limited to, *Verbena bonariensis, Tagetes minuta, Bidens pilosa, Berkeya sp, Hyperrhenia sp, Arundo donax, Pogonarthria squarrosa* and *Loudetia simplex.* Overall the wetlands are considered likely to provide minimal roosting, breeding and feeding habitat for avifauna, small mammals, amphibians, reptiles and invertebrates, although due to the surrounding anthropogenic activities only less sensitive species are likely to utilise the wetlands.	
Extent of modification anticipated.	The proposed substation is located within a valley bottom wetland and will result in an anticipated loss of approximately 2,50ha of wetland habitat. The proposed substation will also result in indirect impacts on the downgradient valley bottom wetland. These impacts include potential sedimentation and erosion. The proposed powerline pose no direct impacts on the valley bottom wetlands, provided that the supporting structures of the powerline are situated outside the delineated extent of the wetlands and the associated NEMA 32m ZoR. Indirect impacts may include potential indiscriminate movement of personnel and vehicles leading to disturbance and dust generation form vehicles.
Risk Assessment Outcome & Business Case:	
High	Since the proposed substation will result in the loss of approximately 2, 50 ha of valley bottom wetland, it is advised that the layout footprint of the substation be revised so as to avoid the freshwater ecosystems and NEMA 32m ZoR associated with the study and investigation areas. Mitigation measures include: • The valley bottom must be demarcated as a "no go" area; and • Movement of personnel and vehicles are restricted to the construction area and is not permitted in the “no-go area”; and • It is imperative that all construction works (with specific mention of potential upgrading of any road crossings) be undertaken during the driest period of the year when the flow is very low in the freshwater ecosystems.
Low	The proposed powerline will pose a “low” risk significance to the valley bottom wetland, provided that the supporting structures are placed outside the delineated extent of the wetlands and associated NEMA 32m ZoR,. The mitigation measures as recommended in Section 6.1 of this report must be adhered to with specific mention of demarcating the wetland boundaries and associated NEMA 32m ZoR as “no-go” areas. The operation of the proposed substation will also pose a “low” risk significance to the valley bottom wetland.

Table 7: Summary of the assessment of Group 2 adjacent to the proposed powerline (Alternative 2) and within the investigation area.

Ecological & socio-cultural service provision graph:

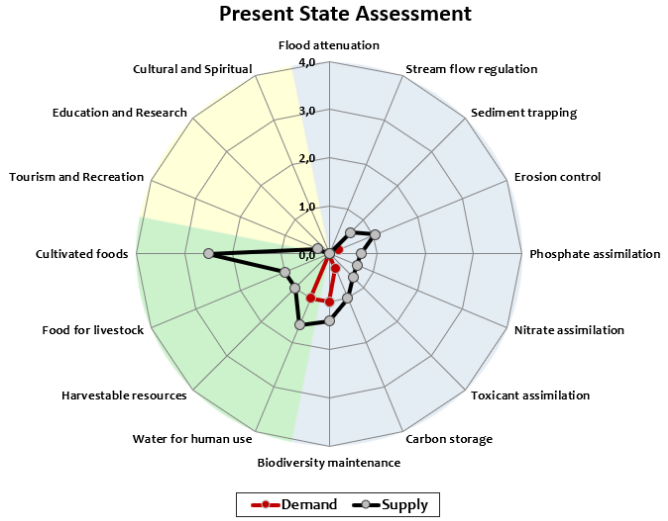

Figure 16: Representative photographs of the depression wetland adjacent to the proposed powerline (Alternative 2) within the northern portion of the investigation area. (left) An existing powerline is located east of the depression wetland.

PES Discussion (WET-Health)	**PES Category: C** The depression wetland is in a moderately modified ecological condition. The primary impacts to hydrology include a minor degree of increased runoff and flood peaks, as well as dense amounts of AIPs. It was also considered likely that portions along and within the depression wetland have been transformed, likely as a result of agricultural practices. The geomorphological processes of the depression wetland were altered due to increased runoff from surrounding agricultural land. The vegetation community of the depression wetland was dominated by grasses and AIPs including *Verbena bonariensis, Tagetes minuta* and *Bidens pilosa.*	**Ecoservice provision**	**Ecoservices category: Low-Very Low** The depression wetland has a low to very low ecoservice provision, majority attributed to water for human use and cultivated food. As the depression wetland is surrounded by dense agricultural activities, extraction of water from the depression wetland was deemed of importance for the surrounding community. The low importance of stream flow regulation, flood attenuation and erosion control is due to the nature of the depression wetland.
EIS discussion	**EIS Category: Moderate** The depression wetland was assessed to be of a moderate EIS. This was attributed to the hydro-functional importance of the wetland and sensitivity of the wetland type to changes in water quality and quantity. In addition, due to the size of the depression wetland, it was considered likely that the wetland supports potential habitat for sensitive and less sensitive biota.	**REC, RMO & BAS Category**	**REC: C /BAS: C/ RMO: Maintain** Based on the PES and EIS, the RMO is to maintain the ecostatus of the depression wetland at a BAS and REC C. As a result, should any activities be planned within the delineated boundary of the wetland, the wetland must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

The hydraulic regime of the depression wetland has likely been affected by increased surface runoff and some infill and deposition which has altered natural infiltration rates within the wetland. AIPs were also considered likely to contribute towards desiccation of the wetland. Whilst depression wetlands are not considered to undergo large changes to geomorphology (Ollis *et al,* 2013), an increased amount of sediment inputs were considered likely due to the potential for increased runoff from surrounding agriculture and deposited material within and along the wetland boundary.

Water quality sampling was undertaken within the depression wetland with measurements including pH, temperature and EC. The pH was 6.24 which was marginally below the lower limit of the ideal range of the RWQO (2011) according to DWA (2011). Temperature was 16.3°C which complied with the TWQR and was considered largely natural for the season and time of day (midday) at which sampling was undertaken. The EC of 98 mS/m which fell below the RWQO according to the DWA (2011). The depression wetland was considered to provide suitable breeding and foraging habitat for potentially sensitive and less sensitive biota. It is also considered likely that the depression wetland is used by other biota including small mammals, avifauna, reptiles and amphibians.	
Extent of modification anticipated.	**Low** A small southern portion of the delineated extent of the depression wetland will be traversed by the proposed powerline. Assuming that the supporting structures are situated outside the delineated extent of the depression wetland and associated NEMA 32m ZoR, minimal direct and indirect impacts are anticipated.
Risk Assessment Outcome & Business Case:	
Low	Construction activities related to the proposed powerline are expected to pose a Low risk significance to the depression wetland provided that the supporting structures are placed outside the delineated extent of the wetland and associated NEMA 32m ZoR. Additionally, the recommended mitigation measures as per Section 6.1 be implemented to minimise any edge effects and cumulative impacts to the wetland.

Table 8: Summary of the assessment of Group 3 within the eastern portion of the investigation area.

Ecological & socio-cultural service provision graph:

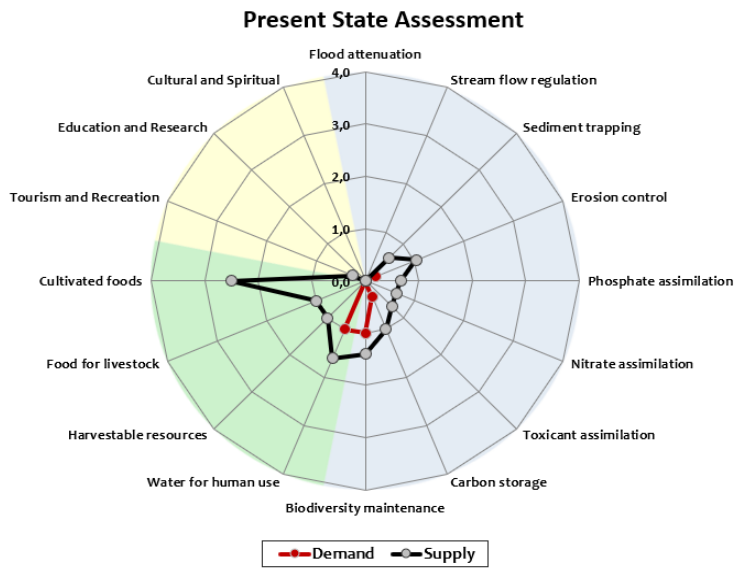

Figure 17: Representative photographs of the depression wetlands along the proposed powerline (Alternative 1) within the investigation area.

PES Discussion (WET-Health)	**PES Category: C** The depression wetlands were assessed to be in a moderately modified ecological condition. The hydrological and geomorphological processes of the depression wetlands have been altered due to the surrounding agricultural activities which have taken place. Changes in flood peaks have been altered due to catchment wide agricultural activities which have increased runoff into the depression wetlands. The depression wetlands are dominated by grasses and AIPs, in particular *Tagetes minuta* and *Verbena bonariensis.*	**Ecoservice provision**	**Ecoservices category: Low-Very Low** The depression wetlands have a low to very low importance for ecoservice provisioning with the most importance ecoservices being water for human use and cultivated foods. This is ascribed to the fact that the depression wetlands are located in a high density agricultural area which rely on wetlands for surface water provisioning. The depression wetlands also provide erosion control, phosphate, nitrate and toxicant assimilation to a limited degree. Biodiversity maintenance is also provided to a limited degree given the degraded nature and dense vegetation cover.
EIS discussion	**EIS Category: Moderate** The depression wetlands were assessed to be of a moderate EIS. This was attributed to the hydro-functional importance of the wetlands and sensitivity of the wetland type to changes in water quality and quantity.	**REC, RMO & BAS Category**	**REC: C /BAS: C/ RMO: Maintain** Based on the PES and EIS, the RMO is to maintain the ecostatus of the depression wetlands at a BAS and REC C. As a result, should any activities be planned within the delineated boundary, the wetland must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):

The hydraulic regime and geomorphological processes of the depression wetlands have been affected by increased surface runoff and altered flood peaks due to catchment wide agricultural activities. AIPs were also considered likely to contribute towards desiccation of the wetland. Whilst depression wetlands are not considered to undergo large changes to geomorphology, an increased amount of sediment inputs were considered likely due to the potential for increased runoff from surrounding agriculture and deposited material within and along the wetland boundaries.

Water quality parameters were not taken for the depression wetlands as surface water was not present at the time of assessment (August 2022). However, it is likely that the water quality parameters would be similar to the surrounding wetlands as similar impacts, such as agricultural activities, have occurred.

Overall the depression wetlands are considered likely to provide minimal roosting, breeding and feeding habitat for avifauna, small mammals, amphibians, reptiles and invertebrates, although due to the surrounding anthropogenic activities and size of the wetlands, only less sensitive species are likely to utilise the wetlands.	
Extent of modification anticipated.	**Low** The proposed powerline will not directly traverse on the depression wetlands, or within the 32 m ZoR in terms of the NEMA. Provided that the route is not changed from that which was assessed, no modification to the depression wetlands as a result of the construction or operation of the powerline is anticipated.
Risk Assessment Outcome & Business Case:	
Low	The delineated boundary of the depression wetlands will be avoided, thereby limiting the potential for direct impacts, however, indirect impacts are still likely to occur. Recommended mitigation measures to limit impacts such as sedimentation include protecting exposed soil for the duration of the construction phase with a suitable geotextile.

Table 9: Summary of the assessment of Group 4 (seep wetland) adjacent to the proposed powerline Alternative 1 and within the investigation area.

Ecological & socio-cultural service provision graph:

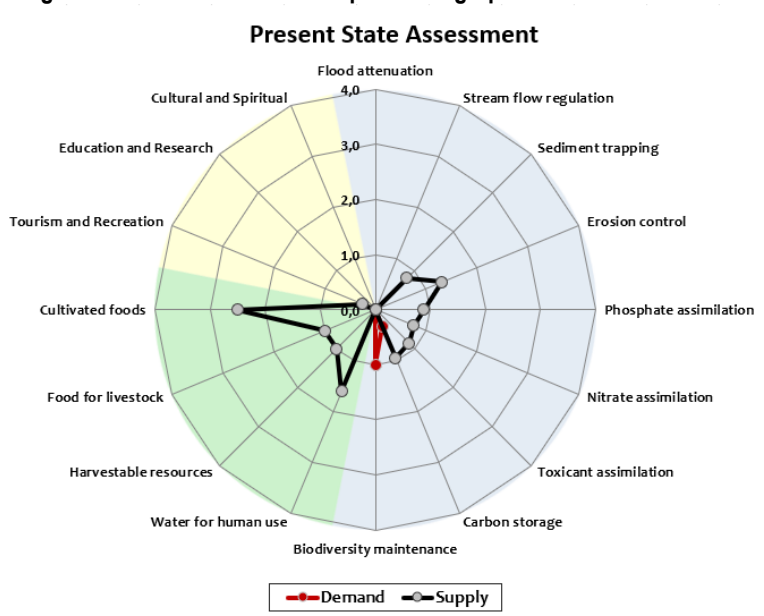

Figure 18: Representative photograph of the seep wetland adjacent to the proposed powerline (Alternative 1 and 2) within the south eastern portion of the investigation area.

PES Discussion (WET-Health)	**PES Category: D** The seep wetland was assessed to be in a largely modified ecological condition. Alterations to the natural hydraulic regime and geomorphological processes of the seep wetland are ascribed to the surrounding agricultural activities, informal road crossing and disturbance in the form of excavation and indiscriminate waste disposal activities. The boundary of the seep wetland has also been infringed upon by cultivated fields which, along with the informal road, has reduced the natural extent of the wetland. The vegetation community of the seep wetland is dominated by grasses, a few sedges and AIPs.	**Ecoservice provision**	**Ecoservices category: Low-Very Low** The seep wetland has a low to very low importance for ecoservice provisioning with the most importance ecoservices being water for human use and cultivated foods. This is ascribed to the fact that the depression wetlands are located in a high density agricultural area which rely on wetlands for surface water provisioning. The seep wetland also provides erosion control, phosphate, nitrate and toxicant assimilation to a limited degree. The demand for biodiversity maintenance is due to the extensive agricultural activities which have occurred in the surrounding area.
EIS discussion	**EIS Category: Low/Marginal** The seep wetland has a low/marginal Ecological Importance and Sensitivity. This is due to the largely modified ecological condition of the wetland. Although the wetland has a good vegetation cover, provision of breeding, feeding and migration habitat is limited due to the surrounding agricultural activities.	**REC, RMO & BAS Category**	**REC: D /BAS: D/ RMO: Maintain** Based on the PES and EIS, the RMO is to maintain the ecostatus of the seep wetland at a BAS and REC D. As a result, should any activities be planned within the delineated boundary, the wetland must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.
Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):			
The geomorphological and hydrological processes of the seep wetland have been altered from the natural condition. Catchment wide agricultural activities increased surface runoff and sediment laden runoff within the wetland. The informal road to the west of the seep wetland has altered the hydrological connectivity of the wetland. Indications of indiscriminate waste disposal and excavation activities were apparent and resulted in AIP encroachment and the formation of small depressional areas where precipitation and runoff could pond.			

Water quality parameters were not taken for the seep wetland as surface water was not present at the time of assessment (August 2022). However, it is likely that the water quality parameters would be similar to the surrounding wetlands as similar impacts, such as agricultural activities, have occurred. The seep wetland was dominated by grasses and AIPs. However, due to the seasonality of the assessment, intense trampling and grazing of livestock, and surrounding cultivation activities, the accurate identification of certain plant species within the wetland was not possible. Overall the seep wetland is considered likely to provide minimal roosting, breeding and feeding habitat for avifauna, small mammals, amphibians, reptiles and invertebrates, although due to the surrounding anthropogenic activities, only less sensitive species are likely to utilise the wetlands.	
Extent of modification anticipated.	**Low** The seep wetland was avoided as a result of the optimisation of the proposed powerline layout, as such no direct and limited indirect impacts are posed by the proposed powerline. The low degree of modification is only applicable provided that the delineated boundary of the seep wetland and NEMA 32m ZoR are demarcated as "no-go" areas and treated as such.
Risk Assessment Outcome & Business Case:	
Low	The delineated boundary of the seep wetland will be avoided, thereby limiting the potential for direct impacts, however, indirect impacts are still likely to occur. Recommended mitigation measures to limit impacts such as sedimentation include protecting exposed soil for the duration of the construction phase with a suitable geotextile.

5 LEGISLATIVE REQUIREMENTS AND APPLICATION OF BUFFER ZONES

The following legislative requirements were considered during the assessment. A detailed description of these legislative requirements is presented in Appendix B of this report:

- The Constitution of the Republic of South Africa, 1996[3];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) (as amended);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA) (as amended); and
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "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 considered to be important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on water resources arising from upstream activities (e.g. by removing or filtering sediment and pollutants), provision of habitat for aquatic and wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

The definition and motivation for a regulated zone of activity for the protection of the assessed wetlands can be summarised as follows:

[3] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it nor the acts amending it are allocated act numbers.

Table 10: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use Authorisation Application for water uses as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) (as amended).	**Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21 (c) and 21 (i) is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500 m radius from the delineated boundary (extent) of any wetland** or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended (2017). The activities which might trigger the required authorisations must be determined by the EAP in consultation with the relevant authorities.	**Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended in 2017) states that: *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or* ***(ii) infrastructure or structures with a physical footprint of 100 square metres or more;*** *where such development occurs—;* *a) within a watercourse;* *b) in front of a development setback; or* *c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse. Excluding where such development occurs within an urban area.*
Specific guidelines for meeting minimum requirements for CBA and ESA wetlands (MBSP, 2014).	• All wetlands are protected under the National Water Act, 1998 (Act No. 36 of 1998). • In terms of the National Water Act, 1998 (Act No. 36 of 1998), freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category); • Conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status. • Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetlands.

The relevant Zone of Regulation (ZoR) are applicable (Figure 19):

- NEMA 32 m ZoR as it relates to the National Water Act, 1998 (Act No. 107 of 1998); and
- GN 509 500m ZoR as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

Figure 19: Conceptual representation of the zones of regulation in terms of NEMA and GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) associated with the proposed powerline and investigation area.

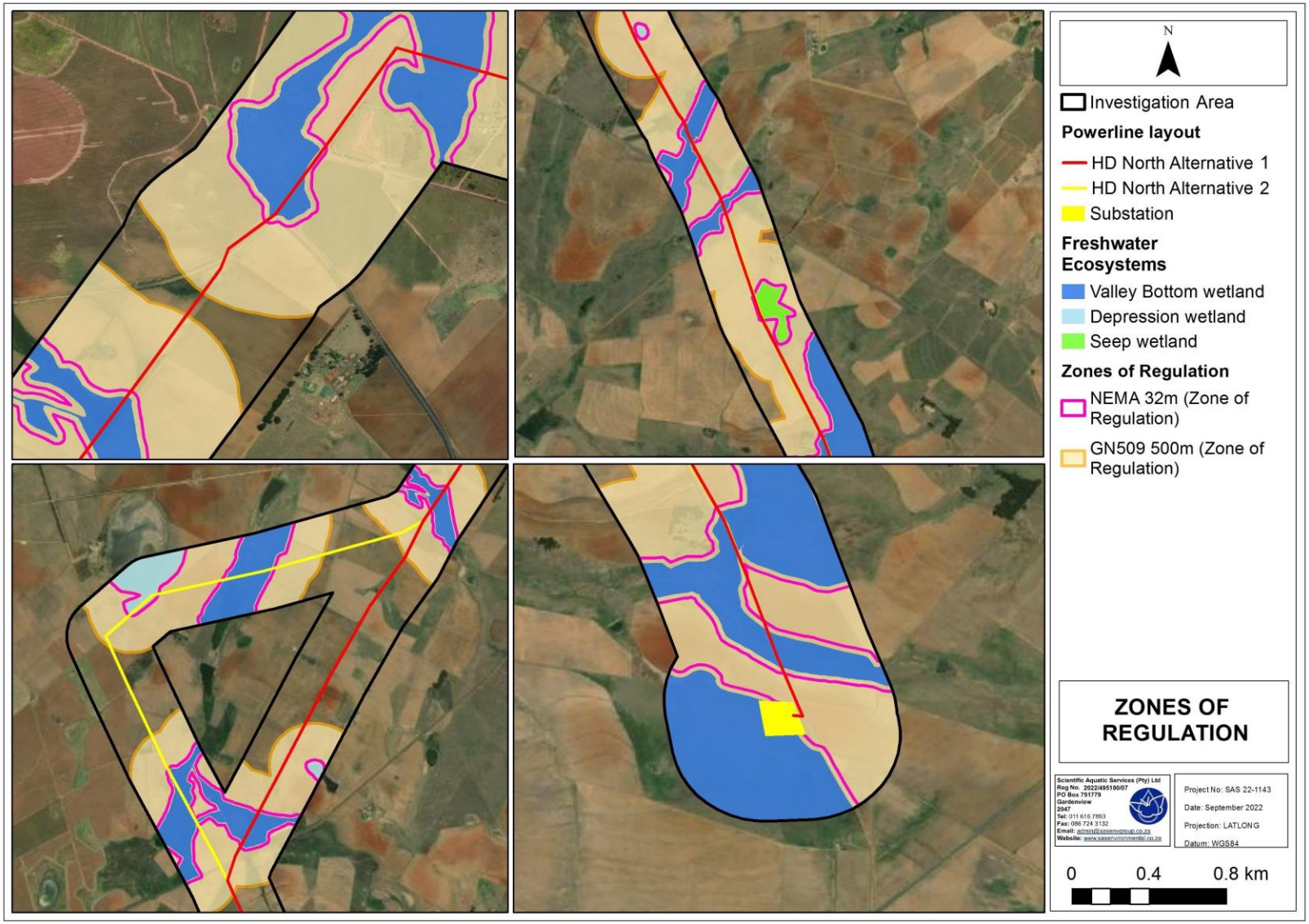

Figure 20: Zoomed in map representing the zones of regulation in terms of NEMA and GN 509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) associated with the proposed powerline and investigation area.

6 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the freshwater ecosystems. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented.

6.1 *Risk assessment analysis*

6.1.1 Consideration of impacts and application of mitigation measures

Following the assessment of the freshwater ecosystems associated with the proposed powerline and substation, the DWS prescribed Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these freshwater ecosystems.

The points below summarise the considerations undertaken when applying the DWS Risk Assessment Matrix (2016):

- The DWS Risk Assessment Matrix (2016) was applied assuming that a high level of mitigation will be implemented, thus the results, provided in this report presents the perceived impact significance ***post-mitigation***;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et al* (2013) (Please refer to Figure D1, Appendix D) would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- Should the proposed powerline route and substation location change from the layout provided and assessed in this report ,or should details pertaining to the construction and use of materials become available, the Risk Assessment Matrix will need to be revised and potentially amended based on the new design layout and specifics;
- It was assumed that the pylons of the proposed powerline will be situated outside the delineated extent of the freshwater ecosystems and the associated NEMA 32m ZoR;
- The majority of the proposed powerline (Alternative 1 and 2) is located within the GN509 500 m ZoR in terms of the National Water Act, 1998 (Act No. 36 of 1998) of the freshwater ecosystems. As such, all legal issues pertaining to aspects and activities relating to the freshwater ecosystems were scored as “5”;

- While the operation of the proposed development will be a permanent activity, the construction thereof is envisioned to take no more than a few months to a year. However, the frequency of the construction impacts may be daily during this time; and
- Most impacts are considered to be easily detectable, with the exception of potential contamination of surface and groundwater which will require some effort. Assessing these potential impacts falls outside of the scope of this freshwater ecosystem study.

6.2 *Risk Assessment discussion of anticipated ecological impacts*

There are four key ecological impacts on the wetlands that are anticipated to occur namely,

- Loss of wetland habitat and ecological structure;
- Changes to the sociocultural and service provision;
- Impacts on the hydrology and sediment balance of the freshwater ecosystems; and
- Impacts on water quality.

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, some impacts can be avoided or adequately minimised where avoidance is not feasible. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment.

A summary of the DWS Risk Assessment Matrix applied to the proposed development activities, is provided in the table below, whilst a comprehensive outcome of the risk assessment is presented in Appendix F.

Table 11: Summary of the results of the DWS risk assessment matrix applied to the wetlands associated with the proposed powerline.

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impacts
1	Construction Phase	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials).	• Loss of freshwater ecosystem vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from potentially spilled oils and hydrocarbons originating from construction vehicles.	Powerline Alternative 1 and 2	1,25	3,25	13	42,25	L	It is assumed that the proposed powerline support structures will be located outside of the delineated extent of the freshwater ecosystems and at least 32 m (as far as possible/feasible) from the delineated edge of the freshwater ecosystems – this in itself is considered a mitigation measure, which entails no direct negative impacts from occurring to the freshwater ecosystems. Should the following mitigation measures (pertaining to the construction of the powerline) be applied, a low risk significance can be expected: • It is imperative that all construction works (with specific mention of potential upgrading of any road crossings) be undertaken during the driest period of the year when the flow is very low in the freshwater ecosystems; • Use must be made of existing freshwater ecosystem crossings only to access the project sites. This will limit edge effects, erosion and sedimentation of the freshwater ecosystems during the construction phase; • The reaches of the freshwater ecosystems where no activities are planned (i.e., no support structures and no spanning of the powerline over the freshwater ecosystems) must be considered no-go areas; • Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the freshwater ecosystems and their associated 32 m NEMA Zone of Regulation (ZoR); • Removed vegetation must be stockpiled outside of the delineated boundary of a freshwater ecosystems. The footprint areas and height of these stockpiles should be kept to a minimum; • The removed indigenous vegetation should be reinstated after the	Fully Reversible
					Proposed substation located within a Valley Bottom wetland.	5	11	14	154	H		Irreversible
2			Removal of vegetation and associated disturbances to soil, and access to the site, including grading of existing informal farm roads (access roads will	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream freshwater ecosystem areas; • Exposure of soil, leading to increased runoff, and	Powerline Alternative 1 and 2	1,25	3,25	14	45,5	L		Fully Reversible

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impacts
			be maintained as informal gravel roads, or a typical jeep track type road).	erosion, and thus increased sedimentation of the freshwater ecosystems; • Increased sedimentation of the freshwater ecosystems, leading to smothering of vegetation associated in the freshwater ecosystems; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Proposed substation located within a Valley Bottom wetland.	5	11	14	154	H	construction phase. However, alien/invasive vegetation species present and removed should not be reinstated but must be disposed of at a registered garden refuse site and may not be burned or mulched on site. The location of the proposed substation must be moved outside the delineated extent of the valley bottom wetland and the associated 32m NEMA ZoR in order to avoid the loss of freshwater ecosystem habitat.	Irreversible
3		Installation of the support structures (outside the 32 m ZoR of the delineated extent of the freshwater ecosystems and spanning of the proposed powerline.	• Excavation of pits for the support structures leading to stockpiling of soil; • Potential movement of construction equipment and personnel in the areas surrounding freshwater ecosystems .	• Disturbances of soil leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems.	Powerline Alternative 1 and 2.	1,25	3,25	14	45,5	L	• Excavation of pits for the support structures foundation may result in loose sediments within the landscape, specifically if works are undertaken during a period of rainfall (if applicable); • During excavation activities, soil must be stockpiled upgradient of the excavated area. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum. This soil must be used to backfill the pits (support structures), immediately after installation of the support structures and/or other infrastructure; • Material used as bedding material (at the bottom of the excavated pit) should be stockpiled outside of the 32m NEMA ZoR and as close as possible to the support structures footprint area. Once the pit has been excavated, the bedding material should directly be placed within the pit, rather than stockpiling it alongside the pit; • When the powerline is strung between the support structures, no vehicles may indiscriminately drive through the freshwater ecosystems, use must be made of the existing access roads.	Fully Reversible

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impacts
4			• Mixing and casting of concrete on site	• Potential contamination of surface water (when present).		1,25	3,25	14	45,5	L	<u>Control measures for concrete mixing on site</u>: • No mixed concrete may be deposited outside of the designated construction footprint; • As far as possible, concrete mixing should be restricted to the batching plant. Additionally, batter / dagga board mixing trays and impermeable sumps should be provided, onto which any mixed concrete can be deposited while it awaits placing; and • Concrete spilled outside of the demarcated area must be promptly removed and taken to a suitably licensed waste disposal site. <u>With regards to backfilling of the concrete encasing (applicable to the construction of the powerline)</u>; • Soil removed for excavating the pit should be used as backfill material; All excavated pits must be compacted to natural soil compaction levels to prevent the formation of preferential surface flow paths and subsequent erosion. Conversely, areas compacted as a result of construction activities must be loosened to natural soil compaction levels; • Any remaining soil following the completion of backfilling of the pits are to be spread out thinly surrounding the installed support structures (outside of the delineated freshwater ecosystems) to aid in the natural reclamation process; and • The construction footprint must be limited to the pit area. The area must be rehabilitated after the completion of the construction phase, including AIP control undertaken until basal vegetation cover is achieved.	Fully Reversible

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impacts
5		Construction of the proposed substation and associated infrastructure within a valley bottom wetland.	• Infilling of a portion of the valley bottom wetland; • Excavation of soil within the valley bottom wetland; Mixing and casting of concrete; and • Movement of construction vehicles and personnel within the valley bottom wetland.	• Direct loss of approximately 2,50 ha of valley bottom wetland and likely secondary (indirect) impacts on the wetland; • Disturbance to soil, vegetation, biota and potentially water quality as a result of construction activities; • Altered runoff patterns as a result of excavation and casting of concrete within the valley bottom wetland, leading to increased erosion and sedimentation of the wetland; • Removal of freshwater ecosystem vegetation; and • Potential spillage and ingress of hydrocarbons from maintenance vehicles into the valley bottom wetland.	Proposed substation located within a Valley Bottom wetland.	5	11	14	154	H	It is advised that the location of the proposed substation be revised so as to avoid the freshwater ecosystems associated with the study and investigation area. • The valley bottom wetland and associated buffer exclusion area (NEMA 32m ZoR) must be demarcated as a "no go" area; and • Movement of personnel and vehicles are restricted to the construction area and is not permitted in the “no-go area”. <u>The following measures are recommended to mitigate against indirect impacts on the remaining extent of wetland habitat:</u> • Infilling of the wetland area associated with the proposed substation may result in sedimentation of the remaining downgradient wetland area. As such, sediment traps must be installed downgradient of the construction area prior to commencement of construction; • With regards to excavation and soil compaction activities within vicinity of the wetland: o During excavation activities, it must be ensured that stockpiles are not higher than 2 m in height and all exposed soil must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) to prevent erosion and sedimentation of the downgradient wetland. Furthermore, measures should be undertaken to limit the time in which soil is exposed; o Dust suppression measures must be implemented (such as spray watering) in the area associated with the proposed substation to prevent excessive dust and suppress the potential for runoff of sediment which may smother hydrophytic vegetation of the downgradient wetland; <u>With regards to concrete mixing on site:</u> Please see control measures related to mixing and casting of concrete as per Activity 5 above.	Irreversible

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impacts
6	**Operational Phase**	Operation and maintenance of the proposed powerline and substation.	• Potential indiscriminate movement of maintenance vehicles within the freshwater ecosystems or within close proximity to the freshwater ecosystems ; and • Increased risk of sedimentation and/or hydrocarbons entering the freshwater ecosystems via stormwater runoff from the access roads.	• Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	Powerline Alternative 1 and 2 and the Proposed substation located within a Valley Bottom wetland.	1	3	12	36	**L**	• Maintenance vehicles must make use of dedicated access roads and no indiscriminate movement in the watercourses may be permitted; • During periodic maintenance activities of the powerline and substation, monitoring for erosion should be undertaken; • Should erosion be noted at the base of the support structure that may potentially impact on a watercourse in the surrounding area, the area must be rehabilitated by infilling the erosion gully and revegetation thereof with suitable indigenous vegetation; and • Monitoring for the establishment for alien and invasive vegetation species must be undertaken, specifically for access roads through or along the watercourses used to service the powerline and substation. Should alien and invasive plan species be identified, they must be removed and disposed of as per an alien and invasive species control plan and the area must be revegetated with suitable indigenous vegetation.	Fully Reversible

The activities associated with the construction and operation of the proposed powerline alternative 1 and 2 pose a “low” risk significance to the freshwater ecosystems within the study and investigation areas, provided that the supporting structures are placed outside the 32m ZoR of the freshwater ecosystems. However, the construction phase of the proposed substation poses a “high” risk significance to the valley bottom wetland, whilst the operational phase of the proposed substation poses a “low” risk significance. Since the proposed substation will result in the loss of approximately 2,50 ha of valley bottom wetland, it is advised that the location of the substation be revised so as to avoid the freshwater ecosystems associated with the study and investigation areas. All mitigation measures as stipulated in the above table, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed powerline are likely to be reduced during the construction and operational phases assuming that a high level of mitigation takes place. Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix G** of this report.

6.2.1 Cumulative Impacts

Freshwater ecosystems within the region are under continued threat due to rapid agricultural development, alien invasive vegetation encroachment and development of infrastructure. Direct and indirect impacts identified within freshwater ecosystems bordering agricultural activities include an increase in alien and invasive species entering the system due to regular disturbance of soil and removal of indigenous vegetation. This results in greater inputs of sediment, and nutrients from runoff that are of higher concentrations.

The impacts associated with the proposed powerline on the freshwater ecosystems are unlikely to contribute to the cumulative effect on the loss of wetland habitat within the region provided that cognisant, well-planned design is implemented. However, the proposed substation, located within a valley bottom wetland, will result in the loss of 2,50ha of wetland habitat and contribute to the cumulative loss of wetland habitat in the region. As such, it is imperative that the location of the proposed substation be revised so as to avoid the freshwater ecosystems associated with the study and investigation areas. The PES and ecoservice provision of the freshwater ecosystems has to be maintained or improved were feasibly possible, as per the REC and RMO.

7 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use License Application (WULA) processes for the proposed Hendrina North 132KV overhead powerline and (hereafter referred to respectively as the 'proposed powerline' or collectively with the proposed substation, the 'study area'), located near Hendrina, Mpumalanga province. The proposed powerline will connect from the existing Eskom Hendrina power station near Pullens Hope, to a proposed substation situated approximately 17 km south of the power station, near Meerlus. The proposed powerline comprises two alternatives. Alternative 1 consists of a 17km 132KV overhead powerline which runs along an informal gravel road and crosses numerous farm portions. Alternative 1 is a shorter route and is the preferred alternative. Alternative 2 consist of a 20km 132KV overhead powerline which is located adjacent to an informal gravel road and to the west t of alternative 1. The two powerline route alternatives join further south and runs adjacent to an informal gravel road to the proposed substation.

The site assessment confirmed the presence of numerous Hydrogeomorphic (HGM) units, and were classified as follows:

- Eight (8) valley bottom wetlands (includes channelled valley bottom HGM units and unchannelled valley bottom HGM units);
- Three (3) depression wetlands; and
- One (1) seep wetland.

The results of the assessment are summarised in the table below:

Table 12: Summary of results of the field assessment as discussed in Section 4.

Freshwater ecosystem	PES	Ecoservices	EIS	REC / RMO / BAS
Valley Bottom wetlands (Group 1)	E	Moderately Low-Very low	Moderate	D/Improve/D
Depression wetland (Group 2)	C	Low-Very low	Moderate	C/Maintain/C
Depression wetlands (Group 3)	C	Very Low-low	Moderate	C/Maintain/C
Seep wetland (Group 4)	D	Very Low-Low	Low/Marginal	D/Maintain/D

Following the freshwater ecosystem assessment, the DWS Risk Assessment Matrix (2016) was applied to determine the significance of impacts of the proposed development on the receiving freshwater environment. The activities associated with the construction and operation of the proposed powerline alternative 1 and 2 pose a "low" risk significance to the freshwater ecosystems within the study and investigation areas, provided that the supporting structures are placed outside the 32m ZoR of the freshwater ecosystems. However, the construction phase of the proposed substation poses a "high" risk significance to the valley

bottom wetland, whilst the operational phase of the proposed substation poses a “low” risk significance, as the majority of impacts are likely to have occurred during the construction phase. Since the proposed substation will result in the loss of approximately 2,50 ha of valley bottom wetland (associated with the substation), it is advised that the layout footprint of the substation be revised so as to avoid the freshwater ecosystems and the associated 32m NEMA ZoR associated with the study and investigation areas. All mitigation measures as stipulated in Section 6 and Appendix G of this report, must be implemented to prevent any edge effects and cumulative impacts from occurring on the freshwater ecosystems within the study and investigation areas.

Alternative 1 of the proposed powerline is the preferred alternative from a freshwater ecological management perspective. Alternative 1 traverses fewer freshwater ecosystems and thus poses a lower risk to the freshwater environments. Sections of Alternative 1 are also located along an existing powerline. As such, if the existing supporting structures are upgraded or new pylons erected adjacent to existing pylons, the potential risks associated with the construction of supporting structures will be significantly reduced.

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APPENDIX A – Terms of Use and Indemnity

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS (Pty) Ltd and its staff reserve the right, at their sole discretion, to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field or pertaining to this investigation.

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APPENDIX B – Legislation

LEGISLATIVE CONSIDERATIONS

The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Environmental Management Act (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Environmental Management: Biodiversity Act (2004) (Act 10 of 2004) (NEMBA)	**Ecosystems that are threatened or in need of protection** (1) (a) The Minister may, by notice in the Gazette, publish a national list of ecosystems that are threatened and in need of protection. *(b)* An MEC for environmental affairs in a province may, by notice in *the Gazette,* publish a provincial list of ecosystems in the province that are threatened and in need of protection. (2) The following categories of ecosystems may be listed in terms of subsection (1): *(a)* critically endangered ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation; *(b)* endangered ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems; (c) vulnerable ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and *(d)* protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed in terms of paragraphs *(a), (b)* or (c).
The National Water Act 1998 (Act No. 36 of 1998) (NWA)	The National Water Act (NWA) (Act 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix;

	iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Specific guidelines for meeting minimum requirements for CBA and ESA wetlands (MBSP, 2014).	➢ All wetlands are protected under the National Water Act, 1998 (Act No. 36 of 1998). ➢ In terms of the National Water Act, freshwater ecosystems (all wetlands included) should not be allowed to degrade to an unacceptably modified condition (E or F ecological category). ➢ Conduct a buffer determination assessment around all wetlands, regardless of ecological condition or ecosystem threat status. ➢ Any further loss of area or ecological condition must be avoided, including if needed, a 100 m generic buffer around the wetlands.

APPENDIX C – Method of Assessment

1. Desktop Study

Prior to the commencement of the field assessment, a background study, including a literature review, was conducted in order to determine the ecoregion and ecostatus of the larger aquatic system within which the freshwater features present or in close proximity of the proposed study area are located. Aspects considered as part of the literature review are discussed in the sections that follow.

1.1 National Freshwater Ecosystem Priority Areas (NFEPA, 2011)

The NFEPA project is a multi-partner project between the Council of Scientific and Industrial Research (CSIR), Water Research Commission (WRC), South African National Biodiversity Institute (SANBI), DWA, South African Institute of Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The project responds to the reported degradation of freshwater ecosystem condition and associated biodiversity, both globally and in South Africa. It uses systematic conservation planning to provide strategic spatial priorities of conserving South Africa's freshwater biodiversity, within the context of equitable social and economic development.

The NFEPA project aims to identify a national network of freshwater conservation areas and to explore institutional mechanisms for their implementation. Freshwater ecosystems provide a valuable, natural resource with economic, aesthetic, spiritual, cultural and recreational value. However, the integrity of freshwater ecosystems in South Africa is declining at an alarming rate, largely as a consequence of a variety of challenges that are practical (managing vast areas of land to maintain connectivity between freshwater ecosystems), socio-economic (competition between stakeholders for utilisation) and institutional (building appropriate governance and co-management mechanisms).

The NFEPA database was searched for information in terms of conservation status of rivers, wetland habitat and wetland features present in the vicinity of or within the proposed study area.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa

The freshwater features encountered within the proposed study area were assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems (Ollis *et al*., 2013), hereafter referred to as the "Classification System". A summary of Levels 1 to 4 of the classification system are presented in Table C1 and C2, below.

Table C1: Proposed classification structure for Inland Systems, up to Level 3.

WETLAND / AQUATIC ECOSYSTEM CONTEXT		
LEVEL 1: SYSTEM	LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
Inland Systems	DWA Level 1 Ecoregions OR NFEPA WetVeg Groups OR Other special framework	Valley Floor
		Slope
		Plain
		Bench (Hilltop / Saddle / Shelf)

Table C2: Hydrogeomorphic (HGM) Unit for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
River	Mountain headwater stream	Active channel
		Riparian zone
	Mountain stream	Active channel
		Riparian zone
	Transitional	Active channel
		Riparian zone
	Upper foothills	Active channel
		Riparian zone
	Lower foothills	Active channel
		Riparian zone
	Lowland river	Active channel
		Riparian zone
	Rejuvenated bedrock fall	Active channel
		Riparian zone
	Rejuvenated foothills	Active channel
		Riparian zone
	Upland floodplain	Active channel
		Riparian zone
Channelled valley-bottom wetland	(not applicable)	(not applicable)
Unchannelled valley-bottom wetland	(not applicable)	(not applicable)
Floodplain wetland	Floodplain depression	(not applicable)
	Floodplain flat	(not applicable)
Depression	Exorheic	With channelled inflow
		Without channelled inflow
	Endorheic	With channelled inflow
		Without channelled inflow
	Dammed	With channelled inflow
		Without channelled inflow
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[4] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

For Inland Systems, the regional spatial framework that has been included at Level 2 of the classification system is that of DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et al.,* 2005). There is

[4] Most rivers are indirectly connected to the ocean via an estuary at the downstream end, but where marine exchange (i.e. the presence of seawater) or tidal fluctuations are detectable in a river channel that is permanently or periodically connected to the ocean, it is defined as part of the estuary.

a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.

The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) group's vegetation types across the country according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the National Freshwater Ecosystem Priority Areas (NFEPA) project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

Level 3: Landscape Setting

At Level 3 of the Classification System, for Inland Systems, a distinction is made between four Landscape Units (Table C1) on the basis of the landscape setting (i.e. topographical position) within which an HGM Unit is situated, as follows (Ollis *et al.,* 2013):

- **Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley;
- **Valley floor:** The base of a valley, situated between two distinct valley side-slopes;
- **Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land; and
- **Bench (hilltop/saddle/shelf):** an area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops/crests (areas at the top of a mountain or hill flanked by down-slopes in all directions), saddles (relatively high-lying areas flanked by down-slopes on two sides in one direction and up-slopes on two sides in an approximately perpendicular direction), and shelves/terraces/ledges (relatively high-lying, localised flat areas along a slope, representing a break in slope with an up-slope one side and a down-slope on the other side in the same direction).

Level 4: Hydrogeomorphic Units

Seven primary HGM Types are recognised for Inland Systems at Level 4A of the Classification System (Table C2), on the basis of hydrology and geomorphology (Ollis *et al*., 2013), namely:

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including

WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

Healthy wetlands are known to provide important habitats for wildlife and to deliver a range of important goods and services to society. Management of these systems is therefore essential if these attributes are to be retained within an ever-changing landscape. The primary purpose of this assessment is to evaluate the eco-physical health of wetlands, and in so doing to promote their conservation and wise management.

Level of Evaluation
Two levels of assessment are provided by WET-Health:

- Level 1: Desktop evaluation, with limited field verification. This is generally applicable to situations where a large number of wetlands need to be assessed at a very low resolution; or
- Level 2: On-site evaluation. This involves structured sampling and data collection in a single wetland and its surrounding catchment.

Framework for the Assessment
A set of three modules has been synthesised from the set of processes, interactions and interventions that take place in wetland systems and their catchments: hydrology (water inputs, distribution and retention, and outputs), geomorphology (sediment inputs, retention and outputs) and vegetation (transformation and presence of introduced alien species).

Units of Assessment
Central to WET-Health is the characterisation of HGM Units, which have been defined based on geomorphic setting (e.g. hillslope or valley-bottom; whether drainage is open or closed), water source (surface water dominated or sub-surface water dominated) and pattern of water flow through the wetland unit (diffusely or channelled) as described under the Classification System for Wetlands and other Aquatic Ecosystems above.

Quantification of Present State of a wetland
The overall approach is to quantify the impacts of human activity or clearly visible impacts on wetland health, and then to convert the impact scores to a Present State score. This takes the form of assessing the spatial *extent* of the impact of individual activities and then separately assessing the *intensity* of the impact of each activity in the affected area. The extent and intensity are then combined to determine an overall *magnitude* of impact. The impact scores, and Present State categories are provided in the table below.

Table C3: Impact scores and categories of Present State used by WET-Health for describing the integrity of wetlands.

Impact category	Description	Impact score range	Present State category
None	Unmodified, natural	0-0.9	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	B
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place, but the natural habitat remains predominantly intact.	2-3.9	C
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4-5.9	D
Serious	The change in ecosystem processes and loss of natural habitat and biota is great, but some remaining natural habitat features are still recognisable.	6-7.9	E
Critical	Modifications have reached a critical level and the ecosystem processes have been completely modified with an almost complete loss of natural habitat and biota.	8-10	F

Assessing the Anticipated Trajectory of Change

As is the case with the Present State, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit or within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology and vegetation, five potential situations exist depending upon the direction and likely extent of change (table below).

Table C4: Trajectory of Change classes and scores used to evaluate likely future changes to the present state of the wetland.

Change Class	Description	HGM change score	Symbol
Substantial improvement	State is likely to improve substantially over the next 5 years	2	↑↑
Slight improvement	State is likely to improve slightly over the next 5 years	1	↑
Remain stable	State is likely to remain stable over the next 5 years	0	→
Slight deterioration	State is likely to deteriorate slightly over the next 5 years	-1	↓
Substantial deterioration	State is expected to deteriorate substantially over the next 5 years	-2	↓↓

Overall health of the wetland

Once all HGM Units have been assessed, a summary of health for the wetland as a whole needs to be calculated. This is achieved by calculating a combined score for each component by area-weighting the scores calculated for each HGM Unit. Recording the health assessments for the hydrology, geomorphology and vegetation components provide a summary of impacts, Present State, Trajectory of Change and Health for individual HGM Units and for the entire wetland.

4. General Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans *et al.* 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C5 below.

Table C5: Classification of Present State Classes in terms of Habitat Integrity [Kleynhans *et al.*2008]

Class	Description	Score (% of total)
A	Unmodified, natural.	90 - 100
B	Largely natural with few modifications. The flow regime has been only slightly modified and pollution is limited to sediment. A small change in natural habitats may have taken place. However, the ecosystem functions are essentially unchanged.	80 - 89
C	Moderately modified. Loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.	60 - 79
D	Largely modified. A large loss of natural habitat, biota and basic ecosystem functions has occurred.	40 – 59
E	Seriously modified. The loss of natural habitat, biota and basic ecosystem functions is extensive.	20 – 39
F	Critically / Extremely modified. Modifications have reached a critical level and the 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

5. WET-Health

The Riparian Vegetation Response Assessment Index (VEGRAI)

VEGRAI is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results (Kleynhans *et al.*, 2007a). Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

Riparian vegetation is described in the National Water Act (Act No. 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soil, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas.

Table C6: Descriptions of the A-F ecological categories.

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

6. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[5] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate assimilation;
- Nitrate assimilation;
- Toxicant assimilation;
- Erosion control;
- Carbon storage;
- Biodiversity maintenance;
- Provision of water for human use;
- Provision of harvestable resources;
- Food for livestock;
- Provision of cultivated foods;
- Cultural and spiritual experience;
- Tourism and recreation; and
- Education and research.

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, 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. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.

*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

Table C7: Integrating scores for supply and demand to obtain and overall importance score

Integrating scores for supply & demand to obtain an overall importance score						
		Supply				
		Very Low	Low	Moderate	High	Very High
Demand		0	1	2	3	4
Very Low	0	0,0	0,0	0,5	1,5	2,5
Low	1	0,0	0,0	1,0	2,0	3,0
Moderate	2	0,0	0,5	1,5	2,5	3,5
High	3	0,0	1,0	2,0	3,0	4,0
Very High	4	0,5	1,5	2,5	3,5	4,0

A single overall importance score is generated for each ecosystem service by combining the supply and demand scores. This aggregation therefore places somewhat more emphasis on supply than demand, with the supply score acting as the starting score for a "moderate" demand scenario. The importance score is, however, adjusted by up to one class up where demand is "very high" and by up to one class down where demand is "very low". The overall importance score can then be used to derive an importance category for reporting purposes.

[5] Department of Water Affairs and Forestry, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999

Table C8: Classes for determining the likely extent to which a benefit is being supplied.

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 other wetlands.

7. Ecological Importance and Sensitivity (EIS) (Rountree & Kotze, 2013)

The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).

In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

- Ecological Importance and Sensitivity, incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWA and thus enabling consistent assessment approaches across water resource types;
- Hydro-functional importance, taking into consideration water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- Importance in terms of socio-cultural benefits, including the subsistence and cultural benefits provided by the wetland system.

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C8) of the wetland system being assessed.

Table C9: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.	>2 and <=3	B
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these wetlands is not usually sensitive to flow and habitat modifications.	>1 and <=2	C
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these wetlands is ubiquitous and not sensitive to flow and habitat modifications.	>0 and <=1	D

8. Recommended Management Objective (RMO) and Recommended Ecological Category (REC) Determination

"A high management class relates to the flow that will ensure a high degree of sustainability and a low risk of ecosystem failure. A low management class will ensure marginal maintenance of sustainability but carries a higher risk of ecosystem failure" (DWA, 1999).

The RMO (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the freshwater resource (sections above), with the objective of either maintaining, or improving the ecological integrity of the watercourse in order to ensure continued ecological functionality.

Table C10: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
PES	A	Pristine	A Maintain	A Maintain	A Maintain	A Maintain
	B	Natural	A Improve	A/B Improve	B Maintain	B Maintain
	C	Good	A Improve	B/C Improve	C Maintain	C Maintain
	D	Fair	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	Poor	D* Improve	E/F* Improve	E/F* Maintain	E/F* Maintain

***PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, should a freshwater resource fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater resource may receive the same class for the REC as the PES if the freshwater resource is deemed in good condition, and therefore must stay in good condition. Otherwise, an appropriate REC should be assigned in order to prevent any further degradation as well as enhance the PES of the watercourse.

Table C11: Description of Recommended Ecological Category (REC) classes.

Class	Description
A	Unmodified, natural
B	Largely natural with few modifications
C	Moderately modified
D	Largely modified

APPENDIX D – Risk Assessment Methodology

In order for the EAP to allow for sufficient consideration of all environmental impacts, impacts were assessed using a common, defensible method of assessing significance that will enable comparisons to be made between risks/impacts and will enable authorities, stakeholders and the client to understand the process and rationale upon which risks/impacts have been assessed. The method to be used for assessing risks/impacts is outlined in the sections below.

The first stage of the risk/impact assessment is the identification of environmental activities, aspects and impacts. This is supported by the identification of receptors and resources, which allows for an understanding of the impact pathway and an assessment of the sensitivity to change. The definitions used in the impact assessment are presented below.

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[6]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[7].

[6] The definition has been aligned with that used in the ISO 14001 Standard.
[7] Some risks/impacts that have low significance will however still require mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

"RISK ASSESSMENT KEY" (Based on DWS 2015 publication: Section 21 c and i water use Risk Assessment Protocol)

Table D1: Severity (How severe does the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, habitat)

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table D2: Spatial Scale (How big is the area that the aspect is impacting on)

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional / neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table D3: Duration (How long does the aspect impact on the resource quality)

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table D4: Frequency of the activity (How often do you do the specific activity)

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table D5: The frequency of the incident or impact (How often does the activity impact on the resource quality)

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table D6: Legal issues (How is the activity governed by legislation)

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
Located within the regulated areas	

Table D7: Detection (How quickly or easily can the impacts/risks of the activity be observed on the resource quality, people and resource)

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table D8: Rating Classes

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.
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. License required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve License required.

A low risk class must be obtained for all activities to be considered for a GA

Table D9: Calculations

Consequence = Severity + Spatial Scale + Duration
Likelihood = Frequency of Activity + Frequency of Incident + Legal Issues + Detection
Significance\Risk = Consequence X Likelihood

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
  - Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

The following points presents the key concepts considered in the development of mitigation measures for the proposed construction:

- Mitigation and performance improvement measures and actions that address the risks and impacts[8] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and

[8] Mitigation measures should address both positive and negative impacts.

- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

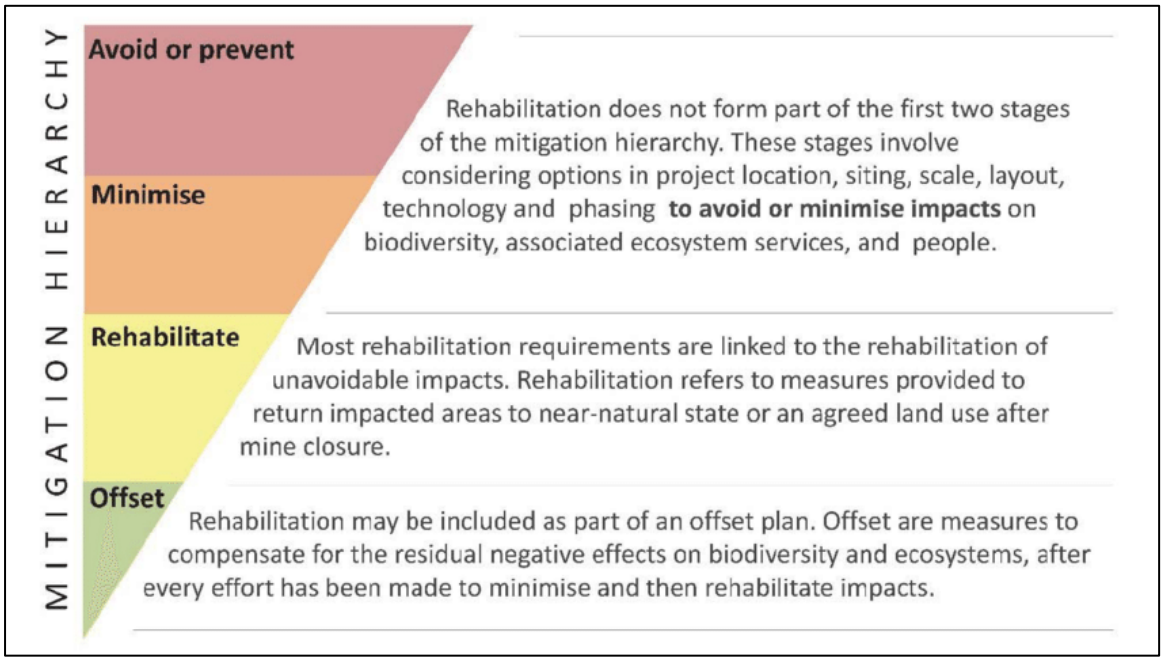

Figure D1: Impact Minimisation hierarchy as advocated by the DEA *et al.*, (2013)

Recommendations

Recommendations were developed to address and mitigate potential impacts on the freshwater ecology of the resources traversed by or in close proximity of the proposed project.

Table D10: Reversibility of impacts on the watercourses

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)
	Partially reversible (The impact is reversible to a degree e.g. acceptable revegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe)

APPENDIX E – Results of Field Investigation

PRESENT ECOLOGICAL STATE (PES) AND ECOLOGICAL IMPORTANCE AND SENSITIVITY (EIS) RESULTS

Table E1: Presentation of the results of the WET-Health PES assessment applied to the freshwater ecosystems associated with the proposed powerline and investigation area.

Freshwater Ecosystems	Hydrology		Geomorphology		Vegetation		Overall Score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
Group 1							
Valley Bottom 1	8	-1	2.4	-1	6.7	-1	6.02 (E)
Valley Bottom 2	9.5	-1	2,2	-1	7.6	-1	6.87 (E)
Valley Bottom 3	8	-1	2,7	-1	7.9	-1	6.45 (E)
Valley Bottom 4	9	-1	2.5	-1	7.4	-1	6.68 (E)
Group 2							
Depression wetland	3.5	-1	0.8	-1	5.1	-1	3.18 (C)
Group 3							
Depression wetlands	2	-1	0.8	-1	5.1	-1	2.54 (C)
Group 4							
Seep wetland	8	-1	2.1	-1	5.9	-1	5.71 (D)

Table E2: Presentation of the results of the Ecoservices assessment applied to Valley Bottom wetlands associated with Group 1.

Ecosystem service	Valley Bottom 1	Valley Bottom 2	Valley Bottom 3	Valley Bottom 4
Flood attenuation	0,6	0,0	0,5	0,8
Streamflow regulation	0,4	0,0	0,4	0,4
Sediment trapping	1,3	0,6	1,7	1,8
Phosphate assimilation	0,7	1,0	0,5	0,7
Nitrate assimilation	1,3	0,7	1,7	1,7
Toxicant assimilation	1,1	0,6	1,5	1,5
Erosion control	1,2	0,7	1,7	1,6
Carbon Storage	0,9	1,0	0,9	0,9
Biodiversity maintenance	1,7	1,4	1,7	1,7
Water Supply	1,6	1,6	1,6	1,6
Harvestable resources	1,0	1,0	1,5	1,0
Cultivated foods	2,0	1,0	3,0	2,0
Cultural value	2,5	2,5	2,5	2,5
Tourism and recreation	0,3	0,3	0,3	0,3
Education and research	0,5	0,0	0,5	0,5

Table E3: Presentation of the results of the Ecoservices assessment applied to the freshwater ecosystems of Groups 2-4.

Ecosystem service	Depression wetland (Group 2	Depression wetlands (Group 3)	Seep wetland (Group 4)
Flood attenuation	0,8	0,0	0,0
Streamflow regulation	0,4	0,0	0,0
Sediment trapping	1,8	0,6	0,8
Phosphate assimilation	0,7	1,0	1,3
Nitrate assimilation	1,7	0,7	0,9
Toxicant assimilation	1,5	0,6	0,8

Ecosystem service	Depression wetland (Group 2	Depression wetlands (Group 3)	Seep wetland (Group 4)
Erosion control	1,6	0,7	0,9
Carbon Storage	0,9	1,0	0,9
Biodiversity maintenance	1,7	1,4	0,0
Water Supply	1,6	1,0	1,6
Harvestable resources	1,0	0,5	1,0
Cultivated foods	2,0	1,0	1,0
Cultural value	2,5	2,5	2,5
Tourism and recreation	0,3	0,1	0,3
Education and research	0,5	0,0	0,0

Table E4: Presentation of the results of the EIS assessment applied to the Valley Bottom wetlands of Group 1.

Freshwater Ecosystem			Valley Bottom 1	Valley Bottom 2	Valley Bottom 3	Valley Bottom 4
Ecological Importance and Sensitivity			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Biodiversity support			A (average)	A (average)	A (average)	A (average)
			0.33	0.67	0.33	0.33
Presence of Red Data species			0	0	0	0
Populations of unique species			0	0	0	0
Migration/breeding/feeding sites			1	2	1	1
Landscape scale			B (average)	B (average)	B (average)	B (average)
			1.40	1.60	1.40	1.40
Protection status of the wetland			4	4	4	4
Protection status of the vegetation type			0	0	0	0
Regional context of the ecological integrity			1	2	1	1
Size and rarity of the wetland type/s present			1	1	1	1
Diversity of habitat types			1	1	1	1
Sensitivity of the wetland			C (average)	C (average)	C (average)	C (average)
			2	1.33	2	2
Sensitivity to changes in floods			2	1	2	2
Sensitivity to changes in low flows/dry season			3	2	2	3
Sensitivity to changes in water quality			1	1	2	1
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	Flood attenuation		3	0	3	3
	Streamflow regulation		3	0	3	3
	Water Quality Enhancement	*Sediment trapping*	2	1	3	2
		Phosphate assimilation	2	1	2	2
		Nitrate assimilation	2	1	2	2
		Toxicant assimilation	2	11	2	2
		Erosion control	2	2	2	2
	Carbon storage		1	1	1	1
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)	Score (0-4)
Subsistence benefits	*Water for human use*		3	3	3	3
	Harvestable resources		2	2	2	2
	Cultivated foods		3	2	3	3
Cultural benefits	*Cultural heritage*		0	0	0	0
	Tourism and recreation		0	0	0	0
	Education and research		1	1	1	1

Table E5: Presentation of the results of the EIS assessment applied to the wetlands of Group 2-4.

Freshwater Ecosystems			Depression wetland (Group 2)	Depression wetlands (Group 3)	Seep wetland (Group 4)
Ecological Importance and Sensitivity			Score (0-4)	Score (0-4)	Score (0-4)
Biodiversity support			A (average)	A (average)	A (average)
			0.33	0.33	0.33
Presence of Red Data species			0	0	0
Populations of unique species			0	0	0
Migration/breeding/feeding sites			1	1	1
Landscape scale			B (average)	B (average)	B (average)
			1.60	1.40	1.00
Protection status of the wetland			4	4	2
Protection status of the vegetation type			0	0	0
Regional context of the ecological integrity			2	2	2
Size and rarity of the wetland type/s present			1	0	0
Diversity of habitat types			1	1	1
Sensitivity of the wetland			C (average)	C (average)	C (average)
			1.67	1.00	1.00
Sensitivity to changes in floods			1	1	1
Sensitivity to changes in low flows/dry season			2	1	1
Sensitivity to changes in water quality			2	1	1
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	Flood attenuation		1	1	0
	Streamflow regulation		0	0	0
	Water Quality Enhancement	*Sediment trapping*	2	1	1
		Phosphate assimilation	2	1	1
		Nitrate assimilation	2	1	1
		Toxicant assimilation	2	1	1
		Erosion control	0	0	0
	Carbon storage		1	1	1
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)
Subsistence benefits	*Water for human use*		3	3	1
	Harvestable resources		2	2	0
	Cultivated foods		3	2	0
Cultural benefits	*Cultural heritage*		0	0	0
	Tourism and recreation		0	0	0
	Education and research		1	0	1

APPENDIX F – Risk Assessment Outcome

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	Construction Phase	Site preparation prior to construction activities.	Vehicular movement (transportation of construction materials).	• Loss of freshwater ecosystem vegetation, associated habitat and ecosystem services; • Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and • Soil and stormwater contamination from potentially spilled oils and hydrocarbons originating from construction vehicles.	Powerline Alternative 1 and 2.	2	1	1	1	1,25	1	1	3,25	5	2	5	1	13	42,25	L
					Proposed substation located within a valley bottom wetland.	5	5	5	5	5	1	5	11	5	3	5	1	14	154	H
2			Removal of vegetation and associated disturbances to soil, and access to the site, including grading of existing informal	• Earthworks could be potential sources of sediment, which may be transported as runoff into the downstream freshwater ecosystem areas; • Exposure of soil, leading to increased runoff, and	Powerline Alternative 1 and 2	2	1	1	1	1,25	1	1	3,25	5	3	5	1	14	45,5	L

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
			farm roads (access roads will be maintained as informal gravel roads, or a typical jeep track type road).	erosion, and thus increased sedimentation of the freshwater ecosystems ; • Increased sedimentation of the freshwater ecosystems , leading to smothering of vegetation associated in the freshwater ecosystems ; and • Proliferation of alien and/or invasive vegetation as a result of disturbances.	Proposed substation located within a valley bottom wetland.	5	5	5	5	5	1	5	11	5	3	5	1	14	154	H
3		Installation of the support structures (outside the 32 m ZoR of the delineated extent of the freshwater ecosystems and spanning of the proposed powerline.	• Excavation of pits for the support structures leading to stockpiling of soil; and • Potential movement of construction equipment and personnel in the areas surrounding freshwater ecosystems.	• Disturbances of soil leading to potential impacts to the freshwater ecosystem vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat; and • Altered runoff patterns, leading to increased erosion and sedimentation of the freshwater ecosystems.	Powerline Alternative 1 and 2.	2	1	1	1	1,25	1	1	3,25	5	3	5	1	14	45,5	L

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
4			• Mixing and casting of concrete for foundations.	• Potential contamination of surface water (when present).		1	2	1	1	1,25	1	1	3,25	5	3	5	1	14	45,5	L
5		Construction of the proposed substation and associated infrastructure within a valley bottom wetland.	• Excavation of soil within the valley bottom wetland; Mixing and casting of concrete; and • Movement of construction vehicles and personnel within the valley bottom wetland	• Loss of approximately 2, 50 ha of valley bottom wetland and indirect impacts on the wetland; • Disturbance to soil, vegetation, biota and potentially water quality as a result of construction activities; • Altered runoff patterns as a result of excavation and casting of concrete within the valley bottom wetland, leading to increased erosion and sedimentation of the wetland; • Removal of freshwater ecosystem vegetation; and • Potential spillage and ingress of hydrocarbons from maintenance vehicles	Proposed substation located within a valley bottom wetland.	5	5	5	5	5	1	5	11	5	3	5	1	14	154	H

	Phases	Activity	Aspect	Impact	Applicable aspect of the proposed powerline	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
				into the valley bottom wetland.																
6	**Operational Phase**	Operation and maintenance of the proposed powerline.	• Potential indiscriminate movement of maintenance vehicles within the freshwater ecosystems or within close proximity to the freshwater ecosystems ; and • Increased risk of sedimentation and/or hydrocarbons entering the freshwater ecosystems via stormwater runoff from the access roads.	• Disturbance to soil and ongoing erosion as a result of periodic maintenance activities; and • Altered water quality (if surface water is present) as a result of increased availability of pollutants.	Powerline Alternative 1 and 2 and the Proposed substation located within a valley bottom wetland.	1	1	1	1	1	1	1	3	3	3	5	1	12	36	L

APPENDIX G – General "Good Housekeeping" Mitigation Measures

General construction management and good housekeeping practices

Latent and general impacts which may affect the freshwater ecology and biodiversity, will include any activities which take place in close proximity to the proposed development that may impact on the receiving environment. Mitigation measures for these impacts are highlighted below and are relevant to the watercourse identified in this report:

Development footprint

- All development footprint areas must remain as small as possible and must not encroach into the freshwater areas unless absolutely essential and part of the proposed development. It must be ensured that the freshwater habitat is off-limits to construction vehicles and non-essential personnel;
- The boundaries of footprint areas, including contractor laydown areas, must be clearly defined and all activities must remain within defined footprint areas. Edge effects will need to be extremely carefully controlled;
- Planning of temporary roads and access routes must avoid freshwater ecosystems and be restricted to existing roads where possible;
- Appropriate sanitary facilities must be provided for the life of the construction phase and all waste removed to an appropriate waste facility;
- All hazardous chemicals as well as stockpiles must be stored on bunded surfaces and have facilities constructed to control runoff from these areas;
- All hazardous storage containers and storage areas must comply with the relevant SABS standards to prevent leakage;
- No fires must be permitted in or near the construction area; and
- Ensuring that an adequate number of waste and "spill" bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place offsite on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and spillage must be p prevented near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly. Contaminated soil must be bagged and disposed off in hazardous waste receptacles.

Vegetation

- Removal of the alien and weed species encountered within the wetlands must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas must be kept as small as possible when removing alien plant species; and

- No vehicles must be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Soil

- Sheet runoff from access roads and the walk ways must be slowed down by the strategic placement of berms;
- As far as possible, all construction activities must occur in the low flow season, during the drier winter months;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soil;
- No stockpiling of topsoil must take place within close proximity to the watercourse, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the watercourse;
- All soil compacted as a result of construction activities as well as ongoing operational activities falling outside of project footprint areas must be ripped and profiled; and
- A monitoring plan for the development and the immediate zone of influence must be implemented to prevent erosion and incision.

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site;
- All alien vegetation in the footprint area as well as immediate vicinity of the proposed development must be removed. Alien vegetation control must take place for a minimum period of two growing seasons after rehabilitation is completed; and
- Side slope and embankment vegetation cover must be monitored to ensure that sufficient vegetation is present to bind these soil and prevent further erosion.

APPENDIX H – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

1. (a) (i) Details of the specialist who prepared the report

Kristen Nienaber	BSc Hons (Environmental Science) (University of the Free State)
Amanda Mileson	Advanced Diploma (Nature Conservation) (UNISA)
Paul da Cruz Witwatersrand)	BA (Hons) (Geography and Environmental Studies) (University of the

1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Kristen Nienaber		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	076 720 5420
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	kristen@sasenvgroup.co.za		
Qualifications	BSc (Hons) Geography and Environmental Science (University of the Free State) BSc Geography and Environmental Science (University of the Free State)		

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Kristen Nienaber, declare that -

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

Signature of the Specialist.

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Amanda Mileson, declare that -

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

Signature of the Specialist.

1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

I, Paul da Cruz, declare that -

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

Signature of the Specialist.

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KRISTEN NIENABER

PERSONAL DETAILS

Position in Company	Junior Ecologist
Joined SAS Environmental Group of Companies	2021

EDUCATION

Qualifications

BSc (Hons) Environmental Science (University of the Free State)	2019
BSc Geography and Environmental Science (University of the Free State)	2018

AREAS OF WORK EXPERIENCE

South Africa – Free State, Northern Cape, Western Cape, Gauteng, Mpumalanga.

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Freshwater Offset Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Senior Ecologist: Wetland Ecology
Joined SAS Environmental Group of Companies	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Wetland Society (SAWS)

Member of the International Society of Wetland Scientists

Member of the Gauteng Wetland Forum (GWF) and Northern Cape Wetland Forum (NCWF)

EDUCATION

Qualifications

N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma Nature Conservation (UNISA)	2020
Postgraduate Diploma Nature Conservation (UNISA)	In progress

Short Courses

Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, Free State, North West, Limpopo, Northern Cape, Eastern Cape

Africa – Zimbabwe, Zambia

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Ecosystem Delineation
- Freshwater Ecosystem Verification Assessment
- Freshwater Ecosystem (wetland / riparian) Delineation and Assessment
- Freshwater Ecosystem EcoService and Status Determination
- Freshwater Ecosystem Rehabilitation Assessment / Planning
- Freshwater Ecosystem Maintenance and Management Plans
- Freshwater Ecosystem Plant Species Plans
- Freshwater Ecosystem Offset Plans

Biodiversity Assessments

- Biodiversity Ecological Assessments
- Biodiversity Offset Plans

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF PAUL DA CRUZ

PERSONAL DETAILS

Position in Company	Senior Ecologist
Joined SAS Environmental Group of Companies	2022

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Certificated Scientist at South African Council for Natural Scientific Professions (SACNASP)
Registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA)
Member of the South African Wetland Society (SAWS)

EDUCATION

Qualifications

BA (Hons) (Geography and Environmental Studies) (University of the Witwatersrand)	1998
BA (Geography) (University of the Witwatersrand)	1997

Short Courses

Taxonomy of Wetland Plants (Water Research Commission)	2017
Advanced Grass Identification (Frits van Outshoorn)	2010
Grass Identification (Frits van Outshoorn),	2009
Soil Form Classification and Wetland Delineation; (TerraSoil Science)	2008

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana
International – United Kingdom (England and Scotland); USA

DEVELOPMENT SECTORS OF EXPERIENCE

1. Renewable energy (Wind and solar)
2. Linear developments (energy transmission, telecommunication, pipelines, roads, border infrastructure)
3. Nature Conservation and Ecotourism Development
4. Commercial development
5. Residential development
6. Environmental and Development Planning and Strategic Assessment

7. Industrial/chemical; Non-renewable power Generation

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- EIA / BA Applications
- Environmental Authorisation Amendments
- EMPr Compilation
- Environmental Compliance Monitoring (Environmental Auditing)
- Environmental Screening Assessments and Listing Notice 3 Trigger Identification / Mapping
- Strategic Environmental Assessments and Environmental Management Frameworks
- EIA / Specialist Study Peer Review

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Assessments in support of Environmental Screening Assessments, Precinct Planning & SEA
- Wetland Construction (Compliance) Monitoring

Biodiversity Assessments

- Avifaunal Assessments
- Strategic Biodiversity Assessment

Visual Impact Assessment

- Visual Impact Assessments

GIS / Spatial Analysis

- GIS Spatial Analysis and Listing Notice 3 mapping