SCIENTIFIC AQUATIC SERVICES

Freshwater Assessment

AS PART OF THE ENVIRONMENTAL AUTHORISATION (EA) AND WATER USE AUTHORISATION (WUA) PROCESSES FOR THE PROPOSED MIXED-USE DEVELOPMENT, NEAR LANSERIA IN THE GAUTENG PROVINCE.

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Report Reference:	SAS 23-1185
Report date:	May 2024

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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 Authorisation Application (WUA) processes for the proposed mixed-use development on the remainder of Portion 72 of the farm Bultfontein in the Gauteng Province. The mixed-use development (hereafter referred to as the 'study area') is located approximately 23 km north of Roodepoort and 18 km northwest of Sandton adjacent to the Lanseria International Airport in Gauteng Province.

A field assessment was undertaken in October 2023 during which freshwater ecosystems were identified within the study area and associated investigation area (defined as a 500m radius around the study area) in line with GN 4167 of December 2023. These freshwater ecosystems include:

- **Two (2) Unchannelled Valley Bottom (UCVB) wetlands;**
- **One (1) Seep wetland; and**
- **In addition, to the above wetlands, two (2) Relic wetland features were identified within the investigation area.**

The UCVB wetlands were only considered using desktop methods given their location in relation to the study area and the focus of the assessment was on the seep wetland which is located within the study area and will potentially be impacted by the proposed development. The results of the field assessment are summarised in the table below:

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category / Recommended Management Objective / Best Attainable State
Seep wetland	Moderately Modified (PES Category C)	Very Low to High	Low	REC: C RMO: Maintain BAS: C

Following the freshwater ecosystem site assessment, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to determine the significance of potential impacts associated with the proposed mixed-use development on the receiving freshwater environment. According to the risk assessment, the activities associated with the proposed mixed-use development during construction and operational phase pose a "Low "risk significance to the wetland associated with the proposed mixed-use developments. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report including general good construction practice, ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation of the seep wetland.

Based on the findings of the study, it is the professional opinion of the freshwater ecologist that the proposed mixed-use development can be considered acceptable, provided that the delineated extent of the wetland and the associated 30m GDARD recommended set back area are demarcated as "no-go areas" and provided that all mitigation measures as detailed are implemented.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation Application (WUA) processes for the proposed mixed-use development on the remainder of Portion 72 of the farm Bultfontein in the Gauteng Province. The mixed-use development (hereafter referred to as the 'study area') is located

approximately 23 km north of Roodepoort and 18 km northwest of Sandton adjacent to the Lanseria International Airport in Gauteng Province.

In order to identify all freshwater ecosystems that may potentially be impacted by the activities associated with the proposed mixed-use development, a 500 m "zone of investigation" was implemented around the study area, in accordance with Government Notice (GN) 4167 of December 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA), in order to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the study area - will henceforth be referred to as the 'investigation area'.

The purpose of this report is to define the freshwater ecology of the area in terms of characteristics, assessing key ecological drivers, and to define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the freshwater ecosystems utilising current industry "best practice" assessment methods. Additionally, this report aims to define the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the freshwater ecosystems associated with the proposed mixed-use development. In addition, the potential impact of the proposed mixed-use development on the freshwater ecosystems has been assessed through the application of the DWS Risk Assessment. Suitable mitigation measures have been specified.

The assessment took the following approach:

- A desktop study was conducted, during which possible freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted; and
- The field assessment was conducted in October 2023 during which the following freshwater ecosystems were identified;
- Two (2) Unchannelled Valley Bottom (UCVB) wetlands;
- One (1) Seep wetland; and
- In addition, to the above wetlands, two (2) Relic wetlands were identified within the investigation area.

Input on the final delineation was provided by Galago Environmental upon request of the proponent and was considered in preparation of the final delineation by SAS. This delineation by Galago Environmental is considered acceptably accurate and is considered as the best estimate of the wetland boundary when soil characteristics are considered with more emphasis and not the presence of facultative wetland vegetation being considered as the key indicator in the landscape as initially prepared by SAS.

The UCVB wetlands were only considered using desktop methods given their location in relation to the study area and the focus of the assessment was on the seep wetland which is located within the study area and will potentially be impacted by the proposed development.

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	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category / Recommended Management Objective / Best Attainable State
Seep wetland	Moderately Modified (PES Category C)	Very Low to High	Low	REC: C RMO: Maintain BAS: C

Table B: Summary of DWS Risk Assessment applied to the proposed mixed-use development.

Phase	Activity	Impact	Risk Rating
PRE-CONSTRUCTION	Vegetation stripping and removal of topsoil to accommodate the services needed to facilitate the construction phase (construction camps, equipment storage yards, workshop facilities, construction administration areas, ablution facilities, (if applicable).	Proliferation of alien and/or invasive vegetation as a result of disturbances.	L
		Increased sedimentation of the watercourse, smothering vegetation associated with it.	L
		Exposure of soils, leading to increased runoff, and erosion.	L
	Stockpiling of topsoil (general).	Stockpiled soils will be vulnerable to erosion. Dispersal of disturbed and destabilised soils, with sediments transported to watercourses during rainfall events.	L
CONSTRUCTION	Development of internal road networks and buildings outside of the watercourse	Loss of freshwater habitat and ecological structure as a result of edge effects associated with the development.	L
		Impacts to the ecoservice provision of the wetland	L
		Potential poor stormwater management associated with impermeable surfaces that could lead to erosion formation to the seep wetland	L
	The use of construction vehicles and heavy equipment on site during the construction phase.	Compaction of soils within sensitive habitat leading to loss of biodiversity and altered hydrological functioning.	L
		Water quality impacts resulting from fluid leaks from poorly serviced vehicles.	L
	Groundbreaking, excavation of foundations and other earthworks upgradient of and outside of the watercourse and the associated 30m GDARD setback area.	Disturbances of soils leading to potential impacts to the watercourse vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat.	L
		Potential dispersal of sediments that could reach the wetland.	L
		Potential hydrological impacts from altered soil profiles and/or surface water runoff patterns.	L
	Construction of stormwater pond, swales and other stormwater infrastructure outside the wetlands and the 30m GDARD (Setback Area).	Disturbance and exposure of soil leading to increased runoff and erosion, and thus increased sedimentation of the downstream reach of the wetlands; Increased sedimentation of the wetlands, leading to smothering of vegetation associated with the wetlands;	L
		Proliferation of alien and/or invasive vegetation as a result of disturbances; and Ground disturbances and dust pollution during construction which may impact on water quality.	L
OPERATIONS	Progressive alien vegetation encroachment following on from soil disturbances.	Alien vegetation will be induced to recruit and encroach following on from soil disturbance impacts. As wetlands provide favourable resources, alien vegetation encroachment into wetland habitat is highly likely when management strategies are lacking.	L
	Increased impermeable surfaces in the vicinity of the watercourse and the catchment.	Decreased infiltration and increase surface runoff from impervious surfaces; Increased water inputs to the freshwater environment at unnatural rates; Impacted soil and water quality condition within the wetland; Altered hydroperiod of the wetland; and Potential change in wetland hydrograph due to modified surrounding landscape.	L

	Operation of the stormwater infrastructure and service infrastructure.	Flow concentration and potentially erosion at concentration points i.e. swales and other stormwater infrastructure; and Altered runoff patterns and increased water inputs to the wetlands, resulting in altered flow regime and subsequent impacts on the wetland vegetation.	L
	Operation and maintenance of planned waste management systems (e.g. sewage infrastructure).	Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances; and Disturbance to and compaction of soil resulting in erosion.	L
	Routine maintenance of infrastructure.	Impacts to wetland habitat resulting from the movement of vehicles and personnel outside of designated service roads.	L
		Potential for increased proliferation of alien floral species, leading to reduced ability to support biodiversity, and provide ecological services such as flood attenuation.	L

Following the freshwater ecosystem site assessment, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to determine the significance of potential impacts associated with the proposed mixed-use development on the receiving freshwater environment. According to the risk assessment, the activities associated with the proposed mixed-use development during construction and operational phases pose a “Low” risk to the wetland associated with the proposed mixed-use developments. Signatures indicating hydropedologically active soils were observed within the moist grassland adjacent to the wetland which must be considered, and the stormwater management plan must be designed to mimic these processes as far as practically possible to reduce impact on the receiving freshwater resource. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report including general good construction practice, ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation of the seep wetland.

Based on the findings of the study, it is the professional opinion of the freshwater ecologist that the proposed mixed-use development can be considered acceptable, provided that the delineated extent of the wetland and the associated 30m GDARD recommended setback area are demarcated as “no-go areas” and provided that all mitigation measures as detailed are implemented.

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 H
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
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
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
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);	Section 4.3

	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); 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.	N/A
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 H
3.2	A signed statement of independence by the specialist;	Appendix H
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 5 and 6
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	N/A
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 flow 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
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.
Mottles:	Soil with variegated colour patterns is described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
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.
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

AIP	Alien Invasive Plant
BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
CSIR	Council of Scientific and Industrial Research
CVB	Channelled Valley Bottom
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
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 Area
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IUCN	International Union for Conservation of Nature
mm	Millimetre
m.a.m.s.l. 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
UCVB	Unchannelled Valley Bottom Wetland
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use Licence Application

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 Authorisation Application (WUA) processes for the proposed mixed-use development on the remainder of Portion 72 of the farm Bultfontein in the Gauteng Province. The mixed-use development (hereafter referred to as the 'study area') is located approximately 23 km north of Roodepoort and 18 km northwest of Sandton adjacent to the Lanseria International Airport in Gauteng Province. The location and extent of the proposed mixed-use development is depicted in Figures 1-3 below.

The study area, which is approximately 33 hectares (ha) in size and is located 1 kilometre (km) south of the Lanseria airport. The N14 is located approximately 2.3 km southeast of the study area and the R512 is located immediately west of the study area. The surrounding landscape consists of industrial development, agricultural practices, and some suburban housing areas.

In order to identify all freshwater ecosystems that may potentially be impacted by the activities associated with the proposed mixed-use development, a 500 m "zone of investigation" was implemented around the study area, in accordance with Government Notice (GN) 4167 of 2023 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended (NWA), in order to assess possible sensitivities of the receiving freshwater environment. This area – i.e., the 500 m zone of investigation around the study area - will henceforth be referred to as the 'investigation area'.

The purpose of this report is to define the freshwater ecology of the area in terms of characteristics, assessing key ecological drivers, and to define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the freshwater ecosystems utilising current industry "best practice" assessment methods. Additionally, this report aims to define the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the freshwater ecosystems associated with the proposed mixed-use development. Lastly the potential impact of the proposed mixed-use development on the freshwater ecosystems has been assessed through the application of the DWS Risk Assessment. Suitable mitigation measures have been specified.

This report, after consideration and a description of the ecological integrity of the study area, must guide the Environmental Assessment Practitioner (EAP), and the relevant specialist, by means of the presentation of results and recommendations, as to the feasibility of the proposed mixed-use development.

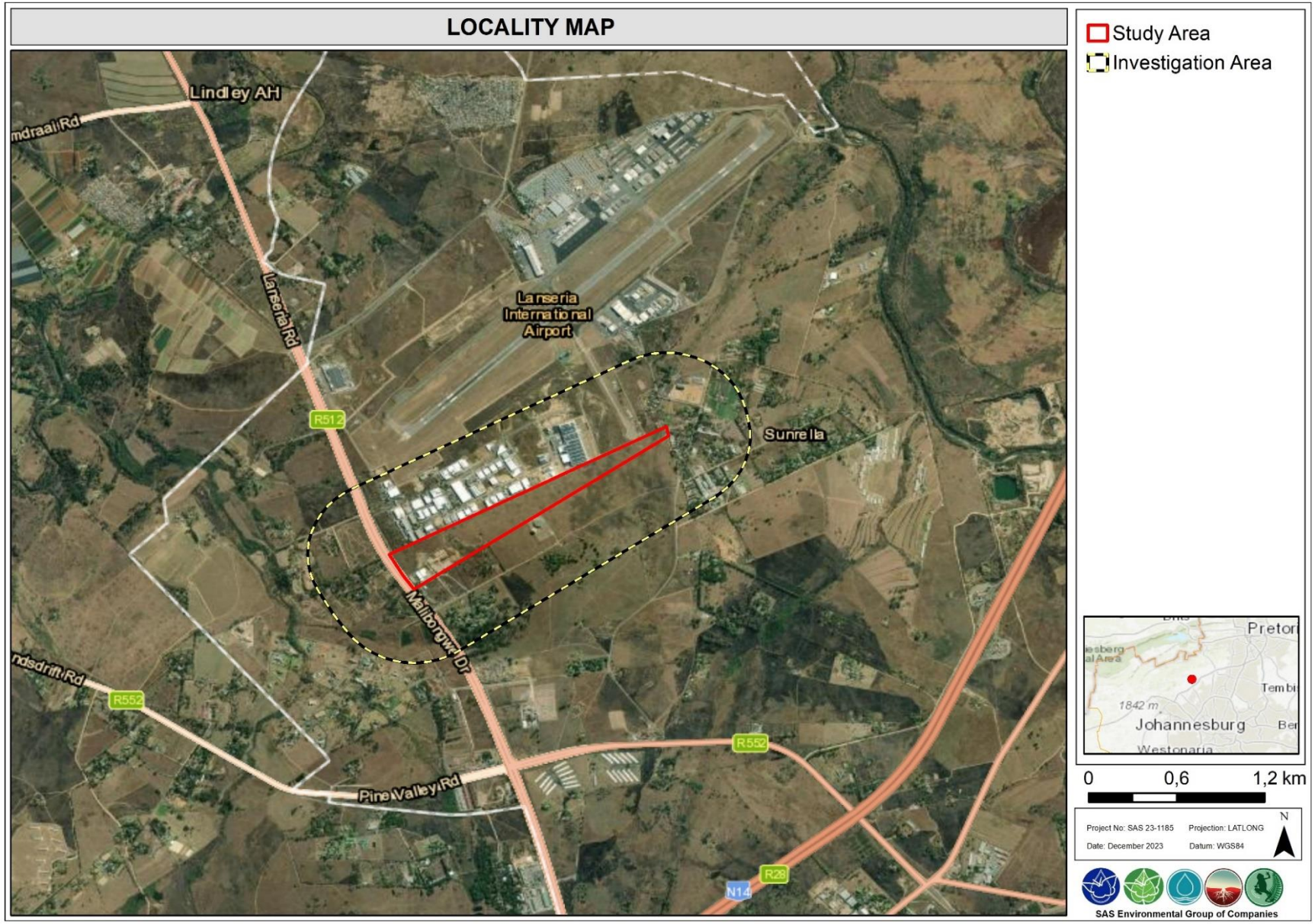

Figure 1: A digital satellite image depicting the location of the study and associated investigation area in relation to the surrounding area.

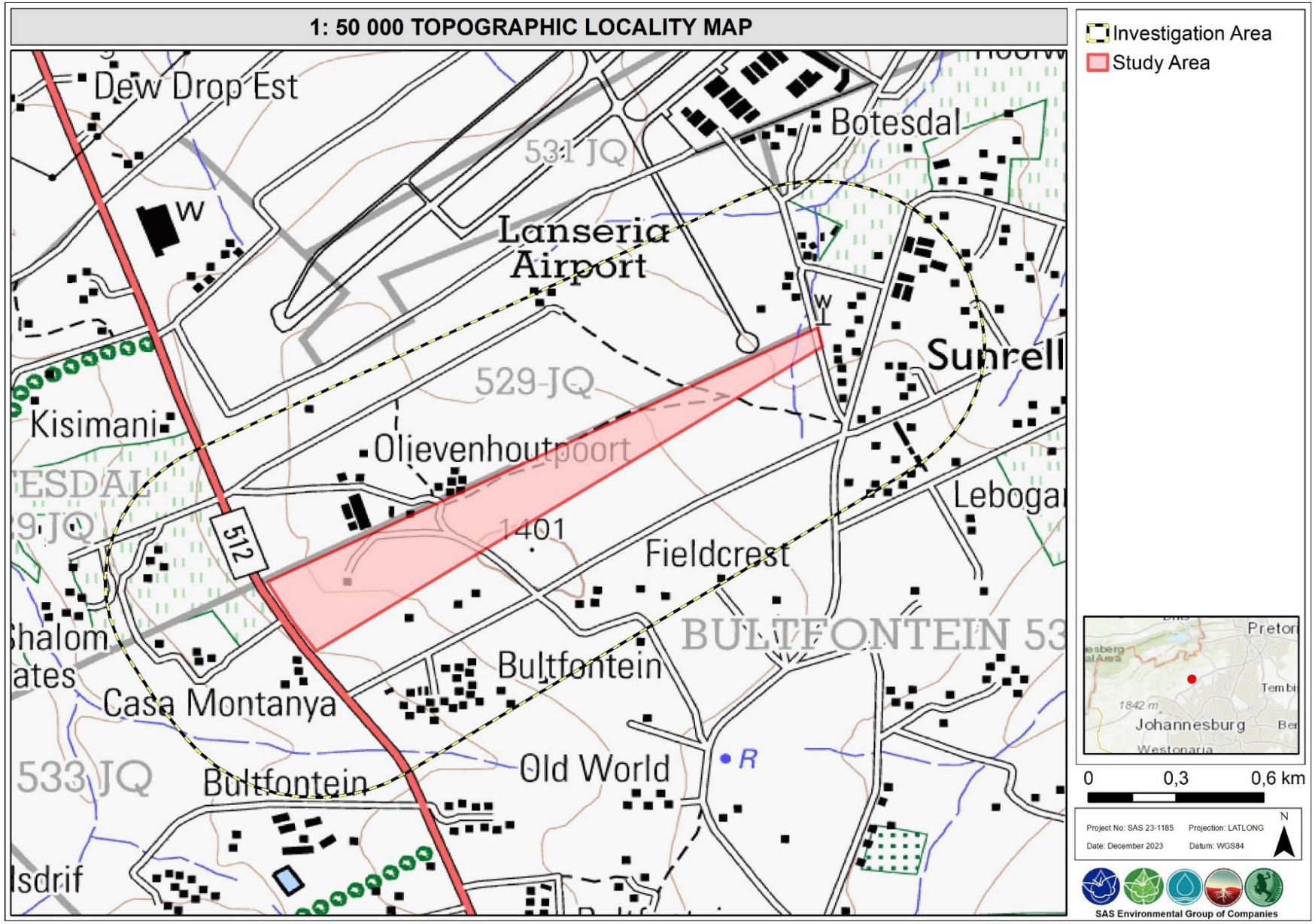

Figure 2: The study and investigation areas depicted on a 1:50 000 topographical map.

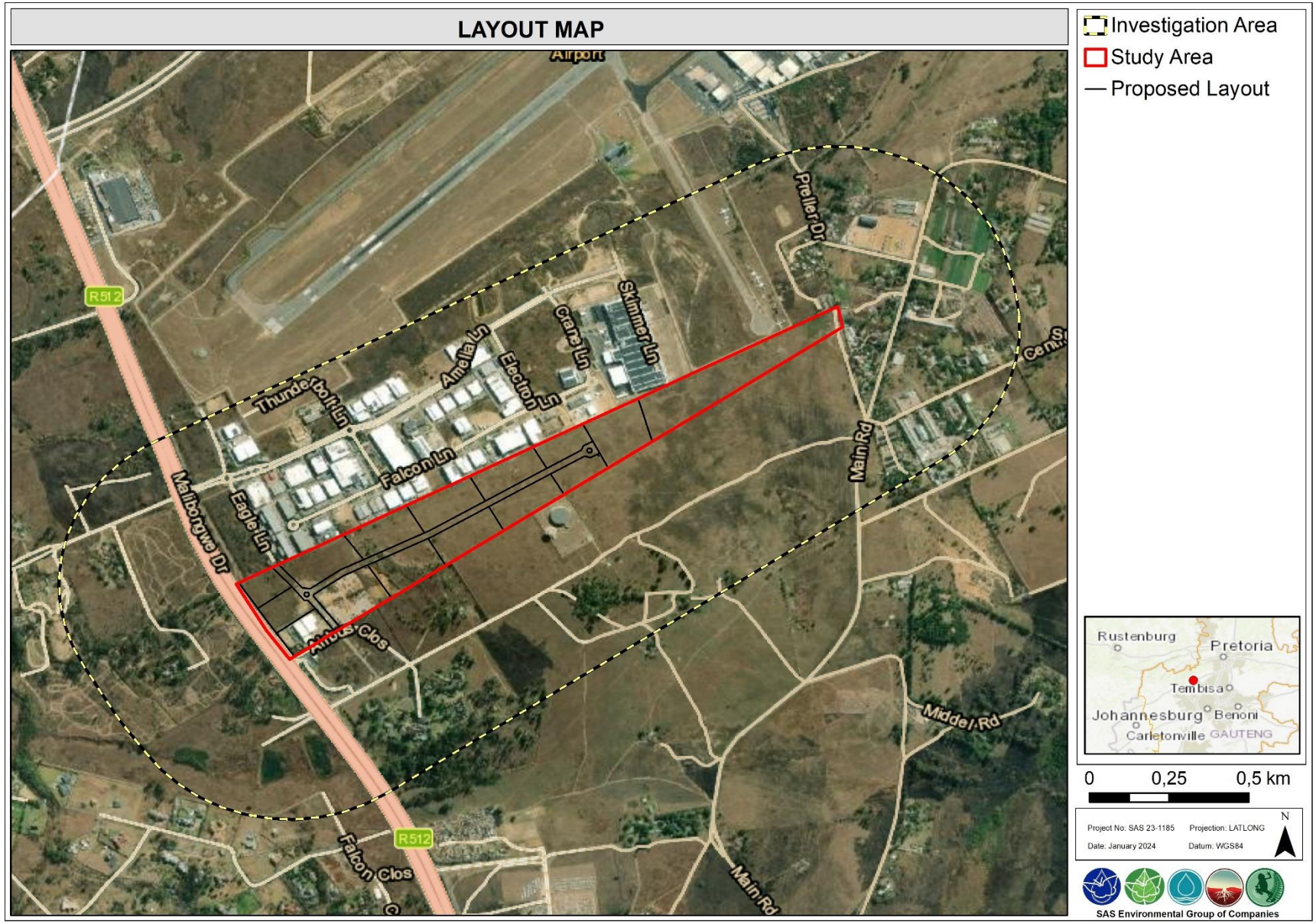

Figure 3: Proposed mixed-use development layout as provided by Seedcracker Environmental.

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 Gauteng Department of Agriculture and Rural Development (GDARD), were undertaken to aid in defining the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of the freshwater ecosystems;
- All freshwater ecosystems within the study and investigation area were delineated using desktop methods in accordance with Government Notice (GN 4167) of 2023 as it relates to activities as stipulated in the National Water Act, 1998 (Act No. 36 of 1998) as amended and verified according to the Department of Water Affairs and Forestry (DWAF)[1] (2008)[2] wetland delineation guidelines: "A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics and wetness along with vegetative and terrain indicators 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 EIS of the freshwater ecosystems was determined according to the method described by Rountree and Kotze*,* (2013);
- The PES of the freshwater ecosystems was assessed according to the WET Health as advocated by Macfarlane *et al.* (2008);
- The freshwater ecosystems were mapped according to each hydrogeomorphic unit in relation to the study area. In addition to the freshwater ecosystem boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- Allocation of a suitable Recommended Management Objective (RMO), Recommended Ecological Category (REC) and Best Attainable State (BAS) to the freshwater ecosystems based on the results obtained from the PES and EIS assessments;

[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.

- The Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to identify potential impacts that may affect the freshwater ecosystems as a result of the proposed mixed-use development within the study area, 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 mixed-use development within the study area on the receiving freshwater ecosystems within the environment.

1.3 *Assumptions and Limitations*

The following assumptions and limitations are applicable to this report:

- The determination of the freshwater ecosystem boundaries is confined to the freshwater ecosystems that are situated within the footprint of the study area and the associated investigation area;
- A degree of transformation (infilling, alteration to the natural soil due to the development of linear infrastructure and historical modifications), made the precision and accuracy of the delineation of the outer boundary of the freshwater ecosystems challenging. As a result, the freshwater ecosystems within the study area were delineated in fulfilment of GN 4167 of 2023 as it relates to the National Water Act (Act No. 36 of 1998) using the method advocated by DWAF (2008) and augmented with various desktop methods including use of topographic maps, historical and current digital satellite imagery, 5 m contours as well as aerial photographs. Freshwater ecosystems within the investigation area were, however, considered on a desktop level only;
- Input on the final delineation was provided by Galago Environmental upon request of the proponent and was considered in preparation of the final delineation by SAS. This delineation by Galago Environmental is considered acceptably accurate and is considered as the best estimate of the wetland boundary when soil characteristics are considered with more emphasis and not the presence of facultative wetland vegetation being considered as the key indicator in the landscape as initially prepared by SAS;
- Should the proposed mixed-use development change from the layout provided and assessed in this report, or should details pertaining to the construction and use of materials change, the Risk Assessment Matrix will need to be revised and potentially amended based on the new design layout and specifics;
- 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 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 ecosystems' 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 ecosystem that may be affected by the proposed activities within the study area have been accurately assessed and considered, based on the site observations undertaken in terms of the freshwater ecosystems' ecology.

2 ASSESSMENT APPROACH

2.1 *Freshwater Ecosystem definition*

The National Water Act, 1998 (Act No. 36 of 1998) as amended 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.

It should be noted that in this report "freshwater ecosystem" is used and carries the same meaning as "watercourse" as defined by the NWA.

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 freshwater ecosystem 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 October 2023 (spring 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; and
- Vegetation adapted to saturated soil.

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 proposed study and investigation area.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	Highveld
Catchment	Limpopo
Quaternary Catchment	Majority A21C and remaining A21E
WMA	Crocodile (West) and Marico
subWMA	Upper Crocodile
Dominant characteristics of the Highveld Level 2 (11.01) (Kleynhans *et al.*, 2007).	
Dominant primary terrain morphology	Plains: low relief. Plains
Dominant primary vegetation types	Rocky Highveld Grassland, Mixed Bushveld
MAP (mm)	500 to 700
Coefficient of Variation (% of MAP)	20 to 34
Rainfall concentration index	55 to 64
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	14 to 18
Winter temperature (July)	0 to 20
Summer temperature (Feb)	12 to 30
Median annual simulated runoff (mm)	20 to 60
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)	
Sub-quaternary reach	A21C-01167 (Jukskei)
Proximity to study area	±1,6 km east of the study area
Assessed by expert?	Yes
PES Category Median	Seriously Modified (Class E)
Mean Ecological Importance (EI) Class	Moderate
Mean Ecological Sensitivity (ES) Class	Moderate
Stream Order	3
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)
National Web based Screening tool (2020) Error! Reference source not found.	

Detail of the study area terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database.	
FEPACODE	The study area and investigation area falls within a catchment which is considered an upstream catchment area. **Upstream Management Areas (4)** are sub-quaternary catchments in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas. Upstream Management Areas do not include management areas for wetland FEPAs, which need to be determined at a finer scale.
NFEPA Wetlands	According to the NFEPA database, there are no wetlands within the study and investigation areas.
Wetland Vegetation Type	The study area falls within the Mesic Highveld Grassland Group 3. This vegetation group is least threatened according to Mbona *et al* (2015).
NFEPA Rivers	According to NFEPA database, there are no rivers within the study and investigation areas. The Jukskei River is located approximately 1,6 km east of the study area. According to the NFEPA Database the river is largely modified (Class D).
Detail of the study area in terms of the Gauteng Conservation Plan (C-Plan V3.3, 2011).	
Critical Biodiversity Area (CBA) **Error! Reference source not found.**	According to the Gauteng C-Plan, the majority of the study area is classified as a CBA. The CBA is considered an important area for orange and red listed plant habitat and primary vegetation. Critical Biodiversity Areas (CBA's) include natural and near-natural terrestrial and aquatic features that are required to meet targets for biodiversity patterns and ecological processes. Furthermore, CBAs are areas considered important for the survival of threatened species and include valuable ecosystems such as wetlands, untransformed vegetation, and ridges.
Ecological Support Area (ESA)	According to the Gauteng C-Plan, a small northern portion of the study area and portions within the investigation area are classified as an ESA. Ecological Support Areas (ESAs) are natural, near natural, degraded or heavily modified areas required to be maintained in an ecologically functional state to support CBAs and/or Protected Areas.
Wetland and River Buffers	According to the Gauteng C-Plan, the study area is traversed by non-perennial river buffer and there are three wetland buffers within the investigation area.
Gauteng Environmental Management Framework (GEMF, 2014).	The study and investigation areas fall within the following EMF Zones: **EMF Zone: (**Urban development zone) The majority of the study area and the investigation area is located within Zone 1. The intention with this zone is to streamline urban development activities in it and to promote development infill, densification, and concentration of urban development, in order

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.	The overall aquatic sensitivity for the study area is **very high** in terms of aquatic CBAs and wetlands. The majority of the study area is designated as being of low aquatic sensitivity while the eastern portion of the study area is designated as very high aquatic sensitivity due to the presence of a wetland within the Mesic Highveld Grassland Vegetation Type.		to establish a more effective and efficient city region that will minimise urban sprawl into rural areas. **EMF Zone 2:** (High control area inside Zone 1) Linear bands associated with drainage in the study and investigation areas are classified as being in Zone 2. This zone is sensitive to development activities. Only conservation should be allowed in this zone. Related tourism and recreation activities must be accommodated in areas surrounding this zone. **EMF Zone 5:** (Industrial and Commercial) The northern portion of the investigation area is located within Zone 5. The intention with Zone 5 is to streamline non-polluting industrial and large-scale commercial (warehouses etc.) activities in areas that are already used for such purposes and areas that are severely degraded but in proximity to required infrastructure.
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (National Wetland Map 5 is included in the NBA).			
According to the NBA 2018: SAIIAE database, A natural seep wetland traverses the eastern portion of the study area, while two unchannelled valley-bottom wetlands and associated seep wetlands are located in the investigation area. The unchannelled valley-bottom wetlands are affected by artificial features such as instream dams and the seep wetlands and unchanneled valley bottom wetlands are affected by roads, therefore, the all the wetlands are currently largely to critically modified (Class D/E/F). The Ecosystem Threat Status (ETS) of the unchanneled valley-bottom wetlands and seep wetlands are critically endangered (CR), and the Ecosystem Protection Level (EPL) of the unchanneled valley-bottoms are Not Protected and the seep wetlands are currently poorly protected.			

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.

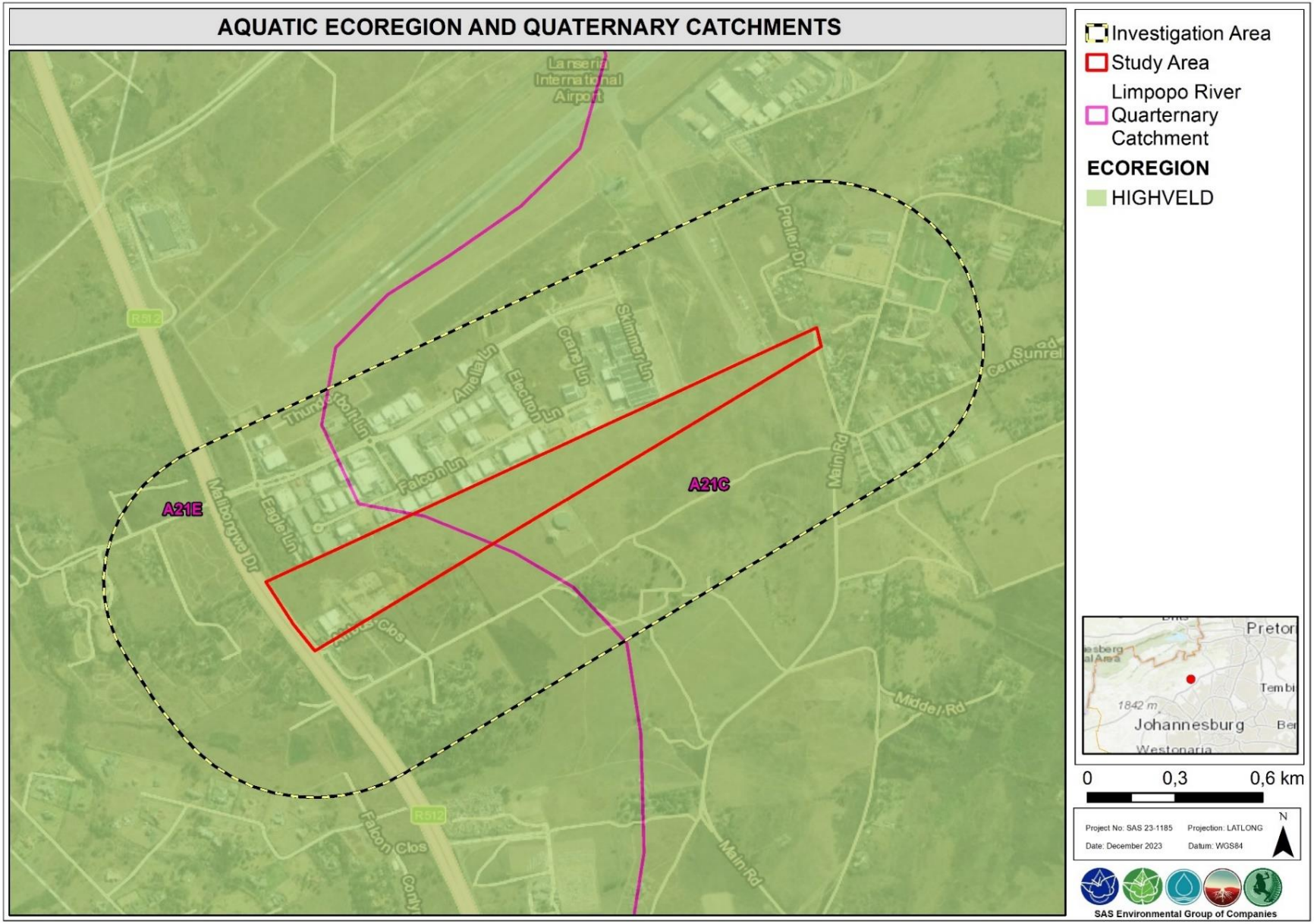

Figure 4: DWS Ecoregions and Quaternary catchments in which the proposed study area and associated investigation area are located.

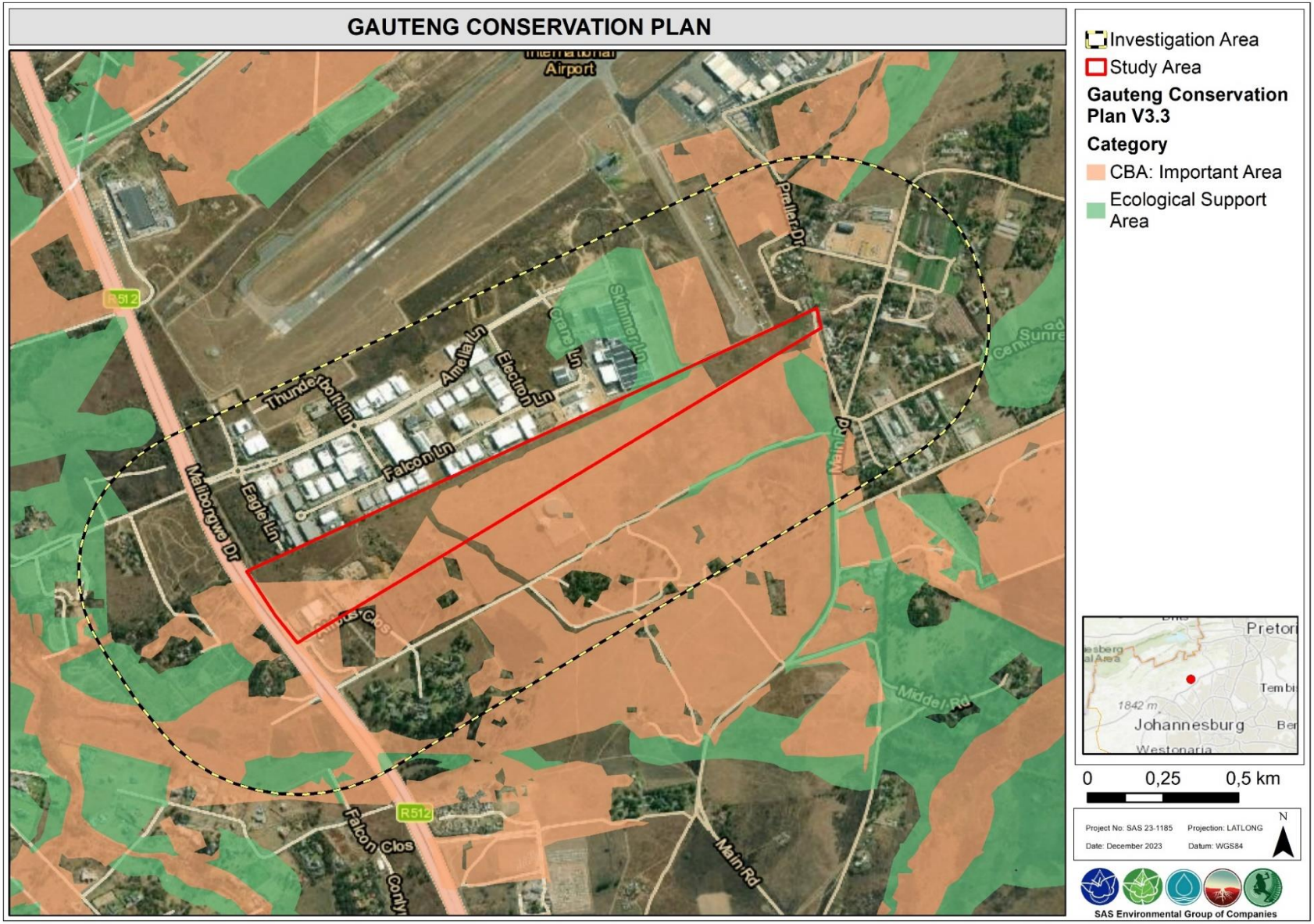

Figure 5: Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's) associated with the study and investigation areas according to the Gauteng C-Plan (2013).

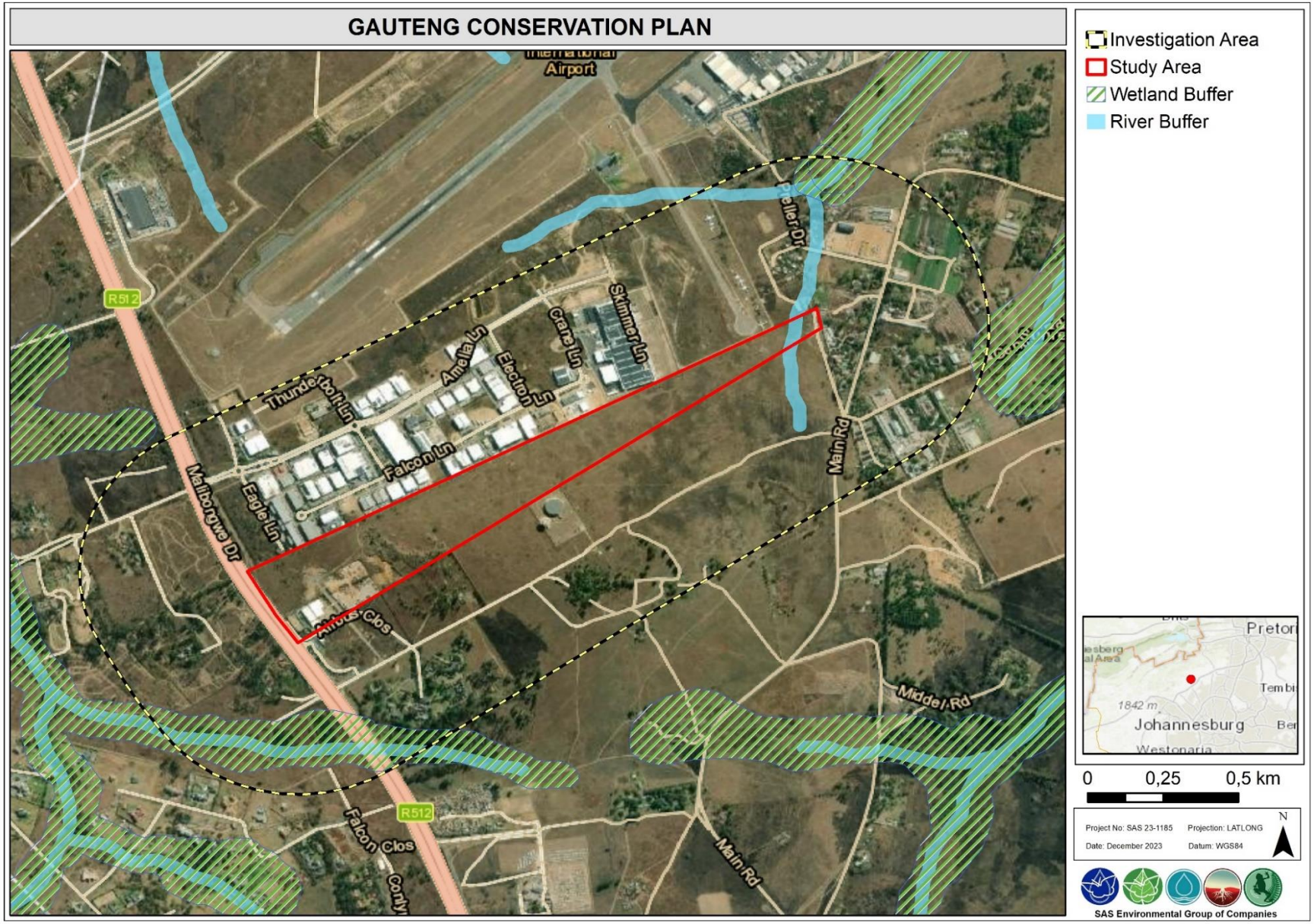

Figure 6: Wetland and river buffers associated with the study and investigation areas according to the Gauteng C-Plan (2013).

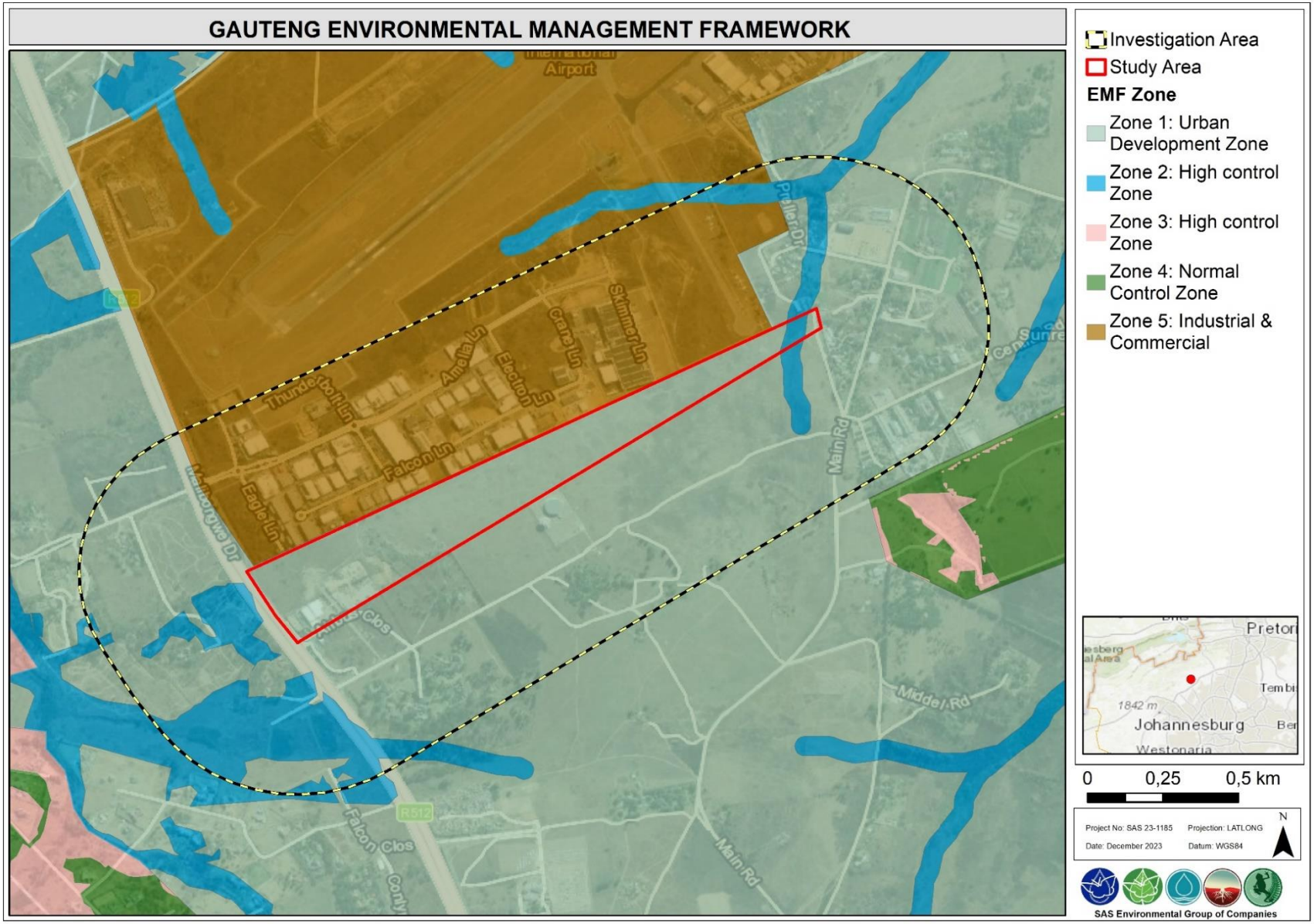

Figure 7: The land-use zones associated with the study and investigation areas according to the Gauteng Environmental Management Framework (2014).

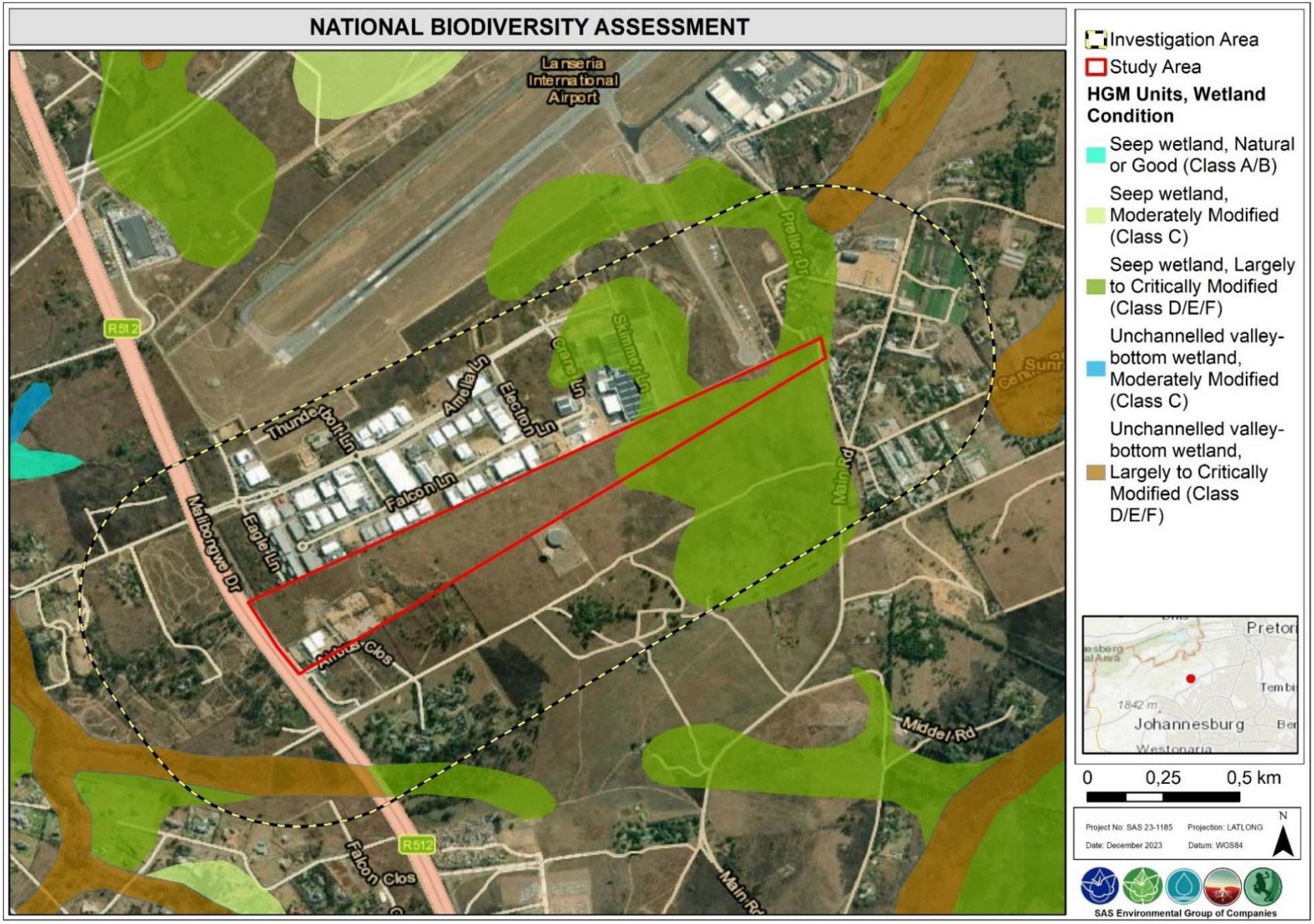

Figure 8: Wetlands associated with the study and investigation areas, according to the National Biodiversity Assessment: South African Inventory of Inland Aquatic Ecosystems (NBA: SAIIAE, 2018).

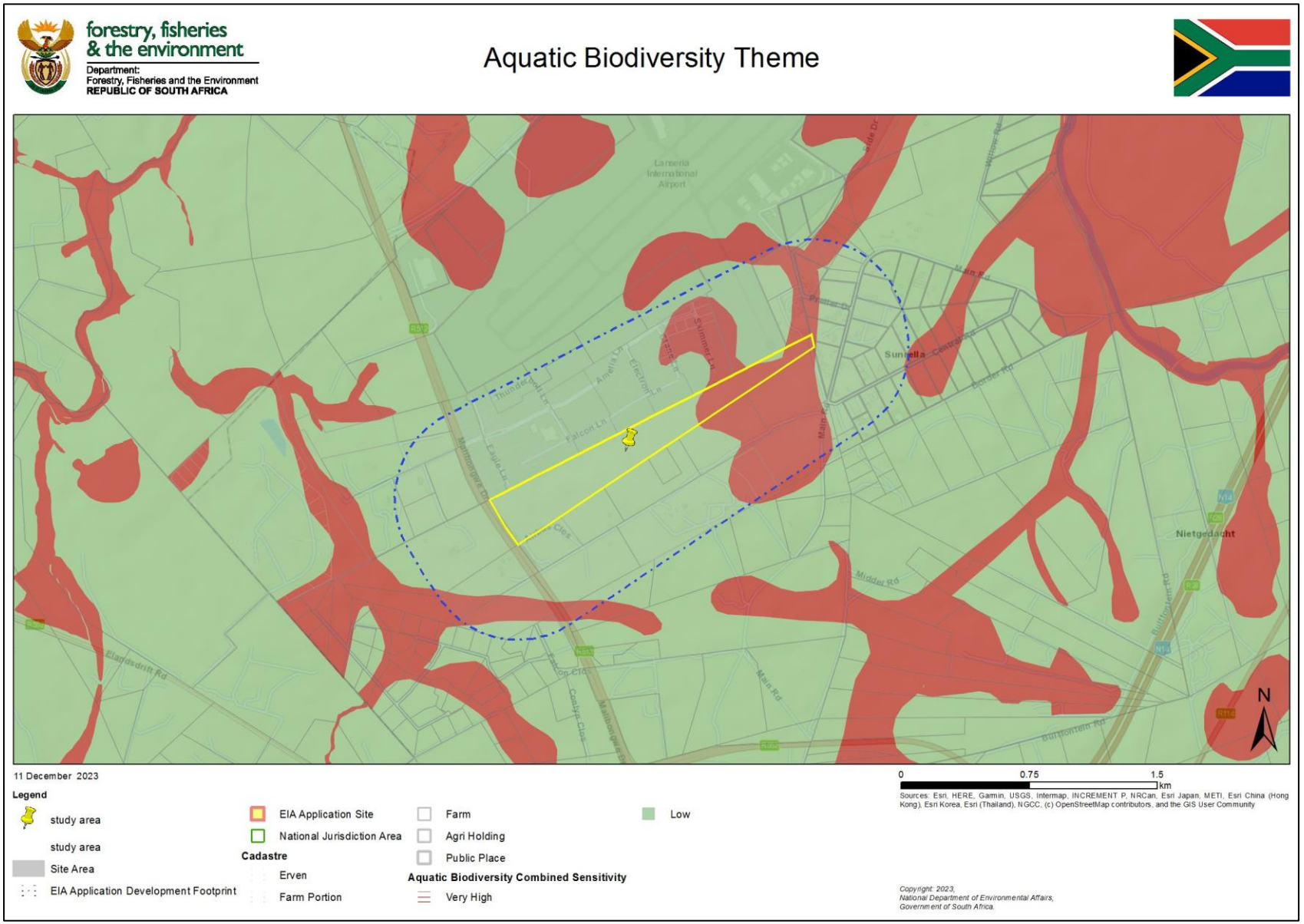

Figure 9 Aquatic Biodiversity Theme Sensitivity associated with the study area according to the National Web-based Screening Tool (Accessed October 2022).

4 RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 *Freshwater Ecosystem Characterisation*

The site assessment confirmed the presence of numerous Hydrogeomorphic (HGM) units within the study and investigation areas, namely:

- Two (2) Unchannelled Valley Bottom (UCVB) wetlands;
- One (1) Seep wetland; and
- In addition, to the above wetlands, two (2) Relic wetland features were identified within the investigation area.

The wetlands identified within the study area 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 3 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 2 below.

Table 2: Characterisation at Levels 3 and 4 of the Classification System (Ollis *et al*., 2013) of the freshwater ecosystems associated with the proposed mixed development and investigation area.

Freshwater ecosystems	Level 3: Landscape unit	Level 4: HGM Type
Seep Wetland located within the study area.	**Slope:**-an inclined stretch of ground typically located on the side of a mountain, hill or valley, not forming part of a valley floor. Includes scarp slopes, mid-slopes and foot-slopes.	**Seep Wetland:** A wetland area located on gently to steeply sloping land and dominated by colluvial (i.e. gravity-driven), unidirectional movement of water and material down-slope.
UCVB wetland located within the investigation area.	**Plain:** an extensive area of low relief characterised by relatively level, gently undulating or uniformly sloping land.	**Unchannelled valley-bottom wetland:** A valley-bottom wetland without a river channel running through it.

The delineated wetlands in relation to the study and investigation area are conceptually depicted in Figure 10 below

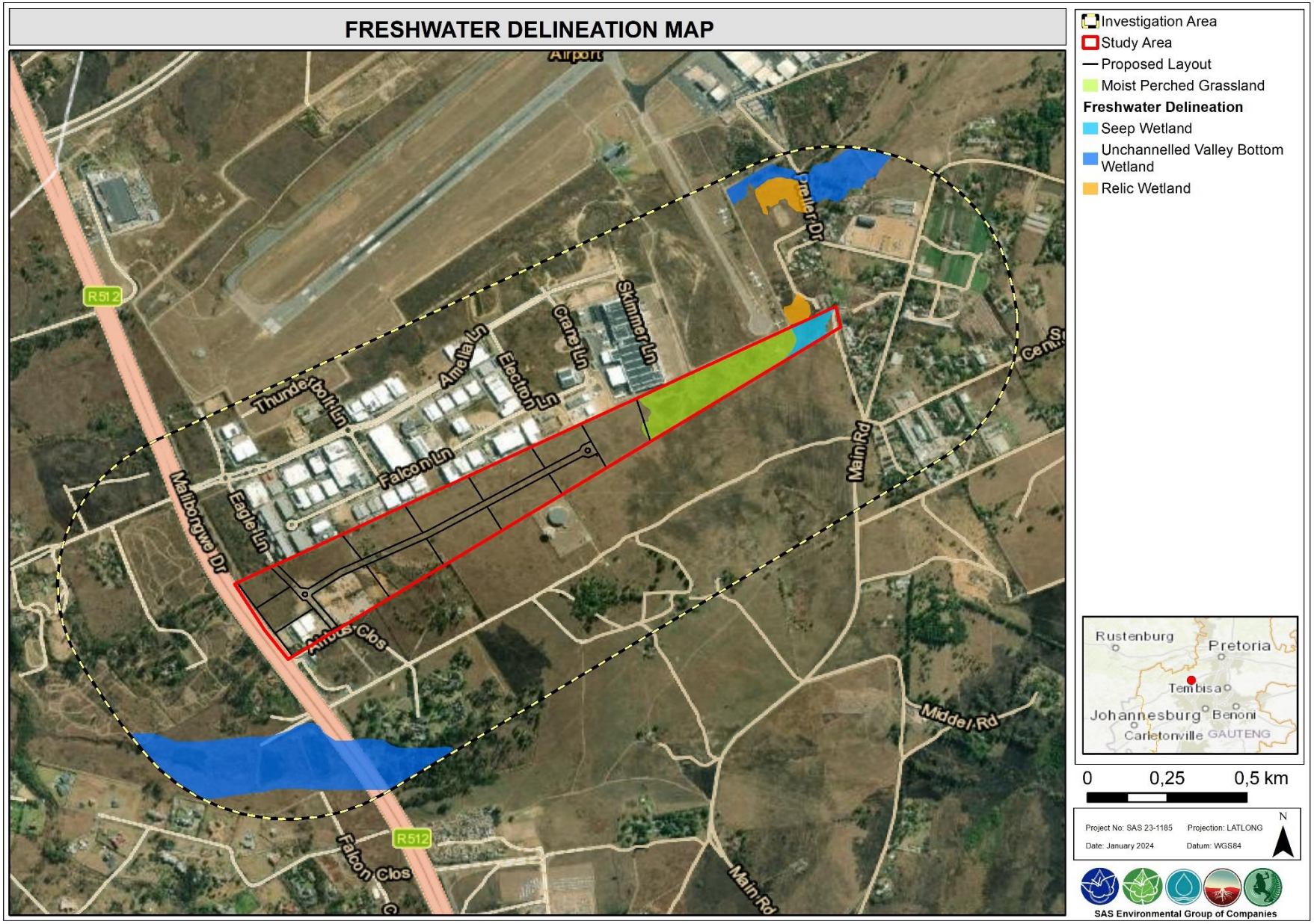

Figure 10: Location of the freshwater ecosystems associated with the proposed study and investigation areas.

4.2 *Freshwater Ecosystem Delineation*

As noted in Section 1.2, the wetland assessment was limited to the proposed study area and associated investigation area as provided by the proponent. During the site assessment historical modifications with the wetlands, as well as within their catchment was noted. The surrounding landscape consists of industrial development, agricultural practices, infilling and some suburban housing areas. 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 adequate to allow for informed decision-making.

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

- Terrain setting indicators were used as a primary, confirmatory indicator. Terrain was utilised to provide an indication of low-lying areas where water is likely to collect and/or move through the landscape.
- Vegetation was utilised as a secondary, confirmatory indicator to identify and define freshwater ecosystems, where feasible. The distinction between obligate, facultative, and terrestrial vegetation was relatively discernible.
- The soil form and redoximorphic indicators were utilised to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50cm of the soil surface. However, the use of this indicator was severely limited due to Halfway House Granite throughout the study area (Terra Soils Science, 2015). This indicator was used to identify 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) and to detect the presence of mottling (i.e. soils with variegated colour patterns, with the “background colour” referred to as the matrix and the spots or blotches of colour referred to as mottles). Mottling occurs as a result of a fluctuating water table, which causes soils to switch from anaerobic to aerobic soil conditions, causing dissolved iron to return to an insoluble state and be deposited in the form of patches, or mottles. However, according to Terra Soil Science (2015) delineation of wetlands in the Halfway House Granite Dome (HHGD) is challenging, due to a range of factors which lead to difficulty in distinguishing between wetland and terrestrial zones. This specific land type, from a soil and wetness perspective, exhibits some form of “wetland” characteristic according to the existing wetland delineation guidelines (DWAF, 2005 and 2008) in approximately

75% of the landscape. This aspect leads to significant challenges regarding the interpretation of the guidelines as well as of the specific soils in the area.

From a soil form perspective, the study and investigation areas fall within the Bb2 landtype. The Bb landtypes are described as ‘plinthic catenas – upland and duplex soils rare’. Catenas of red well drained soil in higher or crest terrain units typically occur with yellow less well drained soils in mid and foot slope positions. The lowest positions in the landscapes are usually occupied by waterlogged soil. Examples of soil forms normally. In the Bb2 landtype, valley bottoms are characterised by a high percentage of wetland soil forms, with half of the valley bottom terrain unit being characterised by the Kroonstad Soil Form – a typical wetland soil form comprising of an E subsoil horizon underlain be a gley (G) horizon. Westleigh Soil Forms (an orthic A topsoil horizon underlain by a soft plinthic B horizon) occupy a further 20% of the valley bottoms. On the footslope terrain unit hydromorphism is completely predominant in soils and is represented by the Longlands Soil Form (characterised by an E subsoil horizon overlain by a soft plinthic B horizon) which occupies 40% of the terrain unit area, along with the Wasbank Soil Form (an E subsoil horizon overlies hard plinthic B material), Kroonstad and Westleigh Soil Forms. In the remainder of the landtype area, the Avalon (characterised by a yellow-brown subsoil horizon underlain by a soft plinthic B horizon) and Wasbank Soil Forms are the only expression of hydromorphism, occupying around 20% of the upper parts of the landscape. The predominance of apedal soils and E horizons is suggestive of the movement of significant volumes of water as interflow within the catena. Soft plinthic horizons are indicative of seasonal rising and falling water tables that lead to hydromorphism.

Vegetation could not be used as an indicator to determine the site conditions due to the recent wildfire in the wetland areas, herbaceous layer had begun to repopulate the area but the graminoid layer was still too immature or non-existent to provide accurate identification of the grass species. However, the abundance of *Seriphium plumosum* increased quite substantially within the wetland area when compared to the non-wetland terrestrial areas and would be a qualitative indicator that this is a seasonal wet area because they usually prefer or tolerate damp areas.

The subject property consists of terrestrial grasslands that grade into a moist perched grassland. Although this area does support some facultative wetland vegetation due to the shallow depth of soil (less than 5cm) it is not deemed a wetland. Following this the area grades into the true wetland area.

Soil redoximorphic indicators were limited by the depth of the soil due to shallow outcrops or shallow base layer. The interflow processes are likely to occur below the base layer (i.e plinthic or lithic material) which may result in seasonal fluctuation of 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**. As mentioned earlier, the UCVB wetlands were only considered using desktop methods given their location in relation to the study area and the focus of the assessment was on the seep wetland which is located within the study area and will potentially be impacted by the proposed development.

Table 3: Summary of the assessment of the Seep wetland associated with the study and investigation areas.

Ecological & socio-cultural service provision graph:

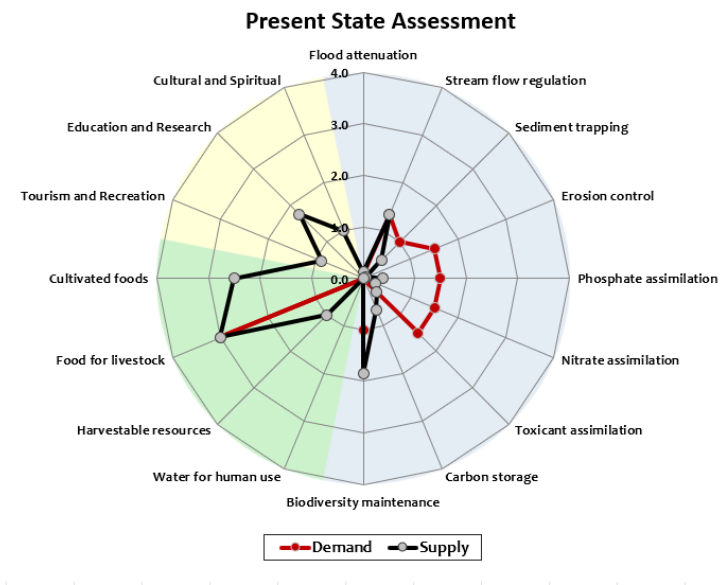

Figure 11: Photographic representation of the seep wetland associated with the study and investigation areas.

Ecoservice Provision	**Ecoservices category: High-Very Low** The ecological service provision by the seep wetland was assessed as very low to high. Ecoservices considered of most significant importance include food for livestock due to the cattle grazing activities that take place in the area. Given the development surrounding the wetland, the demand for ecological services such as erosion control, phosphate assimilation and toxicant assimilation is considered high whereas the supply is limited	**PES Discussion (WET-Health)**	**PES Category: C (Moderately Modified)** The ecological condition of the seep wetland has been moderately modified (PES Category C). This is due to catchment wide activities such as stormwater inflows from the airport and Middel Road adjacent to the study area. There is also an informal road traversing the wetland which has to a degree fragmented the wetland and resulted in desiccation of some portions of the wetland. Excavation and infilling was noted during the site visit, this has impacted on the natural zonation of the wetland and has the potential to result in areas where water ponds artificially during the rainfall events. Livestock (cattle) grazing and trampling is having a large impact on wetland habitat in the seep wetland.
EIS discussion	**EIS Category: Low** The seep wetland was assessed to be of low Ecological Importance and Sensitivity (EIS). The hydro-functional importance of the wetland was assessed to be very low and given that the wetland is located in industrial area, the direct human benefits were also considered to be limited. However, the wetland is considered important on a national scale and the ecological state is currently in a largely to critically modified (Class D/E/F). The Ecosystem Threat Status (ETS) of the seep wetland is critically endangered (CR), and the Ecosystem Protection Level (EPL) of the seep wetland is currently poorly protected as indicated by the NBA.	**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 seep wetland at a BAS and REC of C (Moderately modified). It is unlikely that the wetland will improve due to the land use setting of the wetland. As part of the proposed development project, mitigation measures should be implemented throughout to minimise potential further impacts on the wetlands and ensure that potential edge effects are managed in line with the mitigation hierarchy.

Watercourse drivers and receptors discussion (hydraulic regime, geomorphological processes, water quality and habitat and biota):	
Water inputs for a typical seep system are primarily via subsurface flows from an up-slope direction, where interflow soils intersect the land surface and recharge the soil profile at shallow depths that allow a vegetation response associated with wetland to establish. In addition, overland flow (sheetwash) after rainfall events recharges the seep wetlands. The seep wetland was prominently characterised by a shallow soils depth with rocky outcropping which limits the infiltration of water into deeper soil layers. However, the interflow processes are likely to occur on top of the impermeable plinthic layer and create seasonal wetland conditions that result in the abundance of *Seriphium plumosum.* Alterations to the natural hydraulic regime and geomorphological processes of the seep wetland have occurred due to the presence of the informal road that traverses the south eastern and western portions of the wetland. Additional stormwater inputs from the airport and Middel Road adding increased flow and sediment sources to the wetland. Indiscriminate waste disposal within the wetland was observed and these can act as barriers, diverting and blocking the movement of water during the presence of flow within the wetland. Excavation was noted within the wetland, and this also impacts on the natural distribution of water and flows within the system. During the site assessment, it was observed that cattle were heavily grazing the wetland, as evidenced by their trampling. This has resulted in impacts on the wetland vegetation and altered the hydrology, which in turn encourages the establishment of alien and invasive species. Despite the hydrological and geomorphological impacts on the wetland, the wetland displays little to limited soil erosion. No surface water was present at the time of the assessment and therefore no water quality parameters were able to be assessed. Due to the time of year of the assessment (spring) and recent veld fires few plant species were flowering and the absence of inflorescences meant that the graminoid species could not be easily identified. However, the frequency of *Seriphium plumosum.* increased quite substantially in the wetland areas (presumably in response to increased cattle loads as the species increases significantly under intense grazing pressure (evidence of high cattle loads in trampled areas throughout the wetlands). an abundance of *Denekia capensis* and a lower abundance *of cyperus esculentus* were present in the wetland area. With that being said the wetland is expected to provide habitat for potentially sensitive and less sensitive biota, especially when inundated.	
Extent of modification anticipated	**Low** A low level of modification to the seep wetland is anticipated from the construction and operation of the proposed mixed-use development provided that all mitigation measures as set out in this report are adhered to. Activities associated with the construction phase of the project such as groundbreaking, excavation of foundations and other earthworks including the construction of surface infrastructure surrounding the wetland will have the highest impact on the wetland according to the risk assessment.
Risk Assessment Outcome & Business Case:	
Low	It is essential that the wetland delineations and applicable zones of regulation are taken into consideration during the planning phase of the proposed mixed-use development, and that effort is made to avoid the wetland altogether, in line with the mitigation hierarchy. The construction and operational phase activities related to the proposed development pose a “Low” risk significance to the receiving freshwater environment. The recommended mitigation measures as per table 5 must be implemented to minimise any edge effects and cumulative impacts to the wetland. In addition, given the cumulative loss of wetland habitat in urban areas, it is highly recommended that the ecological functioning of the wetland be maintained and where feasible improved through measures such as the following: ➢ Use of SuDS for improving water quality regime and ability to attenuate floods; ➢ Clearing of alien and invasive species to create habitat for biodiversity; ➢ Limiting construction footprint areas to what is deemed absolutely necessary; ➢ Usage of sediment control devices during construction activities; and ➢ Integrate design of stormwater attenuation in the form of bioswales to manage runoff into the wetland.

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 4167 (GN 4167) as published in the Government Gazette 49833 of 08 December 2023 as it relates to the National Water Act, 1998 as amended (Act No. 36 of 1998);

Certain articles of legislation related to the above Acts and legislation impose potential zones of regulation on freshwater ecosystems in both a national and provincial context. The Zones of Regulation (ZoR) are not necessarily development exclusion zones, rather areas in which EIA and Water Use Authorisation legislative tools have been introduced for the protection and sustainable use of freshwater resources by requiring that certain types of activities within a freshwater ecosystem, or within a certain distance of a freshwater ecosystem require authorisation. The definition and motivation for a regulated zone of activity for the protection of freshwater ecosystems can be summarised as follows:

Table 4: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use Authorisation Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) as amended.	Government Notice 4167 as published in the Government Gazette 49833 of 08 January 2024 as it relates to the National Water Act, 1998 (Act No.36 of 1998) as amended. In accordance with GN 4167, 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 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 distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or • **In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans.**
Listed activities in terms of the National Environmental	**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) states that: *The development of—*

[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.

Regulatory authorisation required	Zone of applicability
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.	*(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.***
	Activity 14 of Listing Notice 3 (GN 324) of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended) states that *The development of—* *(i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or* *(ii) infrastructure or structures with a physical footprint of 10 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 has been adopted, within 32 metres of a watercourse,* *c. Gauteng* *iv. Sites identified as Critical Biodiversity Areas (CBAs) or Ecological Support Areas (ESAs) in the Gauteng Conservation Plan or in bioregional plans*

The relevant Zones of Regulation (ZoR) are applicable (Figure 12-13):

- NEMA 32m ZoR as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) (as amended); and
- Government Notice 4167 (GN 4167) as published in the Government Gazette 49833 of 08 December 2023 as it relates to the National Water Act, 1998 as amended (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).

Although not an article of legislation the GDARD Requirements for Biodiversity Assessments, Version 3 (2014) are also relevant in the context of buffers. The Guidelines specify buffer widths for sensitive features. The guidelines specify that a wetland and a protective buffer zone, beginning from the outer edge of the wetland temporary zone, must be designated as sensitive. Rules for buffer zone widths are as follows:

- **30m for wetlands occurring inside urban areas**; and
- 50m for wetlands occurring outside urban areas;

The guidelines states that it is important to note that these buffer zones are essential to ensure healthy functioning and maintenance of wetland ecosystems. Larger buffer zones may be required for wetlands supporting sensitive species.

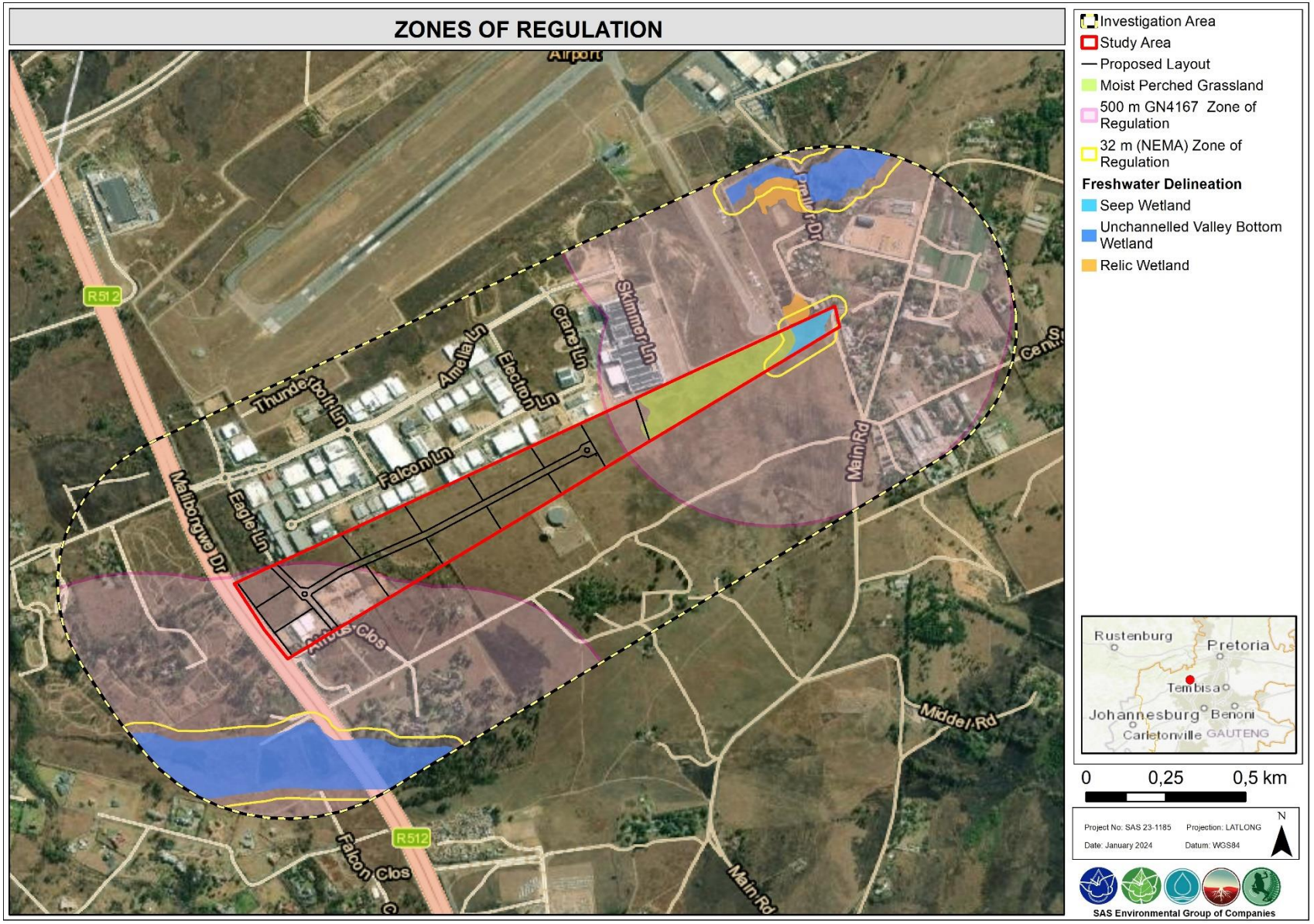

Figure 12: Conceptual representation of the zones of regulation in terms of NEMA and GN 4167 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) as amended associated with the proposed study area and investigation area.

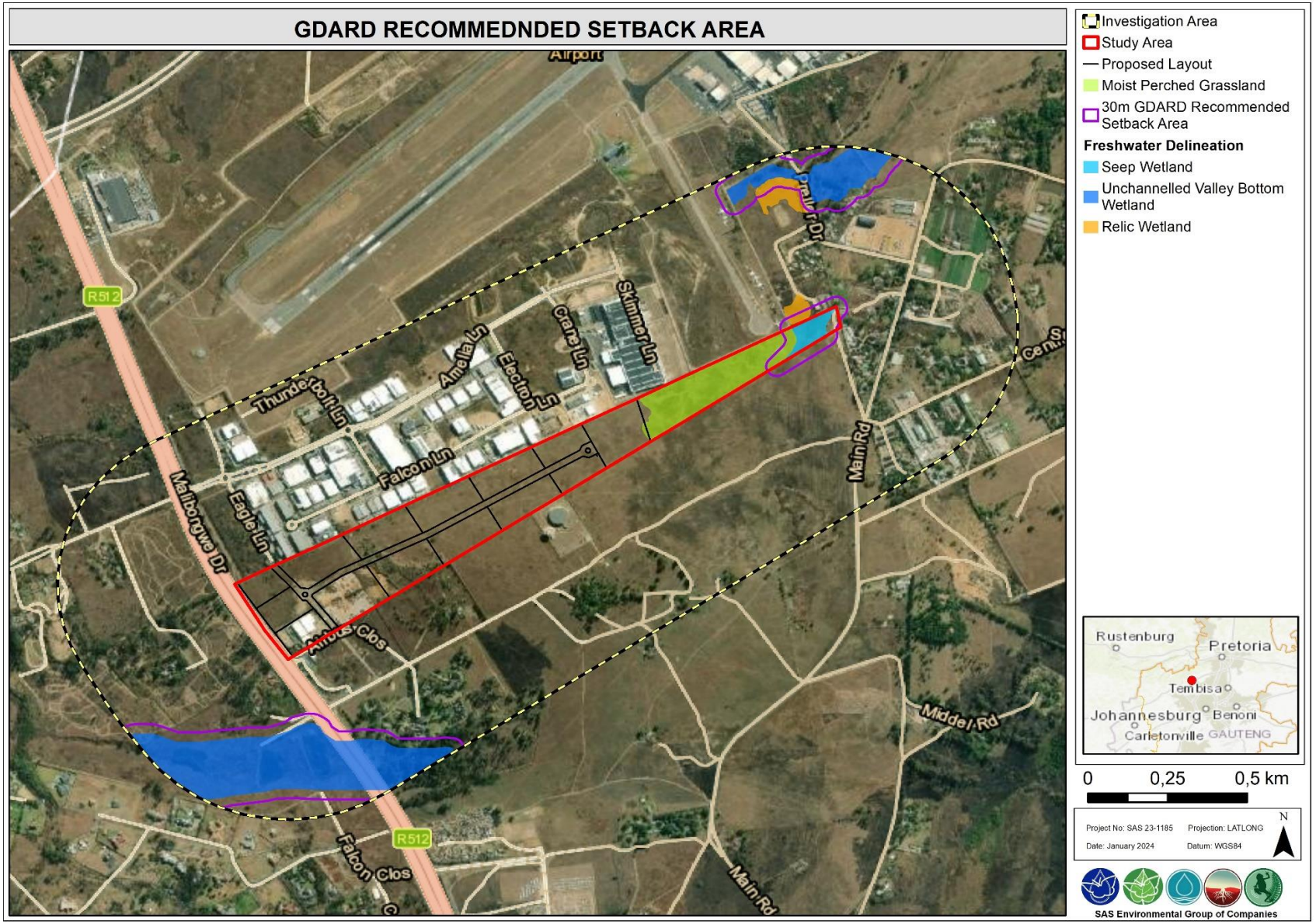

Figure 13: Gauteng Department of Agriculture and Rural Development recommended buffers within the proposed study and investigation areas according to the GDARD 2014.

6 FRESHWATER SENSITIVITY VERIFICATION

The protocol for the assessment of freshwater and aquatic biodiversity prepared in support of the Department of Forestry, Fisheries and Environment (DFFE) (previously the Department of Environmental Affairs (DEA)) National Web-based Environmental Screening Tool (2020), provides the criteria for the assessment and reporting of impacts on aquatic/freshwater biodiversity for activities requiring Environmental Authorisation (EA). For the aquatic / freshwater biodiversity theme, the requirements are for sites which support various levels of biodiversity. The relevant aquatic / freshwater biodiversity theme in the National Web-based Environmental Screening Tool (2020) has been provided by the South African National Biodiversity Institute (SANBI). Based on the sensitivity rating, a suitably qualified specialist must prepare the relevant report or opinion memorandum which is to be submitted as part of the EA application.

According to the guidelines, an applicant intending to undertake an activity on a site identified as being of “very high sensitivity” for an aquatic biodiversity theme must submit an Aquatic Biodiversity Impact Assessment, or if the area is identified as being of “low sensitivity” then an Aquatic Biodiversity Compliance Statement must be compiled and submitted to the competent authority. It is noted, however, that during a site survey undertaken by a suitably qualified freshwater ecologist should the sensitivity be determined different from that assigned by the screening tool (i.e. that a high risk to the regional aquatic biodiversity or freshwater ecosystems in the area is likely even though it is assigned as a “low” sensitivity, or if it is assigned a high sensitivity, however, the proposed development risks are deemed low) then the relevant assessment approach must be followed based on the site survey results and not the screening tool allocation.

As part of the process of the background information gathering, the screening tool was applied to the study and investigation areas. According to the screening tool, the study area and investigation area of the proposed mixed-use development is located within areas of a mix of low and very high aquatic sensitivity (Figure 9).

The only areas of very high freshwater aquatic sensitivity as associated with the study area is the UCVB and the seep wetlands. Based on the site verification undertaken by Scientific Aquatic Services and the findings thereof presented in this report, the designation of very high sensitivity to the wetlands by the DFFE Screening Tool is supported and not disputed.

The designation of very high sensitivity to freshwater features in the wider area by the DFFE Screening Tool is supported through the findings of the freshwater assessment, in the context of all freshwater ecosystems being inherently sensitive. Accordingly, all freshwater ecosystems as delineated are considered to be very highly sensitive.

Under the Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Aquatic Biodiversity, (GN320 of March 2020), for areas of very high aquatic biodiversity sensitivity an Aquatic Biodiversity Assessment must be produced. Such a reporting approach (EIA-phase freshwater reports) have accordingly been compiled.

Please refer to the site sensitivity verification report contained in Appendix E.

7 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the seep wetland associated with the proposed mixed-use development and investigation area. 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. The impact significances were determined using the method provided by the DWS Risk Assessment Matrix (2023).

7.1 *Risk assessment analysis*

7.2 *Considerations taken with the application of the Risk and Impact Assessments*

Following the assessment of the wetland associated with the proposed mixed-use development, the DWS prescribed Risk Assessment Matrix (2023) 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 (2023):

- The risk assessment was the version as contained in GN4167 of 2023, and the RAM was completed before the promulgation of the new GA;

- The DWS Risk Assessment Matrix (2023) 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 mixed-use development change from the layout provided and assessed in this report ,or should details pertaining to the construction and use of materials change, the Risk Assessment Matrix will need to be revised and potentially amended based on the new design layout and specifics;
- The proposed mixed-use development is located within the GN 4167 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”;
- Signatures indicating hydropedologically active soils were observed within the moist grassland adjacent to the wetland which must be considered and the stormwater management plan must be designed to mimic these processes as far as practically possible to reduce impact on the receiving freshwater resource;
- It was also assumed that all fuel and dangerous goods will be stored further than 100m from the identified freshwater ecosystems (as per LN 3 Activity 10 of the National Environmental Management Act, 1998 (Act No.107 of 1998) EIA regulations, 2014 (as amended in 2017);
- 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.

7.3 *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 mixed-use development activities, is provided in the table below, whilst a comprehensive outcome of the risk assessment is presented in Appendix F.

Table 5: Summary of the results of the DWS risk assessment matrix applied to the freshwater ecosystems associated with the proposed mixed-use development.

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
PRE-CONSTRUCTION	Vegetation stripping and removal of topsoil to accommodate the services needed to facilitate the construction phase (construction camps, equipment storage yards, workshop facilities, construction administration areas, ablution facilities, (if applicable).	Proliferation of alien and/or invasive vegetation as a result of disturbances.	Seep Wetland	**7**	**14**	80%	**11.2**	**L**	Careful planning of the construction footprint must be undertaken. It should be ensured that laydown areas are to remain outside of the delineated wetlands and the associated setback areas; Construction and associated activities must preferably take place outside of the wet season in order to minimise the risk of increased and sediment-laden runoff reaching the wetland as a result of these activities; The construction area must be clearly demarcated before any construction activity take place and signage must be displayed during construction phase to inform and prevent the contractors and workers from entering the wetland; It must be ensured that the sediment traps between the wetland and construction areas are installed to manage sediment laden runoff; Removed vegetation must be stockpiled outside of the delineated boundary of the wetland, The footprint areas and height of these stockpiles must be kept to a minimum (not higher than 2m). Should the vegetation not be suitable for reinstatement after the construction phase or be alien/invasive vegetation species, all material must be disposed of at a registered garden refuse site and may not be burned or mulched on site; Dust suppression techniques must be implemented to prevent smothering of freshwater vegetation; The delineated freshwater ecosystem which does not form part of the development must be clearly demarcated on site and remain off-limits to all non-essential activities. It is recommended that a geotextile mesh be used to demarcate the system, as indicated in Figure A:
		Increased sedimentation of the watercourse, smothering vegetation associated with it.	Seep Wetland	**7**	**14**	80%	**11.2**	**L**	
		Exposure of soils, leading to increased runoff, and erosion.	Seep Wetland	**7**	**14**	80%	**11.2**	**L**	
	Stockpiling of topsoil (general).	Stockpiled soils will be vulnerable to erosion. Dispersal of disturbed and destabilised soils, with sediments transported to watercourses during rainfall events.	Seep Wetland	**7**	**14**	60%	**8.4**	**L**	
CONSTRUCTION	Development of internal road networks and buildings outside of the watercourse	Loss of freshwater habitat and ecological structure as a result of edge effects associated with the development.	Seep Wetland	**7**	**14**	60%	**8.4**	**L**	
		Impacts to the ecoservice provision of the wetland	Seep Wetland	**5**	**10**	60%	**6**	**L**	
		Potential poor stormwater management associated with impermeable surfaces that could lead to erosion formation to the seep wetland	Seep Wetland	**7**	**14**	40%	**5.6**	**L**	

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
	The use of construction vehicles and heavy equipment on site during the construction phase.	Compaction of soils within sensitive habitat leading to loss of biodiversity and altered hydrological functioning.	Seep Wetland	**7**	**14**	40%	**5.6**	**L**	 Figure A: Example of netting used to demarcate the wetland and regulated areas.
		Water quality impacts resulting from fluid leaks from poorly serviced vehicles.	Seep Wetland	**7**	**14**	40%	**5.6**	**L**	
	Groundbreaking, excavation of foundations and other earthworks upgradient of and outside of the watercourse and the associated 30m GDARD setback area.	Disturbances of soils leading to potential impacts to the watercourse vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat.	Seep Wetland	**7**	**14**	60%	**8.4**	**L**	Exposed soil, including topsoil, must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent erosion and sedimentation of the freshwater ecosystem; Soil must be stockpiled according to the natural sequence in order to ensure that topsoil and subsoils are not mixed during backfilling processes; and An Environmental Control Officer (ECO) must be appointed in order to ensure all water related aspects are adequately mitigated during the construction phase; <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 contractor laydown area. 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.
		Potential dispersal of sediments that could reach the wetland.	Seep Wetland	**7**	**14**	60%	**8.4**	**L**	
		Potential hydrological impacts from altered soil profiles and/or surface water runoff patterns.	Seep Wetland	**7**	**14**	60%	**8.4**	**L**	

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
	Construction of stormwater pond, swales and other stormwater infrastructure outside the wetlands and the 30m GDARD (Setback Area).	Disturbance and exposure of soil leading to increased runoff and erosion, and thus increased sedimentation of the downstream reach of the wetlands; Increased sedimentation of the wetlands, leading to smothering of vegetation associated with the wetlands.	Seep Wetland	**7**	**14**	40%	**5.6**	**L**	The proponent is encouraged to incorporate Sustainable Drainage Systems (SuDS) principles into the design of the proposed development to manage stormwater during the operational phase. The use of SuDS principles such as bioswales in addition to the attenuation ponds to manage stormwater will further assist in preventing significant impacts on the hydrological functioning of the wetlands, reduce the risk of flooding during high flow periods and reduce the risk of increased erosion. Furthermore, vegetated swales with indigenous wetland or riparian species can assist with water polishing, trapping hydrocarbons from stormwater run-off from roads before this is released into the wetlands. Lastly, the use of swales or similar attenuating features that ensure a diffuse outflow of stormwater into the GDARD setback areas are seen as critical to replicating the subsurface and surface inflows that will be altered by the proposed development, thus assisting in retaining the hydrology of the downgradient seep wetland. The following is deemed applicable for the construction of the development according to SuDs principles: All swales must be constructed through excavation of the in-situ material, sloped to a ratio not steeper than 3:1 and lined with rocks and cobbles to assist with energy dissipation and prevent sedimentation and erosion as well as improve the aesthetic appeal of the swales and stormwater infrastructure (Figure B); Swales must be vegetated with indigenous obligate and facultative species suitable for seasonal saturation. This will assist with energy dissipation and prevent sedimentation and erosion as well as improve habitat provision; and Swales must be designed to allow diffuse discharge of stormwater into the environment to encourage re-infiltration of such water into the soil profile.
		Proliferation of alien and/or invasive vegetation as a result of disturbances; and Ground disturbances and dust pollution during construction which may impact on water quality.	Seep Wetland	**7**	**14**	40%	**5.6**	**L**	

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
									  Figure B: Examples of swales utilised for conveyance of stormwater. At no point should erosion or gully formation be allowed as this will have an impact on the water dispersal into and across the wetland, which could potentially reduce the extent and functionality of the wetlands in the long-term; All materials used to construct the swales must not generate toxic leachates or lead to significant changes in pH or dissolved salt concentrations; No plastic lining may be used as part of the swale and stormwater infrastructure construction as this has various ecological impacts, with special mention of impacts to faunal assemblages. All stormwater channels must be designed to allow stormwater to disperse across the channel before releasing into the wetland. This will prevent incision and scouring; and Regularly inspect vehicles for leaks to prevent hydrocarbon spills in freshwater ecosystems.
OPERATIONS	Progressive alien vegetation encroachment following on from soil disturbances.	Alien vegetation will be induced to recruit and encroach following on from soil disturbance impacts. As wetlands provide favourable resources, alien vegetation encroachment into wetland habitat is highly likely when management strategies are lacking.	Seep Wetland	**10**	**20**	60%	**12**	**L**	Alien vegetation management plan to be implemented that is subject to routine inspection and monitoring.

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
	Increased impermeable surfaces in the vicinity of the watercourse and the catchment.	Decreased infiltration and increase surface runoff from impervious surfaces; Increased water inputs to the freshwater environment at unnatural rates; Impacted soil and water quality condition within the wetland; Altered hydroperiod of the wetland; and Potential change in wetland hydrograph due to modified surrounding landscape.	Seep Wetland	**10**	**20**	60%	**12**	**L**	A stormwater management plan must be incorporated into the design of the development; Release of stormwater into the freshwater environment must not result in further bank incision or erosion and must be done in a diffused manner; and It is highly recommended that Sustainable Urban Drainage Systems (SUDs) principles be incorporated into the stormwater management plan for the development.
	Operation of the stormwater infrastructure and service infrastructure.	Flow concentration and potentially erosion at concentration points i.e. swales and other stormwater infrastructure; and Altered runoff patterns and increased water inputs to the wetlands, resulting in altered flow regime and subsequent impacts on the wetland vegetation.	Seep Wetland	**10**	**20**	40%	**8**	**L**	Ensure that regular maintenance takes place to prevent failure; Develop emergency response plan to be implemented in case of emergency; and Only existing roadways must be utilised during maintenance and repairs to avoid indiscriminate movement of vehicles within the freshwater ecosystem.
	Operation and maintenance of planned waste management systems (e.g. sewage infrastructure).	Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances; and Disturbance to and compaction of soil resulting in erosion.	Seep Wetland	**10**	**20**	40%	**8**	**L**	
	Routine maintenance of infrastructure.	Impacts to wetland habitat resulting from the movement of vehicles and personnel outside of designated service roads.	Seep Wetland	**10**	**20**	60%	**12**	**L**	Alien vegetation management plan to be developed and implemented; and Incorporate indigenous terrestrial and wetland vegetation into landscape plan (if applicable).

Phase	Activity	Impact	Potentially affected watercourses	Severity (max = 20)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Mitigation Measures to be implemented
		Potential for increased proliferation of alien floral species, leading to reduced ability to support biodiversity, and provide ecological services such as flood attenuation.	Seep Wetland	**10**	**20**	60%	**12**	**L**	

The activities associated with the construction and operational of the proposed mixed-use development pose a “Low” risk significance to the seep wetland associated with the proposed mixed-use developments provided 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 associated with the proposed development and within the investigation area.

Assuming that strict enforcement of cogent, well-developed mitigation measures takes place, the significance of impacts arising from the proposed development 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 H** of this report.

7.3.1 Cumulative Impacts

Freshwater ecosystems within the region and local area (outskirts of northern Johannesburg) are under continued threat due to rapid development of urban infrastructure, in particular high density residential development. Such changes to landuse from smallholdings or from farmland are associated with direct and indirect impacts, including include changes to the hydrology of wetlands, primarily related to changes in catchment runoff associated with increased coverage of hardened surfaces and decreased infiltration and direct stormwater discharges. Hydrological impacts result in a knock-on impact on geomorphological state with increased channelisation and erosion often occurring. Other indirect impacts 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.

Provided that the proposed development avoids encroaching on the wetland and with appropriate management of stormwater from the development, it is considered unlikely that the development will contribute significantly to the above-mentioned impacts as modifications have occurred within the wetland.

8 CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation Application (WUA) processes for the proposed mixed-use development on the remainder of Portion 72 of the farm Bultfontein in the Gauteng Province. The mixed-use development (hereafter referred to as the 'study area') is located approximately 23 km north of Roodepoort and 18 km northwest of Sandton adjacent to the Lanseria International Airport in Gauteng Province.

A field assessment was undertaken in October 2023 during which freshwater ecosystems were identified within the study area and associated investigation area (defined as a 500m radius around the study area) in line with GN 4167 of December 2023. These freshwater ecosystems include:

- Two (2) Unchannelled Valley Bottom (UCVB) wetlands;
- One (1) Seep wetland; and
- In addition, to the above wetlands, two (2) Relic wetland features were identified within the investigation area.

Input on the final delineation was provided by Galago Environmental upon request of the proponent and was considered in preparation of the final delineation by SAS. This delineation by Galago Environmental is considered acceptably accurate and is considered as the best estimate of the wetland boundary when soil characteristics are considered with more emphasis and not the presence of facultative wetland vegetation being considered as the key indicator in the landscape as initially prepared by SAS.

The UCVB wetlands were only considered using desktop methods given their location in relation to the study area and the focus of the assessment was on the seep wetland which is located within the study area and will potentially be impacted by the proposed development.

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

Freshwater ecosystem	Present Ecological State (PES)	Ecoservices	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Category / Recommended Management Objective / Best Attainable State
Seep wetland	Moderately Modified (PES Category C)	High-Very low	Low	REC: C RMO: Maintain BAS: C

Following the freshwater ecosystem site assessment, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2023) was applied to determine the significance of potential

impacts associated with the proposed mixed-use development on the receiving freshwater environment. According to the risk assessment, the activities associated with the proposed mixed-use development during construction and operational phases pose a “Low” risk and the to the wetland associated with the proposed mixed-use developments. Signatures indicating hydropedologically active soils were observed within the moist grassland adjacent to the wetland which must be considered and the stormwater management plan must be designed to mimic these processes as far as practically possible to reduce impact on the receiving freshwater resource. Adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures as provided in this report including general good construction practice, ongoing management and maintenance as well as monitoring, is essential if the significance of perceived impacts is to be reduced to limit further degradation of the seep wetland.

Based on the findings of the study, it is the professional opinion of the freshwater ecologist that the proposed mixed-use development can be considered acceptable, provided that the delineated extent of the wetland and the associated 30m GDARD recommended setback area are demarcated as “no-go areas” and provided that all mitigation measures as detailed are implemented.

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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) as amended (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) as amended (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 as amended (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 4167 as published in the Government Gazette 49833 of 08 December 2023 as it relates to the NWA (Act 36 of 1998) as amended	GN 4167 outlines the parameters and process of a General Authorisation (GA), which replaces the need to apply for a licence in terms of Section 40 of the NWA, provided that the water use is within the limits and conditions of the GA. The notice replaces GN 509 of 2016. The GA sets out the need to determine the regulated area of a watercourse, as well as the degree of risk posed by an activity/ies related to a particular water use. In accordance with GN 4167 of December 2023, the 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 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 distance from the edge of a watercourse where the edge of the watercourse (excluding flood plains) is the first identifiable annual bank fill flood bench; or

	c) In respect of a wetland, a 500 m radius around the delineated boundary (extent) of any wetland, including pans. The GA only applies to the use of water in terms of Section 21(c) and (i) of the NWA where the risk class is LOW as determined through the application of the Risk Matrix as prescribed in the Notice. The GA also does not apply where other Section 21 water uses are triggered, does not apply for most sewage infrastructure and pipelines carrying hazardous materials, water uses associated with hazardous materials, water uses associated with water and wastewater treatment works, and for most mining-related water uses. The GA may be exercised as follows: i) Section 21(c) or (i) water use activities that are determined to pose a LOW Risk as determined through the application of the Risk Matrix as prescribed in the Notice can be undertaken subject to the general conditions of the GA; ii) Section 21(c) or (i) water use activities set out in Appendix D1 of the Notice can be undertaken without being subject to the requirement of a risk assessment and subject to the general conditions of the GA. Such water use activities in Appendix D1 include inter alia emergency river crossings, fence erection, solar renewable infrastructure that has no direct impact on watercourses and mini-scale hydropower developments; iii) Prescribed water use activities undertaken by certain State Owned Entities as detailed in Appendix D2 of the Notice can be undertaken without being subject to the requirement of a risk assessment and subject to the general conditions of the GA; iv) Maintenance work associated an 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 can be undertaken ; v) River and stormwater management activities including maintenance of infrastructure as contained in a river management plan or similar management plan, may be conducted subject to the approval of such a plan by the relevant DWS regional office or catchment management agency; vi) Rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix can be conducted; and vii) Emergency work arising from an emergency situation and or incident associated with the persons' existing lawful water use entitlement can be undertaken, provided that all work is executed and reported in the manner prescribed in the Emergency protocol contained in Appendix C of the GA. 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.

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. Freshwater Ecosystem 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).

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

Table C6: 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.

Table C7: 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.

6. 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 C8: 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

7. 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 C9: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

PES			Ecological and Importance Sensitivity (EIS)			
			Very High	High	Moderate	Low
	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 C10: 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.

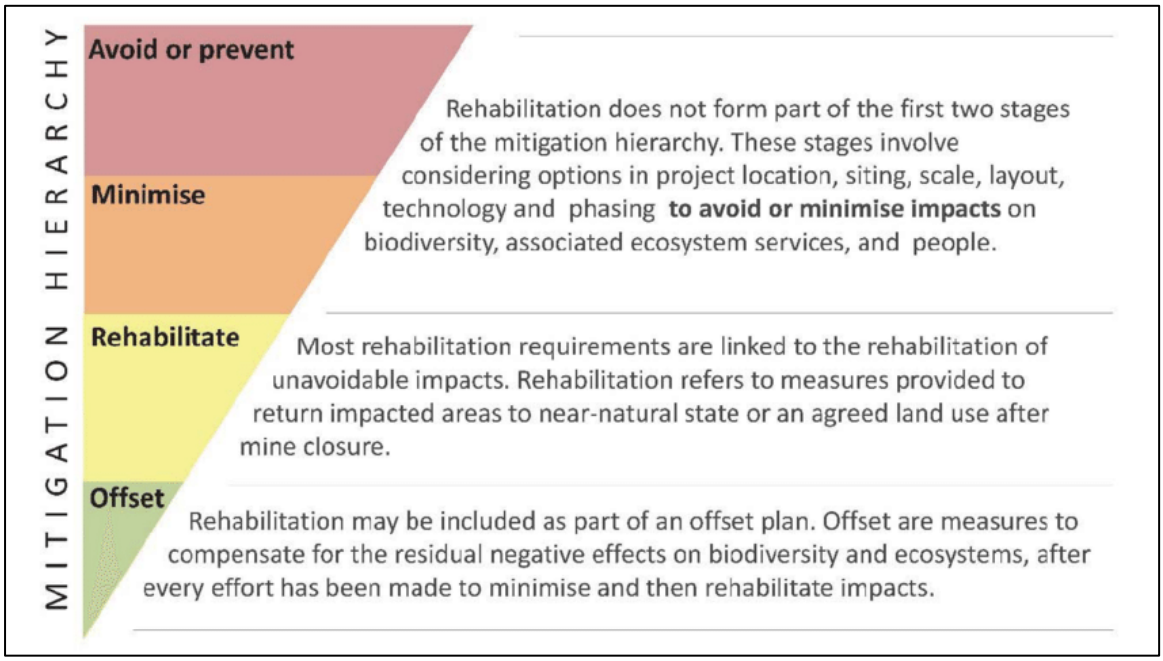

Figure D1: Impact Minimisation hierarchy as advocated by the DEA *et al.*, (2013)

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 D1: 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 study and investigation areas.

Freshwater Ecosystems	Hydrology		Geomorphology		Vegetation		Overall Score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
Seep wetland	2	0	0.1	0	4.1	0	2.02 (C)

Table E2: Presentation of the results of the Ecoservices assessment applied to the Seep wetland.

ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.1	0.1	0.0	Very Low
	Stream flow regulation	1.3	1.3	0.5	Very Low
	Sediment trapping	0.5	1.0	0.0	Very Low
	Erosion control	0.1	1.5	0.0	Very Low
	Phosphate assimilation	0.4	1.5	0.0	Very Low
	Nitrate assimilation	0.3	1.5	0.0	Very Low
	Toxicant assimilation	0.4	1.5	0.0	Very Low
	Carbon storage	0.7	0.0	0.0	Very Low
	Biodiversity maintenance	1.9	1.0	0.9	Low
PROVISIONING SERVICES	Water for human use	0.0	0.0	0.0	Very Low
	Harvestable resources	1.0	0.0	0.0	Very Low
	Food for livestock	3.0	3.0	3.0	High
	Cultivated foods	2.5	0.0	1.0	Low
CULTURAL SERVICES	Tourism and Recreation	0.9	0.0	0.0	Very Low
	Education and Research	1.8	0.0	0.3	Very Low
	Cultural and Spiritual	1.0	0.0	0.0	Very Low

Table E3: Presentation of the results of the EIS assessment applied to the seep wetland.

Freshwater Ecosystems			Seep wetland
Ecological Importance and Sensitivity			Score (0-4)
Biodiversity support			A (average)
			0.67
Presence of Red Data species			1
Populations of unique species			0
Migration/breeding/feeding sites			1
Landscape scale			B (average)
			0.71
Protection status of the wetland			2
Protection status of the vegetation type			1
Regional context of the ecological integrity			1
Size and rarity of the wetland type/s present			1
Diversity of habitat types			1
Sensitivity of the wetland			C (average)
			1.00
Sensitivity to changes in floods			
Sensitivity to changes in low flows/dry season			
Sensitivity to changes in water quality			
Hydro-Functional Importance			Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		0
	Streamflow regulation		0
	Water Quality Enhancement	***Sediment trapping***	0
		Phosphate assimilation	0
		Nitrate assimilation	0
		Toxicant assimilation	0
		Erosion control	0
	Carbon storage		0
Direct Human Benefits			Score (0-4)
Subsistence benefits	***Water for human use***		0
	Harvestable resources		0
	Cultivated foods		0
Cultural benefits	***Cultural heritage***		0
	Tourism and recreation		0
	Education and research		0

APPENDIX F – Risk Assessment Outcome

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorphology	Vegetation	Fauna										
PRE-CONSTRUCTION	Vegetation stripping and removal of topsoil to accommodate the services needed to facilitate the construction phase (construction camps, equipment storage yards, workshop facilities, construction administration areas, ablution facilities, (if applicable).	Proliferation of alien and/or invasive vegetation as a result of disturbances.	Seep Wetland	C	Low / Very low	0	0	0	2	1	**4**	1	2	**7**	**2**	**14**	80%	**11.2**	**L**	High
		Increased sedimentation of the watercourse, smothering vegetation associated with it.	Seep Wetland	C	Low / Very low	1	1	2	2	1	**4**	1	2	**7**	**2**	**14**	80%	**11.2**	**L**	High
		Exposure of soils, leading to increased runoff, and erosion.	Seep Wetland	C	Low / Very low	2	1	2	1	1	**4**	1	2	**7**	**2**	**14**	80%	**11.2**	**L**	High
	Stockpiling of topsoil (general).	Stockpiled soils will be vulnerable to erosion. Dispersal of disturbed and destabilised soils, with sediments transported to watercourse during rainfall events.	Seep Wetland	C	Low / Very low	1	1	2	0	0	**4**	1	2	**7**	**2**	**14**	60%	**8.4**	**L**	High
CONSTRUCTION	Development of internal road networks and buildings outside of the watercourse	Loss of freshwater habitat and ecological structure as a result of edge effects associated with the development.	Seep Wetland	C	Low / Very low	2	1	2	2	1	**4**	1	2	**7**	**2**	**14**	60%	**8.4**	**L**	High
		Impacts to the ecoservice provision of the wetland.	Seep Wetland	C	Low / Very low	1	1	1	1	1	**2**	1	2	**5**	**2**	**10**	60%	**6**	**L**	High
		Potential poor stormwater management associated with impermeable surfaces that could	Seep Wetland	C	Low / Very low	2	1	1	1	1	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	**L**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorphology	Vegetation	Fauna										
		lead to erosion formation to the seep wetland.																		
	The use of construction vehicles and heavy equipment on site during the construction phase.	Compaction of soils within sensitive habitat leading to loss of biodiversity and altered hydrological functioning.	Seep Wetland	C	Low / Very low	2	0	2	2	1	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	**L**	High
		Water quality impacts resulting from fluid leaks from poorly serviced vehicles.	Seep Wetland	C	Low / Very low	1	2	1	1	1	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	**L**	High
	Groundbreaking, excavation of foundations and other earthworks upgradient of and outside of the watercourse and the associated 30m GDARD setback area.	Disturbances of soils leading to potential impacts to the watercourse vegetation, increased alien vegetation proliferation in the footprint areas, and in turn to altered freshwater ecosystem habitat.	Seep Wetland	C	Low / Very low	1	1	1	2	1	**4**	1	2	**7**	**2**	**14**	60%	**8.4**	**L**	High
		Potential dispersal of sediments that could reach the wetland.	Seep Wetland	C	Low / Very low	0	0	2	0	0	**4**	1	2	**7**	**2**	**14**	60%	**8.4**	**L**	High
		Potential hydrological impacts from altered soil profiles and/or surface water runoff patterns.	Seep Wetland	C	Low / Very low	2	1	1	1	1	**4**	1	2	**7**	**2**	**14**	60%	**8.4**	**L**	High
	Construction of stormwater pond, swales and other stormwater infrastructure outside the wetlands and the 30m GDARD (Setback Area).	Disturbance and exposure of soil leading to increased runoff and erosion, and thus increased sedimentation of the downstream reach of the wetlands; Increased sedimentation of the wetlands, leading to smothering of vegetation associated with the wetlands.	Seep Wetland	C	Low / Very low	2	2	2	2	2	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	**L**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorphology	Vegetation	Fauna										
		Proliferation of alien and/or invasive vegetation as a result of disturbances; and Ground disturbances and dust pollution during construction which may impact on water quality.	Seep Wetland	C	Low / Very low	1	2	2	2	2	**4**	1	2	**7**	**2**	**14**	40%	**5.6**	**L**	High
OPERATIONS	Progressive alien vegetation encroachment following on from soil disturbances.	Alien vegetation will be induced to recruit and encroach following on from soil disturbance impacts. As wetlands provide favourable resources, alien vegetation encroachment into wetland habitat is highly likely when management strategies are lacking.	Seep Wetland	C	Low / Very low	1	1	1	2	1	**4**	2	4	**10**	**2**	**20**	60%	**12**	**L**	High
	Increased impermeable surfaces in the vicinity of the watercourse and the catchment.	Decreased infiltration and increase surface runoff from impervious surfaces; Increased water inputs to the freshwater environment at unnatural rates; Impacted soil and water quality condition within the wetland; Altered hydroperiod of the wetland; and Potential change in wetland hydrograph due to modified surrounding landscape.	Seep Wetland	C	Low / Very low	2	2	1	1	1	**4**	2	4	**10**	**2**	**20**	60%	**12**	**L**	High

Phase	Activity	Impact	Potentially affected watercourses			Intensity of Impact on Resource Quality					Overall Intensity (max = 10)	Spatial scale (max = 5)	Duration (max = 5)	Severity (max = 20)	Importance rating (max = 5)	Consequence (max = 100)	Likelihood (Probability) of impact	Significance (max = 100)	Risk Rating	Confidence level
						Abiotic Habitat (Drivers)			Biota (Responses)											
			Name/s	PES	Overall Watercourse Importance	Hydrology	Water Quality	Geomorphology	Vegetation	Fauna										
	Operation of the stormwater infrastructure and service infrastructure.	Flow concentration and potentially erosion at concentration points i.e. swales and other stormwater infrastructure; and Altered runoff patterns and increased water inputs to the wetlands, resulting in altered flow regime and subsequent impacts on the wetland vegetation.	Seep Wetland	C	Low / Very low	1	2	2	2	2	**4**	2	4	**10**	**2**	**20**	40%	**8**	**L**	High
	Operation and maintenance of planned waste management systems (e.g. sewage infrastructure).	Potential loss of indigenous vegetation and the further proliferation of alien floral species due to disturbances; and Disturbance to and compaction of soil resulting in erosion.	Seep Wetland	C	Low / Very low	1	2	1	2	2	**4**	2	4	**10**	**2**	**20**	40%	**8**	**L**	High
	Routine maintenance of infrastructure.	Impacts to wetland habitat resulting from the movement of vehicles and personnel outside of designated service roads.	Seep Wetland	C	Low / Very low	2	2	2	2	2	**4**	2	4	**10**	**2**	**20**	60%	**12**	**L**	High
		Potential for increased proliferation of alien floral species, leading to reduced ability to support biodiversity, and provide ecological services such as flood attenuation.	Seep Wetland	C	Low / Very low	2	2	2	2	2	**4**	2	4	**10**	**2**	**20**	60%	**12**	**L**	High

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APPENDIX G – Site Sensitivity Verification Report

FRESHWATER ECOSYSTEM SITE SENSITIVITY VERIFICATION REPORT FOR THE PROPOSED MIXED-USE DEVELOPMENT ON THE REMAINDER OF PORTION 72 OF THE BULTFONTEIN FARM IN THE GAUTENG PROVINCE

Introduction

According to the "Protocols for the Assessment and Minimum Criteria for Reporting on identified Environmental Themes ("the Protocols") published in Government Gazette No. 43110 on 20 March 2020 and Government Gazette No. 43855 on 30 October 2020, the Environmental Assessment Practitioner (EAP) must verify the current use of the site in question and its environmental sensitivity as identified by the Screening Tool to determine the need for specialist inputs in relation to the themes included in the Protocols. The Protocols are allowed for in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"). The Protocols must be complied with for every new application for Environmental Authorisation that is submitted after 9 May 2020.

This document serves as the Site Sensitivity Verification Report for the aquatic biodiversity theme for the proposed mixed-use development in the Gauteng Province. The mixed-use development Project requires environmental authorisation in terms of the NEMA EIA Regulations (2014), as amended and a Water Use Authorisation (WUA).

Study Area

The proposed mixed-use development is located approximately 23 km north of Roodepoort and 18 km northwest of Sandton adjacent to the Lanseria International Airport in Gauteng Province (Figure E1).

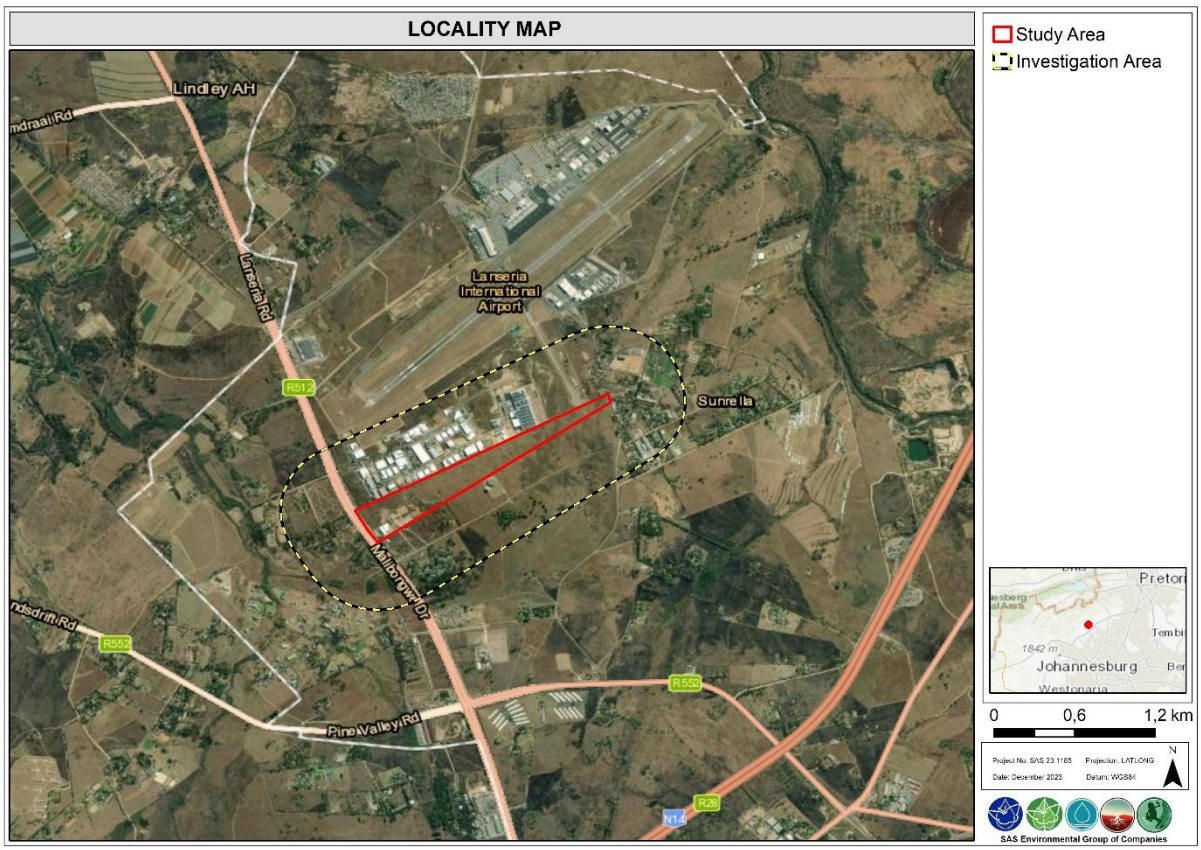


Figure E1: Digital satellite image depicting the location of the proposed mixed use development and associated investigation area in relation to the surrounding area.

This Freshwater Ecosystem site sensitivity verification report relates to a Screening Tool Report (STR) completed for the site in January 2024.

Site Verification Methodology

Information from the in-field delineation and detailed assessment of freshwater ecosystems in the study and investigation areas as part of the freshwater ecological assessment for the proposed mixed-use development.

Aquatic Biodiversity Site Verification

The table below provides information regarding the outcome of the Screening Tool in terms of the aquatic biodiversity theme sensitivity associated with the proposed project as well as a brief summary of the outcome of the freshwater ecosystem specialist report in response.

Table E1: Aquatic Biodiversity Theme Sensitivity analysis for the proposed project.

Environmental Theme	Applicable Protocol	Response
Aquatic Biodiversity Sensitivity Rating, the study area and investigation area of the proposed mixed-use development is located within areas of a mix of **low and high aquatic biodiversity** / freshwater sensitivity. The seep and Unchannelled Valley Bottom (UCVB) wetlands which are located inside the study and within the investigation area is designated as being of very high sensitivity. **Verified Sensitivity**: the designation of very high sensitivity to the wetlands by the DFFE Screening Tool is supported and not disputed. **The designation of low sensitivity for the majority of the study and investigation area is not disputed.**	Protocol for the specialist assessment and minimum report content requirements for environmental impacts on aquatic biodiversity (GN 320 of March 2020).	A Freshwater Ecosystem Assessment was conducted by Scientific Aquatic Services (SAS, 2023). During the assessment and associated field verification it was determined that eastern portions of the study area is designated as very high aquatic biodiversity (freshwater) sensitivity due the confirmed presence of a seep and UCVB wetlands in the eastern portion of the study and investigation area. A detailed study was required to support both the authorisation process required in terms of NEMA as well as the NWA. The study and associated comprehensive report from a site visit in October 2023 provide a detailed description of the freshwater ecosystems associated with the proposed project and considered the potential impacts applicable to the freshwater ecosystems and provided suitable mitigation measures to best minimise the potential impact on the freshwater ecosystems.

APPENDIX H – 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 of 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

Stephen van Staden	MSc (Environmental Management) (University of Johannesburg)
Nqobile Lushozi	MSc (Geoinformatics) (Stellenbosch University)
Zikhona Gqalaqha	MSc (Agric) (Soil Science) (University of the Free State)

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:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	+27 83 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc Environmental Management (University of Johannesburg)		

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

I, Stephen van Staden, declare that -

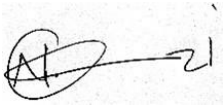
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity 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.

I, Nqobile Lushozi, 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

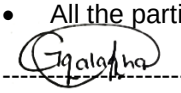


Signature of the Specialist

competent authority

I, Zikhona Gqalaqha, 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



SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Group CEO, Water Resource Discipline Lead, Managing Member, Ecologist, Aquatic Ecologist
Joined SAS Environmental Group of Companies	2003 (year of establishment)

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP)
Accredited River Health Practitioner by the South African River Health Program (RHP)
Member of the South African Soil Surveyors Association (SASSO) Member of the Gauteng Wetland Forum
Member of the Gauteng Wetland Forum
Member of International Association of Impact Assessors (IAIA) South Africa;
Member of the Land Rehabilitation Society of South Africa (LaRSSA)

EDUCATION

Qualifications

MSc Environmental Management (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000

Short Courses

Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017
Tools for Wetland Assessment (Rhodes University)	2017
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2018
Wetland Management: Introduction and Delineation (WLID1502S) (University of the Free State)	2018
Hydropedology and Wetland Functioning (TerraSoil Science and Water Business Academy)	2018

AREAS OF WORK EXPERIENCE

South Africa – All Provinces
Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia
Eastern Africa – Tanzania Mauritius
West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona
Central Africa – Democratic Republic of the Congo

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)
3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)

5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

- Water Use Applications (Water Use License Applications / General Authorisations)
- Environmental and Water Use Audits
- Freshwater Resource Management and Monitoring as part of EMPR and WUL conditions

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 Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, HRC, IHIA & RHAM)
- Aquatic Macro-Invertebrates (SASS5 & MIRAI)
- Fish Assezmblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Biodiversity Assessments

- Floral Assessments
- Biodiversity Actions Plan (BAP)
- Biodiversity Management Plan (BMP)
- Alien and Invasive Control Plan (AICP)
- Ecological Scan
- Terrestrial Monitoring
- Biodiversity Offset Plan

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF NQOBILE LUSHOZI

PERSONAL DETAILS

Position in Company	Freshwater Ecologist Wetland and Aquatic Ecology
Joined SAS Environmental Group of Companies	April 2019

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the International Affiliation for Impact Assessments (IAIAsa) South Africa

Member of the South African Wetland Society (SAWS)

Member of the South African Council for Natural Scientific Professions (SACNASP Reg No - 124679)

EDUCATION

Qualifications

MSc Geoinformatics (Cum laude) (Stellenbosch University)	2019
BSc (Hons) Environmental Sciences (University of KwaZulu-Natal)	2015
BSc Environmental Sciences (University of KwaZulu-Natal)	2014

Short courses

Tools for Wetland Assessment (Rhodes University)	2020
Grass Identification Course (Africa Land-Use Training)	2021

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Northern Cape, Free State

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
- Maintenance and Management Plans

Aquatic Ecological Assessment and Water Quality Studies

- Toxicological Analysis
- Surface and groundwater quality Monitoring
- Screening Test
- Mass and salt balance determination

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF ZIKHONA GQALAQHA

PERSONAL DETAILS

Position in Company	Junior Wetland Ecologist
Joined SAS Environmental Group of Companies	2023

EDUCATION

Qualifications

MSc (Agric) Soil Science (University of the Free State) 2020
BSc (Agric) Honours Soil Science (University of the Free State) 2014
BSc (Agric) Soil Science and Agrometeorology (University of the Free State) 2013

Short Courses

Additional Training

Wetland Management: Introduction and Delineation

AREAS OF WORK EXPERIENCE

South Africa – Free State, Northern Cape, Gauteng

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