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FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION AND WATER USE LICENCE AUTHORISATION PROCESSES FOR THE PROPOSED HLOMENDLINI SPORTS FIELD IN MANDENI, KWAZULU-NATAL PROVINCE.

Prepared for

SRK Consulting (Pty) Ltd

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EXECUTIVE SUMMARY

The proponent wishes to develop a sports field and associated infrastructure in Mandeni, Kwazulu-Natal Province. A valley head seep wetland was identified along the eastern portion of the study area and will be traversed by the proposed sports field development, a channelled valley bottom (CVB) wetland was identified along the western portion of the study area and will be indirectly impacted by the proposed sports field development.

The wetlands in the study area are impacted by catchment land use changes including growing housing development and associated network of road infrastructure which have resulted in increased stormwater input to the receiving freshwater environment. As such, the valley head seep wetland is considered moderately modified from an ecological perspective, while the CVB wetland is considered seriously modified.

Based on the findings of the wetland assessment and the results of the DWS Risk assessment, it is the opinion of the freshwater ecologist that the proposed sports field development poses a Moderate risk to the integrity of the wetlands within the study area, predominantly due to the infilling of the valley head seep wetland to create a flat platform for the sports field development. This activity will result in habitat fragmentation and the loss of 0.089 ha of wetland habitat in the valley head seep wetland. An offset investigation was undertaken, and it was determined that a conservation offset is not appropriate and thus focus was placed on the offset of functional Hactare equivalents to ascertain the functional habitat hectare equivalents that must be conserved by the proponent to account for the above-mentioned residual wetland loss. It is recommended that rehabilitation of the valley had seep wetland be undertaken to improve the functionality and ecological integrity of the remaining extent of the wetland. It is considered imperative that all mitigation measures as provided in this report are strictly adhered to, to minimise the impacts associated with the proposed sports field development.

The proposed activities will occur within the GN509 zone of regulation of the assessed wetlands, therefore, in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), a Water Use Authorisation will need to be applied for in terms of Sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) prior to the commencement of any works.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental Authorisation and Water Use Authorisation (WUA) processes for the proposed Hlomendlini sports field and associated infrastructure (hereafter referred to as “the proposed sports field development”) in Mandeni, Kwazulu-Natal Province.

The purpose of this report is to define the ecology of the freshwater ecosystem associated with the proposed sports field development in terms of the freshwater ecosystem characteristics, including mapping of the freshwater ecosystems, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES) of the freshwater ecosystems associated with the proposed sports field development. The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed sports field development and mitigatory measures were identified which aim to minimise the potential impacts.

The assessment took the following approach:

- A desktop study was conducted, in which the freshwater ecosystems were identified for on-site investigation, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 4 of this report. The proposed sports field development is located within the V50D Quaternary catchment, within the Thukela Water Management Area (WMA);
- A field assessment was undertaken in February 2021, in order to ground-truth the identified freshwater ecosystems associated with the proposed sports field development. A valley head seep wetland was identified along the eastern portion of the study area and will be traversed by the proposed sports field development. A channelled valley bottom (CVB) wetland was identified along the western portion of the study area and will be indirectly impacted by the proposed sports field development given its close proximity to the CVB wetland;
- The identified wetlands were classified according to the classification system by Ollis *et al*. (2013); and
- The detailed results of the field assessment are contained in Section 5 of this report and summarised in the table below:

Table A: Summary of results of the assessment of the wetlands.

Wetland	PES	Ecoservices	EIS	Recommended Ecological Category (REC) and Recommended Management Category (RMO)
Valley head seep	Category: C (Moderately modified)	Intermediate	Moderate	REC: Category C (Moderately modified) BAS: Category: C (Moderately modified) RMO: Maintain
Extent of modification anticipated	**High** Significant modifications are anticipated to the extent of the valley head seep wetland associated with the proposed main soccer field, where 0.089 ha of wetland habitat will be lost as a result of the proposed sports field development due to the proposed main soccer field and terrace encroaching into the western extent of the wetland. Similarly, habitat fragmentation is likely within the seasonal and temporary zones of the wetland due to infilling activities within the wetland which may result in changes to the flooding patterns. However, an offset investigation was undertaken, and it was determined that a conservation offset is not appropriate and thus focus was placed on the offset of functional Hactare equivalents to ascertain the functional habitat hectare equivalents that must be conserved by the proponent to account for the above-mentioned residual wetland loss. Assuming that strict enforcement of cogent, well-developed mitigation measures takes place as stipulated in this report, including stormwater management such that stormwater released from the proposed sports field development into the adjacent valley head seep wetland is appropriately attenuated and released in a dispersed manner before entering the wetland to prevent incision and erosion, the significance of impacts arising from the proposed sports field development are likely to be reduced during the construction and operational phases.			
CVB wetland	Category: E (Seriously modified)	Intermediate	Moderate	REC: Category D (Largely modified) BAS: Category: D (Largely modified) RMO: Improve
Extent of modification anticipated	**None** No modification is anticipated to the extent of CVB wetland as no infrastructure is proposed within the CVB wetland that may fragment or degrade the system. However, stormwater releases alongside the delineated CVB wetland will need to be monitored to ensure base flows, quantity or quality of water within the CVB wetland are not adversely affected.			

Following the site assessment of the wetlands, the DWS Risk Assessment Matrix (2016) was applied in order to ascertain the significance of possible impacts which may occur as a result of the proposed sports field development. The results of this assessment are presented in Section 7 of this report.

Table B: Summary of the DWS Risk Assessment outcomes.

Phases	Activity	Wetland impacted	Risk Rating
Construction Phase	Site preparation prior to construction activities. • Loss of wetland vegetation, associated habitat and ecosystem services, associated with the proposed sports field development; • Exposure of soil, leading to increased runoff, and erosion, and thus increased sedimentation of the wetlands and/or down gradient wetlands.	CVB wetland	L
		Valley head seep wetland	M
	Ground-breaking: excavation of foundations, earthworks and building associated with the construction of the proposed main soccer field, terrace, conservancy tank, gravel access road, fence line, parking area and a guardhouse, combi courts, ablution facilities and stands, and walkway within the 500 m GN509 Zone of Regulation. • Earthworks within the western portion of the valley head seep wetland associated with the proposed main soccer field and terrace; • Removal of vegetation and infilling within the seep wetland and associated disturbance of soil, potentially resulting in altered runoff patterns.	CVB wetland	L
		Valley head seep wetland	M
	Installation potentially via open trenching of: • The proposed water pipeline within the 32 m NEMA ZoR of the CVB; • The proposed irrigation line within the 32 m NEMA ZoR of the valley head seep wetland; and • The proposed sewer line within 40 m of the wetlands (outside the 32 m NEMA ZoR).	CVB wetland	L
		Valley head seep wetland	L
	Stormwater management • Establishment of stormwater channels and outlet structures are recommended for the management of stormwater and sustainable discharge into the wetlands.	CVB wetland	L
		Valley head seep wetland	L
Operational Phase	Small-scale rehabilitation of the area • Proactive monitoring to identify early signs of alien vegetation encroachment; • Small-scale rehabilitation of the wetlands including removal of alien invasive species and revegetation with suitable wetland species.	CVB wetland	L
		Valley head seep wetland	L
	Operation of the proposed sports field development • Operation of the proposed water pipeline • Operation and maintenance of conservancy tanks and associated infrastructure	CVB wetland	L
		Valley head seep wetland	L
	Operation of the stormwater management systems	CVB wetland	L

Phases	Activity	Wetland impacted	Risk Rating
		Valley head seep wetland	L

Based on the findings of the wetland assessment and the results of the risk assessment, it is the opinion of the freshwater ecologist that the proposed sports field development poses a **Moderate risk to the integrity of the wetlands within the study area**, predominantly due to the infilling of the valley head seep wetland associated with the proposed main soccer field and terrace to create a flat platform for the sports field development. This activity will result in habitat fragmentation and the loss of 0.089 ha of wetland habitat in the valley head seep wetland. It is considered imperative that all mitigation measures as provided in Section 7.2, **Appendix F** and wetland offset considerations provided in Section 8 of this report are strictly adhered to, to minimise the impacts associated with the proposed sports field development.

<u>The following additional mitigation measures are considered imperative for the proposed sports field development:</u>

- If the proposed activities are undertaken during the drier winter months, impacts to the hydrological and geomorphological regimes of the wetlands can be managed.
- Heavy earthworks within the wetlands, particularly for the construction of the proposed main soccer field and terrace within portions of the valley head seep wetland, and concrete works must be carefully controlled and major terracing should be avoided.
- All footprint areas must immediately be revegetated after the construction activities are completed. This will ensure fast recovery of the wetlands post construction activities.
- It is strongly recommended that the proponent makes provision for a stormwater management plan to service the proposed sports field development. Careful planning of the stormwater management plan that will ensure that stormwater is released in an attenuated manner outside of the wetlands, is imperative to ensure the hydraulic regime of the receiving wetlands is retained.
- Small-scale rehabilitation, including revegetation with indigenous wetland vegetation and control of AIP vegetation is strongly recommended for the valley head seep wetland specifically, and the CVB wetland in general. The long-term impact of rehabilitation activities is considered positive since this will ensure that the ecological service provision of the wetlands is maintained and where feasible, improved.
- These rehabilitation recommendations should be read in conjunction with the rehabilitation measures following the offset considerations as presented in Section 8 of this report to improve the functionality and ecological integrity of the identified target wetlands.

Activities associated with the proposed sports field development will occur within the GN509 zone of regulation of the CVB wetland and valley head seep wetland, therefore, in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), a Water Use Authorisation will need to be applied for in terms of Sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) prior to the commencement of any works.

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.	Cover Page and Appendix G
2.2	Description of the preferred development site , including the following aspects-	Section 4 and 5
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: Table 1
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 4: Table 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 5: Table 3 and 4
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: Table 1 The entire site is considered of high aquatic importance.
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 7: Table 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 5: Table 3 and 4
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Yes, with implementation of the proposed mitigation measures.
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
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 5: Table 3 and 4
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river); c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled 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);	Section 7: Table 6

	e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc).	
2.4.5	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 5: Table 3 and 4
2.4.6	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 5: Table 3 and 4
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	N/A The closest estuary is 10 km from the proposed sports field development
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 G
3.2	A signed statement of independence by the specialist;	Appendix G
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Section 5.2
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Section 3, Appendix C and Appendix D
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 1.2
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Section 7: Table 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 7: Table 6
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Section 7.1
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Section 7: Table 6
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Section 7: Table 6
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
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	Section 6
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 7: Table 6
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	Section 4: Table 1 The entire site is considered of high aquatic importance.
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 8
3.16	Any conditions to which this statement is subjected.	Section 8

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ACRONYMS

°C	Degrees Celsius.
AC	Alternating Current
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
DC	Direct Current
DM	District Municipality
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
kV	KiloVolt
LM	Local Municipality
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NBA	National Biodiversity Assessment
NC CBA	Northern Cape Critical Biodiversity Areas
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
NWCS	National Wetland Classification System
OHPL	Overhead Power Line
ONA	Other Natural Area
PES	Present Ecological State
PoSEIA	Plan of Study for Environmental Impact Assessment
PV	Photovoltaic
REC	Recommended Ecological Category
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
SEF	Solar Energy Facility
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WRC	Water Research Commission
WULA	Water Use License Application

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.
Alluvial river:	Alluvial river channels are self-formed features, meaning that they are shaped by the magnitude and frequency of the floods that they experience, and the ability of these floods to erode, deposit, and transport sediment. Alluvial channels are, therefore, formed in material that is able to move during moderate floods. This means that the bed and banks of an alluvial river channel are characteristically made up of unconsolidated mobile sediment such as silt, sand or gravel, or (in some cases) cobbles and small boulders. Alluvial river channels tend to erode their banks and deposit the eroded material on bars and on their floodplains.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animans 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.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
Cryptic wetland	Temporary wetlands in very arid areas often too shallow, too saline or too temporarily inundated to exhibit typical wetland features in their soil. Such wetlands are called “cryptic”, and cannot reliably be identified as wetlands during the dry season on the basis of standard wetland identification and delineation tools
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region”.
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the “background colour” referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.

RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

1 INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental Authorisation (EA) and Water Use Authorisation (WUA) processes for the proposed Hlomendlini sports field and associated infrastructure (hereafter referred to as "the proposed sports field development") in Mandeni, Kwazulu-Natal Province. The proposed site to be developed will hereafter be referred to as "the study area" (Figures 1 and 2), refer to Section 2 for the project description.

In order to identify all freshwater ecosystems that may potentially be impacted by the proposed sports field development, a 500 m "zone of investigation" was implemented around the study area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (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 ecology of the freshwater ecosystem associated with the study area in terms of the natural freshwater ecosystem characteristics, including mapping of the freshwater ecosystem, defining areas of increased Ecological Importance and Sensitivity (EIS), and defining the Present Ecological State (PES) of the freshwater ecosystems associated with the study area. Additionally, this report aims to define the socio-cultural and ecological service provision of the freshwater ecosystem and provide the Recommended Management Objectives (RMO), Best Attainable State (BAS) and Recommended Ecological Category (REC) for the freshwater ecosystems. It is a further objective of this study to provide detailed information to guide the proposed sports field development in the vicinity of the freshwater ecosystem, to ensure the ongoing functioning of the ecosystems such that local and regional conservation requirements and the provision of ecological services in the local area are supported.

The Department of Water and Sanitation (DWS) Risk Assessment Matrix as promulgated in Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the impacts associated with the proposed sports field development and mitigatory measures were identified which aim to minimise the potential impacts, while considering the need for sustainable economic development. This report, after consideration of the above, must guide the Environmental Assessment Practitioner (EAP), by means of a reasoned opinion and recommendations, as to the viability of the proposed development activities from a freshwater ecosystem management perspective.

1.2 Assumptions and Limitations

The following assumptions and limitations apply to this report:

- The ground-truthing and delineation of the freshwater ecosystem boundaries and the assessment thereof, are confined to a single site visit undertaken on the 9th of February 2021. All freshwater ecosystems identified within the investigation area were delineated in fulfilment of Government Notice 509 of the National Water Act, 1998 (Act No. 36 of 1998) using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. The general surroundings and existing land uses were also considered as part of the assessment;
- The volume and dimensions of the proposed terrace associated with the proposed sports field development were not available at the time of this assessment;
- Global Positioning System (GPS) technology is inherently somewhat inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur, however, the

delineations as provided in this report are deemed accurate enough to fulfil the authorisation requirements as well as implementation of the mitigation measures provided;

- Freshwater ecosystem 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 resource boundaries may occur, however, if the Department of Water Affairs and Forestry (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. However, it is expected that the proposed sports field development has been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of freshwater ecology.

1.3 Legislative Requirements and Provincial Guidelines

The following legislative requirements and relevant provincial guidelines were taken into consideration during the assessment. A detailed description of these legislative requirements is presented in Appendix B:

- The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) ;
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998); and
- Guidelines for Biodiversity Impact Assessments in KwaZulu-Natal (Ezemvelo KZN Wildlife 2009).

2 PROJECT DESCRIPTION

The development of the Hlomendlini sports field is proposed on erf 1118 in Mandeni, , approximately 2 km south west of the town of Tugela within the Mandeni Municipality, KwaZulu-Natal Province (Figures 1 and 2). The study area is situated in a peri-urban rural community, approximately 2 km south west of the town of Tugela and is characterised by residential development and associated network of linear infrastructure. The site development plan as provided by the proponent for the proposed sports field development in relation to the delineated wetlands within the study as discussed in section 5 of this report, is shown in Figure 3 below.

The proposed sports field development will include the following associated infrastructure as shown in Figure 3 below:

- Main soccer field (110 m x 75 m);
- Terrace/embankment
- A new fence line along the study area;
- Gravel access road to tie in with the existing gravel road north of the study area;
- A guardhouse;
- Combi courts (34.5 m x 19.25 m);
- Ablution facilities and stands;
- An irrigation line south of the proposed main soccer field;
- Water pipeline (90 mm Ø);
- Sewer pipeline (110 mm Ø);
- Conservancy tank (capacity = 9500 L), see Figure 4 below; and
- A walkway south of the study area.

Figure 1: Digital satellite image depicting the study and investigation areas in relation to surrounding areas.

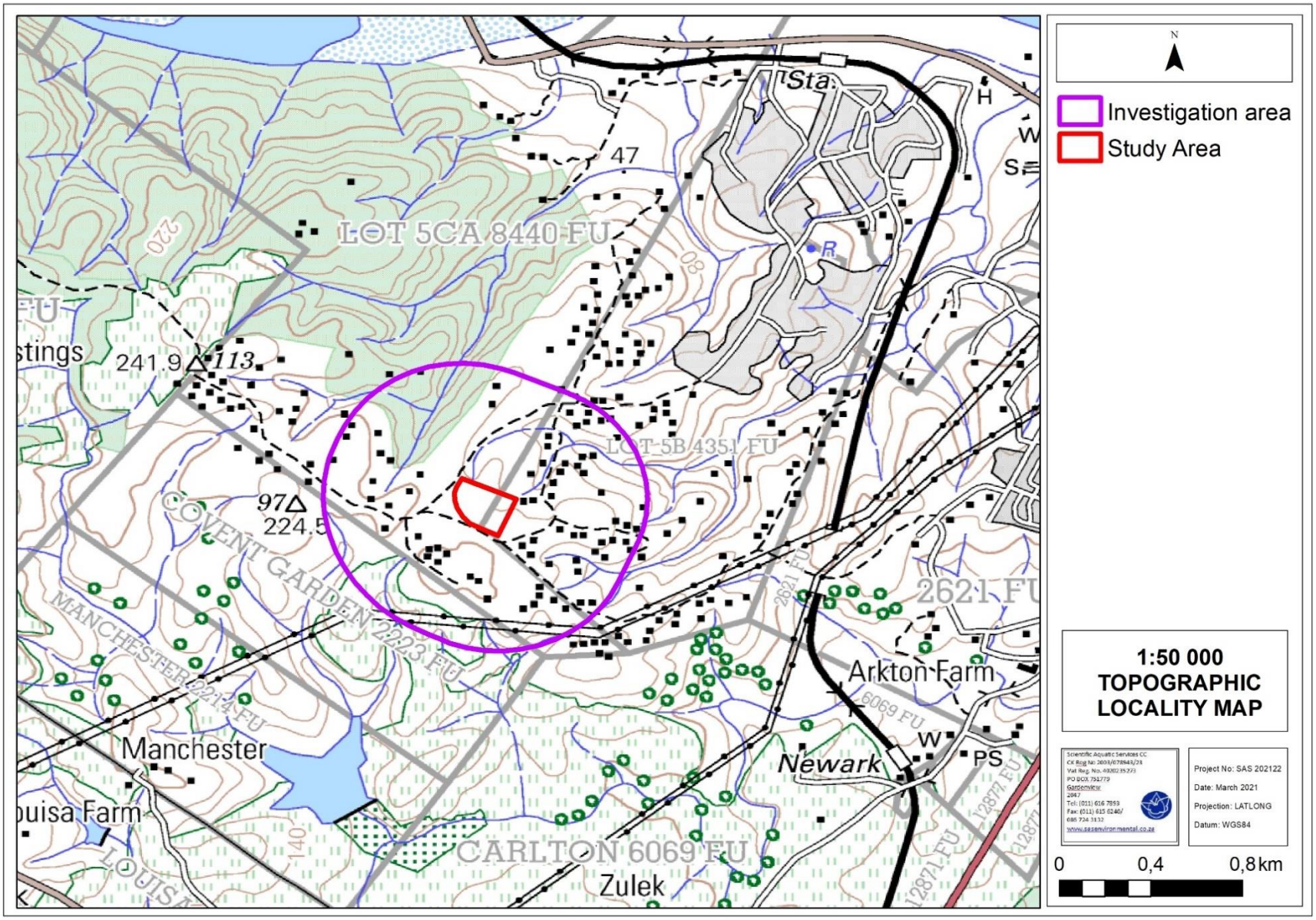


Figure 2: Location of the study and investigation areas depicted on a 1:50 000 topographical map in relation to the surrounding area.

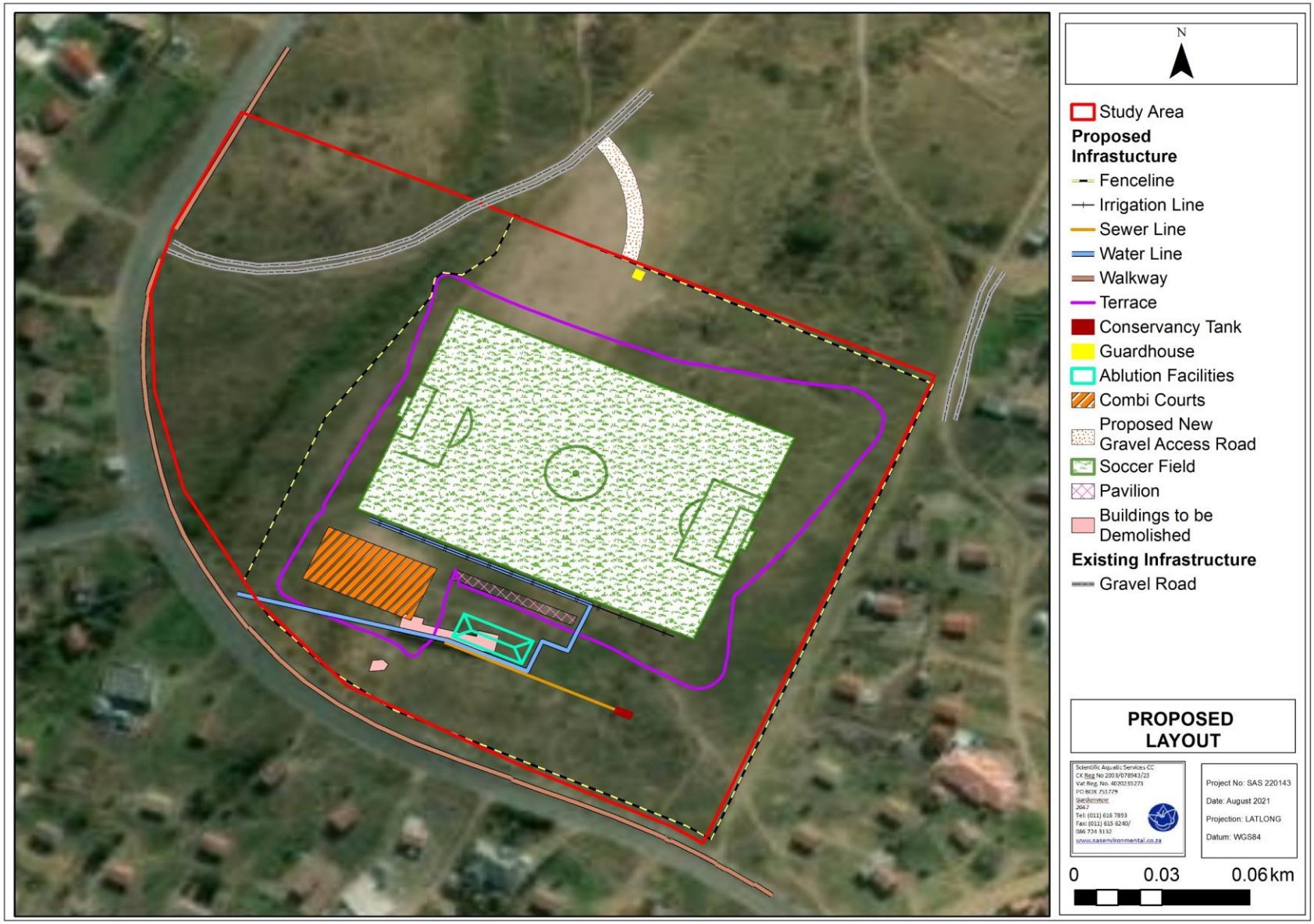


Figure 3: The provisional layout for the proposed sports field development as provided by SRK (2021).

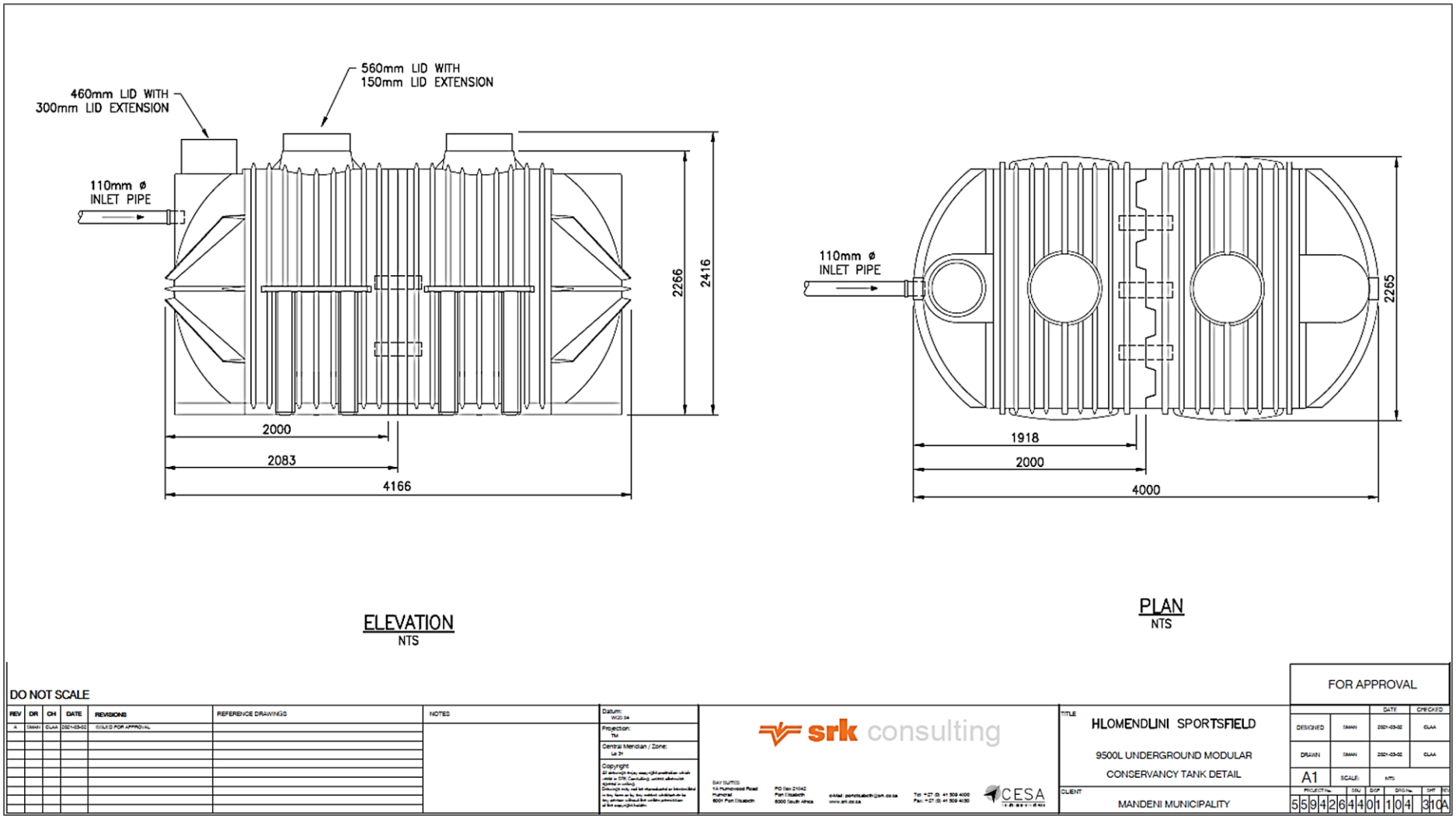


Figure 4: Proposed conservancy tank (capacity = 9500 L) to service the proposed sports field development as provided by SRK (2021).

3 ASSESSMENT APPROACH

3.1 Freshwater Ecosystem Definition

Freshwater ecosystems are defined by Wentzel (2001) in the Encyclopaedia of Biodiversity as "interactive systems within which biotic species and their growth and adaptation, and associated biological productivity, nutrient cycling, and energy flows among inland aquatic microbial, plant, and animal communities, are integrated with their environment. These inland waters include lakes, reservoirs, rivers, streams, and wetlands."

The National Water Act, 1998 (Act No. 36 of 1998) is aimed at the protection of the country's water resources, defined in the Act as "a watercourse, surface water, estuary or aquifer". According to the National Water Act, 1998 (Act No. 36 of 1998) a **watercourse** means:

(a) a river or spring;
(b) a natural channel in which water flows regularly or intermittently;
(c) a wetland, lake or dam into which, or from which, water flows; and
(d) any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse, and a reference to a watercourse includes where relevant, its bed and banks.

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).

3.2 Freshwater Ecosystem Field Verification

During the desktop phase, use was made of topographical maps, digital satellite imagery, and available provincial and national freshwater databases to identify points of interest for the field survey. Details of the relevant databases which were consulted are contained in Section 4 of this report. Points of interest were defined considering the following:

- Encompassing a geographic spread of points to ensure that all conditions in the area were adequately addressed; and
- Ensuring that features displaying a diversity of digital signatures were identified to allow for field verification. In this regard specific mention is made of the following:
  - Freshwater vegetation: a distinct increase in density as well as tree size near drainage lines;
  - Hue: with drainage lines and outcrops displaying soil of varying chroma created by varying vegetation cover and soil conditions identified; and
  - Texture: with areas displaying various textures, created by varying vegetation cover and soil conditions being identified.

The freshwater ecosystem delineations took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The foundation of the method is based on the fact that freshwater ecosystems have several distinguishing factors including the following:

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic soil;
- Vegetation adapted to saturated soil; and
- The presence of alluvial soil in stream systems.

A field assessment was undertaken on the 9th of February 2021 (KwaZulu-Natal summer season), during which the presence of any freshwater ecosystem characteristics as defined by DWAF (2008) or wetland and riparian habitats as defined by the National Water Act, 1998 (Act No. 36 of 1998) were noted (please refer to Sections 4 and 5 of this report). In addition to the delineation process, detailed assessment of the delineated freshwater ecosystems was undertaken, at which time factors affecting the integrity of the freshwater ecosystem were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystem. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

3.3 *Sensitivity Mapping*

All freshwater ecosystems associated with the proposed sport field development were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map presented in Section 6 should guide the design, layout and management of the proposed sports field development.

3.4 Risk Assessment and recommendations

Following the completion of the assessment, the DWS risk assessment was conducted (please refer to Appendix D for the method of approach) and recommendations were developed to address and mitigate impacts associated with the proposed sports field development on the freshwater ecosystems delineated. These recommendations also include general management measures, which apply to the proposed construction and operational/maintenance activities. The detailed mitigation measures are outlined in Section 7 of this report, while the general management measures which are considered best practice mitigation applicable to this project, are outlined in Appendix F.

4 RESULTS OF THE DESKTOP ANALYSIS

The following section contains data accessed as part of the desktop assessment which is presented as a "dashboard-style" report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible, to allow the reader to understand how this information has been integrated into the findings of this report.

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 at the scale required to inform the applicant of any potential environmental authorisation and/or water use authorisation processes that may be needed. Given these limitations, this information is considered useful as background information to the study and is important in legislative contextualisation of the risks and impacts, and was thus used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance during the field survey. It must, however, be noted that site verification 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.

Table 1: Desktop data relating to the character of the freshwater ecosystems associated with the study area.

Aquatic ecoregion and sub-regions in which the study area is located	
Ecoregion	North Eastern Coastal Belt
Catchment	Tugela
Quaternary Catchment	V50D
WMA	Thukela
subWMA	Lower Tugela
Dominant characteristics of the Southern Kalahari (17.01) Aquatic Ecoregion Level 2 (Kleynhans *et al.*, 2007)	
Dominant primary terrain morphology	Highly Dissected Low Undulating Plains, Low Mountains, Undulating Hills, Plains
Dominant primary vegetation types	Coastal Bushveld/Grassland, Coast-Hinterland Bushveld, Valley Thicket, Sand Forest, Afromontane Forest.
Altitude (m a.m.s.l)	0 – 900
MAP (mm)	600 – 800
Coefficient of Variation (% of the MAP)	< 20 – 30
Rainfall concentration index	30 – 45
Rainfall seasonality	Mid Summer, Early Summer, Late Summer.
Mean annual temp. (°C)	16 – 22
Winter temperature (July)	6 – 24
Summer temperature (Feb)	16 – 28
Median annual simulated runoff (mm)	80 - > 250

Detail of the study area in terms of the National Freshwater Ecosystem Priority Area (NFEPA, 2011) database	
FEPACODE	The study area is located within a sub-quaternary catchment currently not considered important in terms of fish or freshwater ecological conservation.
NFEPA Wetlands	According to the NFEPA database (2011), there are no wetlands located within the study and investigation areas.
Wetland Vegetation Type	The study and investigation areas are located within the Indian Ocean Coastal Belt Group 2 Wetland Vegetation Type considered critically endangered according to Mbona *et al.* (2015)
NFEPA Rivers (Figure 5)	According to the NFEPA database there are no rivers within the study area or the investigation area, the Thukela River is located approximately 2.5 km north of the study area and indicated as being in a moderately modified ecological condition (Class C).

Detail National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE)
According to the NBA 2018: SAIIAE, no wetlands or rivers are located within the study and investigation areas. The Thukela River is located approximately 2.5 km north of the study area and is considered to be in a moderately modified ecological condition (Class C). The Thukela River is indicated as least threatened according to the ecosystem threat status (ETS) and poorly protected according to the ecosystem protection level (EPL).

National Web Based Environmental Screening Tool (2020)	
The screening tool is intended for pre-screening of sensitivities in the landscape to be assessed within the EIA process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.	The entire study and investigation areas are considered to be of very high aquatic importance as these areas coincide with Critical Biodiversity Areas, forest, focus areas for land-based protected areas expansion, and critically endangered ecosystems.

Detail of the study area in terms of the KwaZulu Natal (KZN) Biodiversity Spatial Planning (2016) (Figure 6)
According to the KZN biodiversity spatial plan, the study area is not located within Critical Biodiversity Areas (CBAs). However, the northern, eastern, western, and southern portions of the investigation area are located within areas classified as irreplaceable Critical Biodiversity Areas (CBAs). Irreplaceable CBAs are considered critical for meeting biodiversity targets and thresholds and are required to ensure the persistence of viable populations of species and the functionality of ecosystems. The northern portion of the investigation area is also located within Ecological Support Areas (ESAs). ESAs are required to support and sustain the ecological functioning of CBAs. For terrestrial and aquatic environments, these areas are functional but are not necessarily pristine natural areas. They are however required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs, and which also contributes significantly to the maintenance of ecological infrastructure.

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 WMA = Water Management Area

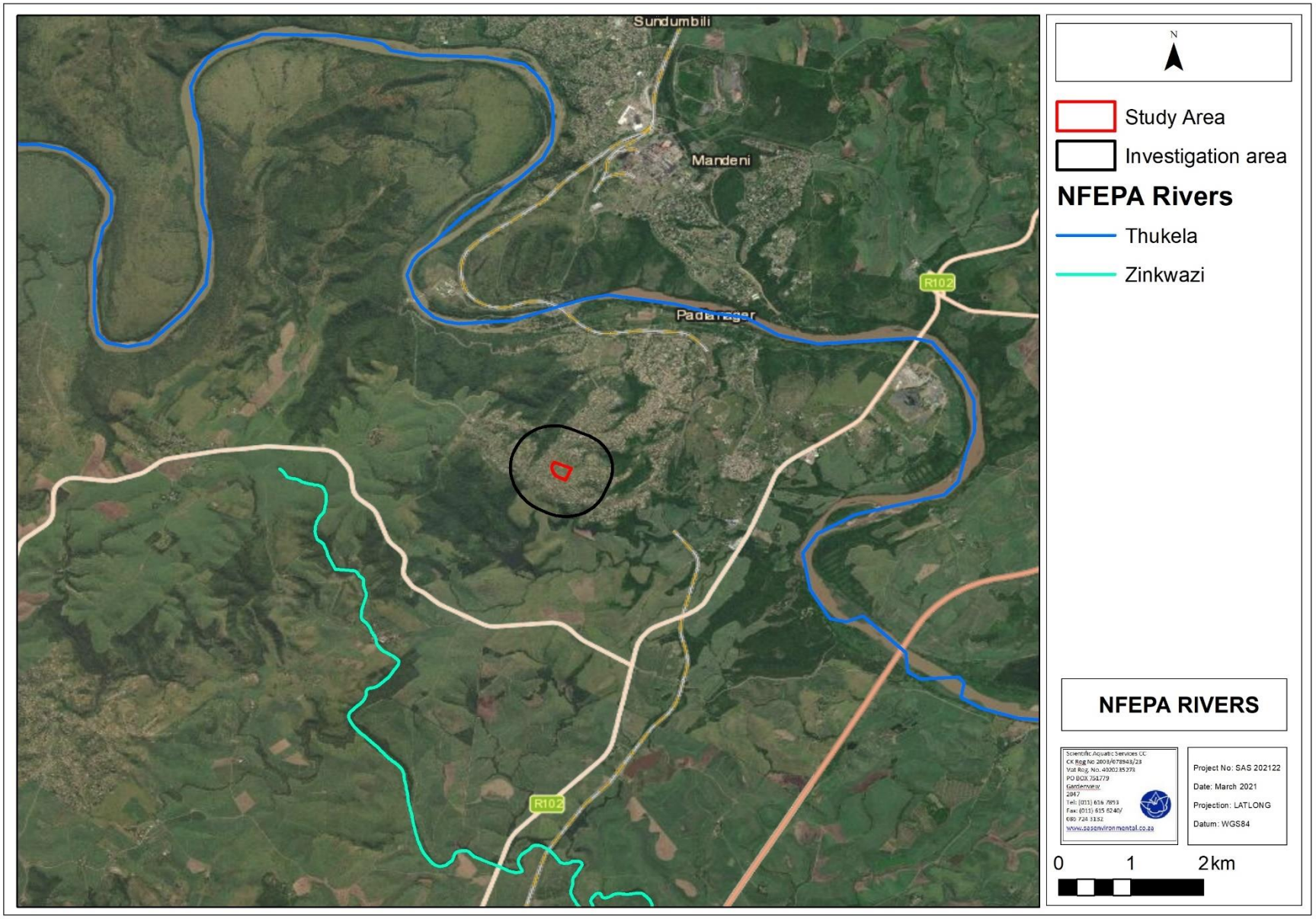


Figure 5: Rivers within the vicinity of the study and investigation areas according to the NFEPA database (2011).

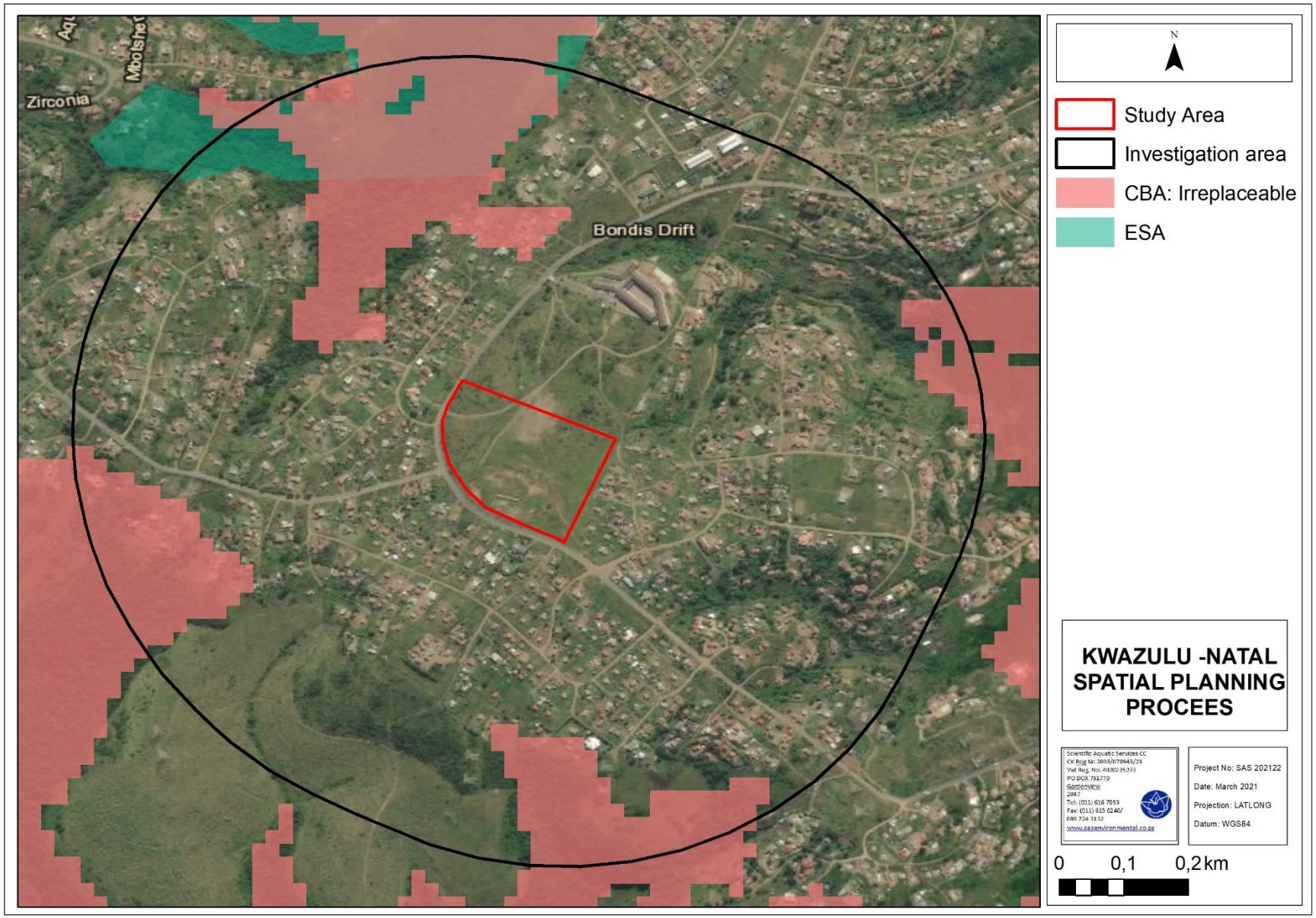


Figure 6: Areas of ecological importance associated with the study and investigation areas according to the KwaZulu-Natal Spatial Planning Processes.

5 RESULTS: FRESHWATER ECOLOGICAL ASSESSMENT

5.1 Desktop assessment of historical vs. most recent imagery

In preparation for the field assessment, aerial photographs, digital satellite imagery and provincial and national wetland databases (as outlined in Section 4 of this report) were used to identify points of interest in the surrounding area at a desktop level. Based on the historical photograph (Figure 7), a diversity of signatures are identifiable that correspond with freshwater ecosystems. In this regard, specific mention is made to the following:

- Linear features: since water flows/moves through the landscape, freshwater ecosystems often have a distinct linear element to their signature which makes them discernable 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 show as white/grey or black and outcrops or bare soil displaying varying chroma created by varying vegetation cover, geology and soil conditions. Changes in the hue of vegetation with freshwater ecosystems 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, created by varying vegetation cover and soil conditions.

On review of the historical imagery circa 1972, no digital signatures are visible within the study area (red outline) (Figure 7). The surrounding landscape is noted to be largely undeveloped, however, linear infrastructure is present (Figure 7).

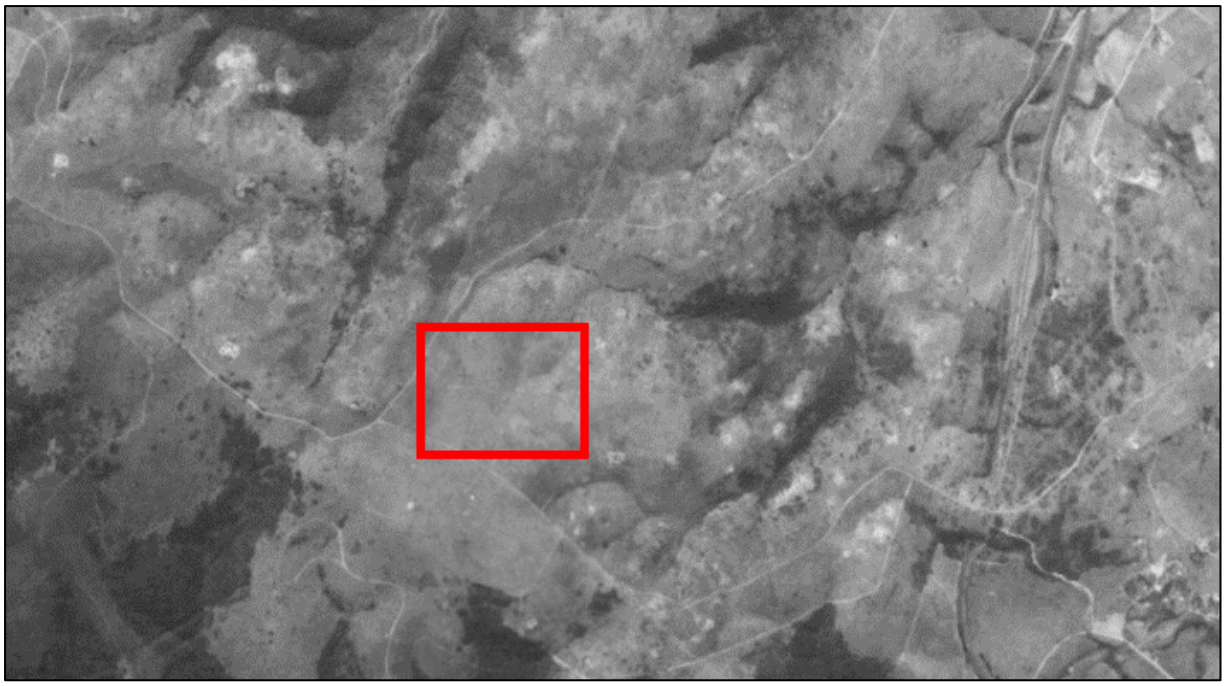


Figure 7: Historical imagery (1972) of the study area (red outline) and surrounding area. Digital signatures are visible as indicated by the yellow arrows (Job 685, Photograph 4998).

On review of the latest digital satellite imagery circa 2021 (Figure 8), digital signatures (depicting wetland signatures) are visible within the study area as indicated by the yellow arrows (Figure 8). The surrounding land uses have largely changed from that visible in the 1972 photograph with housing

development and more road infrastructure now present. The development in the catchment may have consequently contributed to the more pronounced digital signatures observed through increased stormwater input.

Figure 8: Digital satellite image (circa 2021) of the study area (red outline). Digital signatures are still visible within the study area and are indicated by the yellow arrows.

5.2 Field verification and delineation

A site assessment was undertaken on the 9th of February 2021 (KZN summer period)[1], during which the presence of any areas presenting with freshwater ecosystem characteristics as defined above were identified. The following was identified during the site assessment, and discussed as follows:

- A modified channelled valley bottom (CVB) wetland was identified within the western portion of the study area, occurring < 10 m from proposed sports field development;
- A valley head seep wetland was identified within the eastern portion of the study area of which the western portion of this wetland will be traversed by the proposed sports field development; and
- Both systems are connected to drainage features which were identified in the larger investigation area.

The delineation of the CVB wetland and valley head seep wetland associated with the study area, as presented in this report, are considered accurate taking into consideration the conditions at the time of assessment (i.e. disturbances to soil and vegetation, changes to the pattern, flow and timing of water within the wetlands due to linear crossings and increased stormwater input). All wetlands identified within the study area were delineated according to the guidelines advocated by DWAF (2008). Freshwater ecosystems within the larger investigation area were delineated using desktop methods.

[1] Site surveys are recommended to take place during a seasonal period where the probability of detecting an identifiable life history stage of vegetation species (such as facultative vegetation species) is highest and in the raining period to ensure optimised conditions for the identification of seasonal freshwater ecosystems, which may otherwise be overlooked. Therefore, the site conditions at the time of the field assessment are considered optimal as the site assessment was undertaken during the wet season.

During the field assessment, the following indicators were used in order to determine the boundary of the identified wetlands:

- **Topography/elevation** was used to determine in which parts of the landscape the wetlands would most likely to occur. Valley bottom wetlands are typically located on a valley floor between two valley side slopes, while seep wetlands are typically located on gently to steeply sloping land;
- **Obligate and facultative vegetation species** and vegetation associated with wetland habitats were used in conjunction with terrain units as well as the point where a distinct change in the vegetation composition was observed to determine the wetland boundary (Figure 9). Species such as *Bulbostylis sp*. and *Imperata cylindrica,* considered obligate wetland plants, were noted to occur within both the CVB wetland and valley head seep wetland (Figure 9);

Figure 9: The vegetation composition of the (Top left) CVB wetland; and (Top right) valley head seep wetland. (Bottom left) *Bulbostylis sp*. and (Bottom right) *Imperata cylindrica* noted to occur within the wetlands.

- Soil form indicators were used to determine the presence of soil that is associated with prolonged and frequent saturation with key indicators including gleying, low chroma, mottling, organic streaking and increased clay content. Soil within the CVB wetland and valley head seep wetland was saturated and mottling was evident within the first 50 cm of the soil surface of the soil samples taken. Mottling is indicative of a fluctuating water table, where the alternation between aerobic and anaerobic conditions in the soil causes dissolved iron to return to an insoluble state and be deposited in the form of patches, or mottles, in the soil (Figure 10).

Figure 10: Mottling identified within the first 50cm of the soil sample taken from (Left) the CVB; and (Right): valley head seep wetland.

5.2.1 Freshwater ecosystem classification

Classification of the natural wetlands was undertaken at Levels 1 - 4 of the Classification System (Ollis *et al*, 2013) as outlined in **Appendix C** of this report. These systems were classified as Inland Systems, located within the North Eastern Coastal Belt Ecoregion. Table 2 below presents the classification from level 3 to 4 of the Wetland Classification System.

Table 2: Characterisation of the freshwater ecosystems associated with the study area.

Wetland	Level 3: Landscape unit	Level 4: Hydrogeomorphic (HGM) Type
Channelled Valley Bottom Wetland	**Valley Floor:** the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	**Channelled valley-bottom wetland:** A valley bottom wetland with a river channel running through it.
Valley head seep	**Slope:** an included stretch of ground that is not part of a valley floor, which is typically located on the side of a mountain, hill or valley	**Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

Figures 11 and 12 below provides a visual representation of the delineated freshwater ecosystems within the study and investigation areas.

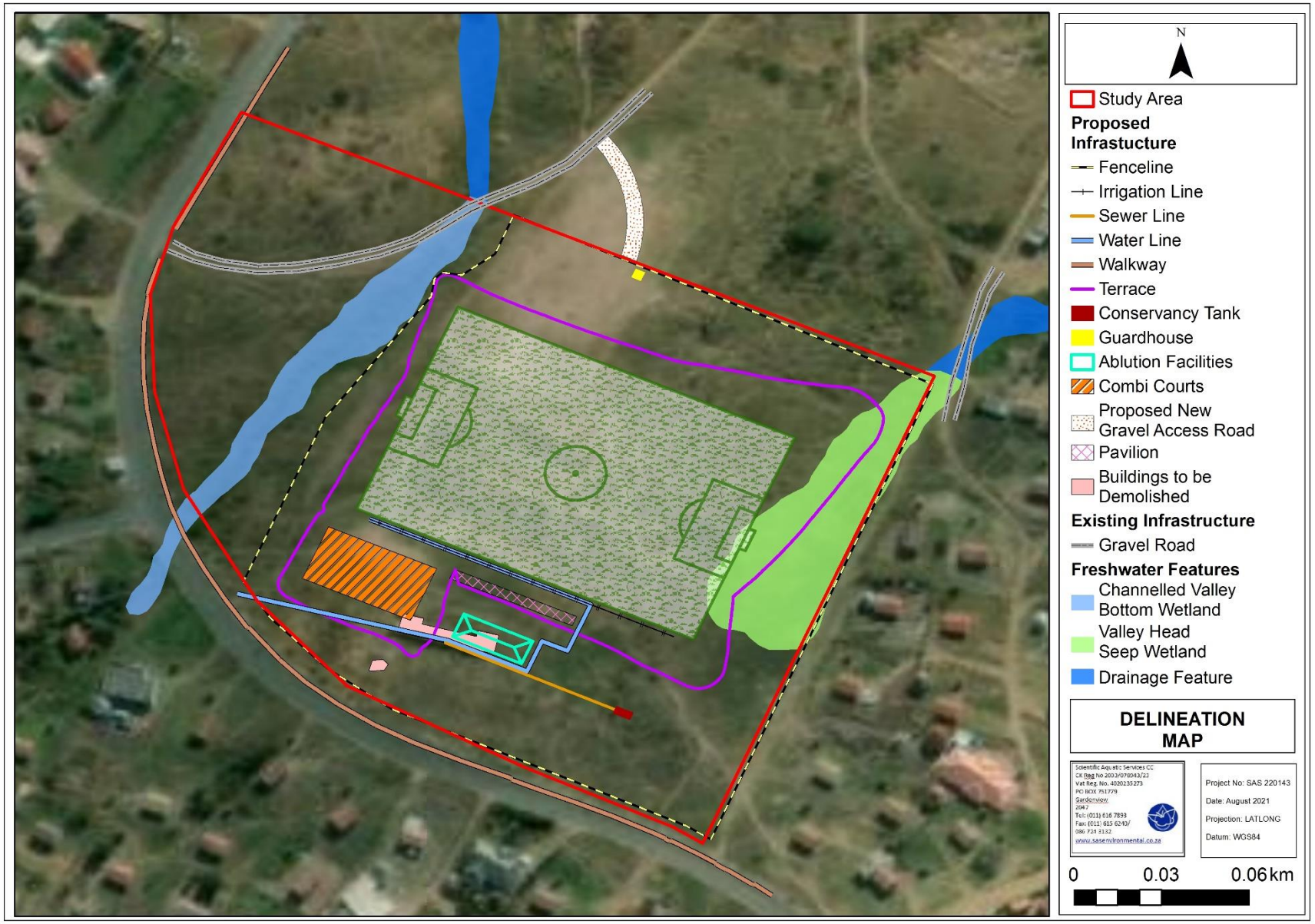


Figure 11: The delineation of the wetlands associated with the study area in relation to the proposed sports field development depicted on digital satellite imagery.

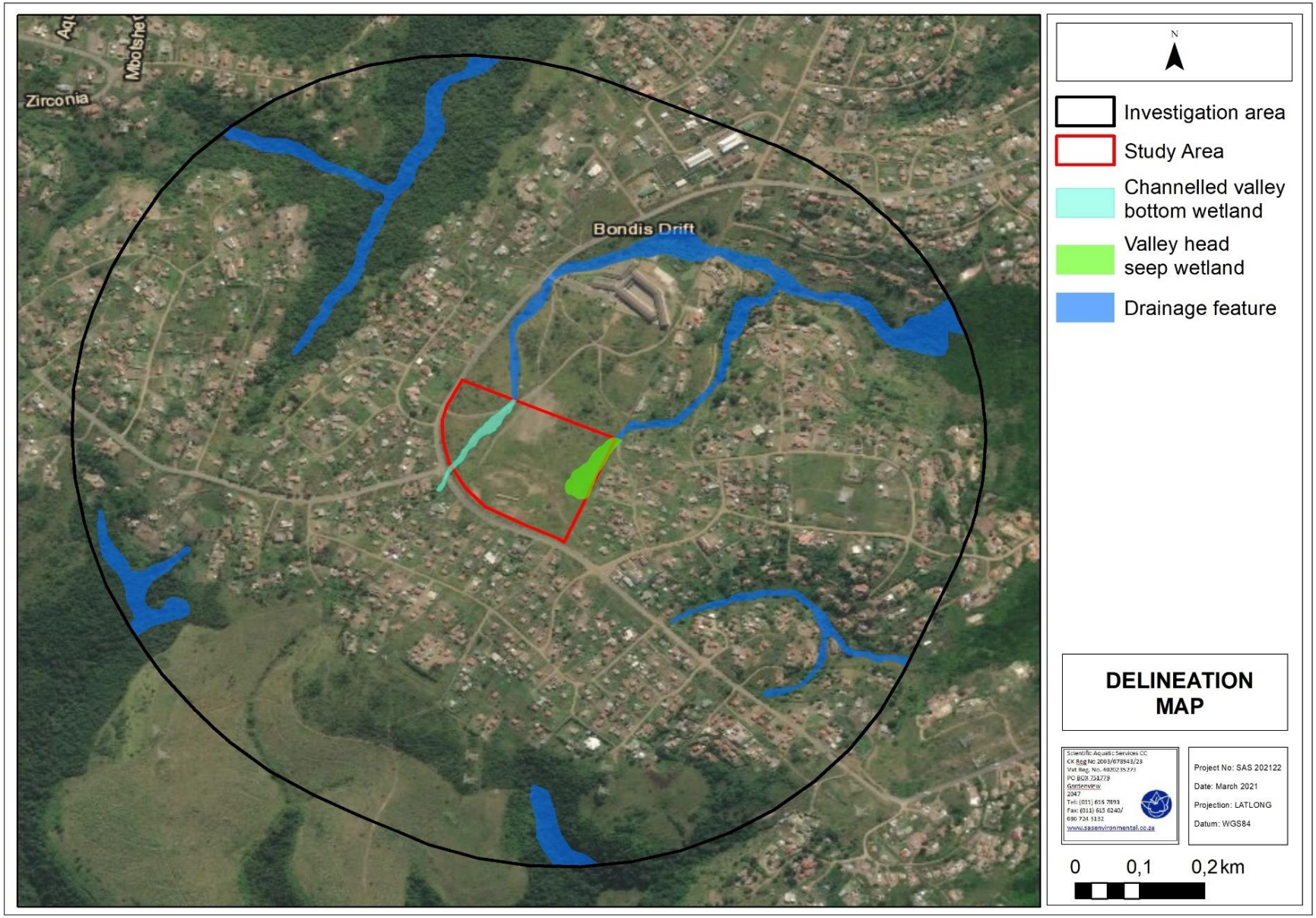
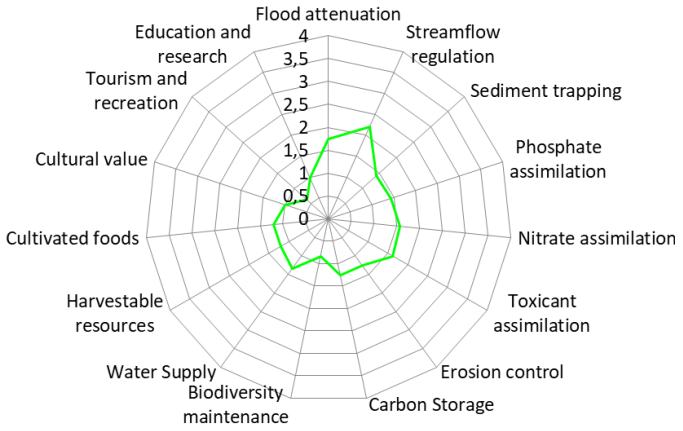


Figure 12: The delineation of the freshwater ecosystems associated with the study and investigation areas depicted on digital satellite imagery.

5.3 Freshwater ecological assessment

Tables 3 and 4 below summarise the findings of the field verification in terms of relevant aspects (hydrology, geomorphology and vegetation components) of the freshwater ecology of the CVB wetland and valley head seep wetland. The details pertaining to the methodology used to assess the wetlands is available in Appendix C of this report.

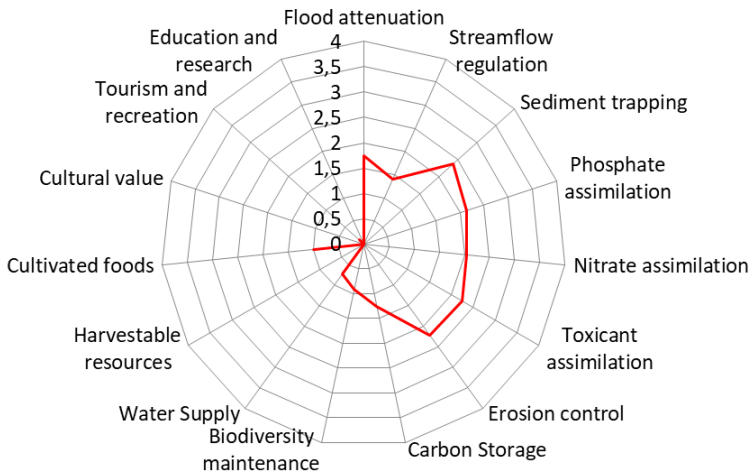
Table 3: Summary of the results of the Channelled Valley Bottom wetland associated with the proposed sports field development.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2">  </td></tr>
<tr><td>PES discussion</td><td>PES Category: E (Seriously Modified)
The CVB wetland has been impacted by various anthropogenic activities in the surrounding catchment, including the surrounding housing development and associated road infrastructure which have altered the pattern, flow and timing of stormwater in the surrounding landscape. This has resulted in increased flood peaks in the CVB wetland, significantly impacting the hydrology. Consequently, runoff from the adjacent residential areas and roads have potentially augmented the surface water input into this system such that the system receives increased volumes of water, leading to development of prominent wetness indicators and hydrophilic plants (for example, see Figures 7 and 8 above). Infilling and modifications to the active channel particularly from the road and culvert crossing within the wetland further impact the hydrological and geomorphological integrity of the system. The CVB wetland is invaded by Alien and Invasive Plant (AIP) species, contributing to the overall disturbance to the system.</td><td>EIS discussion</td><td>Moderate
The CVB wetland is considered to be ecologically important and sensitive on a landscape scale, due to the protection status of wetland within a peri-urban setting. Furthermore, the vegetation type associated with the CVB wetland (according to NFEPA, 2011) is considered to be critically endangered and moderately protected, although no remnants were identified at the time of the site visit and it is considered unlikely that any species that are representative of this vegetation type will be found due to the large scale surrounding impacts. The hydro-functional importance of the system was considered to be moderate due to important services such as streamflow regulation and hydrological connectivity while the direct human benefits are considered to be low as a result of the low dependency of people in the area on the wetland for providing direct benefits such as water supply and harvestable resources.</td></tr>
<tr><td colspan="2"></td><td>Photograph notes</td><td>(Left) The CVB wetland receives additional water input from the surrounding housing development; (Right) Existing culvert crossing within the CVB wetland confining flow.</td></tr>
</table>

<table>
<tr><td>Ecoservice provision</td><td>Intermediate
The CVB wetland is considered of moderately high importance for stream flow regulation, and of intermediate importance for flood attenuation, sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control, largely as a result of the high surface roughness provided by the vegetation within the CVB wetland. The biodiversity maintenance is considered moderately low, mainly due to the significant anthropogenic impacts and the low buffer zone associated with the system. The assessed reach of the CVB wetland is not considered of value for tourism and recreation.</td><td colspan="2" rowspan="2">Wetland characteristics:
a) Hydraulic regime
The hydrological functioning of the CVB wetland is considered to be seriously modified as a result of surrounding housing development and road infrastructure which have resulted in increased impervious/hardened surfaces in the surrounds, contributing to increased stormwater input to the CVB wetland altering the pattern, timing, and flow of water within the CVB wetland. The presence of culverts along the reach of the CVB wetland further impact the hydrology of the wetland through confining flow and increased the risk of incision.
b) Water quality
Due to stormwater inputs and catchment land use changes, the surface water quality of the CVB wetland is expected to be impaired.
c) Geomorphology and sediment balance
The geomorphology of the CVB wetland can be considered moderately modified due to increased sediment loads as a result of run-off from the gravel roads and sediment deposition at culvert outlets. No significant erosion was noted within the CVB wetland due to the surface roughness provided by the vegetation present in the CVB wetland.
d) Habitat and biota
The CVB wetland is hydrologically connected to other freshwater ecosystems (to other drainage features feeding into the Thukela River) and may thus be considered as an important corridor for faunal movement, breeding and foraging. The vegetation of the CVB wetland is impacted by cattle grazing and extensive AIP proliferation.</td></tr>
<tr><td>REC Category and RMO</td><td>REC: Category D
BAS: Category: D; RMO: Improve
The determined Recommended Management Objective (RMO) is to improve the PES of the CVB wetland since it is considered seriously modified and of moderate ecological importance and sensitivity. Thus, it is recommended that no further degradation to the wetland should be permitted as a result of the proposed sports field development. Thus, it is also recommended that the construction and operation of the proposed sports field development follows strict mitigation measures as outlined in this report (refer to Section 7). Careful planning of the stormwater management plan is imperative to ensure the hydraulic regime is retained and not further impaired by stormwater influxes. It is further recommended that portions of the wetland be improved as part of the overall landscaping for the sports field development. This will also assist in improving the ecological condition of the wetland which is considered ecologically unacceptable (Malan and Day 2011).</td></tr>
<tr><td>Extent of modification anticipated</td><td>None
No modification is anticipated to the extent of CVB wetland as no infrastructure is proposed within the CVB wetland that may fragment or degrade the system. However, stormwater releases alongside the delineated CVB wetland will need to be monitored to ensure base flows, quantity or quality of water within the CVB wetland are not adversely affected.</td><td>Impact Significance and Business Case:</td><td>Moderate Risk
While no direct impacts are anticipated to the CVB wetland, activities associated with the proposed sports field development including the removal of vegetation, ground-breaking, excavations, infilling and the construction of stormwater outlet structures will take place adjacent to the delineated edge of the CVB wetland, thus posing a moderate risk significance to the integrity of the CVB wetland. It is thus imperative that adherence to cogent, well-conceived and ecologically sensitive construction plans is implemented, and the mitigation measures provided in this report as well as general good construction practice are adhered to. With implementation of Sustainable Drainage systems (SuDs) to assist with polishing of water prior to release into the CVB wetland, the long-term impacts to the CVB wetland can be considered manageable. It is strongly recommended that small scale rehabilitation be included as part of the development, including AIP control to assist with obtaining the REC of Category D. The CVB wetland must be considered a 'no-go' area during construction, as well as implementing a 32 m conservation buffer.</td></tr>
</table>

All comprehensive results calculated are available in **Appendix E.**

Table 4: Summary of the results of the valley head seep wetland to be traversed by the proposed sports field development.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2">   </td></tr>
<tr><td colspan="2"></td><td>Photograph notes</td><td>(Left) Overview of the valley head seep wetland within the surrounding landscape; (Right) Signs of sediment deposition noted within the valley head seep wetland.</td></tr>
<tr><td>PES discussion</td><td>PES Category: C (Moderately Modified)
The valley head seep wetland has been impacted by land use changes in the surrounding catchment, including the surrounding housing development and associated road infrastructure which have resulted in the increase of impervious surfaces in the surrounding landscape, altering the pattern, flow and timing of flood peaks into the wetland, thus impacting the hydrology regime of the wetland. Signs of sediment deposition were also noted, albeit limited, but having a marked effect on the geomorphology and vegetation of the affected areas.</td><td>EIS discussion</td><td>Moderate
The valley head seep wetland is considered to be ecologically important and sensitive on a landscape scale, due to the protection status of wetland within a peri-urban setting. Furthermore, the vegetation type associated with the valley head see wetland (according to NFEPA, 2011) is considered to be critically endangered and moderately protected, although no remnants were identified at the time of the site visit and it is considered unlikely that any species that are representative of this vegetation type will be found due to the large scale surrioudning impacts. The hydro-functional importance of the system is considered to be moderate while the direct human benefits are considered to be low.</td></tr>
</table>

Ecoservice provision	**Intermediate** The CVB wetland is considered of moderately high importance for sediment trapping, phosphate, nitrate and toxicant assimilation and erosion control, largely as a result of the high surface roughness provided by the vegetation within the valley head seep wetland. Sediment trapping capability evidenced by signs of sediment deposition within the wetland. The valley head seep wetland is of intermediate importance for flood attenuation, stream flow regulation and cultivated food. The biodiversity maintenance is considered moderately low, mainly due to the anthropogenic impacts and the low buffer zone associated with the system. The assessed reach of the valley head seep wetland is not considered of value for tourism and recreation.	**Wetland characteristics:** **a) Hydraulic regime** The hydrological functioning of the CVB wetland is considered moderately modified largely as a result of surrounding housing development and road infrastructure contributing to increased stormwater input to the valley head seep wetland altering the pattern, timing, and flow of water within the wetland. **b) Water quality** Due to stormwater inputs and catchment land use changes, the surface water quality of the valley head seep wetland is expected to be impaired. **c) Geomorphology and sediment balance** The geomorphology of the valley head seep wetland can be considered moderately modified due to increased sediment loads as a result of run-off from the gravel roads resulting in sediment deposition to the wetland. No significant erosion was noted within the wetland due to the surface roughness provided by the vegetation present in the valley head seep wetland. **d) Habitat and biota** The wetland habitat on site forms part of a network of open spaces and natural corridors which provide support for local fauna and flora within a transformed landscape. The high surface roughness offered by the vegetation with the valley head seep wetland assists in sediment trapping and erosion control.	
REC Category and RMO	**REC: Category C** **BAS: Category: C; RMO: Maintain** Although the determined RMO is to maintain the PES of the valley head seep wetland since it is considered moderately modified and of moderate ecological importance and sensitivity, it is recommended that no further degradation to the wetland should be permitted as a result of the proposed development. Development of the surrounding area will decrease surface roughness and increase surface stormwater run-off; thus rehabilitation (including revegetation with indigenous species and AIP control) of this system is necessary to maintain and/or improve its present ecological state. Careful planning of the stormwater management plan is imperative to ensure the hydraulic regime is retained and not further impaired by stormwater influxes.		
Extent of modification anticipated	**High** Significant modifications are anticipated to the extent of the valley head seep wetland associated with the proposed main soccer field, where 0.089 ha of wetland habitat will be lost as a result of the proposed sports field development. Similarly, habitat fragmentation is likely within the seasonal and temporary zones of the wetland. However, an offset investigation was undertaken, and focus was placed on the offset of functional Hactare equivalents to ascertain the functional habitat hectare equivalents that must be conserved by the proponent to account for the above-mentioned residual wetland loss and ensure improved functionality and ecological integrity of the remaining wetland extent. Stormwater released from the proposed sports field development into the adjacent valley head seep wetland must be appropriately attenuated and released in a dispersed manner before entering the wetland to prevent incision and erosion.	**Impact Significance and Business Case:**	**Moderate Risk** **As the infrastructure associated with the proposed sports field development including the proposed main soccer field and terrace encroaches into the western extent of the valley head seep wetland, 0.089 ha of wetland habitat will be lost.** As such, the development activities are considered to pose a moderate risk to the integrity of the valley head seep wetland. Some of the activities associated with the construction of the proposed sports field development, including the removal of vegetation, ground-breaking, excavations, infilling and associated concrete works will necessitate work within the valley head seep wetland, thus posing a moderate risk to the overall integrity of the valley head seep wetland and an anticipated loss of 0.089 ha of wetland habitat. An offset investigation was undertaken, and it was determined that a conservation offset is not appropriate and thus focus was placed on the offset of functional Hactare equivalents to ascertain the functional habitat hectare equivalents that must be conserved by the proponent to account for the above-mentioned residual wetland loss, results provided in Section 8 of this report. It is recommended that rehabilitation of the valley had seep wetland be undertaken to improve the functionality and ecological integrity of the wetland. Furthermore, it is imperative that adherence to cogent, well-conceived and ecologically sensitive construction plans is implemented, and the mitigation measures provided in this report as well as general good construction practice are adhered to.

6 LEGISLATIVE REQUIREMENTS

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[2];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA); and
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998).

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

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

Table 5: Articles of legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998).	**Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the **outer edge of the 1:100 year floodline and/or delineated riparian habitat, whichever is the greatest distance**, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1:100 year floodline or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500 metre radius from the delineated boundary (extent) of any wetland** or pan in terms of this regulation.
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998)	**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:* *(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;* *Where such development occurs—*

[2] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 19996". 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
EIA Regulations (2014), as amended.	*(a) Within a watercourse;* *(b) In front of a development setback; or* *(c) If no development setback has been adopted, within 32 meters of a watercourse, measured from the edge of a watercourse.* *Excluding where such development occurs within an urban area* **Activity 19** of Listing Notice 1 (GN 327) of the NEMA EIA regulations, 2014 (as amended) states "*The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse*".
Guidelines for Biodiversity Impact Assessments in KwaZulu-Natal (Ezemvelo KZN Wildlife 2009)	**Riverine (perennial / non-perennial) Sensitivity Mapping** According to the guideline, a 30 m buffer from the edge of a drainage line is considered applicable for the drainage features identified within the investigation area.

The following Zones of Regulation (ZoR) are applicable to the freshwater ecosystems (Figure 13 and 14):

- A 32 m Zone of Regulation in accordance with the National Environmental Management Act, 1998 (Act No. 107 of 1998) was assigned to the CVB wetland and valley head seep wetland within the study area;
- A 500 m ZoR in accordance with the National Water Act, 1998 (Act No. 36 of 1998) was assigned to the CVB wetland and valley head seep wetland within the study area;
- A 100 m ZoR in accordance with the National Water Act, 1998 (Act No. 36 of 1998) was assigned to the drainage features identified in the larger investigation area; and
- A 30 m buffer is considered applicable to the drainage features in the investigation area in accordance with the Guidelines for Biodiversity Impact assessments in KwaZulu-Natal.

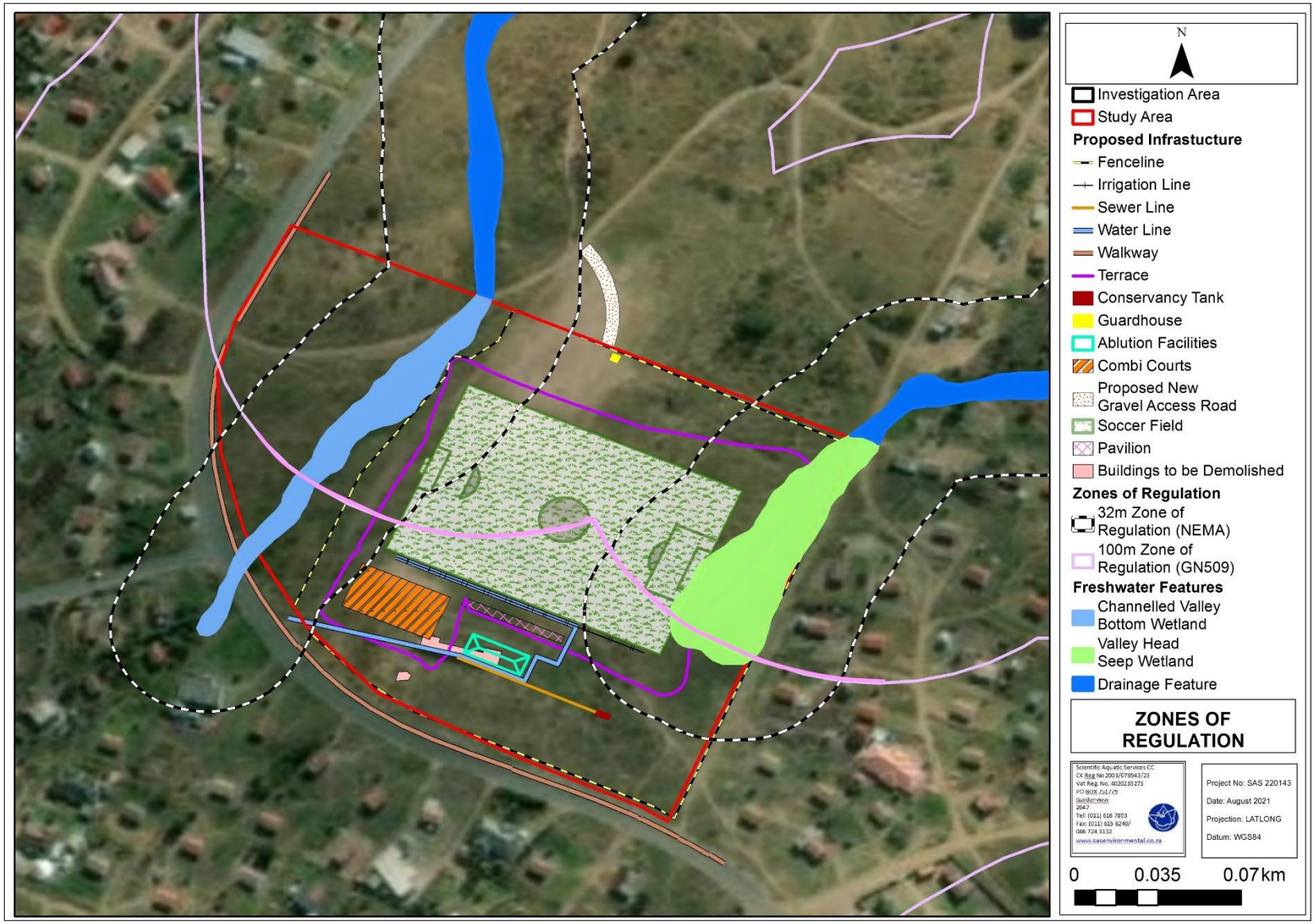


Figure 13: Freshwater ecosystems associated with the study and the associated zones of regulation in terms of NEMA and GN509 as it relates to the NWA in relation to the proposed sports field development. The extent of the 500 m GN509 ZoR exceeds the study area, hence it is not visible on the map.

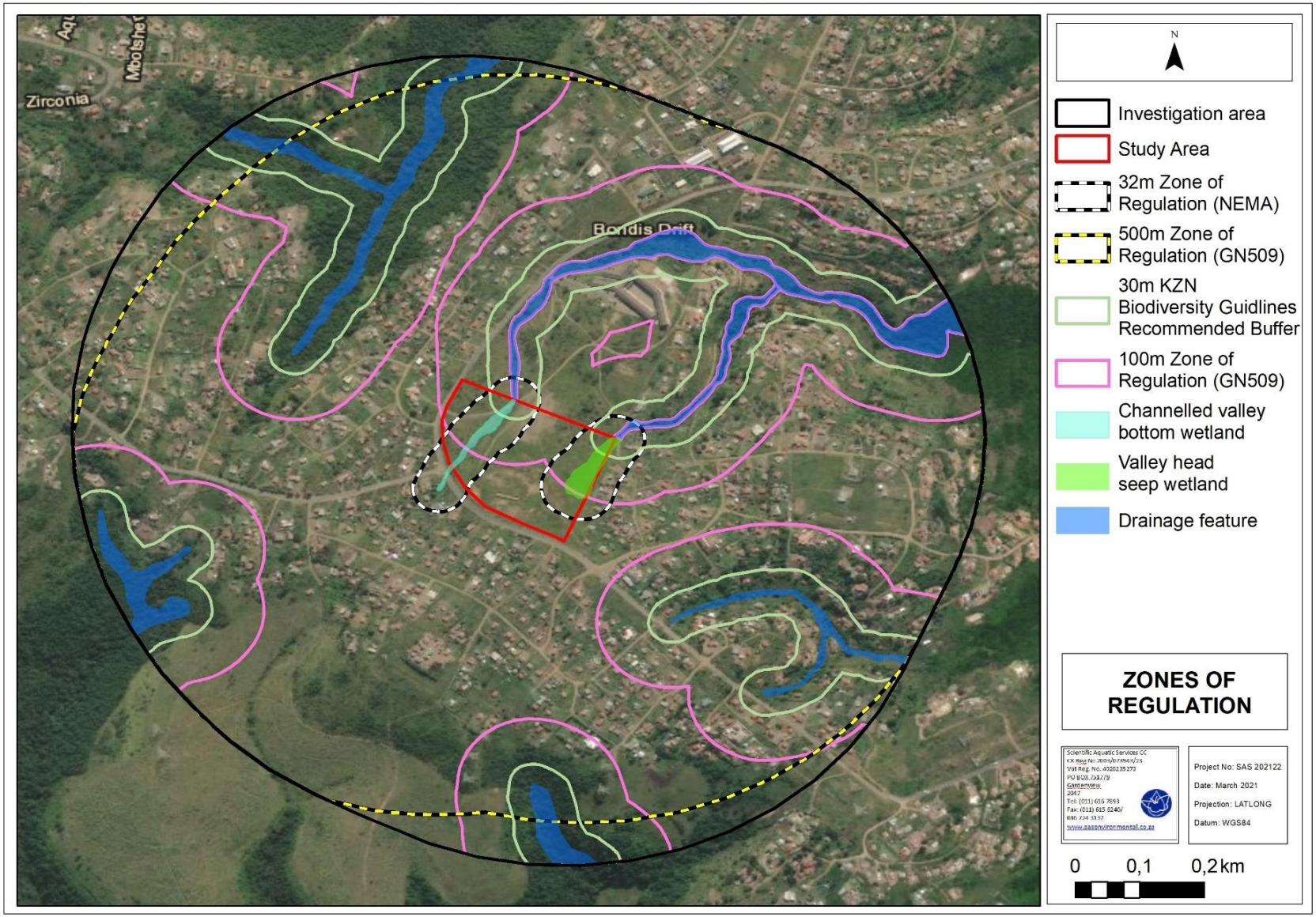


Figure 14: Freshwater ecosystems associated with the study and investigation areas and the associated zones of regulation in terms of NEMA and GN509 as it relates to the NWA.

7 RISK ASSESSMENT

Following the assessment of the wetlands, the DWS specified Risk Assessment Matrix (as promulgated in GN509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)) was applied to ascertain the significance of risks associated with the proposed sports field development on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the assessed CVB wetland and valley head seep wetland. The points below summarise the considerations undertaken:

- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report present the perceived impact significance ***post-mitigation***;
- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the Department of Environmental Affairs (DEA) *et al* (2013) would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- While the wetlands identified are not particularly sensitive as a result of historical and ongoing impacts (associated primarily with the surrounding urban development including linear infrastructure development and increased catchment hardening), adequate mitigation measures are still deemed imperative to prevent further significant impacts and to retain the current level of ecological habitat provision;
- The proposed activities were assessed based on their location in relation to the delineated extent of the wetlands and their applicable ZoRs. The following considerations were undertaken:
- Activities located within the wetland and the 32 m NEMA ZoR include:
    - The proposed main soccer field encroaches into the western extent of the valley head seep wetland (see Figure 15 below);
    - To develop a flat playing field, it is necessary to infill and terrace the landscape to create a flat deck. The terracing encroaches into the western extent of the valley head seep wetland and will result in a loss of 0.089 ha of wetland habitat (Figure 15 below), this equates to approximately 34% wetland habitat loss of the total area of the valley head seep wetland;
    - The proposed fence line traverses the valley head seep wetland and 32 m NEMA ZoR of the valley head seep wetland and CVB wetland; and
    - The western portion of the proposed parking area is located within the 32 m NEM ZoR of the CVB wetland.
- Activities outside the delineated extent of the wetlands and associated 32 m NEMA ZoR but within the 500 m GN509 ZoR of the wetlands, include earth works associated with the construction of the proposed main soccer field, gravel access road, fence line, parking area and a guardhouse, combi courts, ablution facilities and stands, irrigation line, water pipeline (90 mm Ø), sewer pipeline (110 mm Ø), and installation of the conservancy tanks.
- The activities and the associated risks they pose are all highly site-specific, not of a significant extent relative to the wetlands assessed, and therefore have a limited spatial extent (i.e., within the study area). The exception are risks to water contamination due to sediment runoff during the construction phase, however, if the mitigation measures as presented in the report are fully implemented, the risks can be considered low. In addition, given that the proponent proposes to install conservancy tanks (which are closed off tanks that retain all waste water generated) that are regularly serviced, this will prevent the release of any effluent into the surrounding landscape and thus significantly reduce the likelihood of water contamination. If the system is well managed and the recommended mitigation measures implemented, this risk is considered low;
- While the operation of the proposed sports field development will be a permanent activity, the installation thereof is envisioned to take no more than a few months. However, the frequency of the construction impacts may be daily during this time;

- Most impacts are considered to be easily detectable, with the exception of contamination of surface and groundwater which will require some effort;
- The considered mitigation measures are easily practicable; and
- It is highly recommended that the proponent makes provision for small-scale rehabilitation of the areas of the wetlands directly impacted upon by the construction activities, particularly the valley head seep wetland that will be traversed by the proposed main soccer field and terrace. This is especially applicable to the removal of alien and invasive plants and the revegetation of the affected areas. These rehabilitation recommendations should be read in conjunction with the rehabilitation measures following the offset considerations as presented in Section 8.6 below to improve the functionality and ecological integrity of the identified target wetlands. Rehabilitation of these impacted areas can be included as part of the landscaping plans for the proposed sport field development, and this will potentially encourage sustainability of the rehabilitation initiatives.

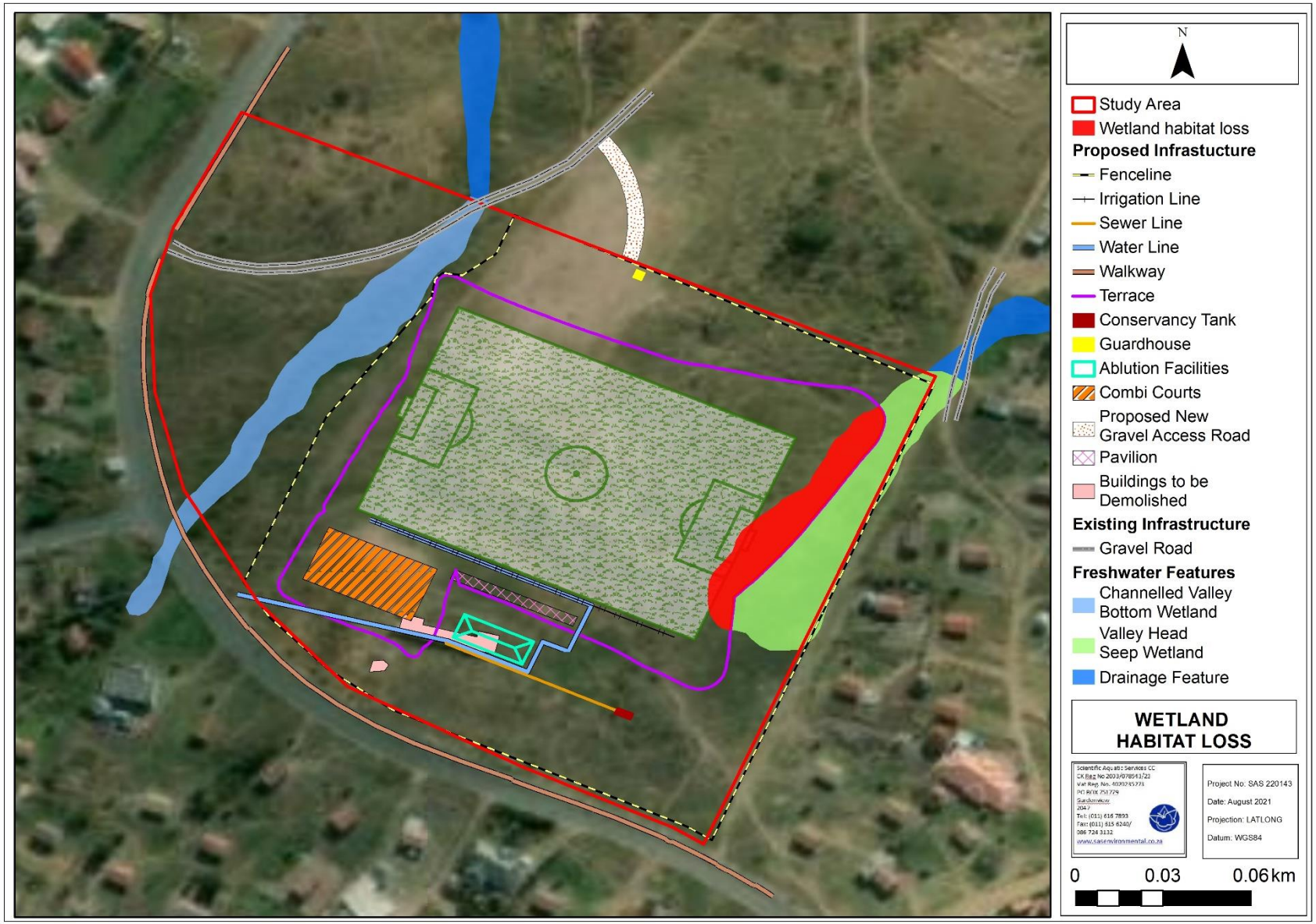


Figure 15: Map depicting the wetland habitat loss associated with the proposed main soccer field and terrace within the western extent of the valley head seep wetland, which will result in an anticipated 0.089 of wetland habitat loss.

7.1 Risk Assessment Discussion

There are four key ecological risks on the wetlands that were assessed, namely:

- Loss of wetland habitat and ecological structure resulting in impacts to biota;
- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the wetlands;
- Proliferation of alien and invasive plant species.

The results of the risk assessment are summarised in Table 6 below, including key mitigation measures for each activity that must be implemented in order to reduce the impacts of the proposed sports field development on the wetlands, as summarised in Section 2 of this report.

Table 6: Summary of the results of the DWS risk assessment applied to the wetlands associated with the proposed sports field development.

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
1	CONSTRUCTION PHASE	Site preparation prior to construction activities.	Movement of construction equipment	· Loss of wetland vegetation, associated habitat and ecosystem services, associated with the proposed water pipelines; · Indiscriminate movement of construction equipment through the wetlands; · Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and · Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	CVB wetland	2,5	4,5	12	54	L	• **It is imperative that all construction works be undertaken during the dry, winter months when surface flow is very low within the wetlands, and no diversion of flow would be necessary;** • Due to the accessibility of the site and the existing roads, no unnecessary crossing of the wetlands may be permitted. this will limit edge effects, erosion and sedimentation of the wetlands during the construction phase; • The assessed wetlands and 32m NEMA ZoR should be clearly demarcated with danger tape by an ECO and marked as a 'no-go' area where no construction activities are planned; • Contractor laydown areas, vehicle re-fuelling areas and material storage facilities to remain outside of the wetlands and their associated 32m NEMA Zone of Regulation (ZoR). • All footprint areas must remain as small as possible and vegetation clearing to be limited to what is absolutely essential to ensure as much indigenous vegetation is retained; • Vehicles to be serviced at the contractor laydown area and all re-fuelling is to take place outside of the delineated wetlands and 32m NEMA ZoR; • Stockpiles should be placed outside demarcated features; • Control of alien vegetation, specifically weeds which may find a niche to encroach disturbed areas; and • All waste to be removed from the site and disposed of at a registered facility.	Fully Reversible
					Valley head seep wetland	3	5	12	60	M		
2			· Removal of vegetation and associated disturbances to soil. · Potential clearing of vegetation within the	· Loss of freshwater habitat and ecological structure, particularly along the western portion of the valley head seep wetland	CVB wetland	1,5	3,5	12	42	L	• The clearing of vegetation must remain within the development footprint and may not extend beyond this area. No unnecessary disturbance within the wetlands must take place; • Retain as much indigenous vegetation as possible outside of the authorised footprint areas; and	Fully Reversible

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
	CONSTRUCTION PHASE		development footprint including within the wetland habitat of the valley head seep wetland for the construction of the proposed main soccer field.	associated with the proposed main soccer field; · Exposure of soil, leading to increased runoff, and erosion, and thus increased sedimentation of the wetlands; · Increased sedimentation of the wetlands, leading to smothering of vegetation in the downstream reaches; and · Proliferation of alien and/or invasive vegetation as a result of disturbances.	Valley head seep wetland	3	5	14	70	M	• The removed vegetation must be stockpiled outside of the delineated boundary of the wetlands. The footprint areas of these stockpiles should be kept to a minimum. 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.	Partially reversible
3		Ground-breaking: excavation of foundations, earthworks and building associated with the construction of the proposed main soccer field, terrace, conservancy tank, gravel access road, fence line, parking area and a guardhouse, combi courts, ablution facilities and stands, and walkway within the 500 m GN509 Zone of Regulation.	· Movement of construction machinery/vehicles within the vicinity of the wetlands; · Possible spills/leaks from construction vehicles; · Earthworks including excavation, infilling and levelling of soil to create a leveled platform, compaction of soil and stockpiling of excess soil;	· Disturbances of soil leading to ponding of water as a result of over compaction of soil in some areas, increased alien vegetation proliferation, and in turn altered wetland habitat and runoff patterns; · Total loss of 0.089 ha of seep wetland habitat as a result of the proposed main soccer field and terrace within the wetland; · Altered runoff patterns, leading to increased erosion and sedimentation of the receiving wetlands;	CVB wetland	1	4	13	52	L	• **Major earthworks near the wetland (particularly the valley head seep wetland) can be avoided if the proposed main soccer field is slightly levelled as needed and major terracing is avoided;** • **Vegetation clearing and movement within the wetlands to be limited to what is absolutely essential. Retain as much indigenous vegetation as possible;** • All vehicles are to remain within existing roads and no new roads should be developed without prior authorisation; • All stockpiles should not exceed 2m in height and be located at least 10 m from the delineated wetlands. Stockpiling of removed materials may only be temporary (may only be stockpiled during the period of construction at a particular site) and should be disposed of at a registered waste disposal facility; • All exposed soil, including stockpiles, must be protected for the duration of the construction phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent excessive dust generation, erosion and sedimentation of the receiving freshwater environment; • Given the topography of the site, it is recommended that that silt traps (for example – Figure A) be installed downgradient of the construction works to limit any sediment entering the downgradient wetland areas, especially considering the excavation activities associated with the valley head seep wetland. Sediment traps should allow for surface runoff should a rainfall event occur;	Fully Reversible

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
4	CONSTRUCTION PHASE	· Earthworks within the western portion of the valley head seep wetland associated with the proposed main soccer field and terrace.	· Removal of vegetation and infilling within the seep wetland and associated disturbance of soil; · Possible discard of construction material within the wetlands; and · Ongoing disturbances to soil leading to AIP proliferation.	· Potential erosion and formation of preferential flow paths as a result of disturbed soil and inappropriate slopes resulting in sedimentation of the wetlands; · Disruption to the embankment, potentially causing sedimentation; and · Ground disturbances, potential concrete works and cement usage, and dust pollution during construction which may impact water quality.	Valley head seep wetland	5	7	13	91	M	 **Figure A: Example of the installation of geotextile sediment traps to be used during the construction phase, to limit additional sediment from entering the downstream portion of the wetlands.** When installing the conservancy tank, double-check regularly to ensure that nothing falls into the tank and no effluent will leaks out of the tank. <u>With regards to the construction of the proposed terrace within the valley head seep wetland</u> • In order to create the proposed terrace all vegetation will need to be cleared. All indigenous vegetation can be stockpiled and mulched, to be used as organic matter during the rehabilitation phase. All exotic or alien vegetation must be removed from the watercourse and disposed of at a registered facility • As far as feasibly possible, imported material used for infilling and terracing of the proposed sports field development must be free of weeds and alien and invasive vegetation species seeds; • The first 10 cm of topsoil should be stripped and stockpiled for reuse once the proposed terrace has been shaped and the wetland has been re-sloped;	Partially reversible

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
	CONSTRUCTION PHASE	.	.	.							• The proposed terrace should be designed in such a way that there are no steep slopes which may limit vegetation growth and result in erosion. A maximum slope with 1:4 is considered the most appropriate balance between reducing footprint and ensuring slopes are stable; • It must be ensured that there is no impedance to stormwater that is released into the valley head seep wetland and that all stormwater is suitably managed; and • The area must be suitably compacted to prevent any erosion or preferential flow paths from occurring. • No hard infrastructure is allowed within the reshaped area and use of hard engineering structure (such as gabion retention structures or reno-mattresses) should be avoided as far as feasibly possible; • It is recommended that a post and wire fence be utilised for the proposed fence line. Although ClearVu fencing is suitable for security as it cannot be easily removed or cut, it does limit the movement of fauna (with only insects and avifaunal species able to navigate it). If ClearVu is desired a suitable faunal specialist should assist in designing under tunnels for larger faunal species (such as porcupine) • No formal paving should be used for the proposed walkway. *In situ* compaction of soil or bark mulch could be utilised (for example see Figure below); • Revegetation of the areas surrounding the walkways with suitable indigenous species of the Indian Ocean Coastal is recommended.	

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
	CONSTRUCTION PHASE	.	.	.							 **Figure B: Example of compacted soil walkway.** <u>Cement usage</u> • Concrete and cement-related mortars can be toxic to aquatic life. Proper handling and disposal should minimize or eliminate discharges into freshwater ecosystems. High alkalinity associated with cement, which can dramatically affect and contaminate both soil and ground water. The following recommendations must be adhered to: - Fresh concrete and cement mortar should not be mixed within 10 m of the identified wetlands. Mixing of cement may be done within the construction camp, may not be mixed on bare soil, and must be within a lined, bound or bunded portable mixer. Consideration must be taken to use ready mix concrete; - No mixed concrete shall be deposited directly onto the ground whilst it awaits placing. A batter board or other suitable platform/mixing tray is to be provided onto which any mixed concrete can be deposited whilst it awaits placing; - Cement bags must be disposed of in the demarcated hazardous waste receptacles and the used bags must be suitably disposed of; and - Spilled or excess concrete must be disposed of at a suitable landfill site. • Only indigenous vegetation species may be used as part of the landscaping of the development, and invasive plant species should be eradicated.	

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
5	CONSTRUCTION PHASE	Installation - potentially via open trenching of: · the proposed water pipeline within the 32 m NEMA ZoR of the CVB; · the proposed irrigation line within the 32 m NEMA ZoR of the valley head seep wetland; and · The proposed sewer line within 40 m of the wetlands (outside the 32 m NEMA ZoR).	· Excavation and trenching leading to stockpiling of soil; · Movement of construction equipment and personnel within the wetlands.	· Disturbances of soil leading to disturbance to the wetland vegetation and resulting in increased sediment loads in the downgradient areas; · Increased alien vegetation proliferation in the footprint areas, and in turn to altered wetland habitat; and · Altered runoff patterns, leading to increased erosion and sedimentation of the wetlands during rainfall events.	CVB wetland	1	3	12	36	L	With regards to open trenching for the installation of the water pipeline, sewer pipeline, and irrigation line • During trenching, soil may be stockpiled on the upgradient edges of the excavation in order to limit potential sedimentation of the downgradient wetlands (Figure C). • Mixture of the lower and upper layers of the excavated soil should be kept to a minimum. The soil must be used to backfill the trenches, immediately after inserting the pipeline; and • The stockpiles must remain as small as possible and may not exceed 2m in height.  **Figure C: An example of a trench being excavated, and the removed soil stockpiled along the trench.**	Fully Reversible
					Valley head seep wetland	1	3	12	36	L		Fully Reversible

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
6		Stormwater management	· Establishment of stormwater channels and outlet structures are recommended for the management of stormwater and sustainable discharge into the wetlands	· Alterations to the sediment loads within the wetlands; · Potential deposition of waste material into the wetlands; and · Potential changes to the water retention pattern of the wetlands.	CVB wetland	1	4	12	48	L	• **An adequate stormwater management plan must be incorporated into the design of the proposed sports field development. Stormwater must be released in an attenuated manner outside of the wetlands in line with the suggestions as follows.** • A suitably qualified freshwater specialist should provide input into this plan; • It is strongly recommended that the developer consider Sustainable Drainage Systems (SuDS) for stormwater management (as opposed to underground stormwater pipelines) and that these systems be vegetated with indigenous freshwater vegetation as this will assist with sediment trapping and "polishing" of stormwater before releasing into the wetlands (for example see Figure E below);  **Figure E: Examples of open swales, considered to be SuDs utilised for conveyance of stormwater.**	Fully Reversible

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
	CONSTRUCTION PHASE				Valley head seep wetland	1	4	12	48	L	• It is further recommended that the developer create a constructed wetland/retention pond for the stormwater to enter so that it is not released directly into the wetlands. This will be a proactive approach to limit contaminated water entering the wetlands; • Energy dissipating structures should be installed at the stormwater outlets to prevent erosion and scouring of the wetlands where the stormwater will be discharged into; • At the drop of stormwater outlets, rocks must be placed, and vegetation established to bind the soil of the bed, and to prevent erosion. This will also diffuse flow and lower the velocity of water entering the wetlands; and • Litter traps should be installed at all the inspection chambers to prevent any litter from entering into the freshwater ecosystems.	Fully Reversible
7	OPERATIONAL PHASE	Small-scale rehabilitation of the area	· Proactive monitoring to identify early signs of alien vegetation encroachment; · Small-scale rehabilitation of the valley head seep wetland; · Re-vegetation of surrounding wetland areas, remove any obstructions to flow; Alien and invasive plant removal.	· Soil compaction within the wetlands; · Potential sedimentation of the valley head seep wetland due to activities within the wetland; and Impacts to water quality of the wetlands as a result of the application of herbicides.	CVB wetland	1	3	12	36	L	• Following construction, a suitable alien invasive management plan must be implemented to ensure that alien invasive plant species do not become established within the areas disturbed by construction activities; • Rehabilitation of the wetlands must be undertaken, including clearing of all alien and invasive vegetation and reinstatement of indigenous wetland vegetation (particularly for the valley head seep wetland where portions of the proposed main soccer field and terrace are proposed. • All disturbed soils must be ripped and loosened. Any existing erosion must be remediated; • It is considered advantageous if the impacted areas adjacent to the wetlands be rehabilitated with indigenous terrestrial vegetation to create an open space corridor and reinstate the ecological buffer to the wetlands; • Planting must start as soon as possible after soil profiling so as to reduce the duration of bare earth being exposed, which could lead to erosion and sedimentation of the area, and to establish ecological habitats;	

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
	OPERATIONAL PHASE				Valley head seep wetland	1.8	3.8	13	48.8	L	• The wetlands must be monitored for alien and invasive vegetation encroachment and all alien vegetation/weeds must be removed according to a suitable alien vegetation control plan. Annual follow up should be undertaken to the wetlands for at least 3 years post construction; • Where applicable for the eradication of alien and invasive vegetation, 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 and water contamination is avoided; and • These rehabilitation recommendations should be read in conjunction with the rehabilitation measures following the offset considerations as presented in Section 8.6 below to improve the functionality and ecological integrity of the identified target wetlands.	Fully Reversible
8		Operation of the proposed sports field development	· Increased impermeable surfaces due to the presence of roofs, parking areas, access roads, etc.; · Potential indiscriminate movement of vehicles within the freshwater ecosystems for perimeter inspections/ maintenance.	· Altered runoff patterns and increased water inputs to the receiving wetlands, resulting in altered flow regime; · Altered flow regime may lead to changes to an impacts on vegetation as a result; · Proliferation of alien and invasive plant species within the wetlands.	CVB wetland	2,5	4,5	12	54	L	• Adequate stormwater run-off measures must be put in place and no stormwater may be directly released into the wetland. Attenuation ponds and/or SuDs must be installed to assist with water "polishing" and reducing the velocity of water before entering the wetlands. This will ensure no erosion or scouring occurs as a result of stormwater inputs; • Incorporate as much indigenous terrestrial and wetland vegetation into the open space areas, SuDS, and stormwater attenuation facilities (where applicable) associated with the proposed sports field development; • Any spills to be immediately cleaned up and treated accordingly; • No vehicles are permitted to enter into the freshwater ecosystems. Any maintenance works must be undertaken by foot or the relevant authorisations obtained beforehand.	Fully Reversible
					Valley head seep wetland	2,5	4,5	12	54	L		

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
9	OPERATIONAL PHASE	· Operation of the proposed water pipeline	· Potential leakage of water from the pipelines.	· Possible incision and alteration of the hydroperiod of the downgradient wetlands; · Potential impacts to the water quality of the wetland	CVB wetland	1	3	12	36	L	• It is recommended that the integrity of the water pipelines be tested at least once every five years or more often should there be any sign of a leak; • It should be ensured that the hydrological regime of the downgradient wetlands not be impacted as a result of leaks or bursting of the pipeline, and that an emergency plan should be compiled to ensure a quick response and attendance to the matter in case of a leakage or bursting of the pipeline; • Should repair of the pipeline be required to address a leak, mitigations as per activity 1 to 5 above are applicable depending on the location of the leak	Fully Reversible
					Valley head seep wetland	1	3	12	36	L		
10		Operation and maintenance of conservancy tanks and associated infrastructure	Possible indiscriminate movement of waste removal vehicles leading to damage to the conservancy tanks.	· Potential failure of infrastructure resulting in anaerobic conditions within the conservancy tanks and possible spillage and runoff of sewage from the conservancy tanks into the wetlands decreasing the quality of surface water; · The anaerobic conditions in the conservancy tank system could lead to a decrease in effluent quality which may enter the wetlands.	CVB wetland	1	3	12	36	L	• Regular monitoring of the conservancy tanks and associated infrastructure must be undertaken to allow for pro-active management, including regularly inspection of all conservancy tanks to ensure they do not leak; • Care must be taken when servicing the conservancy tanks, making sure that no litter or runoff from the servicing of the conservancy tank enters the wetland; and • In the event of that the following warning signs are noticed during regular inspection, contact a professional septic company/preferred installer immediately for assistance: • Surfacing sewerage or wet spots • Gurgling sounds in the plumbing system • Slow draining fixtures	Fully Reversible
					Valley head seep wetland	1	3	12	36	L		

No.	Phases	Activity	Aspect	Impact	Wetland impacted	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures	Reversibility of Impact
11	OPERATIONAL PHASE	Monitoring of the sewer and water pipelines, and operation of the stormwater management system.	Proactive monitoring to ensure structural integrity is maintained.	· Compaction of soil and loss of habitat as a result of ongoing disturbance from vehicles and equipment; and Disturbance of soil which could lead to erosion.	CVB wetland	1	3	12	36	L	• All wetlands are to be considered "off limits" to any vehicular activity; • Disturbances to the wetlands should be limited to what is essential for long-term maintenance in line with the mitigation measures presented herein; • Existing access roads must be used for monitoring purposes. No indiscriminate movement of vehicles is allowed as this would result in the compaction of soil and potential loss of wetland and instream habitat; • The likelihood of erosion is reduced due to a higher surface roughness of SuDs (earth swales), allowing for water to enter the wetlands at a lower velocity; • The SuDs should be inspected regularly to ensure proper functioning, monitoring of erosion and clearing of any debris or litter in the SuDs; • Regular inspection of the stormwater outlet structures should be undertaken to monitor the occurrence of erosion. If erosion has occurred, it should immediately be rehabilitated by means of revegetation; • Water will be diverted around the soccer field in earth cut off trenches and stone pitched swales will be sued to discharge wate into the wetland in an attenuated manner. • Hot spots for the build-up of debris and excess sediment within the wetlands must be identified and when necessary, debris/excess sediment must be removed by hand to prevent future flooding and potential damage to infrastructure. In this regard, special mention is made of periods following high rainfall and subsequent high instream water volumes. Removal of debris must be undertaken in line with the above listed construction mitigation measures; and • Any erosion or gully formation must be identified on an ongoing basis and re-profiled and revegetated accordingly.	Fully Reversible
					Valley head seep wetland	1	3	12	36	L		Fully Reversible

The activities associated with the construction and operational phases of the proposed sports field development, which include site preparation, vegetation clearing and excavation and levelling of the platforms for the construction of the proposed sports field development and associated stormwater management, pose a Moderate risk to the overall integrity of the wetlands. The majority of the impacts are considered fully reversible, except those associated with loss of wetland vegetation of the valley head seep wetland that will be traversed by the proposed main sports field and terrace resulting in 0.089 ha of wetland habitat loss. As such, an offset investigation was undertaken to ascertain the functional and conservation habitat hectare equivalents (hae) that must be conserved by the proponent to account for the residual wetland loss (see Section 8 below). It is highly recommended that the proponent makes provision for small-scale rehabilitation of the wetlands, particularly the valley head seep wetland which will be directly impacted by the proposed sports field development. This is especially applicable to the removal of alien and invasive plants and the revegetation of the affected areas. These rehabilitation recommendations should be read in conjunction with the rehabilitation measures following the offset considerations as presented in Section 8.6 below to improve the functionality and ecological integrity of the identified target wetlands.

Indirect impacts may arise from potential water quality concerns and increased sediment loads entering the wetlands through the stormwater channels. It is thus strongly recommended that the proponent makes provision for a stormwater management plan to service the proposed sports field development. Careful planning of the stormwater management plan that will ensure that stormwater is released in an attenuated manner outside of the wetlands, is imperative to ensure the hydraulic regime of the receiving wetlands is retained.

It is important to note that any infilling and deposition of material (of more than 10 cubic meters) within the wetland will require a basic assessment to be conducted in terms of the NEMA EIA Regulations, 2014 (as amended). Additional “good practice” mitigation measures applicable to a project of this nature are provided in **Appendix F** of this report.

7.2 Cumulative Impacts

Cumulative impacts are activities and their associated impacts on the past, present and foreseeable future, both spatially and temporally, considered together with the impacts identified in Section 7.1 above. Wetlands within the region are under continued threat due to growing urbanisation in the surrounding landscape.

Direct and indirect impacts identified within urban freshwater ecosystems bordering agricultural/rural and urban development 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 in agricultural runoff. The proposed sports field development will contribute to the increased hardened surfaces in the catchment, resulting in more stormwater influxes to the receiving wetlands which are currently impacted by stormwater infixes. The impacts on the reach of the valley head seep wetland to be traversed by the proposed sports field development are likely to add to the cumulative effect on the loss of wetland habitat within the region. However, through rehabilitation efforts such as long-term alien invasive vegetation management, reinstatement of indigenous vegetation, and stormwater management will assist in the positive cumulative impacts on the wetlands.

8 INTRODUCTION TO BIODIVERSITY AND WETLAND OFFSETS

8.1 The Mitigation Hierarchy

Offsets are applied within a mitigation hierarchy and are only aimed at mitigating or compensating for residual impacts of project development on the environment (often called "compensatory mitigation") after all appropriate and feasible steps have first been taken to avoid/prevent, minimize/reduce and remediate/rehabilitate impacts (Macfarlane D. et al 2016).

- First, the proposed sports field development should try to avoid or prevent negative impacts on biodiversity and ecosystem services by seeking alternative types of development, or alternative locations, different scales of development, different layouts and siting of development components, etc.;
- Secondly if the above-mentioned alternatives have been exhausted, every effort should be made to minimize negative impacts and to rehabilitate or remediate affected areas;
- 'Residual impacts' are what will remain after minimising impacts and rehabilitation. These residual impacts would then need to be compensated for, and this may involve the specific application of an offset.

8.2 General Offset Guidelines

In March 2017, a draft National Biodiversity Offset Policy was published for public comment. It should be noted that at the time this report was prepared, the period for public comment had not yet closed, and therefore, the contents of the policy may be amended in due course.

According to this document, biodiversity offsets are defined as "*conservation measures designed to remedy the residual negative impacts of development on biodiversity and ecological infrastructure, once the first three groups of measures in the mitigation sequence have been adequately and explicitly considered (i.e. to avoid, minimise and rehabilitate / restore impacts). Offsets are the 'last resort' form of mitigation, only to be implemented if nothing else can mitigate the impact."*

The South African National Biodiversity Institute (SANBI, 2004) further defines biodiversity offsets as "*measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse biodiversity impacts arising from project development after appropriate prevention and mitigation measures have been taken*."[3]

In terms of the draft National Biodiversity Offset Policy (2017) as well as the Western Cape Provincial Guideline on Biodiversity Offsets (Western Cape; 2007), the significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss of irreplaceable biodiversity, the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss, and other alternatives should be sought (i.e. the proposed activity should not be authorised in its current form). In the case of residual impacts determined to have

[3] Business and Biodiversity Offsets Programme (BBOP). 2009. *Biodiversity Offset Design Handbook*. BBOP, Washington, D.C.

medium to high significance, an offset initiative may be investigated. If the residual biodiversity impacts are considered of *low significance* no biodiversity offset is required.[4]

Whilst thought of as a "last resort" to counteract the cumulative impacts on biodiversity, offset strategies do have the potential to increase the future value of biodiversity within a region. Thus, the recently gazetted draft National Biodiversity Offset Policy (Department of Environmental Affairs (DEA), 2017) aims to provide a set of national guidelines relating to biodiversity offsets for South Africa, since at present, only three sets of provincial draft biodiversity guidelines and/or policies are available, namely the Western Cape (Department of Environmental Affairs and Development Planning (DEA&DP), 2007), Kwa-Zulu Natal (Ezemvelo Kwa-Zulu Natal Wildlife (EKZNW), 2009, 2010) and Gauteng (Gauteng Department: Agriculture and Rural Development (GDARD), 2013).

The principles enshrined in the draft National Biodiversity Offset Policy (DEA, 2017) aim to support the general principles of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA), by ensuring that "due remedy is obtained for significant adverse impacts on biodiversity resulting from development." The policy is intended to "contribute to securing priority biodiversity and ecosystem functioning in perpetuity, for the benefit of both present and future generations".

In terms of biodiversity offsets relating specifically to wetland habitat, the draft National Biodiversity Offset Policy (DEA, 2017) notes that the policy must be read in conjunction with the "Wetland Offsets – A best-practice guidelines for South Africa (Macfarlane D. *et al* 2016). The various protocols for defining wetland impacts and developing appropriate offset metrics were thus considered in the approach to the Hlomendlini sports field offset.

As mentioned previously, the concept of a biodiversity offset is relatively new and there is presently no standard method for determining the most suitable biodiversity offset. The objective of biodiversity offsets, through the development authorisation and associated Environmental Impact Assessment (EIA) process is to ensure that residual impacts on biodiversity and ecosystem services that are of moderate to high significance (i.e. do not represent a 'fatal flaw' from a biodiversity perspective) are compensated by developers in such a way that ecological integrity is maintained and development is sustainable (Macfarlane D. *et al* 2016).

The significance of a residual negative impact on biodiversity is heavily influenced by the characteristics of the receiving environment, for example, if an area is identified in a bioregional plan or fine scale biodiversity plan as a Critical Biodiversity Area (CBA), a priority site, a listed Protected Area (PA), a threatened ecosystem or habitat containing threatened species or special habitat (Macfarlane D. *et al* 2016).

Biodiversity offsets generally target features or areas with similar biodiversity as that residually impacted by development but may target features or areas with biodiversity of higher conservation significance. According to "Wetland offsets: a best-practice guideline for South Africa" (Macfarlane D. *et al* 2016) the goals of wetland offsets in South Africa are as follows:

- Provide appropriate and adequate compensation for residual impacts on key water ecosystem services and contribute to achieving water resource objectives (including both Water Resource Management and Water Resource Quality Objectives) by:
  - Ensuring "no net loss" in the overall wetland functional area by providing gains in wetland area and/or conditions equal to or greater than the losses due to residual impacts;
  - Directing offset activities that will improve key regulating and supporting services towards those wetlands where these specific services can best be enhanced, and where these offset

[4] Provincial Guideline on Biodiversity Offsets, Western Cape, 2007.

activities will contribute best to achieving water resource objectives including both Water Resource Management and Quality Objectives;
- Providing 'in kind' services through offset activities, or substitute services acceptable to affected communities, for residual impacts on direct (provisioning or cultural) services, to ensure that these communities are at least as well off as prior to the development taking place;

- Secure formal protection of wetland systems in a good condition so as to contribute to meeting national biodiversity and protection targets for the representation and persistence of different wetland types, thereby ensuring that cumulative impacts of increased water use, development authorisation and land use change do not jeopardize the ability to meet the country's targets; and
- Adequately compensate for residual impacts on threatened or otherwise important (e.g. wetland dependent) species through appropriate offset activities that support and improve the survival and persistence of these species.

There are many different possible kinds of offsets, but in practice they generally fall into the following broad categories as described by the Business and Biodiversity Offsets Programme (BBOP) Handbook (2009):

- *"Like for like"* - Undertaking positive management interventions to restore an area or stop degradation: improving the conservation status of an area of land by restoring habitats or ecosystems and reintroducing native species. Where proven methods exist or there are no other options, reconstructing or creating ecosystems. Also, reducing or removing current threats or pressures by, for instance, introducing sustainable livelihoods or substitute materials. This can either be done on the development site (on-site offset) or a distance from the site (off-site offset);
- *Averting risk*: Protecting areas of biodiversity where there is imminent or projected loss of that biodiversity; entering into agreements such as contracts or covenants with individuals in which they give up the right to convert habitat in the future in return for payment or other benefits now; or
- *"Trading up"* - Providing compensation packages for local stakeholders affected by the development project or monetary compensation for a biodiversity conservation trust (Western Cape Provincial Guideline on Biodiversity Offsets, 2007).

8.3 Wetland Specific Offset Guidelines

The offset ratios as defined by DEA&DP (2011) were refined in the draft wetland offset calculator specifically pertaining to wetland offsets (Macfarlane D. *et al* 2016). The wetland offset calculator was designed to guide the criteria and importance of wetland habitat in terms of water resource and ecosystem value, ecosystem conservation and presence of species of conservation concern, at the end providing hectare equivalents representative of the wetland that requires an offset. The wetland offset calculator was used during the determination of the Hlomendleni sports field offset.

Hectare Equivalents: To enable the quantification of an appropriate offset, it is important to establish a unit or measurement that will allow for losses (due to the proposed impacts) and gains (due to the proposed offset) in wetland / biodiversity values to be assessed. This is central to the concept of offsets, and the goal of achieving no net loss. In the past, the area of wetland affected (as measured in hectares, for example) was a commonly used 'currency' and is still used in many instances. However, the approach taken in these guidelines which is based on international best practice, shows that a more refined "currency" that better incorporates a measure of ecological function, quality, and/or integrity.

The basic "hectare equivalents" used in these guidelines are a combination of area impacted and the change in condition or functionality. These basic values are modified based on the significance of the feature being impacted (in the case of the calculation of the required offset) or the quality of the offset achieved (in the case of the offset receiving calculation). This currency ('hectare equivalents') is used as a surrogate for residual loss and has been adopted as the primary currency for evaluating impacts to wetlands as a result of the proposed development.

Where a wetland offset is deemed appropriate, various actions may be used to deliver the required outcomes. These actions can be broadly grouped into the different categories listed below as provided by Macfarlane D. *et al* 2016).

- **Protection**: This refers to the implementation of legal mechanisms (e.g. declaration of a Protected Environment or Nature Reserve under the National Environmental Management: Protected Areas Act, 2014 (Act No. 21 of 2014), a legally binding conservation servitude, or a long-term Biodiversity Agreement under National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) and putting in place appropriate management structures and actions. This may include setting appropriate water reserve determinations and specifying protection measures within the DWS planning instruments. Furthermore, inclusion of offset sites into appropriate land use zones and land use plans, including provincial and local conservation plans, ensure that conservation outcomes are secured and maintained in the long-term. In light of the high regional rate of loss of wetlands and associated biodiversity, protection is necessary for any wetland offset, irrespective of the means used to deliver the "no net loss" outcome (i.e. rehabilitation, or other activities that compensate for wetland degradation or loss). It is important to recognise that increased protection (especially at a catchment level) greatly improves the chance of long-term persistence of wetland function and biodiversity, and therefore contributes to "no net loss" objectives. As protection increases the current "value" of a wetland system, it is important that the offset mechanism fully recognises the benefits associated with increased protection in reducing potential for long term loss and adding to the overall conservation estate, in line with national conservation goals and targets;
- **Averted loss*:*** This refers to physical activities which prevent the loss or degradation of an existing wetland system, its ecosystem services and its biodiversity, where there is a clearly demonstrated threat of decline in the system's condition, ability to provide ecosystem services or support overall Water Resource Objectives (both quality and quantity). This would apply in situations where a wetland head-cut[5] is stabilised to prevent an erosion gully from propagating further into the wetland, where excessive sediment inputs are prevented from entering a wetland through the stabilisation of erosion dongas alongside the wetland or by creating structures to trap such sediment before reaching the wetland, or where there is significantly improved management of a wetland (e.g. reduced grazing pressure or control of invasive aliens impacting on wetland ecosystem functioning). These actions can therefore count as 'gains' which contribute to achieving a "no net loss" outcome for key wetland services. Although, it can be argued that protection mechanisms measured against the regional background rate of wetland / biodiversity loss are part of 'averted loss';
- **Rehabilitation**: Rehabilitation results in an improvement in wetland condition, function, and associated biodiversity. Rehabilitation involves the manipulation of the physical, chemical, or biological characteristics of a degraded wetland system in order to repair or improve wetland integrity and associated ecosystem services. This could involve actions such as removing obstructions to flow or assisting the regeneration of the natural vegetation. By increasing the condition of a wetland system and its biodiversity, a positive contribution is made towards the goal of "no net loss";
- **Establishment**: This involves the development (i.e. creation) of a new wetland system where none existed before by manipulating the hydrological drivers, physical, chemical, or biological characteristics of a specific site. Successful establishment would result in 'gains' in wetland area, functions and biodiversity values. It is important to note however, that while selected ecosystem services may quite readily be created through establishment, many ecological values – let alone whole intact systems - are very difficult if not impossible to create. In general, establishment as a mechanism for delivering an offset should therefore be avoided, or only used in exceptional circumstances, where it is known (based on research and demonstrated experience) that a

[5] Erosion occurring upstream of a specific point.

particular system or service that has been lost can be reliably created elsewhere. Sites would also need to be located such that they do impact on important terrestrial resources (e.g. intact natural grasslands); and

- **Direct compensation**: Direct compensation involves directly compensating affected parties for the ecosystem services lost as a result of development activities. This is ideally done by providing an equivalent substitute form of offset or in some cases may take the form of monetary compensation. This form of offset action is generally most relevant to direct services (e.g. loss of grazing land) but may occasionally be applied to compensate for losses of regulating and supporting services (e.g. through the direct treatment of polluted water).

8.4 Implementation of the Mitigation Hierarchy

The mitigation hierarchy has been defined by Macfarlane D. *et al* 2016 and necessitates specific steps that first need to be taken to avoid/prevent, minimise/reduce and remediate/rehabilitate impact prior to investigation into any offset initiative (please refer to section 2.1 of this report for details regarding each step). The different pathways investigated for the proposed sport field complex are summarised in the points below:

Step 1: Avoid or prevent negative impacts on biodiversity and ecosystem services:

A consultation process was undertaken between the proponent, engineers and the freshwater specialist prior to this offset plan to optimise the layout in order to avoid the identified wetlands as far as feasibly possible, in line with the minimum project footprint.

Step 2: Make effort to minimise negative impacts and to rehabilitate or remediate affected areas:
As part of the proposed layout, and in line with the final layout plan, all unavoidable impacts on the watercourses must be mitigated to minimise the impacts. Although avoidance of the wetland habitat (as indicated in Step 1) was undertaken as far as possible, an anticipated unavoidable loss of 0.089 ha of wetland is still anticipated. Strict mitigation measures have therefore stipulated in the freshwater ecological assessment in order to minimize the impacts as far as possible (for example, see Table 6 above).

Due to complete avoidance and recreation of wetland HGM units not being a feasible mitigation option, the residual impacts as a result of the proposed sports field complex development needs to be compensated for and the best alternatives (including onsite rehabilitation of the remaining portions of the wetlands) has therefore been identified as part of this project.

From the results of the analyses it is evident that the proposed sports field development will lead to a loss of 0.0305 functional hectare equivalents and 0.0454 conservation target hectare equivalents.

The required ecosystem conservation hectare equivalents equate to .429 Hae. This is attributed to the threat status and protection level of the applicable WetVeg group (according to Mbona *et al.*, 2015). As the WetVeg group is considered “critically endangered”, a factor of 1:15 is utilised by the wetland offset calculator tool (Macfarlane *et al.* 2016). The functional hectare equivalent target is 0.031 functional Hae.

8.5 Opinion and Recommendation

The need and desirability of a wetland offset was considered. Taking into consideration the loss of habitat associated with wetlands within the proposed sports field development an offset to compensate for loss of habitat will assist in limiting any residual loss of wetland.

Due to the limited extent of the wetland loss and the location of the development a formal offset initiative is not deemed possible and it is therefore proposed to compensate for the loss by improving the

functionality of the remaining wetland extent. The combined functional hectare equivalents and conservation hectare equivalents equates to .4594 ha. This was rounded to 0.5 ha which will be rehabilitated to offset the effects of the wetland to compensate for the wetland impact.

8.6 Recommended Rehabilitation Measures for Target Wetlands

Based on the outcomes of the offset analyses, the following preliminary rehabilitation measures have been recommended in order to improve the functionality and ecological integrity of the identified target wetlands:

- Implementation of an alien invasive vegetation plan, to eradicate as far as possible all alien floral species which are identified within wetland areas.
- Re-introduction of indigenous vegetation, in particular, graminoid species and sedges where vegetation is sparse. Manure sourced from local farmers is likely to contain seeds of naturally occurring floral species, and this could be utilised in the rehabilitated areas to further encourage growth of indigenous flora;
- Erosion control within the wetlands and their buffer zones in order to prevent sedimentation, enable natural vegetation to become re-established, and improve water quality. Examples of possible management methods include monitoring of access by domestic livestock, protection of small areas of exposed soils with suitable geotextiles or organic material (e.g. branches) until such time as vegetation is re-established, appropriate stormwater management practices and installation of erosion berms;
- Indiscriminate grazing practices and crop cultivation bordering the wetlands are widespread in the surrounding community and are largely responsible for the poor condition of the vegetation communities of the wetlands. Thus, whilst it may not be feasible to prevent grazing of livestock altogether, the local community should be educated about sustainable grazing practices.

9 CONCLUSION

SAS was appointed to conduct a freshwater ecological assessment as part Environmental Authorisation and Water Use Authorisation (WUA) processes for the proposed sports field development in Mandeni, Kwazulu-Natal Province.

A valley head seep wetland was identified along the eastern portion of the study area and will be traversed by the proposed sports field development. A channelled valley bottom (CVB) wetland was identified along the western portion of the study area and will be indirectly impacted by the proposed sports field development given its close proximity to the CVB wetland. The results of the ecological assessment as discussed in Section 5 of this report are summarised in the table below:

Table 7: Summary of results of the field assessment as discussed in Section 5.

Wetland	PES	Ecoservices	EIS	REC and RMO
Valley head seep	Category: C (Moderately modified)	Intermediate	Moderate	REC: Category C (Moderately modified) BAS: Category: C (Moderately modified) RMO: Maintain
Extent of modification anticipated	**High** Significant modifications are anticipated to the extent of the valley head seep wetland associated with the proposed main soccer field, where 0.089 ha of wetland habitat will be lost as a result of the proposed sports field development due to the proposed main soccer field and terrace encroaching into the western extent of the wetland. Similarly, habitat fragmentation is likely within the seasonal and temporary zones of the wetland due to infilling activities within the wetland which may result in changes to the flooding patterns. However, an offset investigation was undertaken, and it was determined that a conservation offset is not appropriate and thus focus was placed on the offset of functional Hectare equivalents to ascertain the functional habitat hectare equivalents that must be conserved by the proponent to account for the above-mentioned residual wetland loss. Assuming that strict enforcement of cogent, well-developed mitigation measures takes place as stipulated in this report, including stormwater management such that stormwater released from the proposed sports field development into the adjacent valley head seep wetland is appropriately attenuated and released in a dispersed manner before entering the wetland to prevent incision and erosion, the significance of impacts arising from the proposed sports field development are likely to be reduced during the construction and operational phases.			
CVB wetland	Category: E (Seriously modified)	Intermediate	Moderate	REC: Category D (Largely modified) BAS: Category: D (Largely modified) RMO: Improve
Extent of modification anticipated	**None** No modification is anticipated to the extent of CVB wetland as no infrastructure is proposed within the CVB wetland that may fragment or degrade the system. However, stormwater releases alongside the delineated CVB wetland will need to be monitored to ensure base flows, quantity or quality of water within the CVB wetland are not adversely affected.			

Based on the findings of the wetland assessment and the results of the risk assessment, it is the opinion of the freshwater ecologist that the proposed sports field development poses a **Moderate risk to the integrity of the wetlands within the study area**, predominantly due to the infilling of the valley head seep wetland associated with the proposed main soccer field and terrace to create a flat platform for the sports field development. This activity will result in habitat fragmentation and the loss of 0.089 ha of wetland habitat in the valley head seep wetland. It is considered imperative that all mitigation measures as provided in Section 7.2, **Appendix F** and wetland offset considerations provided in Section 8 of this report are strictly adhered to, to minimise the impacts associated with the proposed sports field development.

Activities associated with the proposed sports field development will occur within the GN509 zone of regulation of the CVB wetland and valley head seep wetland, therefore, in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), a Water Use Authorisation will need to be applied for in terms of Sections 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) prior to the commencement of any works.

10 REFERENCES

Department of Water Affairs and Forestry. 1999. IER (Floodplains): Determining the Ecological Importance and Sensitivity (EIS) and the Ecological Management Class (EMC). DWA, Pretoria, RSA.

DWA, South Africa Version 1.0 of Resource Directed Measures for Protection of Water Resources, 1999. [Appendix W3].

Department of Water Affairs and Forestry. 2007. Manual for the assessment of a Wetland Index of Habitat Integrity for South African floodplain and channelled valley bottom wetland types.

Department of Water Affairs and Forestry. 2005. A practical field procedure of identification and delineation of wetlands and riparian areas. DWA, Pretoria.

DWAF 2005. A practical field procedure of identification and delineation of wetlands and riparian areas. DWA, Pretoria, RSA.

Kleynhans C.J., Thirion C., Moolman J, Gaulana L. 2007. *A Level II River Ecoregion Classification System for South Africa, Lesotho and Swaziland.* Report No. N/0000/00/REQ0104. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria

NFEPA: Driver, A., Nel, J.L., Snaddon, K., Murruy, K., Roux, D.J., Hill, L., Swartz, E.R., Manuel, J. and Funke, N. 2011. Implementation Manual for Freshwater Ecosystem Priority Areas. Water Research Commission. Report No. 1801/1/11. Online available: http://bgis.sanbi.org/nfepa/project.asp

Nel, JL, Driver, A., Strydom W.F., Maherry, A., Petersen, C., Hill, L., Roux, D.J, Nienaber, S., Van Deventer, H., Swartz, E. & Smith-Adao, L.B. 2011. Atlas of Freshwater Ecosystem Priority Areas in South Africa: Maps to support sustainable development of water resources. Water Research Commission Report No. TT 500/11, Water Research Commission, Pretoria, RSA.

Ollis, DJ; Snaddon, CD; Job, NM & Mbona, N. 2013. Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland Systems. SANBI Biodiversity Series 22. South African Biodiversity Institute, Pretoria, RSA.

The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org.

APPENDIX A: INDEMNITY AND TERMS OF USE OF THIS REPORT

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 CC and its staff reserve the right 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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This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

APPENDIX B: LEGISLATIVE REQUIREMENTS

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 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 normalization 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, 1998 (Act No. 107 of 1998)	The National Environmental Management Act, 1998 (Act No. 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 Water Act , 1998 (Act No. 36 of 1998)	The National Water Act, 1998 (Act No. 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). A watercourse is defined as: 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.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act , 1998 (Act No. 36 of 1998)	In accordance with Government Notice (GN)509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: ➢ The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; ➢ In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or ➢ A 500 m radius from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and storm water management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.

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 ecosystems present in close proximity of the proposed sports field development 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 feature present in the vicinity of the proposed sports field development.

1.2 *Department of Water and Sanitation (DWS) Resource Quality Information Services Present Ecological State / Ecological Importance and Sensitivity (PES/EIS) Database (2014)*

The PES/EIS database as developed by the DWS RQIS department was utilised to obtain background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (subquat reach) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as SA RHP sites, EWR sites and Hydro WMS sites. The results obtained serve to summarise this information as a background to the conditions of the freshwater ecosystems traversed by the proposed sports field development.

2. Classification System for Wetlands and other Aquatic Ecosystems in South Africa (2013)

All wetland or riparian features encountered within the investigation area was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis et. al., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

Table C1: Classification System 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) Units 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**[6] (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**

[6] 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.

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 in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is 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) groups' 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 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-Ecoservices (2009)

"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" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

- Flood attenuation;
- Stream flow regulation;
- Sediment trapping;
- Phosphate trapping;
- Nitrate removal;
- Toxicant removal;
- Erosion control;
- Carbon storage;
- Maintenance of biodiversity;
- Water supply for human use;
- Natural resources;
- Cultivated foods;
- Cultural significance;
- Tourism and recreation; and
- Education and research.

The characteristics were used to quantitatively determine the value, and by extension sensitivity, of the wetlands. Each characteristic was scored to give the likelihood that the service is being provided. The scores for each service were then averaged to give an overall score to the wetland.

Table C3: Classes for determining the likely extent to which a benefit is being supplied.

Score	Rating of the likely extent to which the benefit is being supplied
<0.5	Low
0.6-1.2	Moderately low
1.3-2	Intermediate
2.1-3	Moderately high
>3	High

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

The purpose of assessing importance and sensitivity of freshwater ecosystems is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Freshwater ecosystems with higher ecological importance may require managing such freshwater ecosystems 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 freshwater ecosystem 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 freshwater ecosystems by DWA and thus enabling consistent assessment approaches across freshwater ecosystem 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 C7) of the wetland system being assessed.

Table C6: 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

5. 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 C5: 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 C6: 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.

6. 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 ecosystems (sections above), with the objective of either maintaining, or improving the ecological integrity of the freshwater ecosystem in order to ensure continued ecological functionality.

Table C7: Recommended management objectives (RMO) for freshwater ecosystems 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 unnacceptable (Malan and Day, 2012) and therefore, should a freshwater ecosystem fall into one of these PES categories, an REC class D is allocated by default, as the minimum acceptable PES category.**

A freshwater ecosystem may receive the same class for the REC as the PES if the freshwater ecosystems are 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 freshwater ecosystem.

Table C8: Description of Recommended Ecological Category (REC) classes.

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

7. Freshwater ecosystem Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act, 1998 (Act No. 36 of 1998) as "land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil".

The wetland zone delineation took place according to the method presented in the DWAF (2005) document "A practical field procedure for identification and delineation of wetlands and riparian areas.

An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

- The position in the landscape, which will help identify those parts of the landscape where wetlands are more likely to occur;
- The type of soil form (i.e. the type of soil according to a standard soil classification system), since wetlands are associated with certain soil types;
- The presence of wetland vegetation species; and
- The presence of redoxymorphic soil feature, which are morphological signatures that appear in soil with prolonged periods of saturation.

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008).
Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soil and the growth of wetland vegetation. The object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

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 risk 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'[7]. 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 wetlands, 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; and
- **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[8].

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, 1998 (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.

[7] The definition has been aligned with that used in the ISO 14001 Standard.

[8] Some risks/impacts that have low significance will however still require mitigation

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

Table C1: 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 C2: 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 C3: 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 C4: 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 C5: 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 C6: 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 C7: 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 C8: 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. Licence 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. Licence required.

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

Table C9: 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 develop 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[9] 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
- 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.

Recommendations

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

[9] Mitigation measures should address both positive and negative impacts

Reversibility and/or irreplaceable loss

The following indicates the rationale for the reversibility scoring in relation to the freshwater ecosystems.

Table D10: Reversibility of impacts on the freshwater ecosystem

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: RESULT OF FIELD INVESTIGATION

Table E1: Presentation of the results of the Wet-Health assessment applied to the valley head seep wetland.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	2	100	3.5	-2	2.6	-2	4.2	-2
Area weighted impact scores*			3.5	-2.0	2.6	-2.0	4.2	-2.0
PES Category			C	↓↓	C	↓↓	D	↓↓

Table E2: Presentation of the results of the Wet-Health assessment applied to the channelled valley bottom wetland.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	6	100	7.0	-2	3.0	-2	8.8	-2
Area weighted impact scores*			7.0	-2.0	3.0	-2.0	8.8	-2.0
PES Category			E	↓↓	C	↓↓	F	↓↓

Table E3: Presentation of the results of the Socio-cultural and Ecoservice provision provided by the wetlands assessed.

Ecosystem service	Valley head seep wetland	Channelled valley bottom wetland
Flood attenuation	1.8	1.8
Streamflow regulation	1.4	2.2
Sediment trapping	2.4	1.4
Phosphate assimilation	2.1	1.4
Nitrate assimilation	2.0	1.6
Toxicant assimilation	2.2	1.6
Erosion control	2.2	1.3
Carbon Storage	1.3	1.3
Biodiversity maintenance	0.9	0.8
Water Supply	0.7	1.3
Harvestable resources	0.0	1.2
Cultivated foods	1.0	1.2
Cultural value	0.0	1.0
Tourism and recreation	0.1	0.6
Education and research	0.0	1.0
SUM	**18.2**	**19.7**
Average score	**1.2**	**1.3**

Table E4: Presentation of the EIS assessment applied to the valley head seep wetland

Ecological Importance and Sensitivity			Score (0-4)	*Confidence (1-5)*
Biodiversity support			A (average)	(average)
			1.00	3.00
Presence of Red Data species			1	3
Populations of unique species			0	3
Migration/breeding/feeding sites			2	3
Landscape scale			B (average)	(average)
			1.80	4.00
Protection status of the wetland			3	4
Protection status of the vegetation type			2	4
Regional context of the ecological integrity			2	4
Size and rarity of the wetland type/s present			1	4
Diversity of habitat types			1	4
Sensitivity of the wetland			C (average)	(average)
			1.67	2.67
Sensitivity to changes in floods			1	3
Sensitivity to changes in low flows/dry season			2	3
Sensitivity to changes in water quality			2	2
ECOLOGICAL IMPORTANCE & SENSITIVITY			**(max of A,B or C)**	*(average of A, B or C)*
			Fill in highest score:	**B**	**1.80**
Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	4
	Streamflow regulation		1	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	2	4
		Toxicant assimilation	2	4
		Erosion control	2	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			**(average score)**	**(average confidence)**
			1.75	4

Direct Human Benefits		Score (0-4)	*Confidence (1-5)*
Subsistence benefits	***Water for human use***	1	3
	Harvestable resources	0	4
	Cultivated foods	0	4
Cultural benefits	***Cultural heritage***	0	4
	Tourism and recreation	0	4
	Education and research	0	4
DIRECT HUMAN BENEFITS		(average score)	(average confidence)
		0.17	4

Table E5: Presentation of the EIS assessment applied to the valley bottom wetland

Ecological Importance and Sensitivity			Score (0-4)	*Confidence (1-5)*
Biodiversity support			A (average)	(average)
			0.00	3.67
Presence of Red Data species			0	3
Populations of unique species			0	4
Migration/breeding/feeding sites			0	4
Landscape scale			B (average)	(average)
			1.00	4.00
Protection status of the wetland			0	4
Protection status of the vegetation type			2	4
Regional context of the ecological integrity			1	4
Size and rarity of the wetland type/s present			1	4
Diversity of habitat types			1	4
Sensitivity of the wetland			C (average)	(average)
			1.33	2.67
Sensitivity to changes in floods			2	3
Sensitivity to changes in low flows/dry season			1	3
Sensitivity to changes in water quality			1	2
ECOLOGICAL IMPORTANCE & SENSITIVITY			**(max of A,B or C)**	*(average of A, B or C)*
		Fill in highest score:	**C**	**1.67**
Hydro-Functional Importance			Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		3	4
	Streamflow regulation		3	4
	Water Quality Enhancement	***Sediment trapping***	2	4
		Phosphate assimilation	2	4
		Nitrate assimilation	3	4
		Toxicant assimilation	2	4
		Erosion control	3	4
	Carbon storage		1	4
HYDRO-FUNCTIONAL IMPORTANCE			**(average score)**	**(average confidence)**
			2.38	4
Direct Human Benefits			Score (0-4)	*Confidence (1-5)*
Subsistence benefits	***Water for human use***		0	3
	Harvestable resources		0	4
	Cultivated foods		0	4
Cultural benefits	***Cultural heritage***		0	4
	Tourism and recreation		0	4
	Education and research		0	4
DIRECT HUMAN BENEFITS			(average score)	(average confidence)
			0.00	4

APPENDIX F – RISK ANALYSIS AND MITIGATION MEASURES

General management and good housekeeping practices

The following essential mitigation measures are considered to be standard best practice measures applicable to development of this nature, and must be implemented during all phases of the proposed development activities, in conjunction with those stipulated in Section 7 of this report which define the mitigatory measures specific to the minimisation of impacts on freshwater resources.

Development and operational footprint

- Sensitivity maps have been developed for the study area, indicating the location of the cryptic wetlands and the relevant regulatory zones in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), as shown in Section 6. It is recommended that these sensitivity maps be considered during all phases of the development and with special mention of the planning of any additional infrastructure or relocating the infrastructure footprint, to aid in the conservation of riparian habitat and environmental resources within the study area;
- All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas. It must be ensured that the cryptic wetlands and the associated regulatory zones are off-limits to construction vehicles and personnel;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If additional roads are required, then wherever feasible such roads should be constructed a distance from the more sensitive cryptic wetland / riparian areas and not directly adjacent thereto. If crossings are required they should cross the system at right angles, as far as possible to minimise impacts in the receiving environment, and any areas where bank failure is observed due to the effects of such crossings should be immediately repaired by reducing the gradient of the banks to a 1:3 slope and where needed necessary, installing support structures. This should only be necessary if existing access roads are not utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- The duration of impacts on the freshwater system should be minimised as far as possible by ensuring that the duration of time in which flow alteration and sedimentation will take place is minimised;
- Appropriate sanitary facilities must be provided for the life of the proposed project and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the riparian buffer zones;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

- All areas of increased ecological sensitivity should be marked as such and kept off limits to all unauthorised construction and maintenance vehicles as well as personnel;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage. All vehicles must be regularly inspected for leaks. Re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil; and
- All spills, should they occur, should be immediately cleaned up and treated accordingly.

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the project footprint, particularly as the study area is located within a sensitive area. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)). Removal of species should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ 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 should be kept as small as possible when removing alien plant species*;*
  - No vehicles should be allowed to drive through designated sensitive drainage line and riparian areas during the eradication of alien and weed species.

Cryptic wetland habitat

- Ensure that as far as possible all infrastructure is placed outside of the cryptic wetlands and applicable regulatory zones. If these measures cannot be adhered to, strict mitigation measures will be required to minimize the impact on the receiving freshwater ecosystems. Such measures include those stipulated in Section 7 of this report, in addition to the following:
  - Ensuring that measures are implemented to prevent dirty runoff water entering the receiving freshwater environment; and
  - Ensuring that where necessary, exposed soil in the vicinity of cryptic wetland habitat are protected from erosion by means of reinstating natural vegetation following construction, or installation of an appropriate commercially available product such as Geojute or MacMatR;
  - Any additional measures which may be considered necessary by the project Environmental Officer during the construction and/or operational phases;
- Permit only essential construction personnel within 32m of the cryptic wetlands, if absolutely necessary that they enter the regulatory zone;
- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise environmental damage;
- During the construction phase, no vehicles should be allowed to indiscriminately drive through the wetland or riparian areas;
- The characteristics of the cryptic wetlands could potentially be altered locally, if construction materials, such as rock and rubble created during construction which is likely to have sharp edges (and not the smooth surfaces typically associated with river rocks and pebbles) are not prevented from entering these features. Such material must therefore be prevented from entering the cryptic wetlands or within 50m thereof, and all construction related waste must be must be removed from the study area once construction has been completed; and
- Implement effective waste management in order to prevent construction related waste from entering the freshwater environments.

Soil

- To prevent the erosion of soil, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas particularly susceptible to erosion;
- Install erosion berms during construction to prevent gully formation. Berms every 50m should be installed where any disturbed soil have a slope of less than 2%, every 25m where the track slopes between 2% and 10%, every 20m where the track slopes between 10% and 15% and every 10m where the track slope is greater than 15%;
- Sheet runoff from access roads should be slowed down by the strategic placement of berms and sandbags;
- Maintain topsoil stockpiles below 5 meters in height;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;

- All soil compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision, particularly any riparian crossings. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible and in conjunction with other role players in the catchment.

Rehabilitation

- All soil compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat;
- Rehabilitate all cryptic wetland habitat areas affected by construction to ensure that the ecology of these areas is re-instated during all phases. In this regard, special mention is made of the need to stockpile soil separately during the construction and/or operation phase where relevant in order for these soil to be utilised during the rehabilitation phase;
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;
- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier winter months.
- As much vegetation growth (of indigenous/endemic floral species) as possible should be promoted within the proposed development area in order to protect soil;
- All alien vegetation should be removed from rehabilitated areas and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by construction and operation should be rehabilitated upon completion of the specific construction and operation activity throughout the life of the development;
- Cryptic wetland vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the soil and prevent erosion and incision; and
- It is recommended that a detailed rehabilitation plan be developed by a suitably qualified ecologist prior to commencement of the operations phase in order to address specific rehabilitation requirements.

Table F1: Risk Assessment outcomes for the proposed sports field development.

	Phases	Activity	Aspect	Impact	Wetland impacted	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
1	CONSTRUCTION PHASE	Site preparation prior to construction activities.	Movement of construction equipment	· Loss of wetland vegetation, associated habitat and ecosystem services, associated with the proposed water pipelines; · Indiscriminate movement of construction equipment through the wetlands; · Transportation of construction materials can result in disturbances to soil, and increased risk of sedimentation/erosion; and · Soil and stormwater contamination from oils and hydrocarbons originating from construction vehicles.	CVB wetland	2	2	3	3	**2.50**	1	1	**4.50**	5	1	5	1	**12**	**54.00**	L
					Valley head seep wetland	3	3	3	3	**3.00**	1	1	**5.00**	5	1	5	1	**12**	**60.00**	M
2			· Removal of vegetation and associated disturbances to soil. · Clearing of vegetation within the development footprint including within the wetland habitat of the valley head seep wetland for the construction of the proposed main soccer field.	· Loss of freshwater habitat and ecological structure, particularly along the western portion of the valley head seep wetland associated with the proposed main soccer field; · Exposure of soil, leading to increased runoff, and erosion, and thus increased sedimentation of the wetlands; · Increased sedimentation of the wetlands, leading to smothering of vegetation in the downstream reaches; and · Proliferation of alien and/or invasive vegetation as a result of disturbances.	CVB wetland	1	1	2	2	**1.50**	1	1	**3.50**	5	1	5	1	**12**	**42.00**	L
					Valley head seep wetland	3	3	3	3	**3.00**	1	1	**5.00**	5	3	5	1	**14**	**70.00**	M
3		· Ground-breaking: excavation of foundations, earthworks and building associated with the	· Movement of construction machinery/vehicles within the vicinity of the wetlands;	· Disturbances of soil leading to ponding of water as a result of over compaction of soil in some areas, increased alien vegetation proliferation, and in turn altered wetland habitat and runoff patterns;	CVB wetland	1	1	1	1	**1.00**	1	2	**4.00**	5	2	5	1	**13**	**52.00**	L

	Phases	Activity	Aspect	Impact	Wetland impacted	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
		construction of the proposed main soccer field, terrace, conservancy tank, gravel access road, fence line, parking area and a guardhouse, combi courts, ablution facilities and stands, and walkway within the 500 m GN509 Zone of Regulation.	· Possible spills/leaks from construction vehicles; Earthworks including excavation, infilling and levelling of soil to create a leveled platform, compaction of soil and stockpiling of excess soil;	· Total loss of 0.089 ha of seep wetland habitat as a result of the proposed main soccer field and terrace within the wetland; · Altered runoff patterns, leading to increased erosion and sedimentation of the receiving wetlands;																
4		· Earthworks within the western portion of the valley head seep wetland associated with the proposed main soccer field and terrace.			Valley head seep wetland	5	5	5	5	**5.00**	1	1	**7.00**	5	2	5	1	**13**	**91.00**	M

	Phases	Activity	Aspect	Impact	Wetland impacted	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
5	CONSTRUCTION PHASE	Installation potentially via open trenching of: · the proposed water pipeline within the 32 m NEMA ZoR of the CVB; · the proposed irrigation line within the 32 m NEMA ZoR of the valley head seep wetland; and · the proposed sewer line within 40 m of the wetlands (outside the 32 m NEMA ZoR).	· Excavation and trenching leading to stockpiling of soil; · Movement of construction equipment and personnel within the wetlands.	· Disturbances of soil leading to disturbance to the wetland vegetation and resulting in increased sediment loads in the downgradient areas; · Increased alien vegetation proliferation in the footprint areas, and in turn to altered wetland habitat; and · Altered runoff patterns, leading to increased erosion and sedimentation of the wetlands during rainfall events.	CVB wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
					Valley head seep wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
6		· Stormwater management	· Establishment of stormwater channels and outlet structures are recommended for the management of stormwater and sustainable discharge into the wetlands	· Alterations to the sediment loads within the wetlands; · Potential deposition of waste material into the wetlands; and · Potential changes to the water retention pattern of the wetlands.	CVB wetland	1	1	1	1	**1.00**	1	2	**4.00**	5	1	5	1	**12**	**48.00**	L
					Valley head seep wetland	1	1	1	1	**1.00**	1	2	**4.00**	5	1	5	1	**12**	**48.00**	L

	Phases	Activity	Aspect	Impact	Wetland impacted	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
7	OPERATIONAL PHASE	· Small-scale rehabilitation of the area	· Proactive monitoring to identify early signs of alien vegetation encroachment; · Small-scale rehabilitation of the valley head seep wetland; · Re-vegetation of surrounding wetland areas, remove any obstructions to flow; · Alien and invasive plant removal.	· Soil compaction within the wetlands; · Potential sedimentation of the valley head seep wetland due to activities within the wetland; and · Impacts to water quality of the wetlands as a result of the application of herbicides.	CVB wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
					Valley head seep wetland	1	2	2	2	1.8	1	1	3.8	5	2	5	1	13	48.75	L
8		· Operation of the proposed sports field development	· Increased impermeable surfaces due to the presence of roofs, parking areas, access roads, etc.; · Potential indiscriminate movement of vehicles within the freshwater ecosystems for perimeter inspections/ maintenance.	· Altered runoff patterns and increased water inputs to the receiving wetlands, resulting in altered flow regime; · Altered flow regime may lead to changes to an impacts on vegetation as a result; · Proliferation of alien and invasive plant species within the wetlands.	CVB wetland	2	2	3	3	**2.50**	1	1	**4.50**	5	1	5	1	**12**	**54.00**	L
					Valley head seep wetland	2	2	3	3	**2.50**	1	1	**4.50**	5	1	5	1	**12**	**54.00**	L
9		· Operation of the proposed water pipeline	· Potential leakage of water from the pipelines.	· Possible incision and alteration of the hydroperiod of the downgradient wetlands; · Potential impacts to the water quality of the wetland	CVB wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
					Valley head seep wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L

	Phases	Activity	Aspect	Impact	Wetland impacted	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph & Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
10		· Operation and maintenance of conservancy tanks and associated infrastructure	· Possible indiscriminate movement of waste removal vehicles leading to damage to the conservancy tanks.	· Potential failure of infrastructure resulting in anaerobic conditions within the conservancy tanks and possible spillage and runoff of sewage from the conservancy tanks into the wetlands decreasing the quality of surface water; · The anaerobic conditions in the conservancy tank system could lead to a decrease in effluent quality which may enter the wetlands.	CVB wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
					Valley head seep wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
11		· Monitoring of the sewer and water pipelines, and operation of the stormwater management system.	· Proactive monitoring to ensure structural integrity is maintained.	· Compaction of soil and loss of habitat as a result of ongoing disturbance from vehicles and equipment; and · Disturbance of soil which could lead to erosion.	CVB wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L
					Valley head seep wetland	1	1	1	1	**1.00**	1	1	**3.00**	5	1	5	1	**12**	**36.00**	L

APPENDIX G: DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Rabia Mathakutha	MSc Plant Science (University of Pretoria)
Nqobile Lushozi	MSc Geoinformatics (Stellenbosch University)
Stephen van Staden	MSc (Environmental Management) (University of Johannesburg)

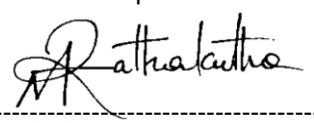
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services (Pty) Ltd		
Name / Contact person:	Rabia Mathakutha		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville,		
Postal code:	7539	Cell:	083 739 2284
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	rabia@sasenvgroup.co.za		
Qualifications	MSC Plant Science		
Registration / Associations	Registered Candidate Member of the South African Council for Natural Scientific Professions (SACNASP)		

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

I, Rabia Mathakutha, declare that -

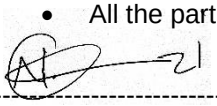
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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



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

I, Kim Marais, 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



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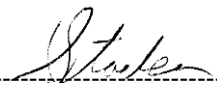
1. (b) a declaration that the specialist is independent in a form as may be specified by the competent authority

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

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF RABIA MATHAKUTHA

PERSONAL DETAILS

Position in Company	Field Ecologist Wetland ecology
Joined SAS Environmental Group of Companies	2020

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate member of the South African Council for Natural Scientific Professions (SACNASP – Reg. No. 120040)
Member of the Western Cape Wetland Forum (WCWF)
South African Association of Botany (SAAB)

EDUCATION

Qualifications

MSc Plant Science (University of Pretoria)	2018
BSc (Hons) Environmental Science (Biogeography) (University of KwaZulu-Natal)	2015
BSc Environmental Science (Life Science stream) (University of KwaZulu-Natal)	2014

Short Courses

Official DWS Section 21 (c) and (i) Water Use Authorisation Course	2018
Basic and Applied Statistics in R	2016

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga
Africa – Lesotho, Mozambique

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
- Plant Species Plan

SAS ENVIRONMENTAL GROUP OF COMPANIES – SPECIALIST CONSULTANT INFORMATION CURRICULUM VITAE OF NQOBILE LUSHOZI

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

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

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

Soil, Land use, Land Capability and Agricultural Potential Studies

- Soil contamination assessment

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
Tools for wetland assessment short course Rhodes University	2016
Legal liability training course (Legricon Pty Ltd)	2018
Hazard identification and risk assessment training course (Legricon Pty Ltd)	2013

Short Courses

Certificate – Department of Environmental Science in Legal context of Environmental Management, Compliance and Enforcement (UNISA)	2009
Introduction to Project Management - Online course by the University of Adelaide	2016
Integrated Water Resource Management, the National Water Act, and Water Use Authorisations, focusing on WULAs and IWWMPs	2017

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

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

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

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
- Plant species and Landscape Plan
- Freshwater Offset Plan
- 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 Assemblage Integrity Index (FRAI)
- Fish Health Assessments
- Riparian Vegetation Integrity (VEGRAI)
- Toxicological Analysis
- Water quality Monitoring
- Screening Test
- Riverine Rehabilitation Plans

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Soil Monitoring
- Soil Mapping

Visual Impact Assessment

- Visual Baseline and Impact Assessments
- Visual Impact Peer Review Assessments
- View Shed Analyses
- Visual Modelling

Legislative Requirements, Processes and Assessments

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