WATERCOURSE AND AQUATIC ECOLOGICAL ASSESSMENT AS PART OF THE WATER USE LICENCE APPLICATION PROCESS FOR VARIOUS ACTIVITIES FOR THE EKLAND SAFARI LODGE, NEAR LOUIS TRICHART, LIMPOPO PROVINCE

Prepared for

Aurecon Environmental Services

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EXECUTIVE SUMMARY

Based on the findings of the freshwater ecological assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed Lion Lodge Development within 150m of a pan wetland will not pose a direct impact to the wetland. The operation of the existing water uses that require water use authorisation (the Sulphur Spring Spa adjacent to a wetland flat, a boundary fence crossing the Mutamba River, and earth berms within ephemeral drainage lines) was determined to pose a Low risk significance to the watercourses, provided that all mitigation measures as stipulated in this report are adhered to. This is essential to ensure that the ecological integrity of the watercourses in the study area is not further compromised.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Water Use Licence Application (WULA) process for various activities (proposed and existing) associated with the Ekland Safari Lodge, near Louis Trichard, Limpopo Province, hereafter referred to as the 'study area'. Due to the extent of the study area, only areas where water uses were identified by the proponent, were investigated. These areas (seven in total) within the larger study area will hereafter be referred to as the 'focus areas'.

Several existing and proposed activities within the study area (as provided by the proponent) requires authorisation by means of a Water Use Licence Application (WULA) in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). A description of the locality and applicable water uses of each of the focus areas are provided below:

Table A: A description of the water uses associated with the different Focus Areas.

Focus Area	Locality	Applicable watercourse	Applicable Section 21 activities	Description of water uses
1	Located in the north eastern portion of the study area, approximately 2km east of the N1.	Pan wetland 1	Section 21 (c) and (i)	Construction of a 60-sleeper lodge, known as the Lion Farm Lodge (Figure 3).
2	Located in the north eastern portion of the study area, approximately 1km east of the N1.	Artificial impoundment (Dam 1)	Section 21 (a) and (b)	Water pumped from boreholes is stored in this impoundment. This artificial impoundment is currently used for recreational purposes.
3	Located on the central eastern boundary of the study area, approximately 50m west of the N1.	Mutamba River	Section 21 (c) and (i)	An existing palisade and concrete fence traverses the Mutamba River.
4	Located in the central portion of the study area, approximately 3,1km west of the N1.	Wetland flat	Section 21 (c) and (i)	The existing Sulphur Spring Spa (Figure 4) is constructed at least 32m from the natural and delineated boundary of a wetland.
5	Located in the central portion of the study area, approximately 750m west of the N1.	Pan wetland 2	Section 21 (c) and (i)	An earth berm is located on the north eastern boundary of the watercourse.

Focus Area	Locality	Applicable watercourse	Applicable Section 21 activities	Description of water uses
6	Located in the south eastern portion of the study area, approximately 1,6km west of the N1.	Ephemeral drainage line	Section 21 (a), (b), (c) and (i)	An artificial impoundment (Dam 2) was historically constructed in the watercourse. Borehole water is pumped and stored in this dam.
7	Located in the south eastern portion of the study area, approximately 190m west of the N1.	Ephemeral drainage line	Section 21 (a), (b), (c) and (i)	An artificial impoundment (Dam 3) was historically constructed in the watercourse. Borehole water is pumped and stored in this dam.

A desktop study was conducted in which watercourses 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. In order to identify all watercourses that may potentially be impacted by proposed activities (where applicable), a 500m "zone of investigation" around each focus area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), was used as a guide in which to assess possible sensitivities of the receiving freshwater environment. This area – i.e. the 500m zone of investigation around the focus areas - will henceforth be referred to as the "investigation area".

During the site assessment undertaken several watercourses were identified within the seven identified focus areas, consisting of three hydrogeomorphic (HGM) units (two pan wetlands, a wetland flat and riparian systems, including the Mutamba River and ephemeral drainage lines). A large artificial impoundment ('Dam 1') is located in Focus Area 2. Based on the digital satellite imagery and the outcome of the site assessment, Dam 1 is not hydrologically connected to any natural watercourses and can be described as an artificial feature. Dam 1 is therefore not considered a natural watercourse as it does not conform to the definition of a true watercourse as per the National Water Act, 1998 (Act No. 36 of 1998), thus no further ecological assessment of this feature was undertaken.

A summary of the assessment of the watercourses associated with the relevant focus areas is provided in Table B below:

Table B: Summary of results of the field assessment of the watercourses associated with the focus areas.

Watercourse	Focus Area	PES	Ecoservices	EIS	REC and RMO
Pan wetland 1	1	B (Largely natural with few modifications)	Moderately low	Moderate	REC Category: B (Largely natural with few modifications) BAS Category: B (Moderately modified) RMO: Maintain
Mutamba River	3	B/C (Largely natural with modifications)	Moderately High	High	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Wetland flat	4	B/C (Largely natural with modifications)	Intermediate	High	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Pan wetland 2	5	C (Moderately modified)	Intermediate	Moderate	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Ephemeral Drainage Lines (EDLs)	5, 6 and 7	C (Moderately modified)	Intermediate	Moderate	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain

Following the assessment of the watercourses, the DWS approved Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts (of the proposed and existing water use activities) on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the watercourses associated with the focus areas.

Table C: Summary of the results of the DWS risk assessment applied to watercourses associated with Focus Areas 1 and 3 to 7.

Phases	Activity	Significance	Risk Rating
Construction Phase	Construction of the Lion Lodge development (focus area 1) approximately 150m north west of pan wetland 1 (outside the catchment of the pan wetland). ➢ Disturbances of soils leading to the establishment of alien vegetation within the buffer zone of the wetland (albeit not in its catchment); ➢ Increase of movement and construction vehicles surrounding the wetland may have a noise impact which can disturb the biota residing in the immediate vicinity of the wetland.	24	L
Operational Phase	Operation of the Lion Lodge development (focus area 1) approximately 150m north west of pan wetland 1 (outside the catchment of the pan wetland). ➢ Proliferation of alien and invasive plant species within the buffer zone of the wetland, decreasing the potential habitat provisioning.	28	L
	Operation of the concrete and grid fence crossing the Mutamba River (focus area 3). ➢ Reduced hydrological connectivity and functioning; ➢ Disturbance to habitats and their associated biota; ➢ Reduced capacity of the river to provide habitat due to alien and invasive species invasion.	52	L
	Operation of the Sulphur Spring Spa on the boundary of the wetland flat in focus area 4. ➢ Compaction of wetland soils; ➢ Disturbance to the wetland habitat and biota; ➢ Invasion of alien and invasive vegetation species. ➢ Decreasing the surface water quality of the wetland; ➢ Degradation to the habitat provisioning of the wetland; ➢ Possible incision and alteration of the hydroperiod of the wetland.	51,75	L
	Operation of the earth berms in the ephemeral drainage lines in focus areas 5, 6 and 7, and pan wetland 2 in focus area 5. ➢ Loss of aquatic biodiversity downstream of the earth berms; ➢ Fish migration barrier (only when sufficient surface water is present to host such species); ➢ Terrestrial vegetation encroachment downstream of the dam; ➢ Creating new aquatic habitats and altering freshwater and riparian vegetation due to inundation (Positive Impact); ➢ Backfilling of soil and compaction thereof to infill the existing erosion gullies can lead to trampling of established riparian vegetation; ➢ Potential increase of the sediment load of the EDLs due to imported soils in the EDLs; ➢ Invasion of alien and invasive species can reduce the habitat provided by the EDLs.	52,5	L

Based on the findings of the freshwater ecological assessment, several recommended mitigation measures are made to minimise the impact on the watercourses. Key mitigation measures include (but are not limited to):

- It is strongly advised the steel grid structure atop the concrete base (focus area 3) be spaced a minimum of 150mm between the balusters to allow free movement of smaller faunal species through the fence (thus allowing for migratory movement), but still maintain security of the reserve;
- Where erosion is noted at the concrete base, it must be infilled and compacted or protected from erosion by other means;
- All alien and invasive vegetation species must be eradicated where disturbances to the river has occurred. These species must be removed by hand (no mechanical nor chemical treatments allowed), since the alien vegetation species identified within the river is saplings and can easily be removed;
- During general maintenance activities of the Sulphur Spring Spa (Focus Area 4), no personnel may be permitted to enter the wetland flat, unless it entails maintenance activities of the wetland;

- As the wetland flat (Focus Area 4) is expanded and wetland vegetation has been planted in this area, it is recommended that no further landscaping takes place and allows for the wetland species to establish and proliferate. However, the control of alien and invasive species must be implemented, and such species regularly monitored, to prevent the spread thereof while the wetland vegetation is still establishing;
- No fertilisers may be added to the wetland flat to encourage wetland vegetation growth and the release of spring water into the wetland must be controlled to promote zonation of the wetland;
- Sufficient water quantities must be released (via spillway during high flow periods or pipe outlet during low flow periods) to ensure ongoing functioning of the EDLs (Focus Areas 5, 6 and 7), and ultimately ensure maintenance of the downstream Mutamba River water quantity, habitat, biota, and water quality resource quality objectives (RQO's);
- The earth berms and the EDL embankments (Focus Areas 5, 6 and 7) must be reinstated with a minimum slope ratio of 3:1, although a 5:1 ratio is recommended. This will prevent any further erosion from occurring and provide a stable enough slope for vegetation to establish on;
- Where hard engineering structures are required to stabilise the earth berms or the spillway (due to extensive erosion), use should be made of gabion baskets or reno mattresses, in consultation with a civil engineer and a freshwater specialist. The use of these methods should be minimised as far as possible;
- All disturbed areas must be revegetated with indigenous vegetation species. A graminoid mix is recommended to be established on the earth berms, while appropriate facultative riparian species be considered for the portions of the EDLs where erosion gullies will be rehabilitated.

Based on the findings of the watercourse assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed Lion Lodge development (Focus Area 1) is located in a different local catchment from pan wetland 1, no negative impacts from the construction, nor operation of the lodge development is expected to occur. The operation of the existing water uses (boundary fence, the Sulphur Spring Spa and the earth berms) also pose a Low risk significance to the ecological integrity of the watercourses. Adherence to cogent, well-conceived and ecologically sensitive site development and maintenance plans, the mitigation measures provided in this report as well as general good construction practice and ongoing management, maintenance and monitoring, are essential if the significance of perceived impacts is to be reduced to limit further degradation of the freshwater environment.

It is the opinion of the freshwater specialist that the proposed and existing activities, from a freshwater resource management perspective, are considered acceptable provided that strict adherence to all mitigation measures as stipulated within this report takes place.

DOCUMENT GUIDE

The following table indicates the requirements for Specialist Studies as per Appendix 6 of Government Notice 326 of 2017, amendments to the Environmental Impact Assessment (EIA) Regulations, 2014 as it relates to the National Environmental Management Act, 1998 (Act No. 107 of 1998), promulgated in Government Notice 40772 of 2017.

No.	Requirement	Section in report
a)	Details of -	
(i)	The specialist who prepared the report	Appendix G
(ii)	The expertise of that specialist to compile a specialist report including a curriculum vitae	Appendix G
b)	A declaration that the specialist is independent	Appendix G
c)	An indication of the scope of, and the purpose for which, the report was prepared	Section 1.2
cA)	An indication of the quality and age of base data used for the specialist report	Section 2.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 4.1 and 5.1
d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3.1
e)	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Appendix C
f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 5
g)	An identification of any areas to be avoided, including buffers	Section 5.3
h)	A map superimposing the activity including the associated structure and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 5.3
i)	A description of any assumption made and any uncertainties or gaps in knowledge	Section 1.3
j)	A description the findings and potential implication\s of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities	Section 5, 6, and 7
k)	Any mitigation measures for inclusion in the EMPr	Section 6.1
l)	Any conditions for inclusion in the environmental authorisation	Section 6
m)	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 6
n)	A reasoned opinion -	
(i)	As to whether the proposed activity, activities or portions thereof should be authorised	Section 7
(iA)	Regarding the acceptability of the proposed activity or activities	Section 7
(ii)	If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 7
o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/A
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q)	Any other information requested by the competent authority	N/A

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, 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 flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils 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 soils, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

BAR	Basic Assessment Report
BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
°C	Degrees Celsius.
CBA	Critical Biodiversity Area
C-Plan	Conservation Plan
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
EMP	Environmental Management Program
ESA	Ecological Support Area
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
m	Meter
MAP	Mean Annual Precipitation
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SA RHP	South Africa River Health Programme
SAS	Scientific Aquatic Services
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
UCVB	Unchannelled Valley Bottom
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Area
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use Licence Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Water Use Licence Application (WULA) process for various activities (proposed and existing) associated with the Ekland Safari Lodge, near Louis Trichard, Limpopo Province, hereafter referred to as the 'study area'. The study area is depicted in Figures 1 and 2 (please refer to Section 2 for the project description). Due to the extent of the study area, only areas where water uses were identified by the proponent, were investigated. These areas (seven in total) within the larger study area will hereafter be referred to as the 'focus areas'.

In order to identify all watercourses that may potentially be impacted by proposed activities (where applicable - please refer to Section 2 for the project description), a 500m "zone of investigation" around each focus area, in accordance with Government Notice (GN) 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), was used as a guide in which to assess possible sensitivities of the receiving freshwater environment. This area – i.e. the 500m zone of investigation around the focus areas - will henceforth be referred to as the "investigation area".

The purpose of this report is to define the ecology of the area in terms of watercourse characteristics, including mapping of the watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), and to define the Present Ecological State (PES) of the watercourses associated with the focus areas. Additionally, this report aims to define the socio-cultural and ecological service provision of the watercourses and the Recommended Management Objectives (RMO) and Recommended Ecological Category (REC) for the watercourses. It is a further objective of this study to provide detailed information when considering the proposed and existing activities in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystems, such that local and regional conservation requirements and the provision of ecological services in the local area are supported while considering the need for sustainable economic development.

Additionally, this document presents the results of the aquatic ecological assessment performed during winter (July 2019) when the Mutamba River system was dry. This report includes a desktop assessment of the aquatic ecosystems and a field assessment. The latter

includes an assessment of the general habitat integrity and the riparian vegetation response assessment index. The following aquatic ecological indices could not be applied due to the lack of flow; *in-situ* water quality analysis, habitat availability for aquatic macro-invertebrates, aquatic macro-invertebrate and fish community integrity assessments.

The Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) as it relates to activities as stipulated in Section 21(c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998) was applied to determine the significance of the perceived impacts associated with the proposed activities, and the operational impacts of the existing activities on the receiving freshwater environment. In addition, mitigatory measures were developed which aim to minimise the perceived impacts associated with the proposed activities, followed by an assessment of the significance of the impacts after mitigation, assuming that they are fully implemented.

This report, after consideration and a description of the ecological integrity of any watercourses associated with the focus areas, must guide the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed and existing activities from a watercourse management point of view.

1.2 Scope of Work

1.2.1 Watercourse Assessment

Specific outcomes relating to the watercourse assessment are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database and the Limpopo Conservation Plan (2013) database) was undertaken to aid in defining the PES and EIS of the watercourses;
- The watercourse associated with the study area was delineated according to "Department of Water Affairs and Forestry (DWAF)[1] (2005)[2]: A practical field procedure for identification of wetlands and riparian areas". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the watercourse;

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

- All watercourses within the investigation area were delineated using desktop methods in accordance with GN509 of 2016 as it relates to activities as stipulated in Section 21 (c) and (i) of the National Water Act, 1998 (Act No. 36 of 1998);
- The watercourse classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis *et al*., 2013);
- The EIS of the watercourses associated with the focus areas were determined according to the method described by Rountree and Kotze (2013);
- The PES of the watercourses associated with the focus areas were determined according to the resource-directed measures as per the WET-Health guideline of Macfarlane *et al.* (2008);
- The watercourses were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the focus areas. In addition to the watercourse boundaries, the appropriate provincial recommended buffers and legislated zones of regulation were depicted where applicable;
- Allocation of a suitable RMO, REC and Best Attainable State (BAS) to the watercourses associated with the focus areas based on the results obtained from the PES and EIS assessments;
- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the watercourses as a result of the construction phase of the proposed activities and the operational impacts of the existing activities, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving freshwater environment.

1.2.2 Aquatic Ecological Assessment

Best practice methodologies (detailed methodologies provided in Appendix C) were used to assess the aquatic ecological integrity of the monitoring sites (focus area 3) based on water quality, instream and riparian habitat conditions and biological impacts and integrity. All work was undertaken by a South African River Health Program (SA RHP) accredited assessor. Factors investigated included the following (where conditions allowed/surface water was present):

- Visual conditions of the site;
- On-site testing of biota specific water quality parameters could not be performed as the sites were dry at the time of assessment;

- Habitat suitability for aquatic macro-invertebrates using the Integrated Habitat Assessment System (IHAS) method according to the protocol of McMillan (1998) and the assessment of the general habitat integrity of the site (based on the application of the Index of Habitat Integrity (IHI) of Kleynhans *et al.* (2008)) could not be performed due to the lack of flow. Nevertheless, use was made of the Riparian Vegetation Response Assessment Index (VEGRAI) (Kleynhans *et al.*, 2007b) to assess the riparian vegetation and to use the outcome of this assessment to provide an overview of the ecological condition of the Mutamba River;
- Macro-invertebrate biological monitoring indices such as the South African Scoring System version 5 (SASS5) as defined by Dickens & Graham (2002) and Macro-Invertebrate Response Assessment Index (MIRAI) Ecostatus tool as described by Thirion (2007) could not be applied due to lack of surface water in the Mutamba River. However, aquatic macro-invertebrates expected within the Mutamba River system were derived from the DWS Resource Quality Information Services (RQIS) PES/EIS database;
- The integrity of the fish community could also not be assessed, as the Fish Response Assessment Index (FRAI) as described by Kleynhans (2007) could not be applied due to lack of surface water in the Mutamba River;
- The EIS of the aquatic resources was determined according to the protocols of DWAF (1999); and
- The DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the Mutamba River as a result of the operational impact of the existing boundary fence crossing (focus area 3), provide possible mitigation measures, monitoring requirements and to aim to quantify the significance thereof.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this assessment:

- The determination of the watercourse boundaries and the assessment thereof, is confined to the watercourses associated with the focus areas. All watercourses identified within 500m of the focus areas were delineated in fulfilment of GN509 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) using desktop methods; however, these watercourses were not assessed individually. The general surroundings were considered in the desktop assessment of the focus areas;
- Due to access constraints relating to the safety of the specialist, given that the study area is a big game reserve, limitations were experienced in the verification of some portions of the watercourses within the focus areas. These delineations were supplemented with delineations based on desktop assessment methods.

Nevertheless, 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. If more accurate assessments are required, the watercourse will need to be surveyed and pegged according to surveying principles;

- Due to the degree to which some areas have been disturbed within certain focus areas, the watercourse delineations as presented in this report are regarded as a best estimate of the watercourse boundaries based on the site conditions present at the time of assessment (during the winter season). Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur;
- Future construction activities are only proposed in focus area 1, for which the DWS Risk Assessment Matrix (2016) was applied to identify potential impacts that may affect the watercourses as a result of the construction and operational phase activities. All other water uses within focus areas 3 to 7 are existing, thus the DWS Risk Assessment Matrix (2016) was applied considering only the operational phase impacts of these water uses and possible mitigation measures that should be implemented to reduce operational impacts;
- Freshwater 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 watercourse boundary may occur. However, if the DWAF (2005) method is followed, all assessors should get largely similar results. Due to seasonal constraints the use of the vegetation indicator was limited in certain focus areas;
- Due to the majority of watercourses being ephemeral within the region, very few areas were encountered that displayed more than one watercourse characteristic as defined by the DWAF (2005) method (such as containing alluvial or inundated soils, or hosts vegetation adapted to saturated conditions). As a result, identification of the outer boundary of the temporary watercourse zones and marginal riparian zones proved difficult in some areas and, in particular, in the areas where watercourse conditions and riparian zones are marginal. Therefore, the watercourse delineations as presented in this report are regarded as a best estimate of the watercourse boundaries based on the site conditions present at the time of assessment; 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 watercourses have been accurately assessed and considered, based on the field observations in terms of freshwater ecology.

Specific assumptions and limitations applicable to the aquatic ecological assessment (of the Mutamba River in focus area 3):

- ***Reference conditions are unknown:*** The composition of aquatic biota in the Mutamba River, prior to the disturbance (construction of the existing boundary fence crossing – focus area 3), is unknown. For this reason, reference conditions are hypothetical, and are based on professional judgement and/or inferred from limited data available such as the Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database as discussed in Section 4.2.
- ***Temporal variability:*** The data presented in this report is based on a single site visit undertaken during the winter season (July 2019). The effects of natural seasonal and long-term variation in the ecological conditions and aquatic biota found in the system is, therefore, unknown. Ideally aquatic assessments should be undertaken, as a minimum in the summer/high flow and winter/low flow seasons to account for and define seasonal variability. However, consideration was given to local data on the DWS RQIS PES/EIS database which assists in understanding variability in the system, and thus ensures that observations and discussions on impacts are adequately understood to inform this study;
- ***Ecological assessment timing:*** Aquatic and terrestrial ecosystems are dynamic and complex. It is possible that aspects, some of which may be important, could have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low flow and high flow conditions. Due to the episodic nature of the Mutamba River which was dry at the time of the assessment, the observations made in this study are deemed adequate to provide the information required to define the risk to the aquatic ecosystem and to ensure that sufficient insight into management and mitigation measures is provided to adequately protect the system and to maintain the PES of the system.

1.4 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);
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- The Limpopo Environmental Management Act (Act No. 7 of 2003) (LEMA); 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).

2 PROJECT DESCRIPTION

The study area is located approximately 20km north of Louis Trichard, Limpopo Province. The N1 is located on the south eastern boundary of the study area and traverses the central northern portion thereof. The study area is a privately owned game farm and lodge, with predominantly untransformed areas consisting of vegetation typical to that of the Savanna biome. Cultivated areas (albeit limited) are located within the south eastern portion of the study area.

Several existing and proposed activities within the study area (as provided by the proponent) requires authorisation by means of a Water Use Licence Application (WULA) in terms of Section 21 of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). The areas where these water uses are located are hereafter referred to as the 'focus areas'. The following Section 21 water use activities are associated with this project:

(a) taking water from a water resource;
(b) storing water;
(c) impeding or diverting the flow of water in a watercourse; and
(i) altering the bed, banks, course or characteristics of a watercourse;

A description of the locality and applicable water uses of each of the focus areas are provided below:

Table 1: A description of the water uses associated with the different focus areas.

Focus Area	Locality	Applicable watercourse	Applicable Section 21 activities	Description of water uses
1	Located in the north eastern portion of the study area, approximately 2km east of the N1.	Pan wetland 1	Section 21 (c) and (i)	Construction of a 60-sleeper lodge, known as the Lion Farm Lodge (Figure 3).
2	Located in the north eastern portion of the study area, approximately 1km east of the N1.	Artificial impoundment (Dam 1)	Section 21 (a) and (b)	Water pumped from boreholes is stored in this impoundment. This artificial impoundment is currently used for recreational purposes.
3	Located on the central eastern boundary of the study area, approximately 50m west of the N1.	Mutamba River	Section 21 (c) and (i)	An existing palisade and concrete fence traverses the Mutamba River.
4	Located in the central portion of the study area, approximately 3,1km west of the N1.	Wetland flat	Section 21 (c) and (i)	The existing Sulphur Spring Spa (Figure 4) is constructed at least 32m from the natural and delineated boundary of a wetland (Figure 4).
5	Located in the central portion of the study area, approximately 750m west of the N1.	Pan wetland 2	Section 21 (c) and (i)	An earth berm is located on the north eastern boundary of the watercourse.
6	Located in the south eastern portion of the study area, approximately 1,6km west of the N1.	Ephemeral drainage line	Section 21 (a), (b), (c) and (i)	An artificial impoundment (Dam 2) was historically constructed in the watercourse. Borehole water is pumped and stored in this dam.
7	Located in the south eastern portion of the study area, approximately 190m west of the N1.	Ephemeral drainage line	Section 21 (a), (b), (c) and (i)	An artificial impoundment (Dam 3) was historically constructed in the watercourse. Borehole water is pumped and stored in this dam.

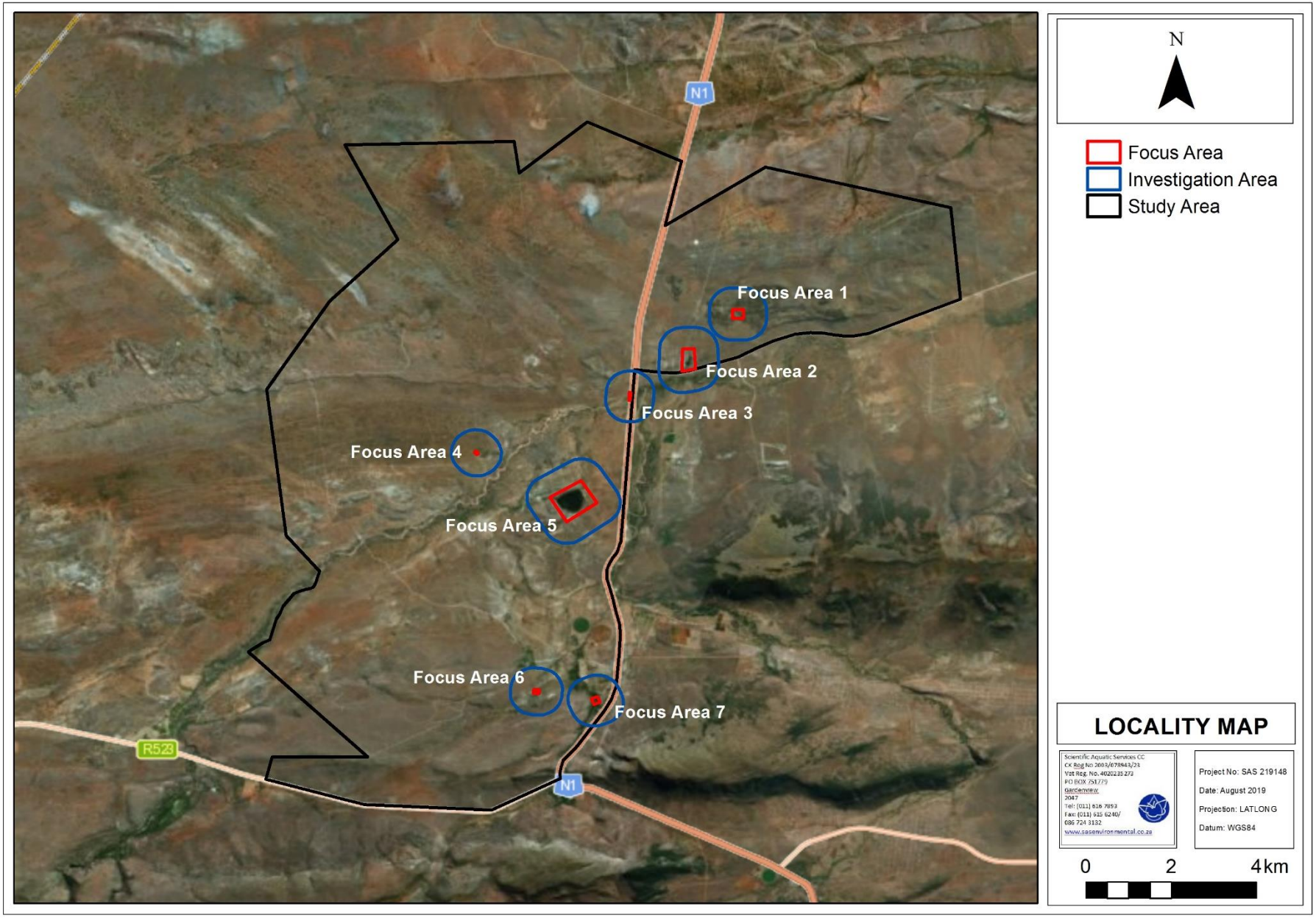


Figure 1: A digital satellite image depicting the location of the focus and investigation areas in relation to the surrounding environment.

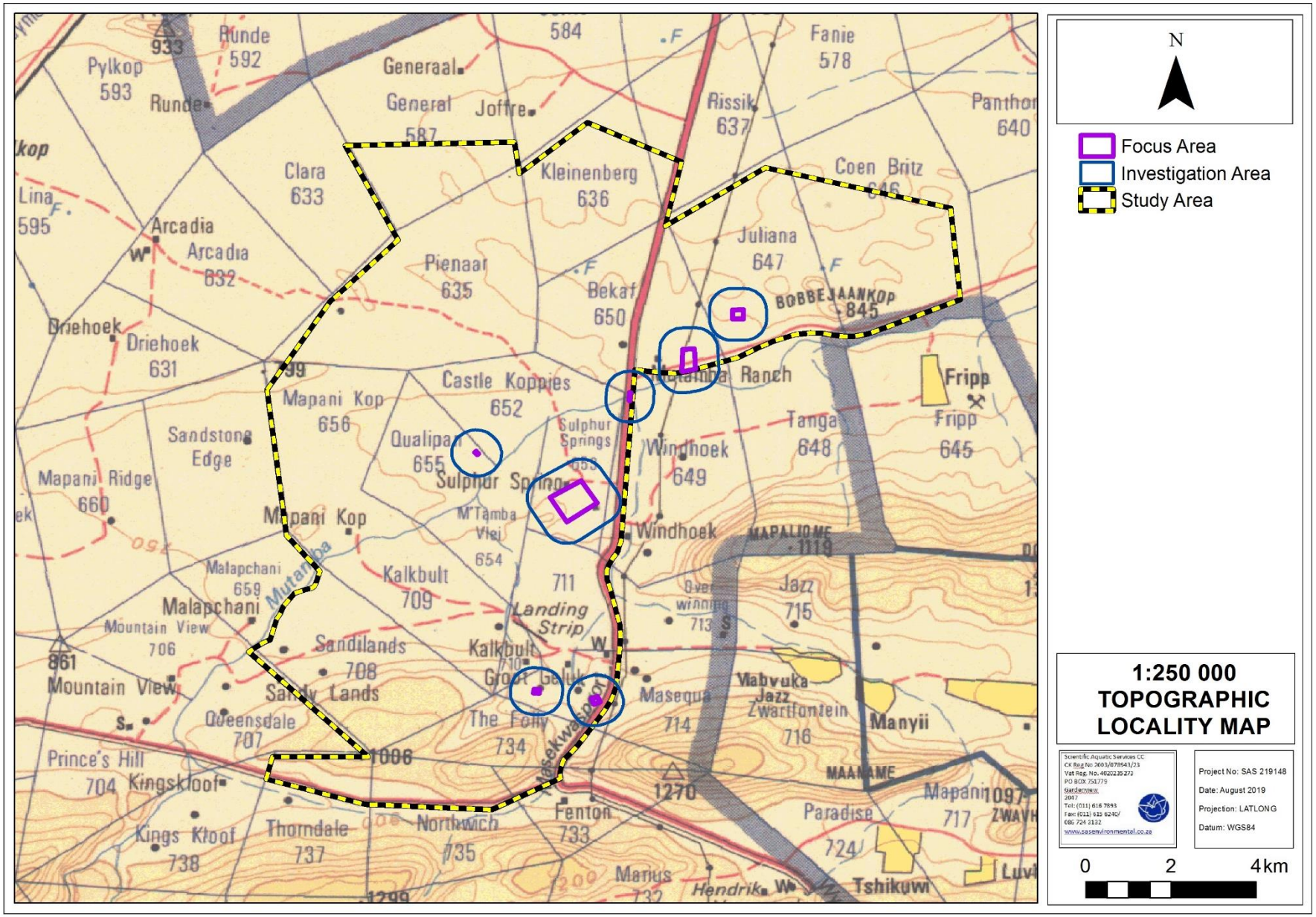


Figure 2: The focus and investigation areas depicted on a 1:50 000 topographical map in relation to the surrounding environment.

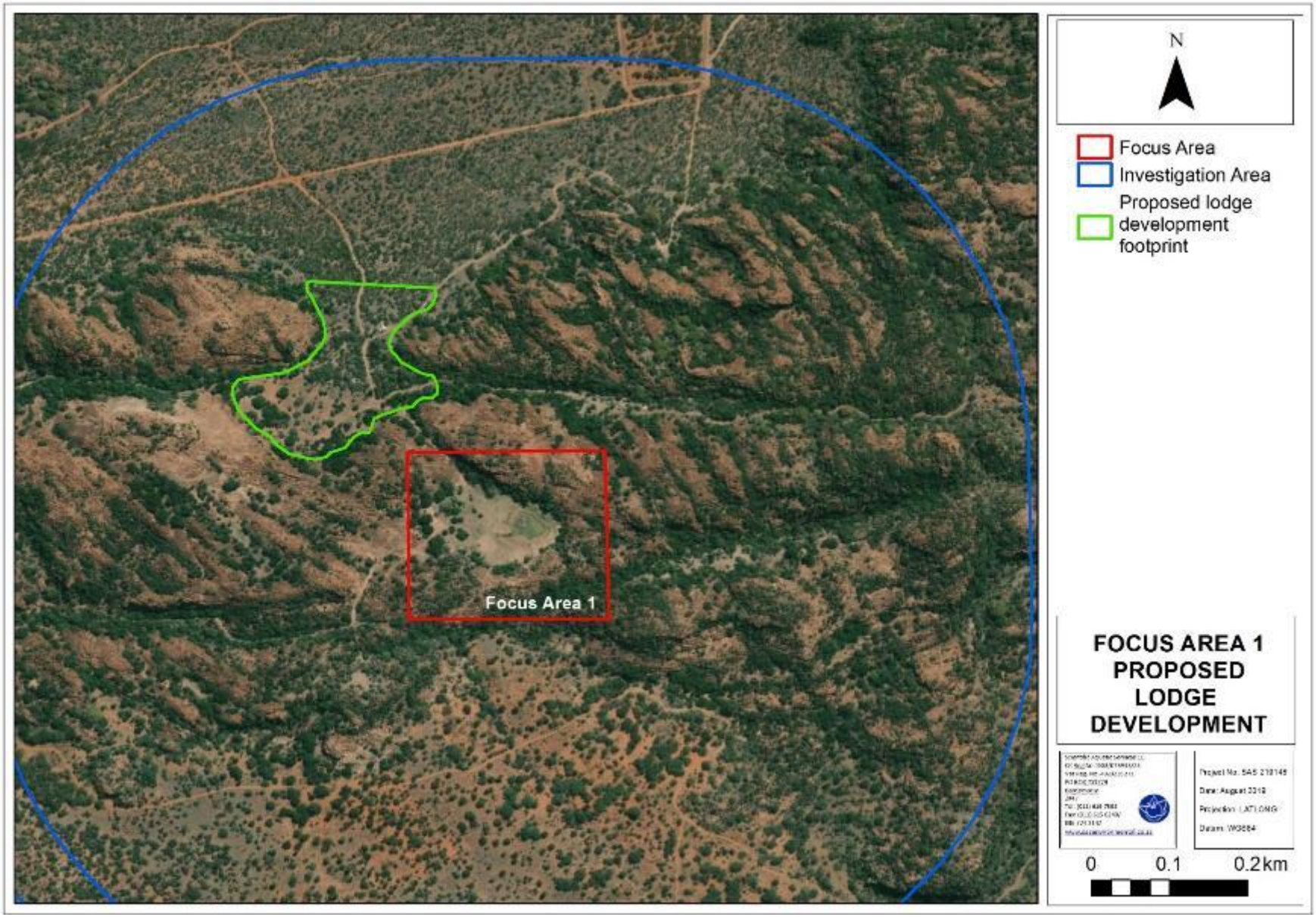


Figure 3: The proposed lodge development located north west of Focus Area1.

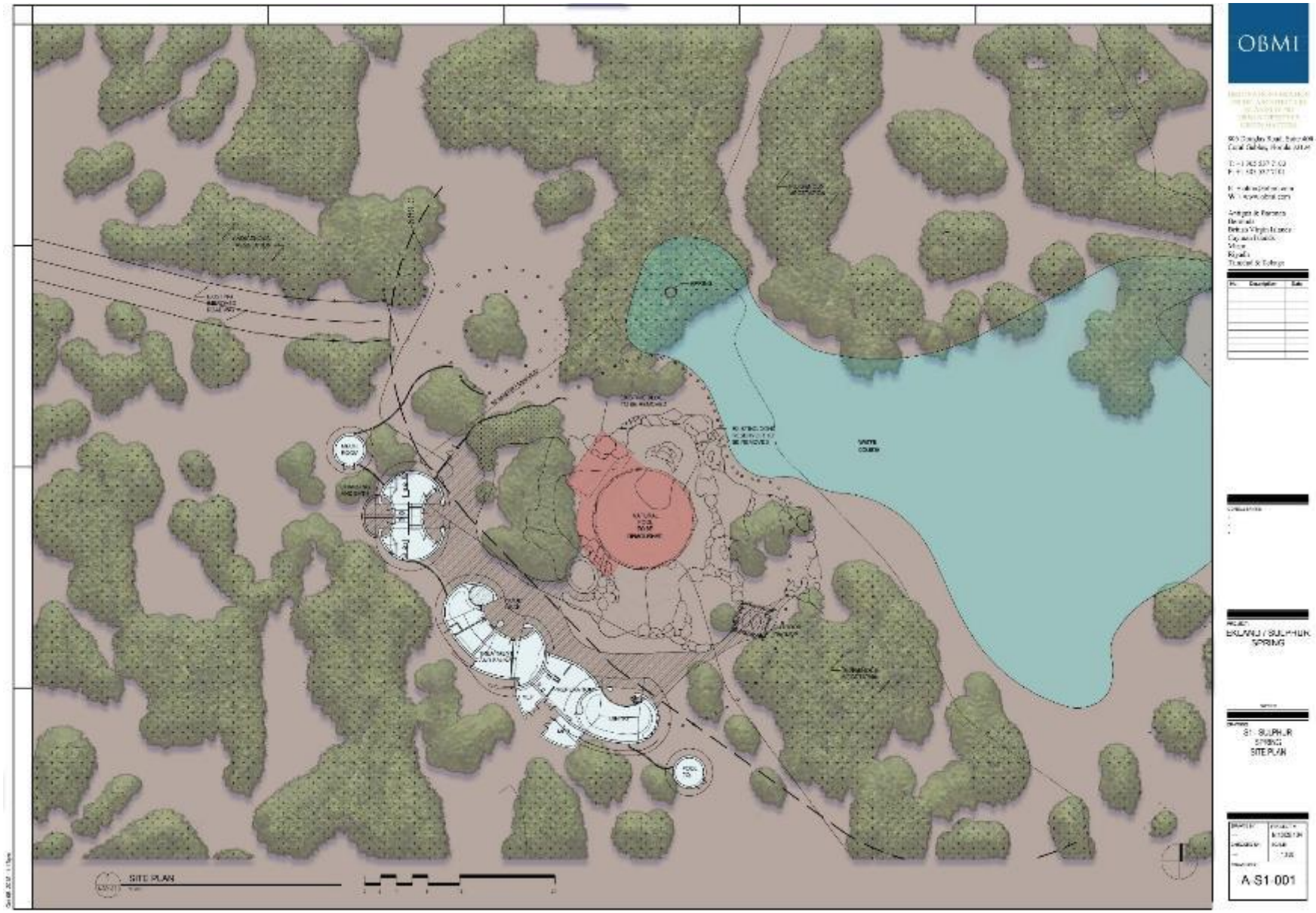


Figure 4: The proposed layout of the Sulphur Spring Spa, located in Focus Area 4.

3 ASSESSMENT APPROACH

3.1 Watercourse Field Verification

For the purposes of this investigation, the definition of a watercourse, riparian habitat and a wetland were taken as per that in the National Water Act, 1998 (Act No. 36 of 1998). The definitions are as follows:

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.

Riparian habitat includes the physical structure and associated vegetation of areas associated with a watercourse which are commonly characterised 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 land areas**.**

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."

A field assessment was undertaken on the 1st and 2nd of July 2019, during which the presence of any freshwater characteristics as defined by DWAF (2008) and by the National Water Act, 1998 (Act No. 36 of 1998), were noted (please refer to Section 5 of this report). The watercourse delineation took place, as far as possible, according to the method presented in "A practical field procedure for identification and delineation of wetlands and riparian areas" published by DWAF in 2005. The foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

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

- Vegetation adapted to saturated soils.

In addition to the delineation process, a detailed assessment of the watercourse associated with the study area was undertaken, whereby factors affecting the integrity of the watercourse were taken into consideration and aided in the determination of the functioning as well as the provision of ecological and socio-cultural services by the watercourse. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

3.2 Sensitivity Mapping

The watercourse associated with the study area was delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project the feature onto digital satellite imagery and topographic maps.

3.3 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 lodge development activities in focus area 1, and the operational activities associated with focus areas 3 to 7. These recommendations also include general 'best practice' management measures which are presented in Appendix F. Mitigation measures have been developed to address issues in all phases throughout the life of the operation including planning, construction and operation (where applicable). The detailed site-specific mitigation measures are outlined in Section 6 of this report.

4 RESULTS OF THE DESKTOP ANALYSIS

4.1 Analyses of Relevant Databases

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard style” report below (Table 2). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place.

It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area’s actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. However, this information is considered to be useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance.

Table 2: Desktop data relating to the character of the watercourses associated with the study area.

Aquatic ecoregion and sub-regions in which the study area is located		
Ecoregion (Figure 5)	Limpopo Plain and Central Highlands	
Catchment	Limpopo	
Quaternary Catchment (Figure 6)	A80F and A80E	
WMA	Limpopo	
subWMA	Nzhelele/Nwanedzi	
Dominant characteristics of the Limpopo Plain Ecoregion Level II (2.03) and the Central Highlands Ecoregion Level II (2.02) (Kleynhans *et al.,* 2007)		
Level II Code	2.02	2.03
Dominant primary terrain morphology	Plains; Slightly undulating plains; Extremely irregular plains (low hills) and pans; Lowlands with hills	Slightly undulating plains; Low mountains
Dominant primary vegetation types	Soutpansberg Arid Mountain Bushveld	Soutpansberg Arid Mountain Bushveld
Altitude (m a.m.s.l)	300 to 900	300 to 1500
MAP (mm)	200 to 500	300 to 700
Coefficient of Variation (% of MAP)	25 to 39	20 to 34
Rainfall concentration index	60 to >65	60 to >65
Rainfall seasonality	Mid-summer	Mid-summer
Mean annual temp. (°C)	16 to >22	16 to 22
Winter temperature (July)	4 to 26	4 to 26
Summer temperature (Feb)	18 to 32	14 to 32
Median annual simulated runoff (mm)	<5 (limited) to 40	5 to 10; 20 to 100

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 of no freshwater ecological importance (FEPA CODE = 0).
NFEPA Wetlands (Figure 7)	According to the NFEPA Database, artificial wetland features are located in focus areas 5 and 6. These are classified as channelled valley bottom wetlands. Although, a natural wetland (also classified as channelled valley bottom wetland) is associated with the artificial wetland located in focus area 5. These wetlands are considered to be heavily to critically modified (WETCON = Z2/Z3).
Wetland Vegetation Type	Focus areas 1, 3 4, 5, 6 and 7 are located within the Mopane Group 1 wetland vegetation group (Critically Endangered). Focus area 2 is located within the Mopane Group 2 wetland vegetation group (Least Threatened). The threat status of the wetland vegetation groups is provided by Mbona *et al* (2014).
NFEPA Rivers (Figure 7)	As per the NFEPA database, the Mutamba River bisects focus area 3 and is located within the investigation area of focus area 2. According to the NFEPA Database, the Mutamba River is considered to be largely modified (WETCON = C).
Importance of the study area according to the Limpopo Conservation Plan V2 (2013)	
All the focus areas are classified as Critical Biodiversity Areas (CBA) 2. CBAs are areas selected to meet biodiversity pattern and/or ecological process targets. CBA 2 represent areas where there are spatial options for achieving targets and the selected sites are the ones that best achieve targets within the landscape design objectives of the Limpopo Conservation Plan.	

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 8)			
Sub-quaternary reach	A80D-00075	Mean Ecological Importance (EI) Class	High
Proximity to focus area	Approximately 3.5 km south east of focus area 4.	Mean Ecological Sensitivity (ES) Class	Very High
Assessed by expert?	Yes	Stream Order	1
PES Category Median	C (Moderate)	Default Ecological Class (based on median PES and highest EI or ES mean)	A (Very High)

CBA = Critical Biodiversity Areas; DWS = Department of Water and Sanitation; EI = Ecological Importance; EMF = Environmental Management Framework; ES = Ecological Sensitivity; ESA = Ecological Support Area; FEPA = Freshwater Ecosystem Priority Area; m.a.m.s.l = Meters Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; WMA = Water Management Area.

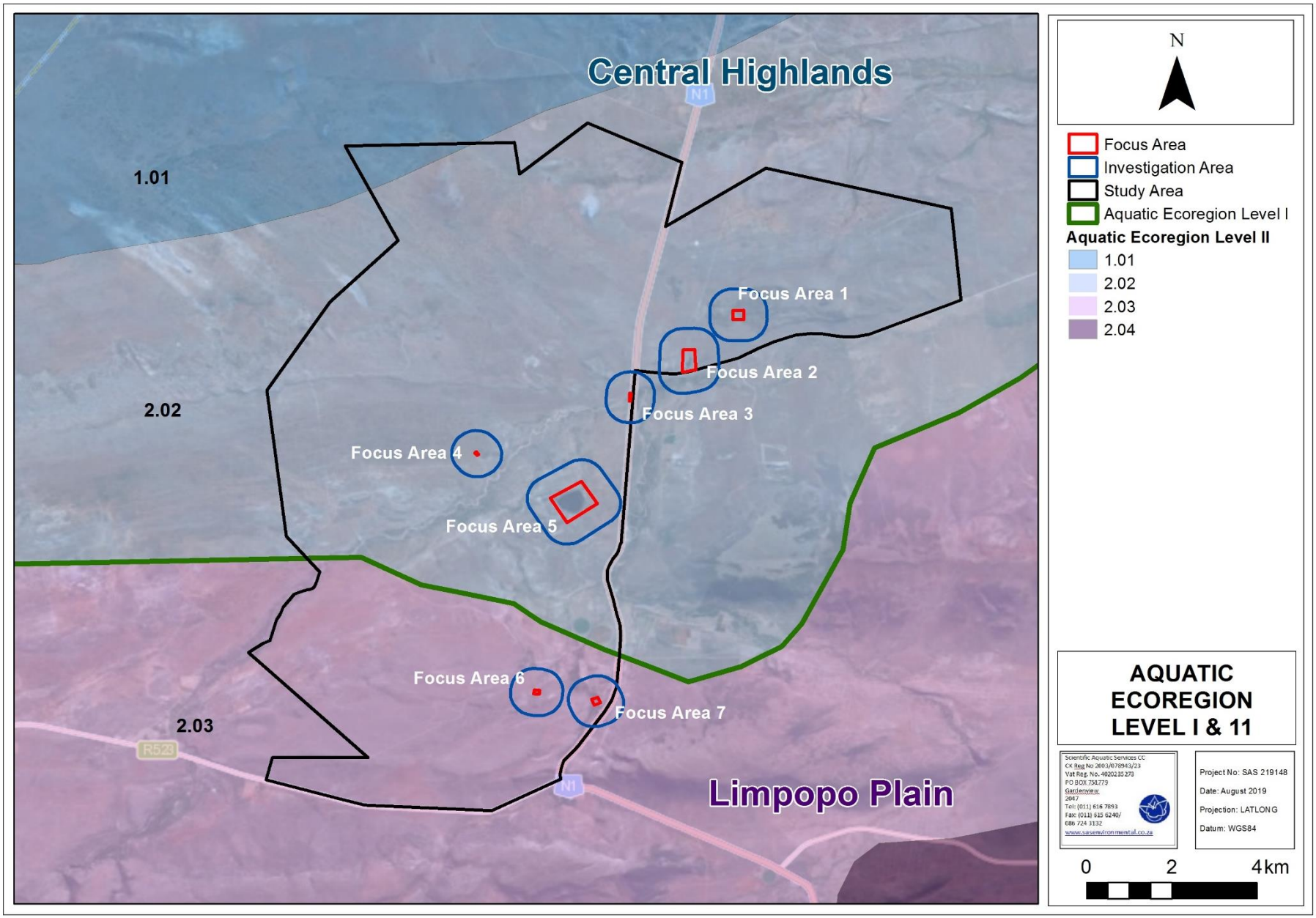


Figure 5: The focus areas are located in two different Aquatic Ecoregions (Level I) and in two different Level II Aquatic Ecoregions (2.02 and 2.03).

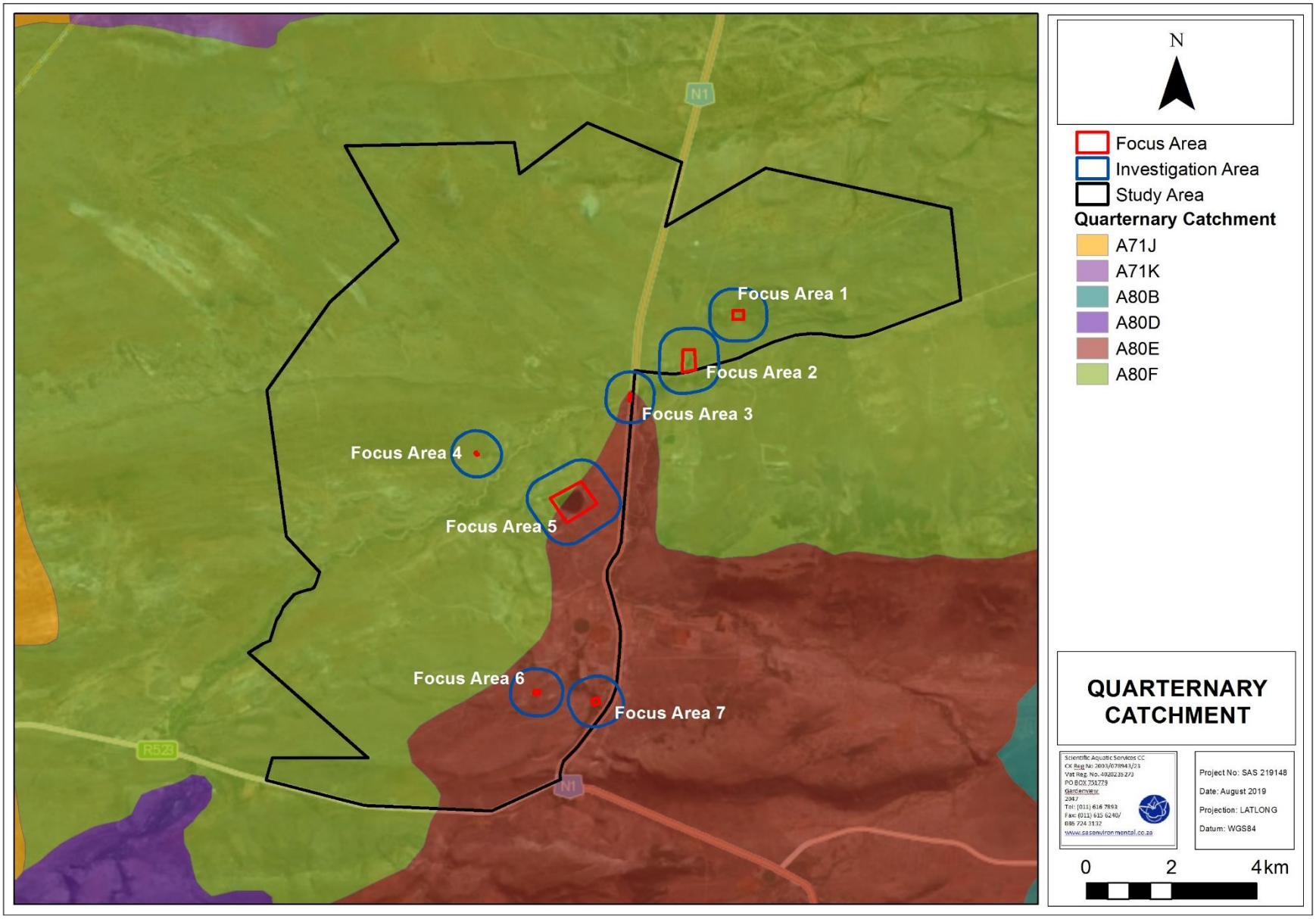


Figure 6: The two different quaternary catchments (A80F and A80E) associated with the focus areas.

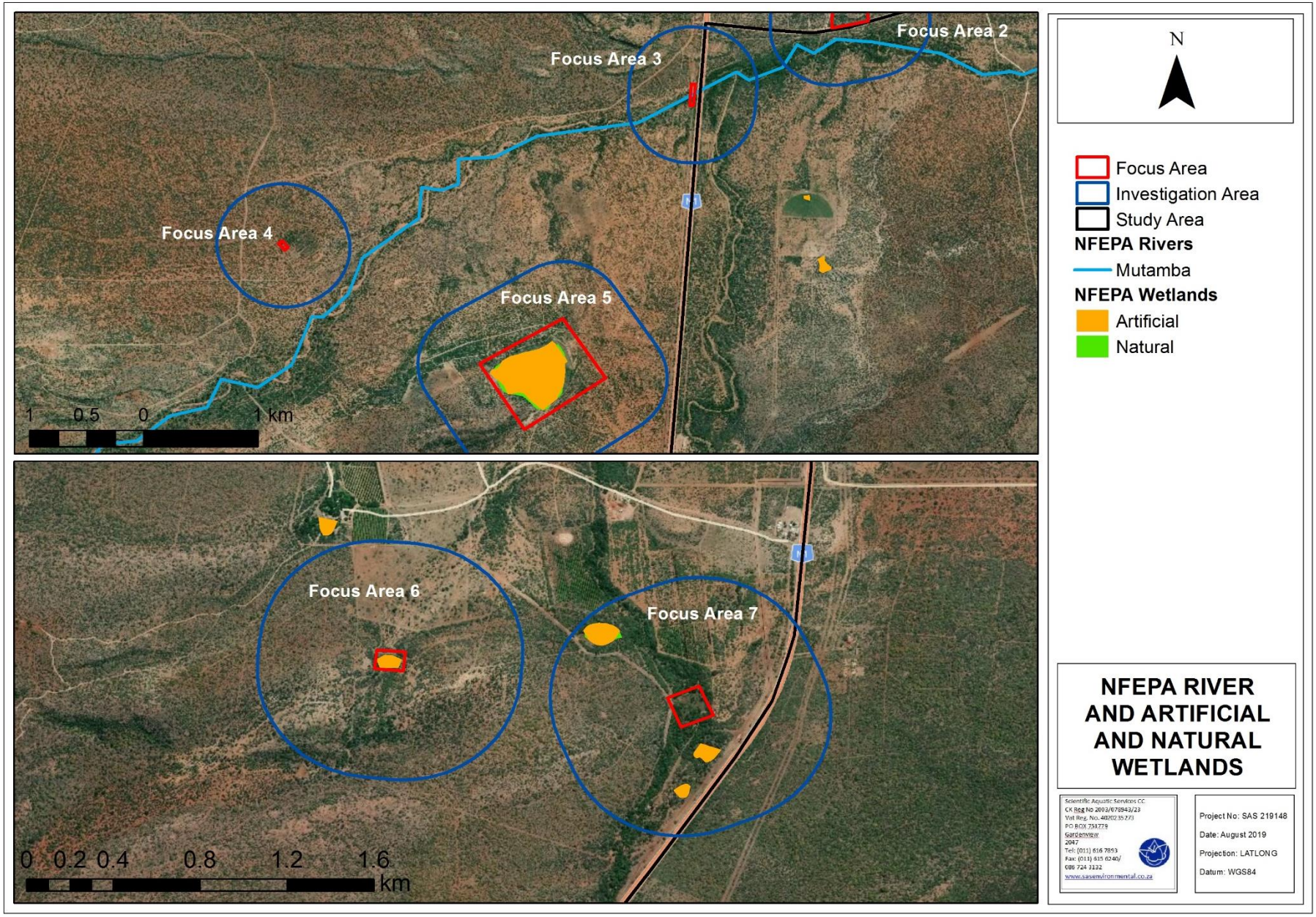


Figure 7: The natural and artificial wetlands and river associated with the focus areas according to the NFEPA Database (NFEPA, 2011).

4.2 Ecological status of sub-quaternary catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS database]

The PES/EIS database, as developed by the DWS RQS department, was utilised to obtain additional background information on the study area. 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, Ecological Water Requirement (EWR) sites and Hydro Water Management System (WMS) sites.

Key information on background conditions associated with the study area, as contained in this database and pertaining to the PES, ecological importance and ecological sensitivity for the sub-quaternary catchment reach (SQR) (A80D-00075) Mutamba River source is tabulated in Table 3 and indicated in Figure 8.

The Ecological Importance (EI) data for SQR A80D-00075 (Mutamba River) indicates that the following macro-invertebrate species are expected to occur at this site:

Aeshnidae	Elmidae/Dryopidae	Muscidae
Ancylidae	Gerridae	Naucoridaenepidae
Atyidae	Gomphidae	Notonectidae
Baetidae 2 spp.	Gyrinidae	Oligochaeta
Belostomatidae	Hirudinea	Perlidae
Caenidae	Hydracarina	Pleidae
Ceratopogonidae	Hydrometridae	Potamonautidae
Chironomidae	Hydrophilidae	Simuliidae
Coenagrionidae	Hydropsychidae 2 sp.	Tabanidae
Corbiculidae	Hydroptilidae	Thiaridae
Corixidae	Leptoceridae	Tipulidae
Culicidae	Leptophlebiidae	Turbellaria
Dixidae	Libellulidae	Veliidae/Mesoveliidae
Dytiscidae	Lumnaeidae	

The Ecological Importance (EI) data for SQR A80D-00075 (Mutamba River) indicate that the following fish species are expected to occur at this site:

Amphilus uranoscopus	*Enteormius paludinosus*	*Enteromius trimaculatus*
Labeobarbus marequensis	*Enteromius unitaeniatus*	*Enteromius viviparous*
Clarias gariepinus	*Chiloglanis pretoriae*	*Labeo cylindricus*
Labeo molybdinus	*Oreochromis mossambicus*	*Pseudocrenilabrus philander*
Tilapia sparmanii		

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reach SQR A80D-00075 (Mutamba River) based on the DWS RQS PES/EIS database.

SYNOPSIS (SQR A80D-00075 (Mutamba River))					
PES[1] category median	Mean EI[2] class	Mean ES[3] class	Length (km)	Stream order	Default ECat[4]
C	High	Very High	49,3	1.0	A
PES DETAILS					
Instream habitat continuity MOD		Small	**Riparian/wetland zone MOD**		Moderate
RIP/wetland zone continuity MOD		Small	**Potential flow MOD activities**		Small
Potential instream habitat MOD activities		Large	**Potential physico-chemical MOD activities**		Moderate
EI DETAILS					
Invertebrate taxa/SQ		42	**Invertebrate average confidence**		1.1
Invertebrate representivity per secondary class		High	**Invertebrate rarity per secondary class**		High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating		Very High	**Habitat diversity class**		High
Habitat size (length) class		Very High	**Instream migration link class**		Very High
Riparian-wetland zone migration link		Very High	**Riparian-wetland zone habitat integrity class**		High
Instream habitat integrity class		Moderate	**Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500 m**		Very High
Riparian-wetland natural vegetation rating based on expert rating		High			
Fish spp./SQ		13	**Fish: Average confidence**		2.8
Fish representivity per secondary class		Low	**Fish rarity per secondary class**		Very High
ES DETAILS					
Fish physical-chemical sensitivity description		Very High	**Fish no-flow sensitivity description**		Very High
Invertebrates physical-chemical sensitivity description		Very High	**Invertebrates velocity sensitivity**		Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description					Very High
Stream size sensitivity to modified flow/water level changes description					Very High
Riparian-wetland vegetation intolerance to water level changes description		24% of assessed species (84 taxa) are marginal zone riparian obligates, permanent or seasonal wetland obligates, or aquatic species, which are more sensitive to water availability than other riparian species.			

[1] PES = Present Ecological State; confirmed in the database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity
[4] EC = Ecological Category; default based on median PES and highest of EI or ES means.

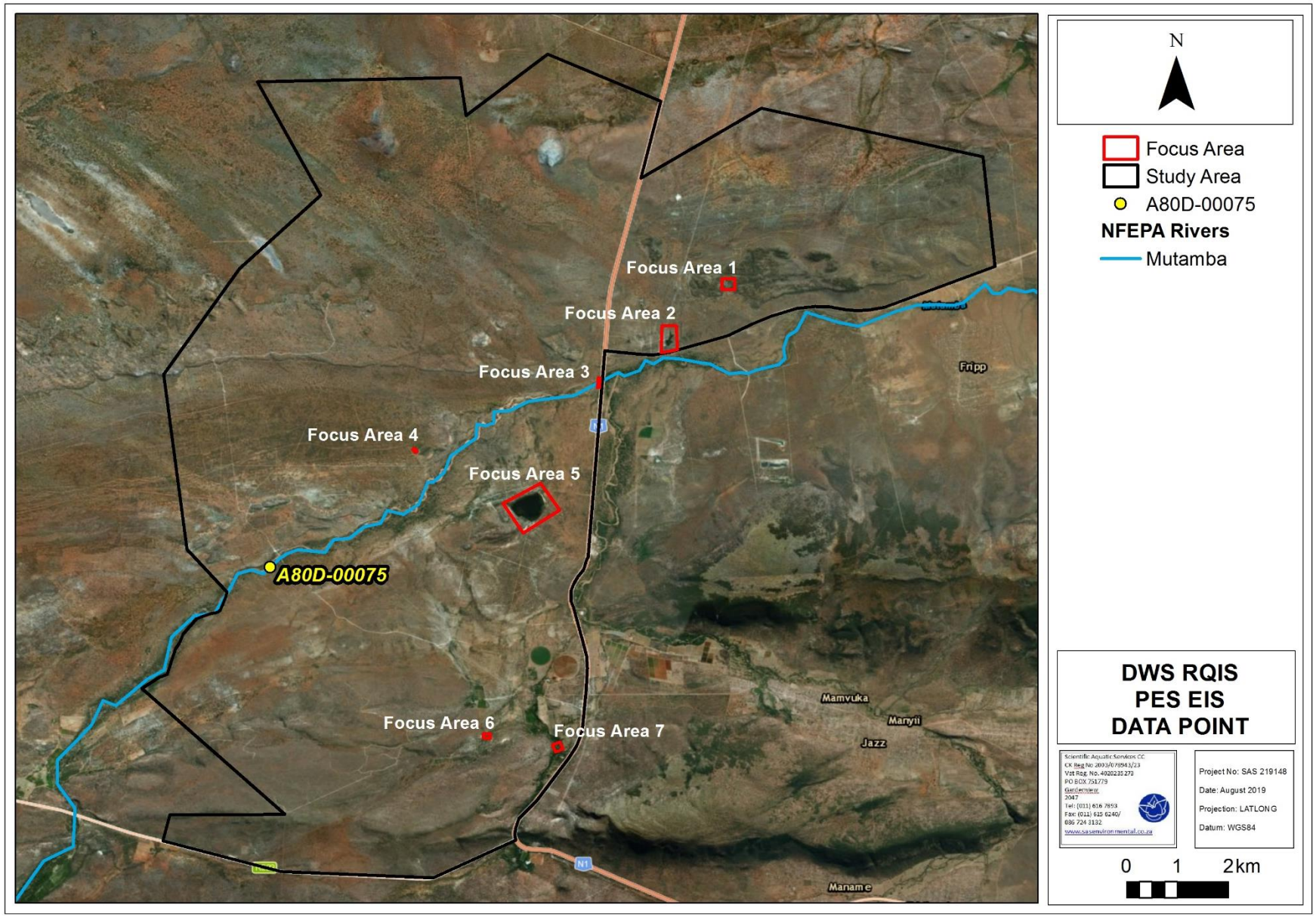


Figure 8: DWS RQIS PES/EIS sub-quaternary catchment reach (SQR) indicated relative to the focus areas.

5 RESULTS: WATERCOURSE ASSESSMENT

5.1 Watercourse System Characterisation

During the site assessment undertaken on the 1st and 2nd of July 2019, several watercourses were identified within the focus areas, consisting of three hydrogeomorphic (HGM) units. The delineation of these watercourses in relation to the focus areas are presented in Figure 9 and 10.

These watercourses were characterised according to the classification system (Ollis *et al*., 2013) as inland systems (i.e. systems having no existing connection to the ocean, but which is inundated or saturated with water, either permanently or periodically), falling in the Central Highlands (Focus Area 1 to 5) and Limpopo Plain (Focus Area 6 and 7) aquatic ecoregions. A summary of the classification at Levels 3 and 4 of the Classification System is presented in the table below.

Table 4: Characterisation of the watercourse associated with the study area according to the Classification System (Ollis *et al.,* 2013).

Watercourse	Focus Area	Level 3: Landscape unit	Level 4: HGM Type
Pan Wetland 1	**1**	**Bench:** a relatively discrete area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops, saddles and shelves. Benches are significantly less extensive than plains, typically being less than 50 ha in area.	**Depression:** a wetland or aquatic ecosystem with closed (or near-closed) elevation contours, which increases in depth from the perimeter to a central area of greatest depth and within which water typically accumulates.
Pan Wetland 2	**5**	**Plain:** an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	
Wetland Flat	**4**		**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.
Mutamba River	**3**		**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water. A river is taken to include both the active channel and the riparian zone as a unit.
Ephemeral Drainage Lines (EDLs)	**6 and 7**		

A description of each watercourse in the respective focus areas is presented in the sections that follow. The outcome of the ecological assessment of these watercourses is presented in Section 5.3.

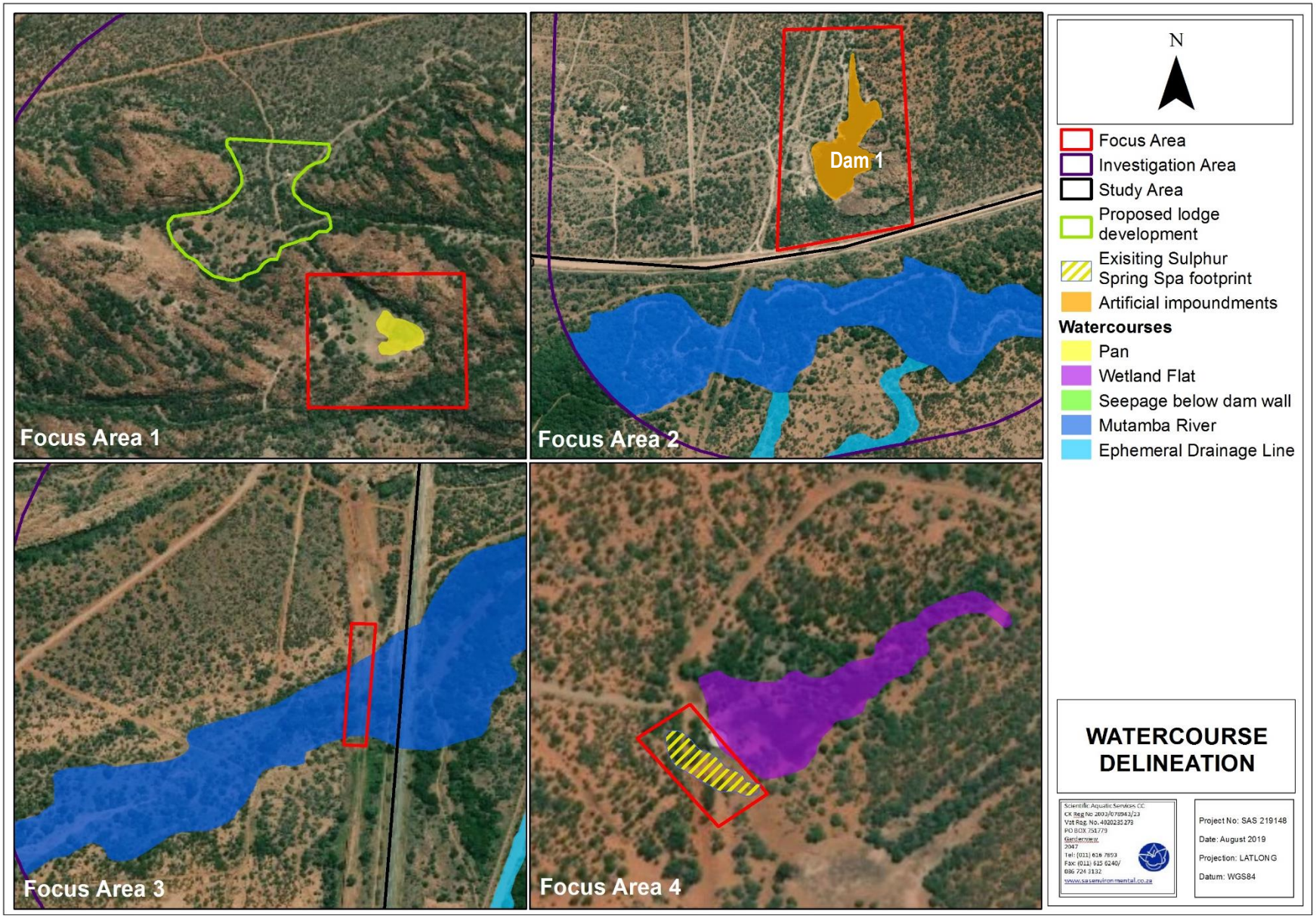


Figure 9: A map presenting the delineated boundaries of the watercourses associated with Focus Areas 1 to 4.

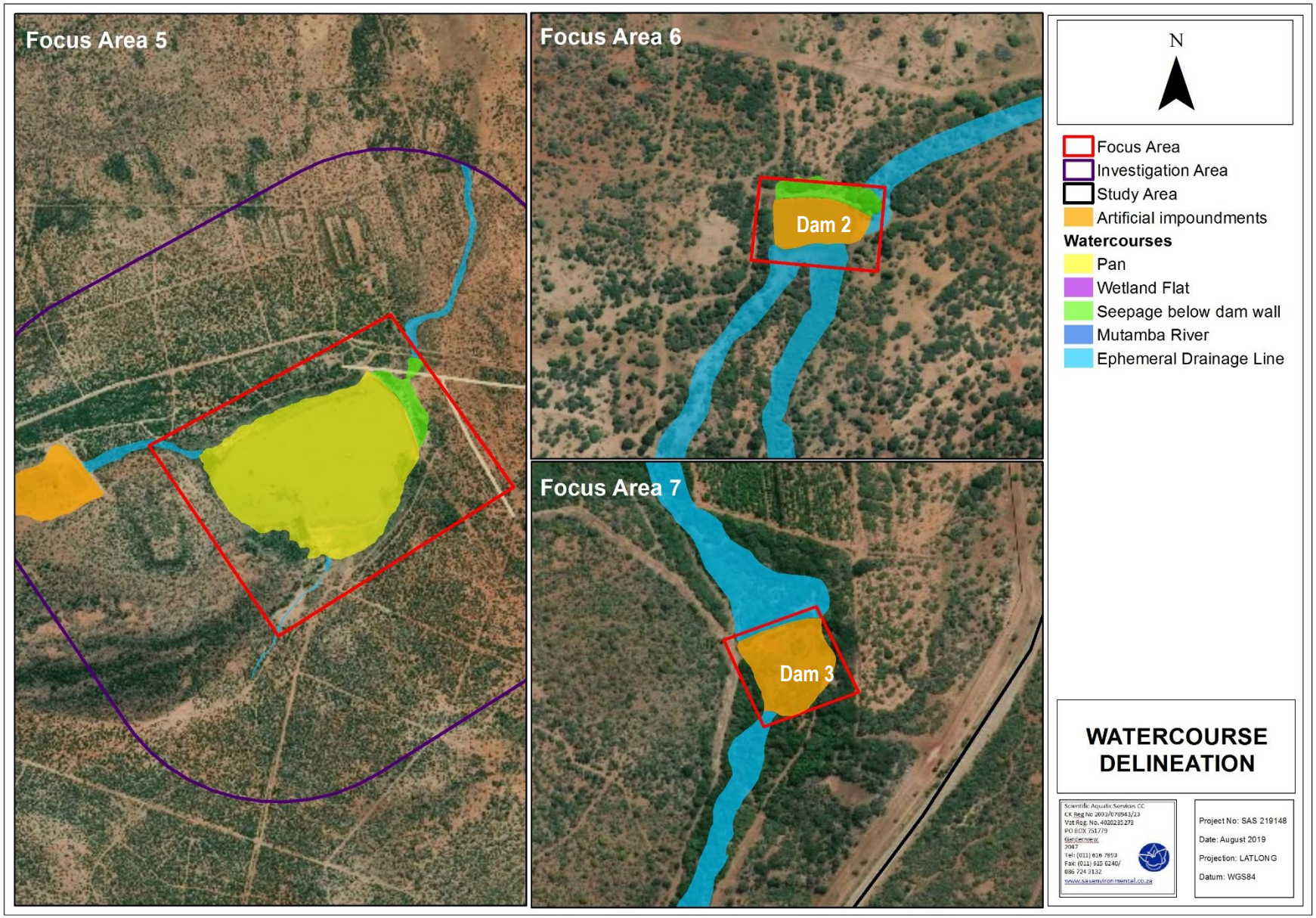


Figure 10: A map presenting the delineated boundaries of the watercourses associated with Focus Areas 5,6 and 7.

5.1.1 Focus Area 1

A pan wetland (hereafter referred to as pan wetland 1) is associated with Focus Area 1, positioned in a bench[3] landscape setting in an enclosed sandstone outcrop, with only one entry point. The proposed Lion Lodge development (Figure 9) is located approximately 150m north west of the delineated boundary of pan wetland 1. Access to pan wetland 1 is through a natural sandstone corridor south of the development site (Figure 11).

Pan wetland 1 lacks vegetation except for the edges of the pan where grasses were dominant (Figure 11). As a result, no obligate or facultative floral species associated with the seasonal and permanent zones of the pan were identified. The wetland buffer consists of mixed woodland, where *Senegalia burkei* forms prominent thickets at the foot of the outcrop where runoff enters into the pan wetland. Due to the high evaporation rate of this area, surface water is only present in the pan for short periods of time annually.

Figure 11: The pan wetland located in an enclosed sandstone outcrop. Access to the wetland is through a corridor indicated by the red arrow.

Figure 12 depicts pan wetland 1 relative to the proposed lodge development footprint. This figure indicates the small catchment area of the pan wetland (utilising 2m contour intervals), which receives surface runoff from the surrounding outcrops. There is, however, a catchment divide between pan wetland 1 and the proposed lodge development site (see orange and blue arrows in Figure 12). Based on the outcome of the hydrological study (Aurecon, 2019[4]), the potential exists that during extreme rainfall events, water accumulated in the enclosed sandstone catchment of pan wetland 1, which flows through the natural sandstone corridor (as the pan wetland is at a slightly higher elevation) towards the proposed lodge development.

[3] According to Ollis *et al.* (2013) "A bench is a relatively discrete area of mostly level or nearly level high ground (relative to the broad surroundings), including hilltops, saddles and shelves. Benches are significantly less extensive than plains, typically being less than 50 ha in area.

[4] Aurecon. 2019. Ekland Lion Farm Lodge: Hydrological Study Report. March 2019. Report Reference: 113527

Figure 12 also indicates that pan wetland 1 is located upgradient of the proposed lodge development site and therefore the potential of edge effects from the proposed development is expected to be negligible.

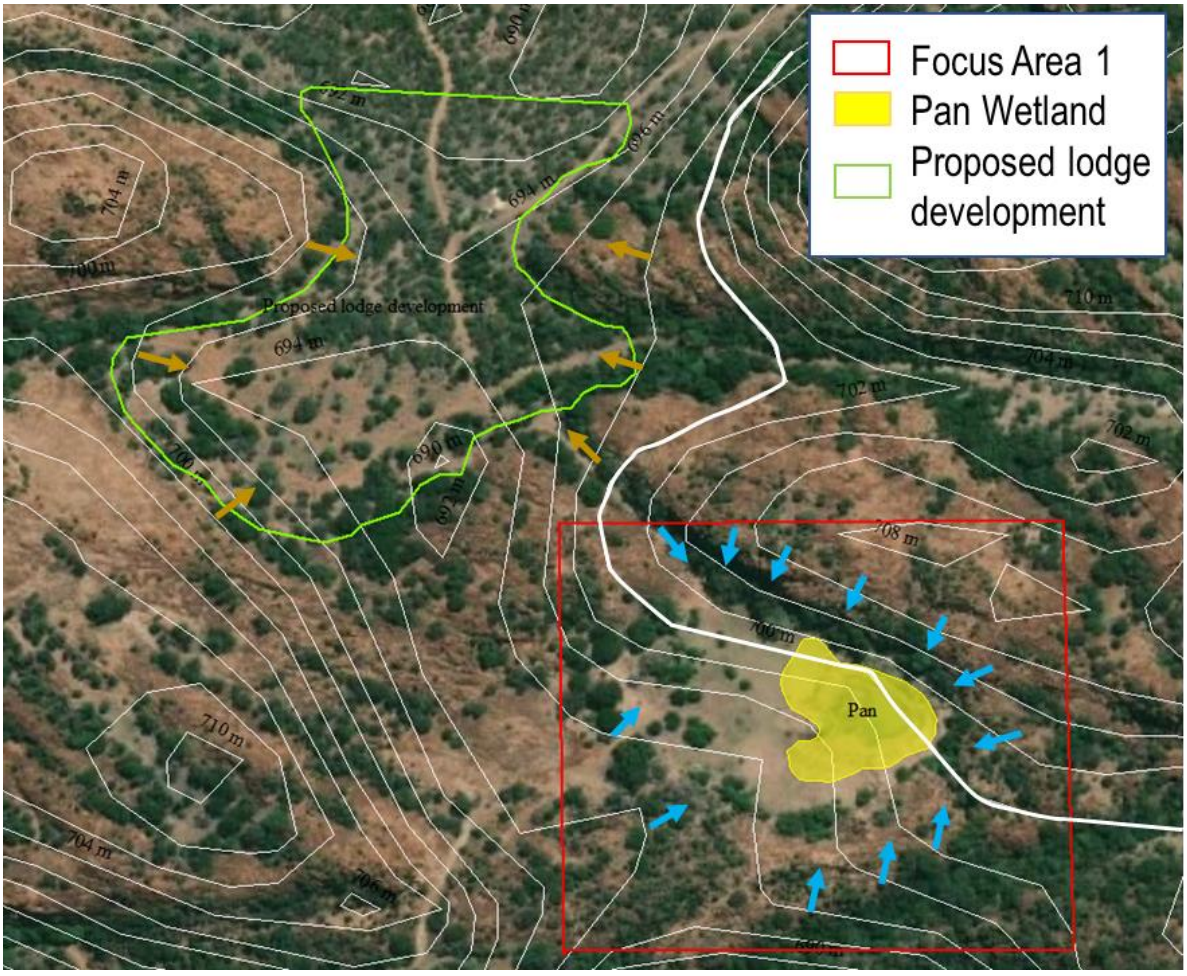


Figure 12: The blue arrows indicate the surface runoff that will enter the pan wetland located in Focus Area 1, while the orange arrows indicate flow that will enter the proposed lodge development site.

The ecological assessment of pan wetland 1 is presented in Table 5 in Section 5.3.

5.1.2 Focus Area 2

A large artificial impoundment (hereafter referred to as 'Dam 1') is located in Focus Area 2. Groundwater pumped from boreholes is stored in Dam 1. Based on digital satellite imagery, a small impoundment is visible on digital imagery dating back to 2003 (Figure 13). Digital satellite imagery from 2007 depicts that the footprint area of Dam 1 increased. It is assumed that pumping of groundwater into this dam occurred during 2003 and 2007. Most recent digital satellite imagery (April 2019) indicates that the footprint of Dam 1 is more or less the same as it was in 2007 (Figure 13).

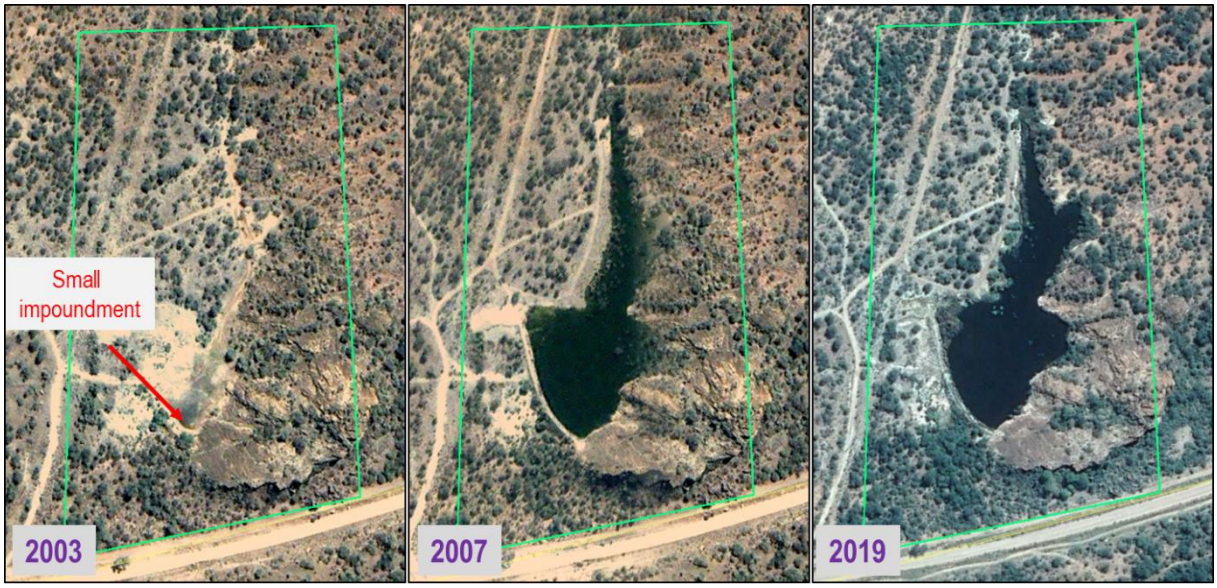


Figure 13: Digital satellite imagery of Dam 1 located in Focus Area 2 in 2003, 2007 and 2019.

A sandstone outcrop forms the eastern boundary of Dam 1, while the dam wall (constructed from calcareous materials) forms its south western boundary (Figure 14). Seepage below the dam wall has created a permanently inundated area where the reed species *Typha capensis* has established.

Figure 14: A photograph taken atop the dam wall. Dam 1 is bounded by a sandstone outcrop (red arrow).

Based on the digital satellite imagery and the outcome of the site assessment, Dam 1 is not hydrologically connected to any natural watercourses and can be described as an artificial feature. Dam 1 is therefore not considered a natural watercourse as it does not conform to the definition of a true watercourse as per the National Water Act, 1998 (Act No. 36 of 1998), thus no further ecological assessment of this feature was undertaken.

5.1.3 Focus Area 3

The boundary fence of the study area traverses the Mutamba River, which flows through the study area in a north easterly direction. The boundary fence traversing the river is constructed out of palisade, which utilises concrete foundations. Furthermore, a large steel grid structure with a fine mesh size has been installed (Figure 15). The grid atop the concrete base allows for flow through the fence when surface flow is present (only during high rainfall events), however the spacings between the palisade bars is limited (approximately 100mm), therefore faunal movement will be critically constrained, and debris will likely get trapped along the fence during a flood event.

Figure 15: A grid and concrete base forms part of the study area boundary fence which crosses the Mutamba River. The yellow arrow indicates the direction of flow.

This fence was constructed late 2018, which entailed clearing of riparian vegetation and compaction of soils (Figure 16). As the fence line is patrolled regularly, the fence corridor is maintained clear of vegetation, which has resulted in erosion and likely scouring at the base of the concrete slab during a flood event (Figure 15, left photograph).

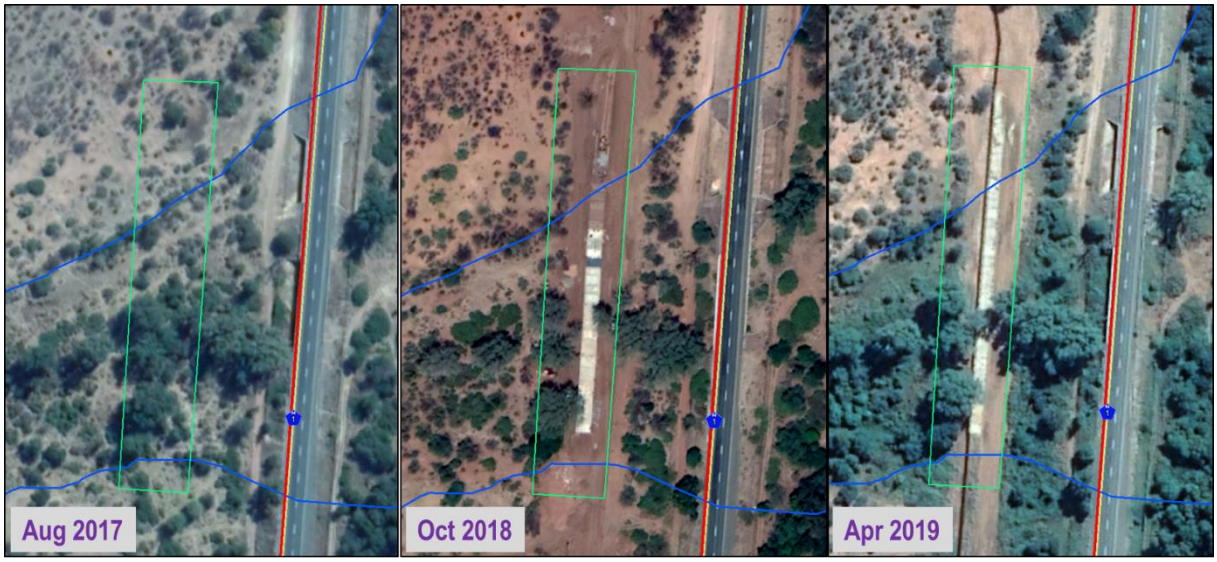


Figure 16: (Left) the Mutamba River prior to any construction activities; (center) the fence was constructed in late 2018; an approximate 15m corridor was cleared as part of the construction activities; (right) the fence traverses the Mutamba River.

The upstream portion of the Mutamba River is less disturbed than the fence crossing. The Mutamba River is an episodic river with the bed characterised by deep alluvial soils (Figure 17) which often contains baseflow. A distinctive change in vegetation structure and abundance, as well as diversity, was noted in the marginal and non-marginal zone compared to the surrounding terrestrial zones. The marginal riparian zone of the river hosts a variety of tree species (such as *Combretum imberbe, Schotia brachypetala, Gymnosporia senegalensis* and *Senegalia nigrescens*).

Figure 17: The active channel of the Mutamba River upstream of the fence is characterised by deep red alluvial soils, with dense riparian tree species located within the marginal zone of the river.

The watercourse ecological assessment of the Mutamba River is presented in Table 6 in Section 5.3 and the aquatic ecological assessment of the river is presented in Section 6.

5.1.4 Focus Area 4

The Sulphur Spring Spa was constructed in Focus Area 4 in late 2018. The wetland delineation and vegetation verification report developed by van der Walt (2018[5]) as part of the Environmental Authorisation process identified a spring just north east of Focus Area 4. Groundwater emerges to the surface which has resulted in the formation of, a wetland flat.(van der Walt, 2018 - Figure 18). Considering the proposed footprint and locality of the Sulphur Spring Spa (Figure 4) and the delineation of the wetland flat (Figure 18) the Sulphur Spring Spa was constructed at least 30m from the original delineated edge of the wetland flat.

Subsequently, the extent of the wetland was anthropogenically enlarged (Figure 19), where a pipeline was installed from the original spring source to divert water closer to the Sulphur Spring Spa and release it south of the wetland flat to flow in a northerly direction, resulting in an enlarged wetland feature. The current wetland extent is close to the edge of the wooden deck associated with the Sulphur Spring Spa (located on the eastern boundary of Focus Area 4) (Figure 20).

[5] Van der Walt, D. 2018. Specialist Report: Wetland delineation and vegetation verification: Sulphur Springs, Ekland Safaris, Limpopo Province. Complied by Afrika Enviro & Biology. October 2018

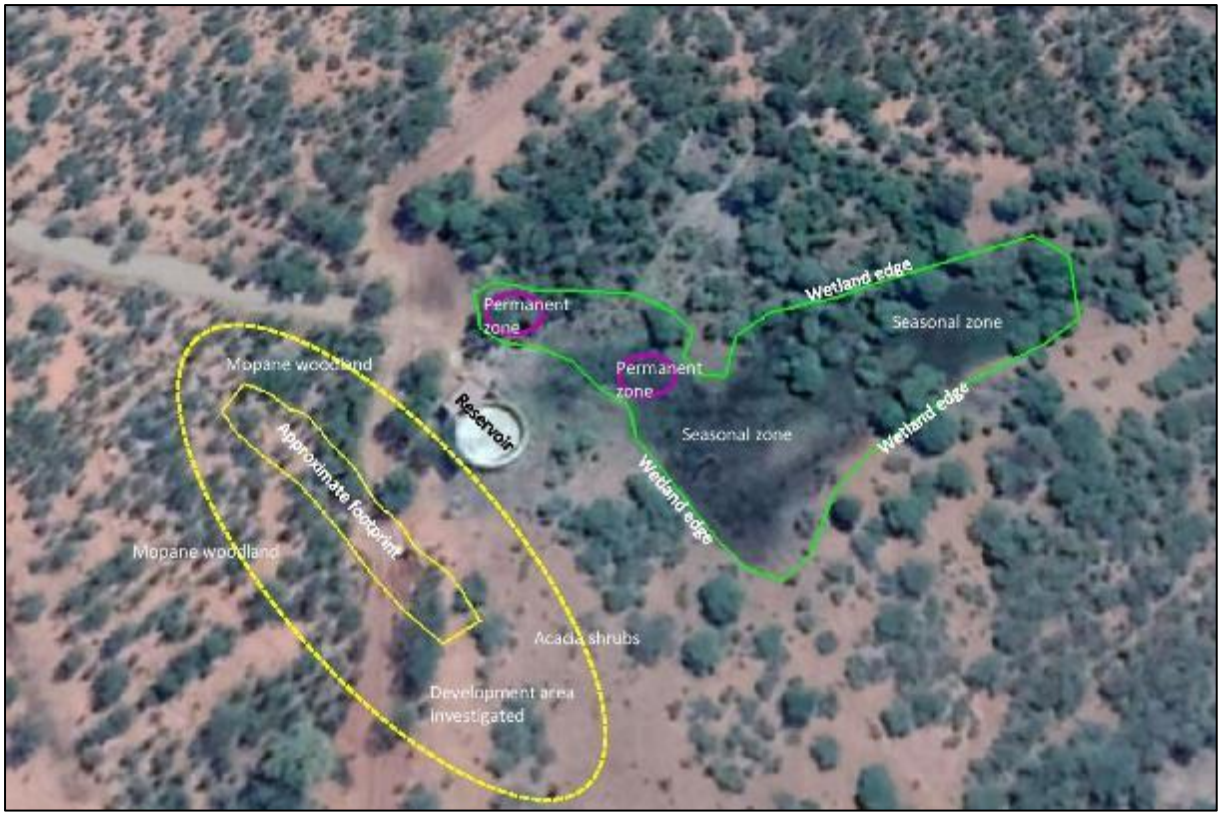


Figure 18: Delineation of the wetland flat as per the wetland delineation and vegetation verification report (van der Walt, 2018).

Figure 19: (Left) the proposed building footprint relative to the delineated wetland by van der Walt (2018); (center) the construction footprint and delineated wetland during the construction phase; (right) the constructed buildings relative to the anthropogenically extended wetland, delineated by SAS (2019).

Figure 20: (Left) the delineated boundary of the wetland as per the SAS site visit in July 2019, is within 5m from the constructed building; (right) the locality of the eye of the spring indicated by the yellow arrow, from where the groundwater is piped.

The ecological assessment of the wetland flat is presented in Table 7 in Section 5.3.

5.1.5 Focus Area 5

A large pan wetland (hereafter referred to as 'pan wetland 2') is located in Focus Area 5 (Figure 21). Pan wetland 2 is located at the eastern foot of a sandstone outcrop. Pan wetland 2 is fed by an ephemeral drainage line (EDL) noted to have riparian vegetation, flowing into the wetland on its north western boundary. An earth berm was constructed along the eastern boundary, allowing water the reside in the wetland for a longer period. This limits throughflow of water to the downstream EDL.

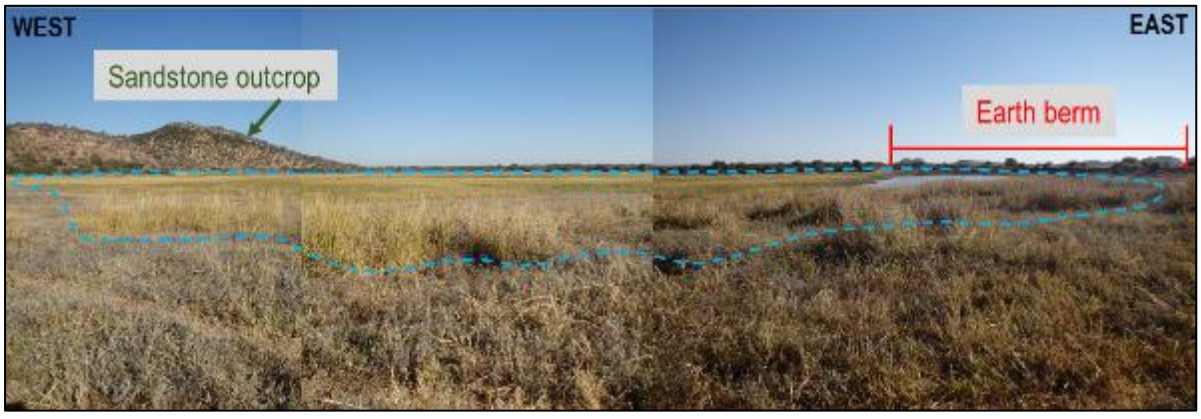


Figure 21: Pan wetland 2 (blue dashed line) located at the foot of a sandstone outcrop and is bounded by an earth berm on its eastern boundary.

From digital satellite imagery it is evident that the permanent zone of this wetland is located on the north eastern edge of the wetland, although during high rainfall periods, a large extent of the wetland is inundated (Figure 22). This wetland is dominated by the obligate vegetation species *Schoenoplectus brachyceras*, a medium to large, perennial, grass-like sedge, often

found in water. *Sporobolus pyramidalis* is located within the seasonal and temporary zone of the wetland.

The ecological assessment of the pan wetland 2 is presented in Table 8 in Section 5.3.

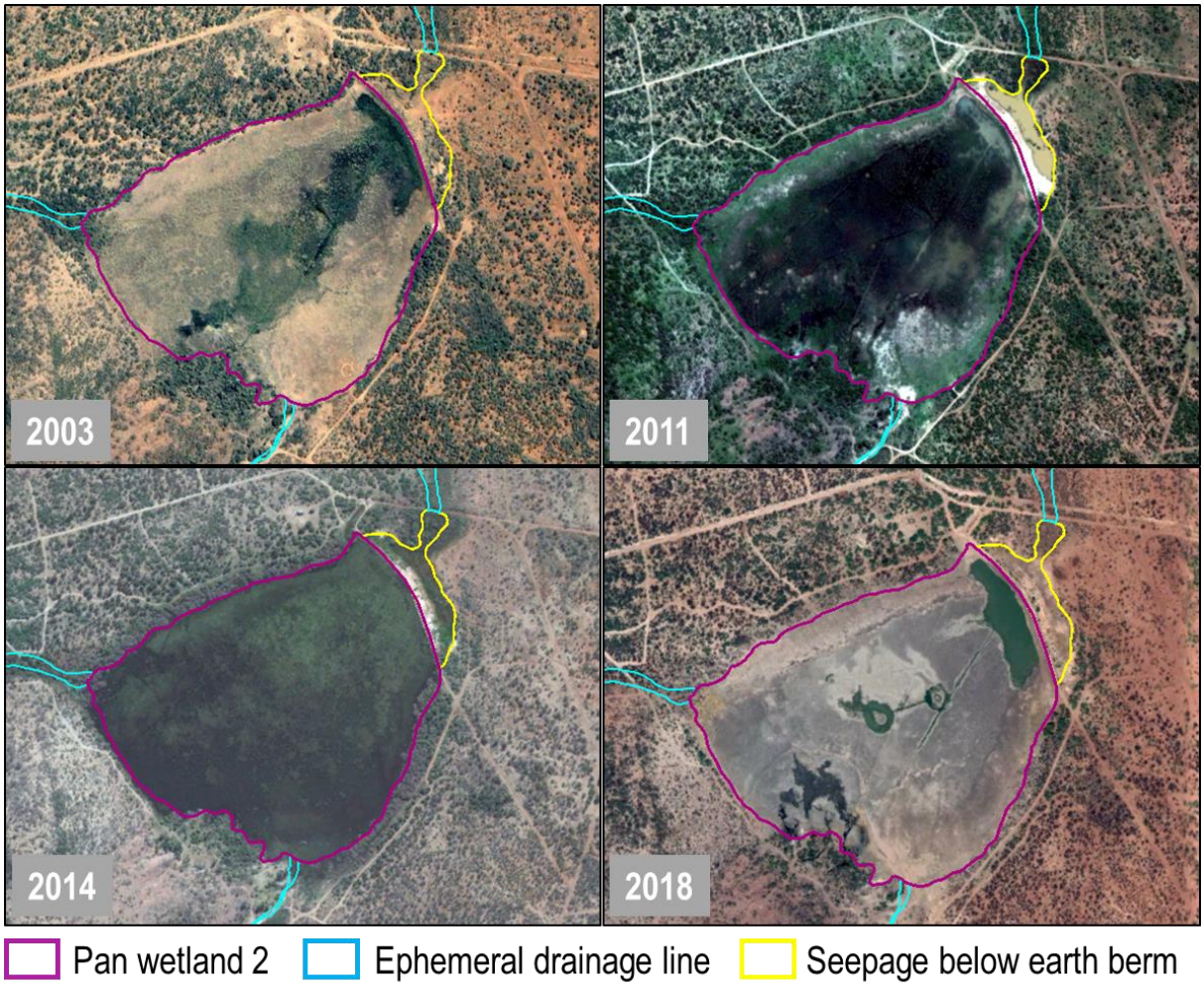


Figure 22: Digital satellite imagery of pan wetland 2, depicting the extent of surface water between 2003 and 2018.

5.1.6 Focus Area 6

An artificial impoundment (hereafter referred to as 'Dam 2') is located in an ephemeral drainage line (EDL) noted to have riparian vegetation in Focus Area 6. Water ponds in the dam before it flows into the downstream reach of the EDL. Digital satellite imagery shows that Dam 2 has surface water all year round (Figure 23). No outlet from the dam releasing water into the downstream EDL was noted, although seepage below the dam was evident. A pipe outlet was noted to transfer water into Dam 2, thus it is considered likely (although unconfirmed at the time of this assessment) that groundwater is pumped into Dam 2 (Figure 24).

Despite Dam 2 being considered an artificial feature, it is an instream feature which connects the upstream reach of the EDL to the downstream reach. The ecological assessment of the

EDL is presented in Table 9 in Section 5.3, which considers the influence of Dam 2 on the drivers and receptors of the EDL.

Figure 23: Digital satellite imagery of Dam 2 within an ephemeral drainage line (blue dashed line), in 2003 (left), 2011 (center) and 2019 (right).

Figure 24: (Left) the EDLs (yellow dashed lines) upstream of Dam 2; (right) the red arrow indicates the pipe releasing water into Dam 2.

5.1.7 Focus Area 7

An artificial impoundment (hereafter referred to as 'Dam 3') is located in an EDL noted to have riparian vegetation in Focus Area 7. An earth berm is located on the northern boundary of the dam, allowing for water to flow into the downstream reach of the EDL via a spillway (Figure 25). From digital satellite imagery of Focus Area 7 (Figure 25), during 2003 Dam 3 was noted to be a small impoundment within the larger EDL, however due to the pumping of groundwater into the upstream reach of the EDL, the footprint area of the dam has substantially increased between 2007 and 2011, and is the same ever since then.

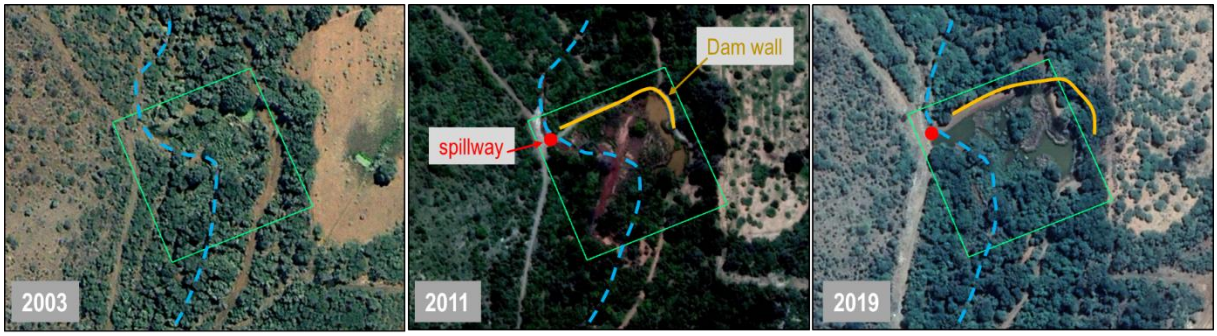


Figure 25: (Left) the EDL (blue dashed line) flowing through Focus Area 7 in 2003. Only a small extent of surface water is noted in the north eastern corner of the focus area; (center and right) the footprint area of Dam 3 has increased due to the storing of water pumped into the upstream reach of the EDL.

As with the case of Dam 2 located in Focus Area 6, Dam 3 in Focus Area 7 is also considered an artificial instream feature, which connects the upstream reach of the EDL to the downstream reach. The ecological assessment of the EDL is presented in Table 9 in Section 5.3, which considers the influence of Dam 3 and the pumping of groundwater into the EDL on the drivers and receptors of the EDL.

5.2 Watercourse Delineation

The watercourse delineation, as presented in this report, is regarded as the best estimate of the watercourse boundaries based on the site conditions present at the time.

During the assessment, the following indicators were used to delineate the boundary of the watercourses:

- ***Topography/elevation*** was used to determine in which parts of the landscape watercourses were most likely to occur;
- ***Obligate and facultative vegetation species*** 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 watercourse boundaries;
  - A riparian zone is defined as an area that supports vegetation with a composition and physical structure distinct from the adjacent terrestrial zones. Vegetation could, therefore, be used as secondary indicator for rivers and smaller drainage lines. The marginal riparian zone of the Mutamba River hosts a variety of tree species such as *Combretum imberbe, Schotia brachypetala, Gymnosporia senegalensis* and *Senegalia nigrescens*, which was utilised to define the riparian zone;
  - Facultative and obligate wetland floral species were encountered within the wetlands, with a distinct increase of *Colophospermum mopane* (Mopane tree) density and tree size within terrestrial areas surrounding these wetlands;

- The ***soil form indicators:*** To confirm the presence of a wetland, the soil needs to present redoxymorphic soil features, which are morphological signatures that appear in soils with prolonged periods of saturation and water level fluctuation (due to the resultant anaerobic conditions). These redoxymorphic soil features would be identifiable in the soil irrespective of the season in which the soil sample is taken, as they are not determined by how 'wet' the soil is, but rather by the mottling or signs of gleying that has occurred over a period of time within the soil;
- The ***presence of alluvial soils***: the National Water Act, 1998 (Act No. 36 of 1998) definition of a riparian habitat refers to the structure of the banks and likely presence of alluvium. A good indicator of the presence of riparian zones is the occurrence of alluvial deposited material adjacent to the active channel. Alluvial soils are soils derived from material deposited by flowing water, especially in the valleys of large rivers. Riparian areas often, but not always, have alluvial soils. While the presence of alluvial soils cannot always be used as a primary indicator to delineate riparian areas accurately, it can be used to confirm the topographical and vegetative indicators. Unlike wetland areas, riparian zones are usually not saturated for a long enough duration for redoximorphic features to develop. This is because rivers are mainly driven by flow, originating from its local catchment which flows through the river (not residing in the river as with wetlands), thus not allowing enough time for redoximorphic features to form. The Mutamba River and the ephemeral drainage lines within the focus areas presented with deep sandy alluvial soils, characteristic of riparian resources within the local region;
- No surface water or saturated soils were present along most of the lengths of the smaller drainage lines, while the Mutamba River and some isolated areas on the smaller drainage lines had surface water and saturated soils present at the time of assessment.

5.3 Field Verification Results

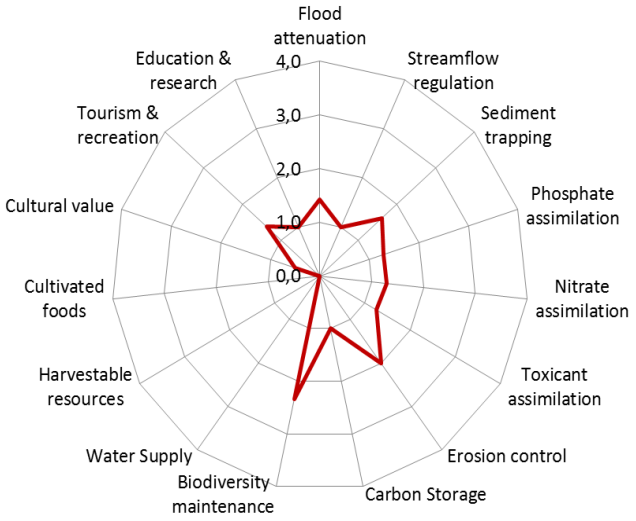
Following the site visit, various assessments were undertaken to determine the following for the watercourses as described in Section 5.1:

- PES, incorporating aspects such as hydrology, vegetation and geomorphology;
- The service provision of the watercourses, incorporating a qualitative assessment of aspects such as biodiversity maintenance, flood attenuation, streamflow regulation and assimilation of nutrients and toxicants, to name a few;
- The EIS was guided by the results obtained from the assessment of PES and service provision of the watercourses;

- An appropriate REC, RMO and BAS to guide the management of the watercourses with the intent of enhancing the ecological integrity thereof, where feasible; and
- Assessment of impacts of the construction phase of the proposed lodge development (Focus Area 1) and operation of the existing water uses of the watercourses (Focus Area 3 to 7).

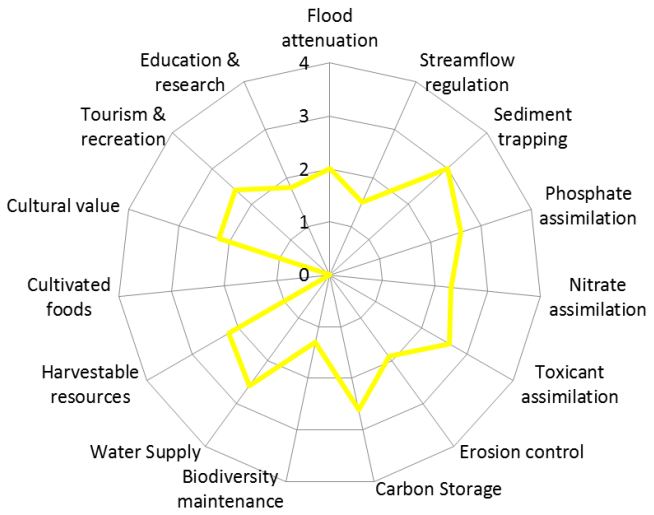
The results of the assessments of the watercourses are presented in the "dashboard style" report below (Tables 5 to 9). Due to the relatively homogenous characteristics of the EDLs located in focus areas 5, 6 and 7, the assessment of these watercourses is reported upon in a combined fashion in Table 9 and not individually.

Table 5: Summary of the assessment of pan wetland 1 located in Focus Area 1.

<table>
<tr>
<td colspan="2">Ecological & socio-cultural service provision graph:
 
</td>
<td colspan="2"> 
This pan wetland is bounded by sandstone outcrops. Acacia burkei thickets are located on the northern boundary of the wetland. A sparse layer of graminoid species is located along the outer temporary zone of the wetland.</td>
</tr>
<tr>
<td>PES discussion</td>
<td>PES Category: B (Largely natural with few modifications)
Due to the isolated locality of this pan wetland, very few modifications to this wetland has occurred. When surface water is present, this wetland serves as a waterhole for a variety of faunal species, which trample the vegetation associated with the outer boundary of the pan wetland.</td>
<td>EIS discussion</td>
<td>EIS Category: Moderate
The ecological integrity of the pan is largely natural, with a few modifications to the geomorphology of the pan. The pan provides habitat for a variety of species (albeit only seasonal) and is therefore important on a landscape scale.</td>
</tr>
<tr>
<td>Ecoservice provision</td>
<td>Moderately Low
Since this pan is located within a semi-arid area, only having surface water present during certain periods of the year, it is considered to have moderately low ecological functionality. The opportunity of this pan for attenuating floods is limited by its position in the landscape as it is also isolated from the surrounding drainage network. Due to its inward draining nature (endorheic), the pan is not considered to play a significant role in streamflow regulation. Seasonally, this pan and its surrounding area do provide habitat for a variety of species which rely on the presence of surface water (thus of high importance of biodiversity support).</td>
<td>REC Category</td>
<td>REC Category: B (Largely natural with few modifications)
BAS Category: B (Moderately modified)
RMO: Maintain
As the proposed lodge development will not directly impact on the pan wetland, the PES of the wetland must be maintained. Additionally, no deterioration to the PES of the wetland by edge effects may be permitted. As this wetland may potentially be used as a tourist attraction to view game species during the operational phase of the project, no vehicles may indiscriminately drive into the pan wetland.</td>
</tr>
</table>

Watercourse drivers:	
a) Hydrology This pan is hydrologically driven by subsurface flow and by precipitation. Surface water is not always present within the pan, as the water table fluctuates. Surface was is expected to be present with the rising of the water table, likely due to overland inflow (especially during rainfall events). Due to the high evaporation rate of this area, surface water is only present within the pan for short periods.	**b) Water quality** No obvious influencing factors could be identified, which may impact on the water quality of this pan. Some enrichment of the water due to grazing and trampling by antelope is possible. Drying out of the pan drives the concentration of minerals due to the concentrating effects of evaporation. Some of the accumulated salts and nutrients (such as organic nitrogen, and various phosphate and sulphate salts) can be transported out of the pan by the wind and deposited in the surrounding area. Those remaining may dissolve again when the water table rises, and the pan fills up again.
c) Topography: Geomorphology and sediment balance Few impacts to the geomorphology were noted, and it is anticipated that under current conditions, natural deterioration of the geomorphology is considered unlikely. Due to the extent of the grazing activities of antelope species within and surrounding the pan, some areas are left bare, from which sediment enters the pan.	**d) Habitat and biota** Disturbances relating to vegetation removal associated with antelope grazing have led to the transformation of the habitat within and surrounding the pan. However, no other significant impact to the habitat of the pan has occurred. The pan wetland is not considered to host a large variety of biota, but the buffer zone of the pan (sandstone outcrops) provide micro-habitat for several species of specialist fauna. The accumulated salts and nutrients are likely to attract a variety of mammals during dry periods.
Risk Assessment outcome & Business Case:	
LOW	
Due to the proposed Lion Lodge development footprint located outside of the local catchment of pan wetland 1 and downgradient of the wetland, no negative impacts from the construction phase of the lodge development is anticipated. Nevertheless, construction and operational edge effects may potentially impact on the wetland. An alien vegetation management plan should be implemented and managed, for the lodge footprint area and any areas where ornamental garden species may be planted. No vehicles are permitted to enter into the pan wetland. No wastewater may be disposed into the pan wetland nor the surrounding buffer zone. All wastewater must be suitably disposed of. Indigenous vegetation will reduce the irrigation requirements as well as fertilizers. It is important to note that the Department of Water and Sanitation do not consider irrigation of exotic garden ornamentals as a beneficial use, and care must be taken when using herbicides and pesticides in gardens, especially during the rainy season. These chemicals must be used in accordance with the prescribed quantities to prevent contamination of surface water runoff.	

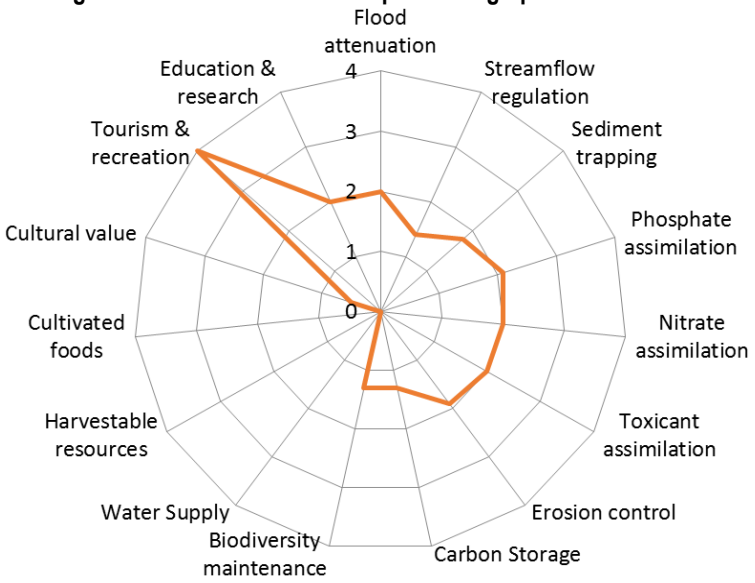
Table 6: Summary of the assessment of the Mutamba River located in Focus Area 3.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
The Mutamba River upstream of the boundary fence. The river is characterised by deep red alluvial soils. The marginal riparian zone consists of large tree species such as Faidherbia albida and Grewia flava tree species.</td></tr>
<tr><td>VEGRAI discussion</td><td>PES Category: B/C (Largely natural with modifications)
As per the outcome of the VEGRAI assessment, the riparian ecosystem of this river has remained largely intact, with limited change to the cover, abundance and species composition when compared to the reference conditions in both the marginal as well as non-marginal zones. Some disturbance from anthropogenic activity (informal road crossings, overhead powerline crossings) in the immediate surroundings of the river is noted, which resulted in an increase in non woody species and some loss of tree diversity within the riparian zone and the presence of alien forb species.

The aquatic ecological assessment of the Mutamba River is presented in Section 6.</td><td>EIS discussion</td><td>EIS Category: High
The Mutamba River system is considered of high ecological importance due to its hydro-functional importance with specific mention of the streamflow and flood attenuation. Game farming is the current land use of the majority of the study area with limited areas utilised for crop cultivation. Consequently, the river system has remained largely undisturbed and is therefore important in terms of biodiversity value. The Mutamba River has significant downstream importance for socio-cultural purposes with special mention of water supply as well as biodiversity maintenance and other basic ecosystem services. Measures to ensure the ongoing functioning of the river, and to ensure hydrological connectivity where the fence of the study area is crossing the river must be ensured.</td></tr>
</table>

Ecoservice provision	**Moderately High** Due to the seasonal nature of this river, its capacity to provide certain ecological services is reduced, although this is counteracted by the relative intact ecological integrity of the river, which increases its overall functionality. This river is considered important for biodiversity maintenance. As this is an episodic river, it is of seasonal importance for the supply of water for harvestable resources. As this reach of the river is located within a private reserve, which will cater to tourists, it is also considered of importance for tourism and education.	**REC Category**	**REC Category: C (Moderately modified)** **BAS Category: C (Moderately modified)** **RMO: Maintain** As the fence crossing is existing, it must be ensured that the hydrological functioning and connectivity of the river is maintained during high flow periods so that the PES of the reach of the river is preserved. Effort must be made to maintain the riparian zone of the river at the crossing and limit any further erosion and invasion of alien and invasive species.
Watercourse drivers:			
a) Hydrology The Mutamba River rises in the Soutpansberg mountainous area, approximately 10km south of the study area. It flows through the study area in a north easterly direction, into the Nzhelele River. Despite a relatively large drainage network (consisting of ephemeral drainage lines) associated with this river, since most of these watercourses are only active during the wet season and do not consist of water bearing strata with the capacity to store and then to transmit water to rivers, discharge into the larger Mutamba River is highly variable due to the seasonal nature of the rainfall of the area. Notwithstanding the direct crossing of the fence through the river, the hydrological connectivity and functionality of the river reach upstream and downstream of the river crossing is deemed intact.		**b) Habitat and biota** The Mutamba river is characterised by flat alluvial riverine terraces supporting a variety of macorphytic vegetation, marginal reed belts as well as riverine thickets. The vegetation component of the river is considered intact. Due to the seasonal nature of the river, the river does not retain water long enough to provide breeding and foraging habitat for aquatic macro-invertebrates or avifaunal species. However, it does provide migratory connectivity as well as sheltered nesting habitat for terrestrial avifaunal species. The construction of the fence crossing the river resulted in the loss of riparian vegetation and invasion of alien and invasive species in the immediate upstream and downstream area of the crossing. No alien or invasive vegetation species were noted within the upstream reach of the river investigated, however within the footprint area of the crossing, alien vegetation species such as *Onopordum acanthium* were noted.	
c) Topography: Geomorphology and sediment balance The river is characterised by relatively flat, uniform topography. No significant erosion was noted within the river, primarily due to the lack of pronounced embankments (only within certain reaches of the river). Baseflow is continuous in the thick alluvial soil of the river and sand and sediment is transported downstream during high flood periods. Thus, the sediment load of the river is high during flood events.		**d) Water quality** No surface water was present in the river during the site assessment; thus, no water quality parameters could be measured. Nevertheless, due to the relatively remote locality of this river, the low degree of catchment transformation, and the river located in a private reserve, it can be concluded that if surface water is present, the water quality is unlikely to be significantly impacted by pollutants but the water is known to be naturally brackish.	
Risk Assessment outcome & Business Case:			
LOW			
As the boundary fence crossing in the Mutamba River (Focus Area 3) is an existing structure, only the operational phase was assessed as part of the risk assessment. Based on the onsite conditions at the time of the field assessment, no significant impact to the Mutamba River due to the presence of the fence were noted and the operational risk significance of the fence is considered 'Low'. It is recommended that the steel grid structure atop the concrete base be spaced a minimum of 150mm between the balusters to allow free movement of smaller faunal species through the fence (thus allowing for migratory movement), but still maintain the security of the reserve. Furthermore, the fence must be inspected after storm events and any debris must be removed to ensure no impedance to the flow of water is encountered.			

Table 7: Summary of the assessment of the wetland flat located in Focus Area 4.

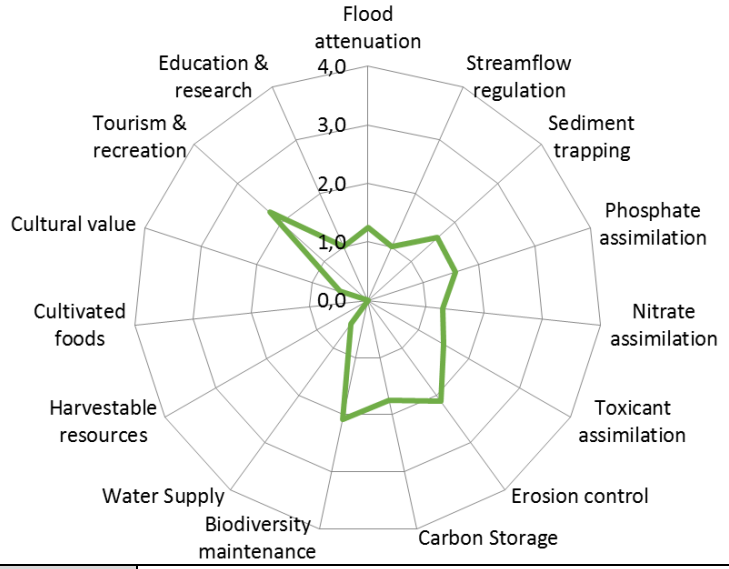
<table>
<tr>
<td colspan="2">Ecological & socio-cultural service provision graph:
 
</td>
<td colspan="2"> 
(Left) The wetland has a large permanent zone, relative to its seasonal and temporary zones; (Right) terrestrial woody vegetation encroaches into the wetland (e.g. Colophospermum mopane and Vachellia tortilis) implies that this zone is not saturated for long periods of time.</td>
</tr>
<tr>
<td>PES discussion</td>
<td>PES Category: B/C (Largely natural with modifications)
This wetland is deemed to be largely natural as the construction activities occurred outside the NEMA regulated zone of the wetland. No edge effects nor residual edge effects from the construction phase were noted to impact on the wetland. Modification to the hydroperiod occurred by increasing the extent of the wetland towards to building footprint.</td>
<td>EIS discussion</td>
<td>EIS Category: High
This wetland is considered of high ecological importance due to its hydro-functional importance, but also due to its direct human benefits (for tourism and aesthetical purposes). The intact terrestrial buffer zone of the wetland hosts a variety of species, to which the wetland provides water during high rainfall periods.</td>
</tr>
<tr>
<td>Ecoservice provision</td>
<td>Intermediate
This wetland provides intermediate flood attenuation functioning and the assimilation of a variety of minerals. Due to the untransformed nature of the area surrounding the wetland, the buffer zone provides habitat for a variety of faunal species. Since the Sulphur Spring Spa in the focus area will host tourists, this wetland has a very high importance in terms of tourism and recreational functions.</td>
<td>REC Category</td>
<td>REC Category: C (Moderately modified)
BAS Category: C (Moderately modified)
RMO: Maintain
No operational nor edge effects from the Sulphur Spring Spa may impact on the PES of this wetland. Given that only a few modifications to this wetland has occurred, no further impacts or alterations to the extent of the wetland and is hydro functionality may occur.</td>
</tr>
</table>

<table>
<tr><th colspan="2">Watercourse drivers:</th></tr>
<tr><td>a) Hydrology
Wetland flats are characterised by the dominance of vertical water movements associated with precipitation, groundwater inflow, infiltration and evapotranspiration. Horizontal water movements within these wetlands, if present, are multi-directional, due to the lack of any significant change in gradient within the wetland. A hard calcrete horizon is present at a depth of 50cm, implying that a perched water table (associated with precipitation) recharges the wetland flat (van der Walt, 2018).

By extending the footprint area of the wetland, the hydroperiod of the wetland is augmented. The permanent zone of the wetland has increased, and water resides in the wetland for a longer period. Thus, the period of which this wetland provides supporting services is prolonged, however, evapotranspiration and infiltration (due to the increased footprint of the wetland) is higher.</td><td>b) Water quality
Geohydrological investigation (Aurecon, 2019[6]) did not test the water quality parameters of this spring. Based on the site observations of the surface water of the spring, the water is clear with no obvious impacts originating from the Sulphur Spa development. Due to the abundance of the wetland vegetation species in the permanent zone of the wetland, the surface water quality appears to be fair.</td></tr>
<tr><td>c) Topography: Geomorphology and sediment balance
Very few alterations to the geomorphology of the wetland has occurred. The edge of the extended wetland has been landscaped (Figure 19) and vegetated with sedge species. It is not considered that these landscaping activities nor the construction phase of the Sulphur Spring Spa had a significant impact on the sediment load of the wetland, as no obvious sediment disposition was evident at the time of this assessment.</td><td>d) Habitat and biota
Due the larger permanent zone of the wetland, facultative wetland species are only present along the seasonal and temporary zone of the wetland. The sedges, Schoenoplectus brachyceras and Cyperus sexangularis, are the dominant vegetation indicators present in the wetland and forms a distinctive boundary from that of the terrestrial area (van der Walt, 2018). The wetland does have a variety of habitat types, thus the wetland in itself is considered to host a diversity of various faunal species. The terrestrial buffer zone, dominated by Colophospermum mopane and the vegetation structure can be described as Mopane woodland, does however provide more habitat structure, which the wetland supports by providing drinking water.</td></tr>
<tr><th colspan="2">Risk Assessment outcome & Business Case:</th></tr>
<tr><td colspan="2">LOW</td></tr>
<tr><td colspan="2">The release of spring water has had a positive impact on the wetland – with an increased extent it can host more species and provide drinking water for a longer period of time in a year. The service infrastructure (potable water and sewer pipelines) of the Sulphur Spring Spa when malfunctioning, can impact on the wetland flat due to its close proximity to the wetland. Despite the risk significance of the failure of the service infrastructure only having a Low significance, it must be ensured that additional wetland areas are not inundated 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. The pipelines must be regularly inspected for leakages, to prevent any additional inundation or impacts to the surface water quality of the wetland.</td></tr>
</table>

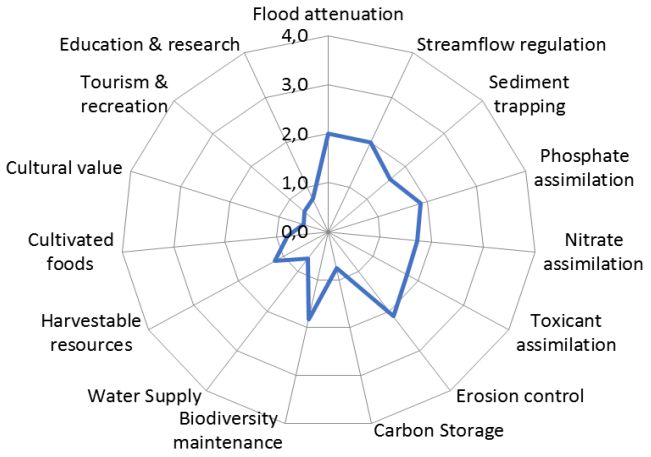
[6] Aurecon. 2019. Geohydrological Investigation for purposes of a Water Use Licence Application. Compiled for Manupoint 124 (Pty) Ltd. Report number: 113527 GHD V1.0

Table 8: Summary of the assessment of pan wetland 2 located in Focus Area 5.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
(Left) the large earth berm located on the north eastern boundary of the pan wetland; (right) sandstone outcrops bound the southern edge of the pan. The permanent zone of the wetland is extensive, which allows for obligate sedge species to inhabit the pan wetland.</td></tr>
<tr><td>PES discussion</td><td>PES Category: C (Moderately modified)
Other that the earth berm on the north eastern boundary of this pan wetland, no other anthropogenic impacts were noted. The berm has changed the hydrological regime of this pan, allowing for water the reside in the pan for longer periods rather than discharging into the downstream EDL. The longer inundation period resulted in a monoculture of obligate sedge species to establish in the pan, rather than host a diversity of obligate and facultative wetland species.</td><td>EIS discussion</td><td>EIS Category: Moderate
This pan wetland is considered of ecological importance due to its hydro functionality. Additionally, it is considered to be of importance for direct human benefits (for tourism and recreational activities). As the pan in itself does host a high diversity of species, it is also connected to the larger drainage system in the study area and functions as a migratory corridor. Additionally, it has ecological importance in terms of biodiversity support.</td></tr>
<tr><td>Ecoservice provision</td><td>Intermediate
This pan plays an important role in the assimilation of nutrients due to the nature of this wetland within the landscape. The vegetation component (wetland and terrestrial) within and surrounding this wetland provides habitat to a variety of species. Additionally, since it is exorheic (linked to an EDL) it is also a migratory corridor. Due to this pan forming part of a private reserve, it does have tourism and recreational functionality.</td><td>REC Category</td><td>REC Category: C (Moderately modified)
BAS Category: C (Moderately modified)
RMO: Maintain
Since no activities are proposed to occur in or surrounding the pan, it must be ensured that the PES of the wetland is maintained. As this wetland may potentially be used as a tourist attraction to view game species, no unauthorised access into the delineated wetland may be permitted.</td></tr>
</table>

Watercourse drivers:	
a) Hydrology Due to this pan wetland having a large permanently inundated area (see Figure 21) during the raining and dry seasons, it is assumed that the pan is hydrologically driven by groundwater and receives flow from the EDL it is connected to. The berm has altered the hydroperiod of the pan through the prevention of the water into the downstream EDL.	**b) Water quality** Other than surface water quality enrichment due to game and antelope grazing and trampling in the pan, no other anthropogenic influencing factors could be identified. Due to the extent of the pan and the vegetation in the pan, water is naturally filtered, and any potential toxicants diluted, leaving the surface water of the pan to be of fair quality.
c) Topography: Geomorphology and sediment balance Few impacts to the geomorphology were noted and it is anticipated that under current conditions, natural deterioration of the geomorphology is considered unlikely. The flat topography of the pan wetland and the high surface roughness provided by the monoculture of sedge species naturally prevents erosion to occur. Despite this, erosion was noted (albeit limited) at the berm where the embankment is steep and unvegetated. Sediment deposition was noted at the EDL inlet on the north western boundary of the pan, although not of concern to significantly increase the sediment load of the pan wetland.	**d) Habitat and biota** A monoculture of the obligate vegetation species *Schoenoplectus brachyceras* dominates the wetland. *Sporobolus pyramidalis* is located within the seasonal and temporary zone of the wetland. The pan wetland lacks a variety of habitat types to support a diversity of faunal species. Nevertheless, the terrestrial buffer, including the sandstone outcrops, supports a variety of species which utilise the pan wetland.
Risk Assessment outcome & Business Case:	
LOW	
No construction activities will occur in pan wetland 2, nor its buffer zone. The existing earth berm has created a permanently inundated area just upgradient of the earth berm. This creates habitat for a variety of small mammal and avifaunal species and provides drinking water for game species with a semi-arid climate area (thus, a positive impact). The rehabilitation activities proposed for the earth berm (see Section 7.1.2), which should occur on the downgradient side of the berm, cannot impact on the water quality and sediment load of the pan. The risk significance of the proposed rehabilitation activities is considered Low, if the mitigation measures, as proposed in Section 7.1.2, is implemented.	

Table 9: Summary of the assessment of the ephemeral drainage lines (EDLs) with riparian vegetation located in Focus Area 5, 6 and 7.

<table>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td><td colspan="2"> 
(Left) the EDL associated with Focus Area 6, in which a spillway (which conveys water from the EDL to the dam) is constructed in the EDL, upstream of Dam 2; (centre) the EDL flowing through Focus Area 7, upstream of Dam 3 and the EDL downstream of Dam 3 (right).</td></tr>
<tr><td>VEGRAI discussion</td><td>VEGRAI Category: C (Moderately modified)
These EDLs are located in the landscape where runoff flows as surface water over impermeable bedrock at the point of outcropping. The riparian vegetation cover within the marginal zones of the EDLs remains fairly intact and indicative of the natural species composition expected of the vegetation type, however some invasive species were present in areas which disturbance has occurred (i.e. spillway in Focus Area 6; spillway in Focus Area 7). The earth berms (which functions as road crossings) which traverse the EDLs has resulted in localised incidences of increased sediment inputs and altered flow patterns during rainfall events, which has altered the overall ecological integrity of these features.</td><td>EIS discussion</td><td>EIS Category: Moderate
The EDLs are considered of ecological importance on a landscape scale, primarily due to the diversity of habitat types they provide and forming part of the larger drainage system in the landscape. As such, they also function as migratory corridors for a variety of faunal species.</td></tr>
<tr><td>Ecoservice provision</td><td>Intermediate
Due to the ephemeral nature of these EDLs, their capacity to provide certain ecological services is considered reduced, although this is counteracted by the relative ecological integrity of the EDLs which increases its overall functionality. The EDLs are considered important for biodiversity maintenance. The EDLs are not considered important for harvestable resources or cultivated foods, mainly due to it being located in a naturally water scarce region and within an area classified as a game reserve.</td><td>REC Category</td><td>REC Category: C (Moderately modified)
BAS Category: C (Moderately modified)
RMO: Maintain
Effort must be made to ensure the hydrological connectivity and functioning of these EDLs. This will ensure that the current ecological condition of the EDLs are maintained and possibly improved. Although no activities are proposed to be developed in the EDLs, small scale rehabilitation is recommended where erosion and disturbances to the vegetation composition has occurred.</td></tr>
</table>

Watercourse drivers:

a) Hydrology

Due to the presence of the instream impoundments and/or earth berms, all downstream reaches of the EDLs in Focus Areas 5, 6 and 7 are dry or have limited flow. Thus, the hydrological connectivity of the EDLs are interrupted. This has caused a loss of catchment yield for the larger Mutamba River into which these EDLs flows (although it has resulted in an increase in wetland habitat). As the EDLs are ephemeral in nature, they only convey water during times of rainfall, when water from the larger catchment drains into these resources.

b) Water quality

No surface water was present in the EDLs associated with the Focus Areas 5 and 6, thus, no water quality parameters could be measured. Due to their relative remote locality, the low degree of catchment transformation, and located in a private reserve, it can be concluded that when surface water is present, the water quality of these EDLs are unlikely to be impacted by pollutants but may be enriched with nutrients by the presence of game which could trample through the EDLs.

The upstream reach of the EDL associated with Focus Area 7 contain water pumped from boreholes. The water appeared clear and free of any obvious contaminants; thus, the water quality could be regarded as fair.

c) Habitat and biota

Although not necessarily large enough by themselves to support significant populations of larger animals, habitat along the EDLs remains largely intact and representative of the natural vegetation type. The riparian vegetation consisted of primarily of young tree species of *Gymnosporia senegalensis* and *Combretum mossambicensis.* It is thus deemed likely that the EDLs do provide important refuge and migratory corridors for smaller mammals and avifauna, but lack in adequate provision of aquatic habitat and thus biota.

d) Topography: Geomorphology and sediment balance

The geomorphology of the upstream reaches of the EDLs are largely intact. Significant erosion of the downstream reaches of the EDLs just below the earth berms were noted (Figure A - left). Erosion was also noted at the spillway associated with the earth berm of Focus Area 7 (Figure A - right). This is due to the lack of vegetation on the earth berms and the naturally high erodibility of the soils within the study area. Despite erosion noted within the EDLs, no significant deposition of sediment was observed.

Figure A: (Left) highly incised EDL below the earth berm in Focus Area 7; (right) erosion noted at the spillway located in Focus Area 7.

Risk Assessment outcome & Business Case:

LOW

The downstream reaches of the EDLs (below the earth berms) are eroded, and rehabilitation of the earth berms and these EDLs are proposed. The rehabilitation activities (primarily the revegetation of the earth berm and infilling of erosion gullies) were determined to pose a Low risk significance to the EDLs, provided that the mitigation measures as stipulated in Section 7.1.2 are implemented. In order to prevent further degradation to the EDLs it is considered imperative that the rehabilitation activities be implemented to increase the ecological functionality and condition and to ensure connectivity of the EDLs to the larger Mutamba River system.

5.4 Sensitivity Mapping

5.4.1 Legislative Requirements, National and Provincial guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered important to provide protection of basic ecosystem processes (in this case, the protection of aquatic and wetland ecological services), reduce impacts on watercourses 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).

Legislative requirements were taken into consideration when determining a suitable buffer zone for the watercourses within the focus areas. The definition and motivation for a regulated zone of activity as well as buffer zone for the protection of the watercourses can be summarised as follows:

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

Regulatory authorisation required	Zone of applicability
Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations, 2014 (as amended). ***The Department of Environmental Affairs***	➢ **Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Environmental Impact Assessment (EIA) regulations, 2014 (as amended) states that: *The development of:* *(xii) infrastructure or structures with a physical footprint of 100 square metres or more;* *Where such development occurs—* *a) Within a watercourse;* *b) In front of a development setback; or* c) *If no development setback has been adopted,* ***within 32 meters of a watercourse,*** *measured from the edge of a watercourse.*
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).	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 for Section 21 (c) and 21 (i) of the National Water Act, 1998 (Act No, 36 of 1998) is defined as:

Regulatory authorisation required	Zone of applicability
The Department of Water and Sanitation	• the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a **500 m radius from the delineated boundary** (extent) of any wetland or pan in terms of this regulation.

The delineated watercourses and the applicable Zones of Regulation (ZoR) in terms of GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), as well as the relevant ZoR in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) are conceptually depicted in Figures 26 and 27 below.

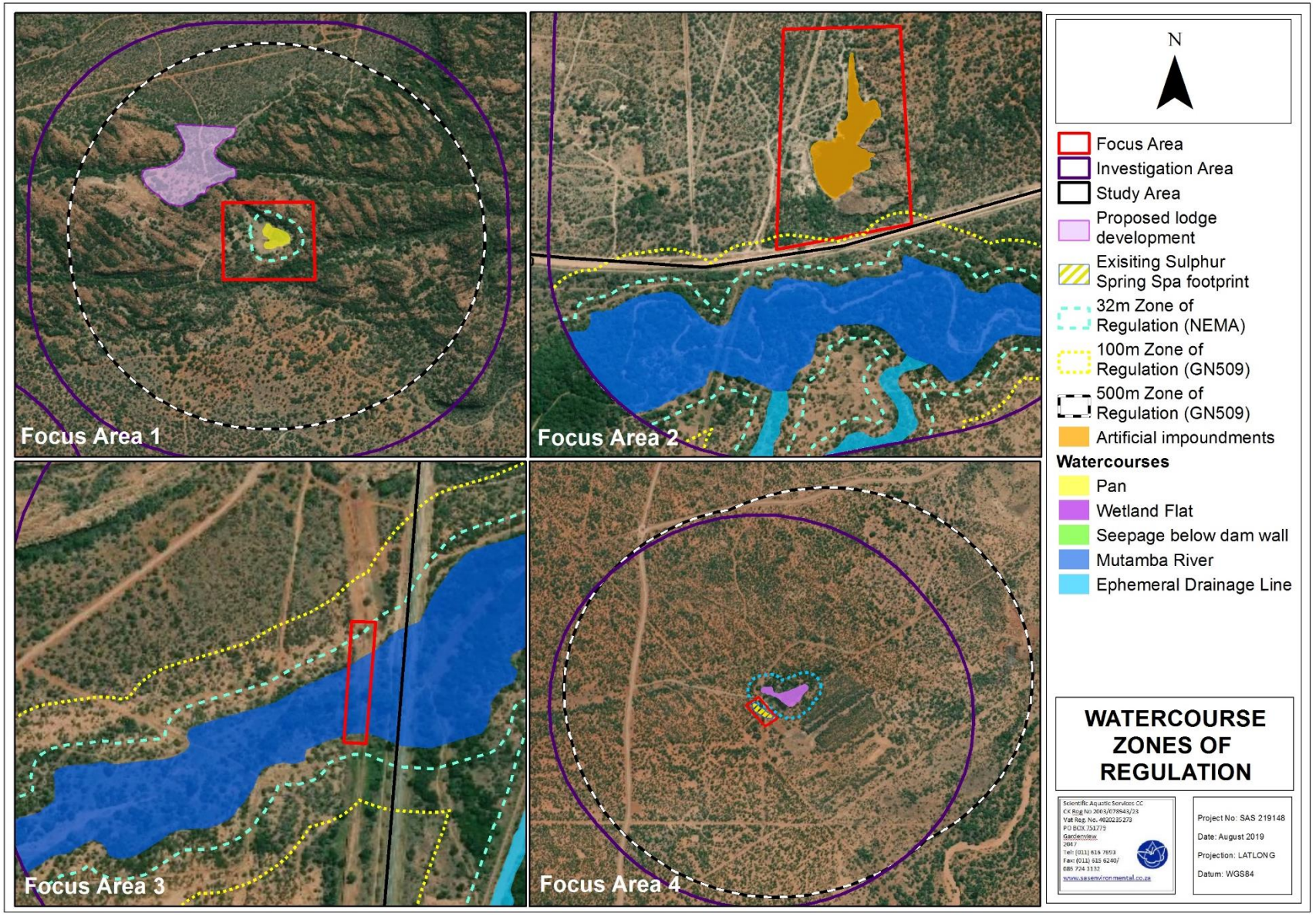


Figure 26: Conceptual presentation of the Zones of Regulation in terms of GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for Focus Areas 1 to 4. (*Wetland flat depicted in this figure is that of the originally delineated extent as delineated by Van der Walt, 2018)

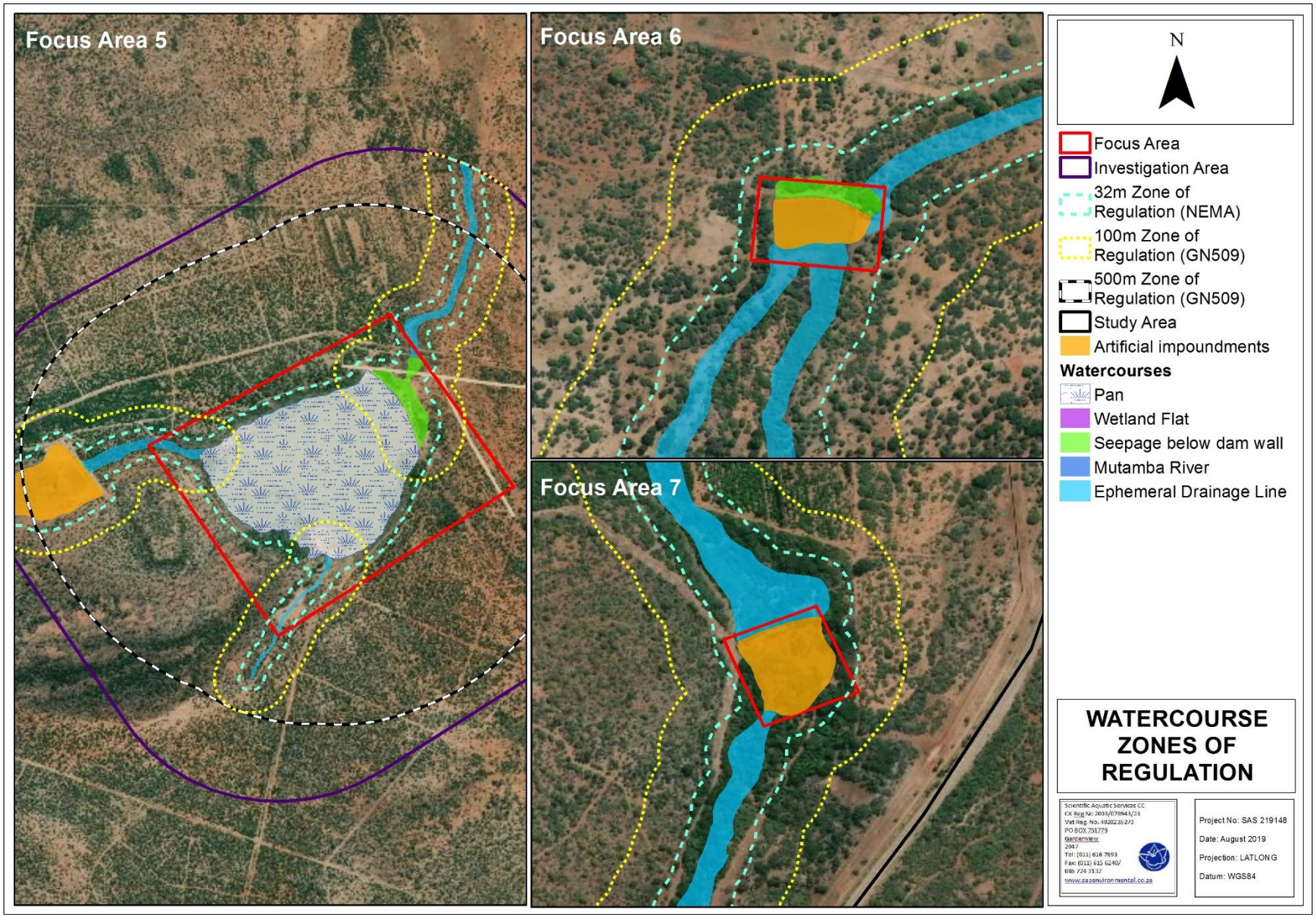


Figure 27: Conceptual presentation of the Zones of Regulation in terms of GN 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), and the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) for Focus Areas 5, 6 and 7.

6 RESULTS: AQUATIC ECOLOGICAL ASSESSMENT

The field assessment took place on the 1st and 2nd of July 2019. Results are presented as “dashboard style” reports (Table 11 to 13). These dashboard reports aim to present concise summaries of the data on as few pages as possible, in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided.

Table 11: Results of the assessment of the Mutamba River, upstream of the boundary fence crossing (approximately 800m upstream of Focus Area 3).

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Figure 28: Upstream reach of the river at the time of the assessment.

Algal proliferation:	The system was dry at the time of the assessment.
Depth profiles:	
Flow condition:	
Riparian zone characteristics:	This section of the riparian zone is considered wide, dominated by large tree species.
Signs of pollution:	None observed.

Riparian Vegetation Response Assessment Index

VEGRAI score	
84.6 (Category B; Largely natural with few modifications)	The Mutamba River is considered to have a true riparian zone, based on the higher vegetation density compared to the terrestrial upland areas. The riparian zone is also dominated by riparian trees, shrubs and grasses. Dominant riparian species observed within the system is the *Faidherbia albida* (Ana tree) and *Grewia flava* (Velvet raisin). The non-marginal zone comprises *Combretum apiculatum* (Red bushwillow), *Senegalia nigrescens* (Knob thorn) and *Sclerocarya birrea* subsp. *caffra* (Marula). Marula trees are protected under The National Forests Act, 1998 (Act No. 84 of 1998). The river at the assessment site has undergone very few disturbance, such as a small recreational picnic area, however, upstream crossings over the river are prevalent which is typical of ephemeral systems.

VEGRAI comparison to RQIS PES (DWS, 2014) data

The VEGRAI classification can be considered as borderline similar to the RQIS PES (DWS, 2014) Riparian-wetland zone habitat integrity class classification of High (Section 4.2, Table 3).

Key Drivers of System Change

The study area is located in a largely untransformed area, however some agricultural activities are located adjacent to the river (limited), thus the river does receive runoff from crop irrigation.

Business Case

The Mutamba River is largely episodic. The reach of the river in the study area is largely natural, with only a few modifications (such as informal road crossings). The construction and operation of the boundary fence crossing does not impact on the upstream reach of the river.

Table 12: Results of the assessment of the Mutamba River at the boundary fence crossing in Focus Area 3.

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Figure 29: The Mutamba river of where the boundary fence crossing is located.

Algal proliferation:	The system was dry at the time of the assessment.
Depth profiles:	
Flow condition:	
Riparian zone characteristics:	This section of the riparian zone is considered wide, dominated by large tree species, shrubs and forbs.
Signs of pollution:	None observed.

Riparian Vegetation Response Assessment Index

VEGRAI score	
79.7 (Category B/C; Largely natural with modifications)	The construction of the boundary fence in the river resulted in the loss of riparian vegetation and alien and invasive species have invaded the immediate upstream and downstream area of the crossing. Alien vegetation species such as *Onopordum acanthium* were noted immediately upstream of the crossing, while all riparian vegetation has been removed between the boundary fence crossing and the N1 road. Despite this, the vegetation upstream and downstream of this crossing is considered largely natural. It must also be noted that the disturbance to the vegetation component of the river in focus area 3 has been an ongoing occurrence as part of the N1 road reserve maintenance activities.

VEGRAI comparison to RQIS PES (DWS, 2014) data

The VEGRAI classification (Largely natural with modifications) at this site differs from the classification provided by the RQIS PES (DWS, 2014) Riparian-wetland zone habitat integrity class classification of High (Section 4.2, Table 3).

Key Drivers of System Change

The study area is located in a largely untransformed area; however, some agricultural activities are located adjacent to the river (limited), thus the river does receive runoff from crop irrigation.

Business Case

The operation of the boundary fence crossing in focus area 3 poses a Low risk significance to the instream flow (when present) of the river, however, any debris collected at the crossing after a rainfall event must be removed to ensure flow connectivity during high flow periods. Additionally, the fence crossing will likely have an insignificant effect on the downstream water quantity and quality of the Mutamba River. It is imperative that the spacing of the palisade fence balustrades be increased to ensure migratory connectivity for biota within the river. Alien and invasive species were noted at the fence crossing, which must be removed and disposed of as part of the rehabilitation of the construction and operational footprint of the fence crossing.

6.1 Ecological Importance and Sensitivity assessment

The Ecological Importance and Sensitivity (EIS) method (DWAF, 1999) was applied to the Mutamba River in order to ascertain the current sensitivity and importance of the system. The results of the assessment are presented in the table below:

Table 13. Results of the EIS assessment for the Mutamba River within the study area.

Biotic Determinants	Score
Rare and endangered biota	3
Unique biota	3
Intolerant biota	2
Species/taxon richness	3
Aquatic Habitat Determinants	
Diversity of aquatic habitat types or features	2
Refuge value of habitat type	2
Sensitivity of habitat to flow changes	1
Sensitivity of flow-related water quality changes	1
Migration route/corridor for instream and riparian biota	3
Nature Reserves, Natural Heritage sites, Natural areas, PNEs	0
RATINGS	**2**
EIS CATEGORY	**High**

The Ecological Importance and Sensitivity Assessment analysis of the Mutamba River provided a score of 2 which can be regarded as of **high importance and sensitivity** and is unique on a national scale. These rivers (in terms of biota and habitat) are not usually very sensitive to flow modifications and often have substantial capacity for use. The system has a high importance in terms of rare and endangered biota with the presence of Marula trees on site, which are protected under the National Forests Act, 1998 (Act No. 84 of 1998).

6.2 Ecological Water Requirements (EWR)

No specific EWR have been determined for the Mutamba River, this is due to the shortage of hydrological and ecological data on non-perennial rivers (such as the Mutamba River). Specific operating rules and instream flow requirements can only be developed when a reserve is determined and implemented to ensure that appropriate flows are maintained downstream of the boundary fence (Focus Area 3) and earth berm crossings (Focus Areas 5, 6 and 7).

Nevertheless, it must be ensured that water is released into the downstream reaches of the watercourses during high rainfall periods (specifically the EDLs connected to the drainage system of the Mutamba River) to ensure hydrological connectivity to the larger system and ensure sufficient water releases to sustain the riparian vegetation associated with the EDLs.

7 RISK ASSESSMENT

This section presents the significance of potential impacts on the freshwater ecology of the identified watercourses associated with the focus areas. In addition, it also indicates the required mitigatory measures needed to minimise the perceived impacts of the construction and operational phases of the proposed lodge development (Focus Area 1) and the operational phases of all other water uses in Focus Areas 3 to 7.

7.1 Risk Analyses

7.1.1 Consideration of impacts and application of mitigation measures

Following the assessment of the wetlands, the DWS approved Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of the watercourses associated with the focus areas. These results are summarised in Table 14 presented in Section 7.1.2 of this report.

Following the risk assessment, mitigation measures were compiled to serve as guidance throughout the construction and operational phases (pending the applicable water use). 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 presents the perceived impact significance *post-mitigation*;
- As the water use activities associated with Focus Areas 3 to 7 are existing, no construction phase assessment was undertaken, thus the impacts to these watercourses were only assessed for the operational phase;
- 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 be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- The lodge development activities (Focus Area 1) are all highly site specific, not of a significant extent relative to the area of the wetland assessed, and therefore have a limited spatial extent. The water use activities of Focus Areas 3 to 7 may impact on the larger drainage system the watercourses are associated with;

- Most impacts are considered to be easily detectable; however, impacts such as surface and/or groundwater contamination would entail specific monitoring to ascertain the occurrence of impacts; and
- The considered mitigation measures are easily practicable.

7.1.2 Impact discussion and essential mitigation measures

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

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

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, these impacts can be avoided or adequately minimised where avoidance is not feasible. The mitigation measures provided in this report have been developed with the mitigation hierarchy in mind, and the implementation of and strict adherence to these measures will assist in minimising the significance of impacts on the receiving freshwater environment. A summary of the risk assessment is provided in the table below, followed by a discussion of the outcome thereof. Kindly refer to **Appendix F** for the full risk assessment table scorings as well as good housekeeping practices that must be implemented.

Table 14: Summary of the results of the DWS risk assessment applied to watercourses associated with Focus Areas 1 and 3 to 7.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
1	Construction Phase	Construction of the Lion Lodge development (Focus Area 1) approximately 150m north west of pan wetland 1 (outside the local catchment of the pan wetland).	*Removal of vegetation and associated disturbances to soils; *Stockpiling of soils; *Construction of the required buildings and bulk services.	*Disturbances of soils leading to the establishment of alien vegetation within the buffer zone of the wetland (albeit not in its catchment); *Increase of movement and construction vehicles surrounding the wetland may have a noise impact which can disturb the biota residing in the immediate vicinity of the wetland.	1	3	8	24	L	*Due to the proposed Lion Lodge development footprint located outside of the local catchment of pan wetland 1 and downgradient of the wetland, no direct negative impacts from the construction phase of the lodge development is expected. Nevertheless, construction edge effects may potentially impact on the wetland. The following control measures must be implemented: *The pan wetland and its 32m NEMA zone of regulation (ZOR) must be demarcated a no-go areas during the construction phase. Demarcation of this area may not interrupt migratory routes into the pan wetland; *Areas which are to be cleared of vegetation (within the pan wetland GN59 ZOR), including contractor laydown areas, must remain as small as possible, in order to reduce the risk of proliferation of alien vegetation, and in order to retain a level of protection to the pan wetland during construction (e.g. dust generation, sediment trapping, slowing of stormwater runoff etc.).
2	Operational Phase	Operation of the Lion Lodge development (Focus Area 1) approximately 150m north west of pan wetland 1 (outside the local catchment of the pan wetland).	*Potential indiscriminate movement of vehicles within the wetland for perimeter inspections/ maintenance.	*Proliferation of alien and invasive plant species within the buffer zone of the wetland, decreasing the potential habitat provisioning.	1,5	3,5	8	28	L	*An alien vegetation management plan should be implemented and managed, for the lodge footprint area and directly affected surrounding areas and any areas where ornamental gardens may be instated; *No vehicles are permitted to enter into the delineated pan wetland; *Indigenous vegetation used in landscaping will reduce the irrigation requirements as well as fertilizers. It is important to note that the Department of Water and Sanitation do not consider irrigation of exotic garden ornamentals as a beneficial use; and *Care must be taken when using herbicides and pesticides in gardens, especially during the rainy season. These chemicals must be used in accordance with the prescribed quantities to prevent contamination of surface water runoff in the buffer zone of the pan wetland.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
3		Operation of the palisade fence crossing the Mutamba River (Focus Area 3).	*Regular vehicle movement along fence; *Debris collection on the fence after rainfall events; *Clearing of vegetation for maintenance purposes; *Alien and invasive species proliferation.	*Reduced hydrological connectivity and functioning; *Disturbance to habitats and their associated biota; *Reduced capacity of the river to provide habitat due to alien and invasive species invasion.	**2**	**4**	**13**	**52**	**L**	*It is strongly advised the steel grid structure atop the concrete base be spaced a minimum of 150mm between the balusters to allow free movement of smaller faunal species through the fence (thus allowing for migratory movement), but still maintain security of the reserve; *Where erosion is noted at the concrete base, it must be infilled (utilising *in situ* soils) and compacted; *All alien and invasive vegetation species must be eradicated where disturbances to the river has occurred. These species must be removed by hand (no mechanical nor chemical treatments allowed), since the alien vegetation species identified within the river is saplings and can easily be removed; *As such, it is strongly recommended that an Alien and Invasive Control Plan be developed as this will need to be monitored and maintained into perpetuity; *Removed alien and invasive vegetation may not be stockpiled within the river, but rather outside of the delineated boundary of the river. These stockpiles must be removed from site as soon as removal activities are done and be disposed of at a registered disposal facility. No mulching of the vegetation may occur on site, as this may cause the spreading and establishment of alien and invasive plant species; *Where vegetation has been removed, suitable indigenous vegetation species must be established to prevent erosion and sedimentation of the river; *The boundary fence crossing must regularly be inspected for erosion and the abundance of alien and invasive vegetation species. Inspection must occur every month, and especially after heavy rainfall events. Any debris that collects against the fence during and after high flood periods must be removed to ensure hydrological connectivity. The debris may not be stockpiled within the river, but rather outside of the delineated boundary of the river.
4		Operation of the Sulphur Spring Spa on the boundary of the wetland flat in Focus Area 4.	*Potential trampling in the wetland during maintenance activities of the buildings and landscaped gardens.	*Compaction of wetland soils; *Disturbance to the wetland habitat and biota; *Invasion of alien and invasive vegetation species.	**1,75**	**3,75**	**8**	**30**	**L**	*During general maintenance activities of the buildings, no personnel may be permitted to enter the wetland, unless it entails maintenance activities of the wetland; *As the wetland has been expanded as a result of anthropogenic influence and wetland vegetation has been planted in this area, it is recommended that no further landscaping takes place so as to allow the

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
										wetland species to establish and proliferate. However, the control of alien and invasive species must be implemented, and such species regularly monitored, to prevent the spread thereof while the wetland vegetation is still establishing; *No fertilisers may be added to the wetland to encourage wetland vegetation growth and the release of water from the spring into the wetland must me controlled to promote zonation of the wetland (i.e. to allow for temporary and seasonal zones on the outer boundary of the wetland, and only the inner zone of the wetland may be periodically inundated).
5			*Potential surface water contamination due to spillages or leakages from the bulk infrastructure servicing the spa.	*Decreasing the surface water quality of the wetland; *Degradation to the habitat provisioning of the wetland; *Possible incision and alteration of the hydroperiod of the wetland.	**3,75**	**5,75**	**9**	**51,75**	**L**	*All bulk infrastructure (sewer and potable water) must be regularly inspected for leakages, to prevent any additional inundation or impacts to the surface water quality of the wetland; *It must be ensured that additional freshwater areas are not inundated 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; *Only existing roadways should be utilised during maintenance and monitoring activities to avoid indiscriminate movement of vehicles; *Should repair of the sewer pipeline be required to address a leak, access to the pipeline should be gained through the manholes, in order to prevent any impact on the wetland; *Should a blockage occur all possible steps are to be taken to prevent the pollution of the wetland during repair, including the placement of sheeting around the manhole used for access as well as containment barrels for any effluent withdrawn; and *Should repair of the sewer line be required to address a leak, the pipeline should be pulled from its sleeve from a nearby manhole, in order to prevent any disturbance to the wetland.

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
6		Operation of the earth berms in the ephemeral drainage lines in Focus Areas 5, 6 and 7, and pan wetland 2 in Focus Area 5.	*Loss of instream flow continuity; *Loss of catchment yield of the Mutamba River to which these EDLs are connected to.	*Loss of aquatic biodiversity downstream of the earth berms; *Fish migration barrier (only when sufficient surface water is present to host such species); *Terrestrial vegetation encroachment downstream of the dam; *Creating new aquatic habitats and altering freshwater and riparian vegetation due to inundation (Positive Impact)	**1,5**	**3,5**	**15**	**52,5**	**L**	Due to these earth berms being in operation for at least 12 years (since 2007), the downstream reaches of the EDLs have adapted to some degree to receive less flow. Due to their ephemeral nature this is not a significant impact, but flow into the downstream reaches must be insured to maintain their and potentially increase their present ecological state. The following control measures are recommended: *Sufficient water quantities must be released (via spillway during high flow periods or pipe outlet during low flow periods) to ensure ongoing functioning of the EDLs, and ultimately ensure maintenance of the downstream Mutamba River water quantity, habitat, biota, and water quality resource quality objectives (RQO's).
7			*Rehabilitation of the earth berms (Focus Area 5, 6 and 7) and the spillway associated with Focus Area 7.	*Trampling of riparian vegetation by personnel when backfilling the existing erosion gullies with soil; *Potential increase of the sediment load of the EDLs due to imported soils in the EDLs; *Invasion of alien and invasive species can reduce the habitat provided by the EDLs.	**1,75**	**3,75**	**12**	**45**	**L**	*Any soil which will be utilised for rehabilitation purposes must be stockpiled outside of the EDLs and their associated 32m NEMA zone of regulation. The footprint of these stockpiles must be as small as possible and may not exceed 2m in height. To prevent further sedimentation of the EDLs, the stockpiles must be covered with suitable geotextiles (such as hessian sheeting); *Imported soils must be certified weed free and should preferably be in situ sustainably sourced soils; *Rehabilitation activities must be performed by manual labour, where possible, to limit soil compaction and disturbance to the riparian vegetation; *The earth berms and the EDL embankments must be reinstated with a minimum slope ratio of 3:1, although a 5:1 ratio is recommended. This will prevent any further erosion from occurring and provide a stable enough slope for vegetation to establish on; *If hard engineering structures are required to stabilise the earth berms or the spillway (due to extensive erosion), use should be made of gabion baskets or reno mattresses, in consultation with a civil engineer and a freshwater specialist. The use of these hard engineering methods should however be avoided as far as practicable;

No.	Phases	Activity	Aspect	Impact	Severity	Consequence	Likelihood	Significance	Risk Rating	Control Measures
										*The 'tie-ins' of the gabions into the natural EDL embankment must be designed and constructed in such a way that, turbulent and/or supercritical flows are not created as far as possible; *The tie-in points of the gabions must be at the same elevation as the EDL streambed level to minimise the risk of erosion and sedimentation; *Construction of the gabions should not be allowed to straighten any section of an EDL, but it should instead mimic the topography and natural flow path of the EDLs as far as possible; *These gabion structures should be monitored for erosion and structural integrity after each rainfall event (especially during the rainy winter season) until suitable basal vegetation cover has re-established; *All disturbed areas must be revegetated with indigenous vegetation species. A graminoid mix is recommended to be established on the dam walls (such as the Mayford's Biomosome Sweet and Mixed Bushveld Reclamation Mixture), while appropriate facultative riparian species be considered for the portions of the EDLs where erosion gullies will be rehabilitated.

Since the proposed Lion Lodge development (Focus Area 1) is located in a different local catchment from pan wetland 1, no direct negative impacts from the construction, nor operation of the lodge development is expected to occur.

As the concrete and grid fence crossing in the Mutamba River (Focus Area 3) is an existing structure, only the operational phase was assessed as part of the risk assessment. Based on the onsite conditions at the time of the field assessment, no significant impact to the Mutamba River due to the presence of the fence in the river was noted and the operational risk significance of the fence is considered 'Low'. It is strongly advised the steel grid structure atop the concrete base (focus area 3) be spaced a minimum of 150mm between the balusters to allow free movement of smaller faunal species through the fence (thus allowing for migratory movement), but still maintain security of the reserve.

The Sulphur Spring Spa is now located within close proximity to the new anthropogenically extended portion of the wetland, although it is still outside of the 32m NEMA regulated zone of the original wetland extent, as delineated by Van der Walt (2018). The service infrastructure (potable water and sewer pipelines) when malfunctioning, has the potential to impact on the wetland flat due to its close proximity. As such, it must be ensured that additional wetland areas are not inundated 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. The pipelines must be regularly inspected for leakages, to prevent any additional inundation or impacts to the surface water quality of the wetland.

Operation of the existing artificial impoundments (Dam 2 and 3) and associated earth berms was determined to have a Low risk significance on the EDLs. This can be attributed to the historical establishment thereof and the ephemeral nature of the drainage lines, being that they are used to only receive surface water during high flow periods. Due to the erosion noted below the earth berms and the downstream reaches of the EDLs, rehabilitation actions must be implemented to ensure no further erosion to the EDLs. Rehabilitation should focus on the establishment of vegetation on the earth berms and within the EDLs to stabilise the highly erosive soils. If hard engineering structures is required, gabions or reno mattresses may be used in consultation with a civil engineer and a freshwater ecologist. It is imperative that the rehabilitation actions do not cause any further degradation to the EDLs and as such, all activities within the EDLs should preferably be undertaken using manual labour rather than heavy vehicles and construction equipment.

8 CONCLUSION

During the site assessment undertaken several watercourses were identified within the seven identified focus areas, consisting of three hydrogeomorphic (HGM) units (two pan wetlands, a wetland flat and riparian systems, including the Mutamba River and ephemeral drainage lines). A large artificial impoundment ('Dam 1') is located in Focus Area 2. The results of the assessments as discussed in Section 5 of this report are summarised in the table below:

Table 15: Summary of results of the field assessment as discussed in Section 5.

Watercourse	Focus Area	PES	Ecoservices	EIS	REC and RMO
Pan wetland 1	1	B (Largely natural with few modifications)	Moderately low	Moderate	REC Category: B (Largely natural with few modifications) BAS Category: B (Moderately modified) RMO: Maintain
Mutamba River	3	B/C (Largely natural with modifications)	Moderately High	High	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Wetland flat	4	B/C (Largely natural with modifications)	Intermediate	High	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Pan wetland 2	5	C (Moderately modified)	Intermediate	Moderate	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain
Ephemeral Drainage Lines (EDLs) with riparian vegetation	5, 6 and 7	C (Moderately modified)	Intermediate	Moderate	REC Category: C (Moderately modified) BAS Category: C (Moderately modified) RMO: Maintain

Based on the findings of the watercourse assessment and the results of the risk assessment, it is the opinion of the ecologist that the proposed Lion Lodge development (Focus Area 1) is located in a different local catchment from pan wetland 1, no direct negative impacts from the construction, nor operation of the lodge development is expected to occur. The operation of the existing water uses (boundary fence, the Sulphur Spring Spa and the earth berms) also pose a Low risk significance to the ecological integrity of the watercourses. Adherence to cogent, well-conceived and ecologically sensitive site development and maintenance plans, the mitigation measures provided in this report as well as general good construction practice and ongoing management, maintenance and monitoring, are essential if the significance of perceived impacts is to be reduced to limit further degradation of the freshwater environment.

It is the opinion of the freshwater specialist that the proposed and existing activities, from a freshwater resource management perspective, are considered acceptable provided that strict adherence to all mitigation measures as stipulated within this report takes place.

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APPENDIX A – Terms of Use and Indemnity

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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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

The Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996)	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 (Act No. 108 of 1996) by way of section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive 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.
The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA)	The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the associated EIA Regulations, 2014 (as amended), 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.
The National Water Act 1998 (Act No. 36 of 1998) (NWA)	The NWA 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 I & (i).
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21(c) and 21(i) of the NWA is defined as: 1. 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; 2. 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 3. A **500 m radius** from the delineated boundary (extent) of any wetland or pan. This notice **replaces GN1199** and may be exercised as follows: ➢ 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; ➢ 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; ➢ 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; ➢ Conduct river and stormwater management activities as contained in a river management plan; ➢ Conduct rehabilitation of wetlands or rivers where such rehabilitation activities have a LOW risk class as determined through the Risk Matrix; and ➢ 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.
Limpopo Environmental Management Act (Act No. 7 of 2003) (LEMA)	The objectives of this Act are: ➢ To manage and protect the environment in the Province; ➢ To secure ecologically sustainable development and responsible use of natural resources in the Province; ➢ Generally, to contribute to the progressive realisation of the fundamental rights contained in section 24 of the Constitution of the Republic of South Africa Act, 1996 (Act No. 108 of 1996), and ➢ To give effect to international agreements effecting environmental management which are binding on the Province. This Act must be interpreted and applied in accordance with the national environmental management principles set out in Section 2 of the National Environmental Management Act, 1998 (Act No. 107 of 1998).

APPENDIX C – Method of Assessment

WATERCOURSE METHOD OF ASSESSMENT

1. Desktop Study

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

1.1 *National Freshwater Ecosystem Priority Areas (NFEPA, 2011)*

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

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

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

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

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

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

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

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

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

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[7] (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but which are inundated or saturated with water, either permanently or periodically. It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups

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

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

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

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

Level 3: Landscape Setting

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

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

Level 4: Hydrogeomorphic Units

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

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

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et al*., 2008), WET-IHI (DWAF, 2007) and WET-EcoServices (Kotze *et al*., 2009).

3. WET-Health

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

Level of Evaluation

Two levels of assessment are provided by WET-Health:

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

Framework for the Assessment

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

Units of Assessment

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

Quantification of Present State of a wetland

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

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

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

Assessing the Anticipated Trajectory of Change

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

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

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

Overall health of the wetland

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

4. Riparian Vegetation Response Index (VEGRAI)

Riparian vegetation is described in the NWA (Act No 36 of 1998) as follows: 'riparian habitat' includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial 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 land areas.

The Riparian Vegetation Response Assessment Index (VEGRAI) is designed for qualitative assessment of the response of riparian vegetation to impacts in such a way that qualitative ratings translate into quantitative and defensible results8. Results are defensible because their generation can be traced through an outlined process (a suite of rules that convert assessor estimates into ratings and convert multiple ratings into an Ecological Category).

[8] Kleynhans et al, 2007

Table C5: Descriptions of the A-F ecological categories.

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

5. Watercourse Function Assessment

"The importance of a water resource, in ecological social or economic terms, acts as a modifying or motivating determinant in the selection of the management class".[9] The assessment of the ecosystem services supplied by the identified freshwater features 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 freshwater features. 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 freshwater features.

Table C6: 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

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

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

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

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

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C6) of the wetland system being assessed.

Table C7: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

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

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

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

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

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

Table C8: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

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

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

Table C9: Description of Recommended Ecological Category (REC) classes.

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

8. Watercourse delineation

The watercourse delineation took place according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" published by DWAF in 2008. The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

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

According to the DWA (2005) like wetlands, riparian areas have their own unique set of indicators. It is possible to delineate riparian areas by checking for the presence of these indicators. Some areas may display both wetland and riparian indicators and can accordingly be classified as both. If you are adjacent to a watercourse, it is important to check for the presence of the riparian indicators described below, in addition to checking for wetland indicators, to detect riparian areas that do not qualify as wetlands. The delineation process requires that the following be taken into account:

- topography associated with the watercourse;
- vegetation; and
- alluvial soils and deposited material.

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 (DWA, 2005).

APPENDIX D – Risk Assessment Methodology

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[10]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[11].

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

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

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

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.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. 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 D9: Calculations

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

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors 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.

i) 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[12] 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.

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

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.

APPENDIX E – Results of Field Investigation

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

Table E1: Presentation of the results of the PES assessment (WET-Health) applied to pan Wetland 1.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall Score
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	3	100	1,0	1,0	1,7	0,0	2,2	0,0	1.5
PES Category			D	↓	B	↑	B	→	B

Table E2: Presentation of the results of the PES assessment (WET-Health) applied to the wetland flat.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall Score
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	3	100	2,0	-1,0	2,0	-1,0	1,8	-1,0	1.9
PES Category			D	↓	C	↓	B	↓	B/C

Table E3: Presentation of the results of the PES assessment (WET-Health) applied to pan wetland 2.

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation		Overall Score
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
1	3	100	3,0	1,0	2,6	0,0	2,2	0,0	2.6
PES Category			D	↓	C	↑	C	→	C

Table E4: Presentation of the results of the VEGRAI assessment applied to the Mutamba River at the boundary crossing.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	83.5	37.1	3.0	2.0	80.0
NON MARGINAL	76.7	42.6	0.0	1.0	100.0
2.0					180.0
LEVEL 3 VEGRAI (%)				79.7	
VEGRAI EC				**B/C**	
AVERAGE CONFIDENCE				1.5	

Table E5: Presentation of the results of the VEGRAI assessment applied to the Mutamba River upstream of the boundary fence crossing.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	85,9	57,3	2,5	1,0	100,0
NON MARGINAL	82,0	27,3	2,5	2,0	50,0
	2,0				150,0
LEVEL 3 VEGRAI (%)				84,6	
VEGRAI EC				**B**	
AVERAGE CONFIDENCE				2,5	

Table E6: Presentation of the results of the VEGRAI assessment applied to the EDLs.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	69,4	46,3	2,5	1,0	100,0
NON MARGINAL	80,0	26,7	2,5	2,0	50,0
	2,0				150,0
LEVEL 3 VEGRAI (%)				72,9	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				2,5	

Table E7: Presentation of the results of the Ecoservices assessment applied to the watercourses

Ecosystem service	Pan Wetland 1	EDLs	Wetland Flat	Pan Wetland 2	Mutamba River
Flood attenuation	1,4	2,0	2	1,3	2
Streamflow regulation	1,0	2,0	1,4	1,0	1,5
Sediment trapping	1,6	1,6	1,8	1,6	3
Phosphate assimilation	1,3	1,9	2,1	1,6	2,6
Nitrate assimilation	1,3	1,7	2	1,3	2,3
Toxicant assimilation	1,3	1,8	2	1,5	2,6
Erosion control	2,0	2,1	1,9	2,1	1,9
Carbon Storage	1,0	0,8	1,3	1,8	2,6
maintenance	2,3	1,8	1,3	2,1	1,3
Water Supply	0,0	0,7	0	0,5	2,6
Harvestable resources	0,0	1,2	0	0,0	2,2
Cultivated foods	0,0	0,8	0	0,0	0,0
Cultural value	0,5	0,5	0,5	0,5	2,2
Tourism & recreation	1,4	0,6	4	2,3	2,4
Education & research	1,0	0,8	2	1,0	1,8
SUM	**16,0**	**20,2**	**22,3**	**18,4**	**31,0**
Average score	**1,1**	**1,3**	**1,5**	**1,2**	**2,1**

Table E8: Presentation of the results of the EIS assessment applied to the watercourses

FRESHWATER FEATURE:			Pan Wetland 1	EDL	Wetland Flat	Pan Wetland 2	Hillslope Seep wetlands	Mutamba River
Ecological Importance and Sensitivity			Score (0-4)					
Biodiversity support			A (average)					
			1,00	0,67	1,00	0,67	0,33	0,67
Presence of Red Data species			0	0	1	0	0	0
Populations of unique species			1	0	1	0	0	1
Migration/breeding/feeding sites			2	2	1	2	1	1
Landscape scale			B (average)					
			1,60	1,40	1,20	1,20	1,00	1,80
Protection status of the wetland			1	1	1	1	1	2
Protection status of the vegetation type			1	1	1	1	1	1
Regional context of the ecological integrity			2	1	1	1	1	2
Size and rarity of the wetland type/s present			3	1	2	2	1	2
Diversity of habitat types			1	3	1	1	1	2
Sensitivity of the wetland			C (average)					
			1,33	1,00	1,00	1,00	1,00	1,00
Sensitivity to changes in floods			1	1	1	1	1	1
Sensitivity to changes in low flows/dry season			1	1	1	1	1	1
Sensitivity to changes in water quality			2	1	1	1	1	1
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			B	B	B	B	B	B
Hydro-Functional Importance			Score (0-4)					
Regulating & supporting benefits	Flood attenuation		1,5	2	1,5	1	1	2
	Streamflow regulation		1	2	1,5	1	1	2
	Water Quality Enhancement	*Sediment trapping*	1,5	1,5	1,5	2	1	1
		Phosphate assimilation	1	1	2	2	1	2
		Nitrate assimilation	1	1	2	2	1	2
		Toxicant assimilation	1	1	2	2	1	2
		Erosion control	1,5	1	1	1	1	2
	Carbon storage		1	1	1	1	1	1
HYDRO-FUNCTIONAL IMPORTANCE (average score)			1	1	2	2	1	2
Direct Human Benefits			Score (0-4)					
Subsistence benefits	*Water for human use*		0	0	0	0	0	2
	Harvestable resources		0	0	0	0	1	2
	Cultivated foods		0	0	0	0	0	1
Cultural benefits	*Cultural heritage*		1	1	1	1	1	1
	Tourism and recreation		1	1	4	4	1	1
	Education and research		1	1	1	1	1	1
DIRECT HUMAN BENEFITS (average score)			0,50	0,50	1,00	1,00	0,67	1,33

APPENDIX F – Risk Assessment and Mitigation Measures

General construction management and good housekeeping practices

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

Proposed feedlot expansion and composting facility footprint

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

Vehicle access

- All vehicles and equipment must be regularly inspected for leaks. Re-fuelling must take place outside of the stipulated setback area, on a sealed surface area to prevent ingress of hydrocarbons into the topsoil;
- In the event of a vehicle breakdown, maintenance of vehicles must take place with care and the recollection of spillage should be practiced near the surface area to prevent ingress of hydrocarbons into topsoil and subsequent habitat loss; and
- All spills should they occur, should be immediately cleaned up and treated accordingly.

Vegetation

- Proliferation of alien and invasive species is expected within any disturbed areas. Alien invasive species are opportunistic, and where disturbances do occur, they will propagate; therefore, these species should be eradicated and controlled to prevent their spread beyond the project footprint. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, must be controlled;
- Removal of the alien and weed species encountered within the study area and particularly any identified within the watercourse 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). Removal of species should take place throughout the construction, operational, and maintenance phases; and
- Species specific and area specific eradication recommendations:
    - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
    - Footprint areas should be kept as small as possible when removing alien plant species; and
    - No vehicles should be allowed to drive through designated sensitive watercourse areas during the eradication of alien and weed species.

Soils

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

Rehabilitation

- Construction rubble must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area as well as immediate vicinity of the study area should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed.

Table F1: Summary of the results of the DWS risk assessment applied to watercourses associated with Focus Areas 1 and 3 to 7.

No.	Phases	Activity	Aspect	Impact	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**	Construction of the Lion Lodge development (Focus Area 1) approximately 150m north west of pan wetland 1 (outside the catchment of the pan wetland).	*Removal of vegetation and associated disturbances to soils; *Stockpiling of soils; *Construction of the required buildings and bulk services.	*Disturbances of soils leading to the establishment of alien vegetation within the buffer zone of the wetland (albeit not in its catchment); *Increase of movement and construction vehicles surrounding the wetland may have a noise impact which can disturb the biota residing in the immediate vicinity of the wetland.	**1**	**1**	**1**	**2**	**1**	**1**	**1**	**3**	**5**	**1**	**1**	**1**	**8**	**24**	**L**
2	**Operational Phase**	Operation of the Lion Lodge development (Focus Area 1) approximately 150m north west of pan wetland 1 (outside the catchment of the pan wetland).	*Potential indiscriminate movement of vehicles within the wetland for perimeter inspections/ maintenance.	*Proliferation of alien and invasive plant species within the buffer zone of the wetland, decreasing the potential habitat provisioning.	**1**	**1**	**2**	**2**	**1,5**	**1**	**1**	**3,5**	**5**	**1**	**1**	**1**	**8**	**28**	**L**

No.	Phases	Activity	Aspect	Impact	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
3		Operation of the concrete and grid fence crossing the Mutamba River (Focus Area 3).	*Regular vehicle movement along fence; *Debris collection om the fence after rainfall events; *Alien and invasive species proliferation.	*Reduced hydrological connectivity and functioning; *Disturbance to habitats and their associated biota; *Reduced capacity of the river to provide habitat due to alien and invasive species invasion.	2	1	2	3	2	1	1	4	5	2	5	1	13	52	L
4		Operation of the Sulphur Spring Spa on the boundary of the wetland flat in Focus Area 4.	*Potential trampling in the wetland during maintenance activities of the buildings and landscaped gardens.	*Compaction of wetland soils; *Disturbance to the wetland habitat and biota; *Invasion of alien and invasive vegetation species.	2	1	2	2	1,75	1	1	3,75	5	1	1	1	8	30	L
5			*Potential surface water contamination due to spillages or leakages from the bulk infrastructure servicing the spa.	*Decreasing the surface water quality of the wetland; *Degradation to the habitat provisioning of the wetland; *Possible incision and alteration of the hydroperiod of the wetland.	3	5	5	2	3,75	1	1	5,75	5	2	1	1	9	51,75	L

No.	Phases	Activity	Aspect	Impact	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
6		Operation of the earth berms in the ephemeral drainage lines in Focus Areas 5, 6 and 7, and pan wetland 2 in Focus Area 5.	*Loss of instream flow continuity; *Loss of catchment yield of the Mutamba River to which these EDLs are connected to.	*Loss of aquatic biodiversity downstream of the earth berms; *Fish migration barrier (only when sufficient surface water is present to host such species); *Terrestrial vegetation encroachment downstream of the dam; *Creating new aquatic habitats and altering freshwater and riparian vegetation due to inundation (Positive Impact)	2	1	1	2	1,5	1	1	3,5	5	4	5	1	15	52,5	L
7			*Rehabilitation of the earth berms (Focus Area 5, 6 and 7) and the spillway associated with Focus Area 7.	*Backfilling of soil and compaction thereof to infill the existing erosion gullies can lead to trampling of established riparian vegetation; *Potential increase of the sediment load of the EDLs due to imported soils in the EDLs; *Invasion of alien and invasive species can reduce the habitat provided by the EDLs.	2	1	2	2	1,75	1	1	3,75	5	1	5	1	12	45	L

APPENDIX G – Specialist information

DETAILS, EXPERTISE AND CURRICULUM VITAE OF SPECIALISTS

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

Stephen van Staden	MSc (Environmental Management) (University of Johannesburg)
Kim Marais	BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)
Christel du Preez	MSc Environmental Science

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

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	082 569 90552
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Natural 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		

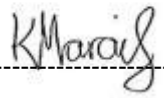
Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Kim Marais		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville		
Postal code:	7539	Cell:	071 413 2245
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	kim@sasenvgroup.co.za		
Qualifications	BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)		
Registration / Associations	Registered Professional Scientist at South African Council for Natural Scientific Professions (SACNASP) Member of the South African Wetland Forum		

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Christel du Preez		
Postal address:	221 Riverside Lofts, Tygerfalls Boulevard, Bellville		
Postal code:	7539	Cell:	076 379 2394
Telephone:	011 616 7893	Fax:	086 724 3132
E-mail:	christel@sasenvgroup.co.za		
Qualifications	MSc Environmental Sciences		
Registration / Associations	Member of the Gauteng Wetland Forum, Western Cape Wetland Forum		

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 -

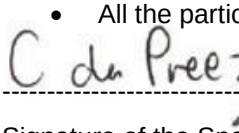
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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



Signature of the Specialist

I, Christel du Preez, declare that -

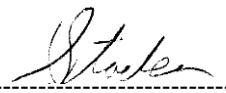
- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity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



Signature of the Specialist

I, 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

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF KIM MARAIS

PERSONAL DETAILS

Position in Company	Consultant
Date of Birth	28 August 1989
Nationality	The Netherlands
Languages	English, Afrikaans
Joined SAS	2015 – Present

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Registered Professional Natural Scientist with the South African Council for Natural Scientific Professions

Member of the South African Wetlands Society

EDUCATION

Qualifications

Short course in wetland and aquatic plant identification	2019
Short course in Tools for Wetland Assessment (Rhodes)	2018
Certificate in Environmental Law for Environmental Managers (CEM)	2014
Certificate for Introduction to Environmental Management (CEM)	2013
BSc (Hons) Zoology (Herpetology) (University of the Witwatersrand)	2012
BSc (Zoology and Environment, Ecology and Conservation) (University of Witwatersrand)	2011

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces

West Africa – Uganda

PREVIOUS EMPLOYMENT

Position	Junior Environmental Scientist
Company	ILISO Consulting (Pty) Ltd
Employment	2013 - 2015

SELECTED PROJECT EXAMPLES

Wetland Delineation and Wetland Function Assessment

Various Freshwater Assessments, including:

- Wetland Offset Plan for the Cape Town International Airport, Cape Town.
- Freshwater Assessment for the Swartklip Site as part of the Cape Town International Airport Wetland Offset requirements, Cape Town.
- Freshwater Assessment for the proposed Heuningklip Solar Farm, Vredenburg, Western Cape.
- Freshwater screening for the proposed Doornfontein Solar Farm, Velddrift, Western Cape.
- Freshwater Screening for the proposed Valentia underground shooting range, Paarl, Western Cape.
- Freshwater Assessment for the proposed Baden Powell Industrial development, Western Cape.
- Freshwater Assessment for the decommissioning of five landfill sites within the Drakenstein Municipality, Western Cape.
- Freshwater Assessment for the proposed De Hoop Residential Development, southern Paarl, Western Cape.
- Freshwater assessment for the proposed Vredenburg Wind Energy Facility, Vredenburg, Western Cape.
- Wetland Assessment for the proposed Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- Wetland Assessment for the sewage Bulk Service System for the Drakenstein Municipality, Paarl, Western Cape.
- Freshwater screening for the proposed Vendome residential Development, Paarl, Western Cape.
- Wetland Assessment for the Riverclub Development for the Val de Vie development, Paarl, Western Cape.
- Wetland Assessment for the Riverfarm Development for the Val de Vie development, Paarl, Western Cape.
- Wetland Assessment for the development of three agricultural dams for irrigation of crops, Cape Farms, Western Cape.
- Wetland Assessment for the Willow Wood Estate Sewage pipeline upgrade, D'Urbanvale, Western Cape.
- Wetland Assessment for the rectification of infilling of a freshwater feature, D'Urbanvale, Western Cape.
- Freshwater Assessment for the stabilisation of the Franschhoek River embankment, Leeu Estates, Franschhoek, Western Cape.
- Freshwater Assessment for the proposed Helderburg Hospital, Somerset West, Western Cape.
- Freshwater Assessment for the Vergenoegd Wine Estate, Cryodon, Western Cape.
- Freshwater assessment for the proposed upgrade of the community school, Elandsdift farm, Sir Lowry's Pass, Western Cape.

Various Freshwater Rehabilitation and Management Plans, including:

- Detailed Method Statement for the rehabilitation and Maintenance of the wetland associated with the Gentleman's Estate Plots, Val de Vie, Paarl, Western Cape.
- Detailed method statement for the rectification and rehabilitation of a storm water system, D'Urbanvale, Western Cape.
- Rehabilitation Plan for the proposed de Hoop Residential Development, Paarl, Western Cape.
- Rehabilitation Plan for the proposed abstraction and storage of water from the Diep River in a 500,000m^3 dam, Durbanville, Western Cape.
- Rehabilitation Plan for the proposed bulk water pipeline over the Kuils River, Belhar, Western Cape.

Water Use Authorisations and ECO input

- WUA for the SANRAL N3 De Beers Pass Section within the Free State and KwaZulu-Natal.
- Assistance with the WULA for the Mzimvubu Water Project, Eastern Cape.
- WUA for the Excelsior Wind Energy Farm and associated powerline infrastructure, Swellendam, Western Cape.
- WUA for the Golden Valley Phase II Wind Energy Facility, Eastern Cape.
- WUA for the Sewage Bulk Service system for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Riverfarm Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Pearl Valley II Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the Levendal Village for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for a residential Development, Klapmuts, Western Cape.
- WUA for the Riverclub Development for the Val de Vie Polo and Lifestyle Estate, Paarl, Western Cape.
- WUA for the proposed Copperton Wind Energy Facility, Northern Cape.
- WUA for the proposed bulk water pipeline crossing over the Kuils River, Bellville, Western Cape.
- WUA for the proposed Vergenoegd Village residential development near Crydon, Western Cape.
- Validation and Verification process of three farms in Franschhoek, Western Cape.
- Validation and Verification process for Farm 1165 in Durbanville, Western Cape.
- WUA for the De Hoop Lifestyle Estate, Paarl, Western Cape.
- WUA for the proposed Platrug Dam with storage capacity of 500,000m^3, Western Cape.
- WUA for the proposed Boland Park residential development, wWestern Cape.

Specialist Environmental Control Work

- ECO of WUL conditions for the proposed bridge and access road over the Berg River, Val de Vie Estate, Paarl.
- ECO of WUL conditions for the proposed bulk water pipeline over the Kuils River, City of Cape Town, Belhar, Western Cape.
- ECO of WUL conditions for the proposed Riverclub residential development, Paarl, Western Cape.
- Various specialist freshwater input into EMP's and landscape plans, Western Cape.

Faunal Assessments

- Faunal Screening for the proposed Brand se Baai Abalone Farm, Troop Namakwa Sand's Mine, Western Cape.
- Faunal Assessment for the proposed Vergenoegd Village residential development near Croydon, Western Cape.
- Faunal Baseline Study for the proposed wetland offset Study at Denel Swartklip, Cape Town international Airport, Western Cape.

Public Participation and Environmental Impact Assessments

- Public Participation for the Environmental Impact Assessment for the Eskom Photovoltaic Plant at Arno and Dubhe Power Station.
- Eskom Hendra to Gunmen sub-stations 400 kV Powerline. Co-ordination of Heritage and Ecological Assessment and updating the Construction and Operation Environmental Management Plan.
- Public Participation Team Leader for the Mzimvubu Dam Environmental Impact Assessment.
- Public Participation Process for Eskom Exemption from and Postponement of Air Emission Licence Applications.
- EIA for Eskom Vierfontien to Wawielpark 22 kV Transmission line refurbishing.
- Junior Environmental Scientist for the Hartbeespoort Waste Charge Discharge System.
- Public Participation Process for City of Tshwane's Bus Rapid Transit from Pretoria Station to Rainbow Junction.
- EIA for the Rwengaaju Model Village Irrigation Scheme in Kabarole District, Uganda.
- EIA for tte Water supply and Sanitation system in Moroto, Bugaddem Kacheri-Lokona, Nakapelimoru and Kotido, Uganda.
- EIA for the Farm Income Enhancement and Forestry Conservation Project: Irrigation Scheme for Katete, Kibimba and Mubuku II, Uganda.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

Position in Company	Freshwater Ecologist
Date of Birth	22 March 1990
Nationality	South African
Languages	English, Afrikaans
Joined SAS	January 2016

EDUCATION

Qualifications

• MSc Environmental Sciences (North West University)	2017
• BSc Hons Environmental Sciences (North West University)	2012
• BSc Environmental and Biological Sciences (North West University)	2011

Additional training and courses

• Wetland and Aquatic plant Identification presented by Carin van Ginkel	February 2019
• Wetland Management: Introduction and Delineation presented by the Centre of Environmental Management University of the Free State	November 2018
• Tools for Wetland Assessment presented by Prof. F. Ellery and Rhodes University	February 2018
• Basic Principles of ecological rehabilitation and mine closure presented by the Centre for Environmental Management North West University	October 2015

COUNTRIES OF WORK EXPERIENCE

South Africa – Western Cape, Eastern Cape, Northern Cape, Gauteng and Mpumalanga

SELECTED PROJECT EXAMPLES

Watercourse Ecological Assessments

- Freshwater resource and aquatic ecological assessment for the proposed West Wits Mining project, in Soweto, Gauteng Province
- Freshwater resource assessment and hydropedological assessment as part of the Water Use License process for the proposed Vlaklaagte 2 Seam, Block 6 coal mining operation, near Kriel, Mpumalanga Province

- Freshwater resource assessment as part of the Water Use License application process for the proposed Middelvlei Mine Project, situated on the remaining extent of portion 2 and 3 of the farm Middelvlei 255-Iq, Randfontein, Gauteng Province
- Freshwater resource assessment as part of the Environmental Assessment and Water Use Authorisation process for the proposed Cygnus Mining Project, Limpopo Province
- Watercourse impact assessment as part of the Environmental Impact Assessment (EIA) for the proposed Hyperion Solar Development 1 - 4, near Kathu, Northern Cape Province
- Freshwater resource ecological assessment as part of the Environmental Assessment and Water Use Authorisation process for the proposed industrial development on farm Cumberland No. 915, Simondium, near Paarl, Western Cape Province
- Watercourse ecological assessment as part of the Environmental Assessment and authorisation process for the proposed periodic maintenance of the MR201 Road (Bain's Kloof Pass), between Wellington and Breederivier, Western Cape Province
- Freshwater resource ecological assessment as part of the Environmental Assessment and Authorisation Processes for the proposed development on portion 12 of the Vergenoegd Farm, Western Cape Province

Watercourse Rehabilitation, Implementation and Management Plans

- Residual wetland impact compensation plan for the proposed extension of Erica Drive from Belhar to Oakdene over the R300 and dualling of Erica Drive / Belhar Main Road, east of Reuter Street, over the Kuils River, Western Cape Province
- Surface water Rehabilitation and Management Plan for the proposed development of portion 204 of the farm Alewynspoort145, Near Alberton Gauteng Province
- Surface water Rehabilitation and Management Plan as part of the Water Use Authorisation requirements for the Twickenham Platinum Mine, Limpopo Province
- Surface water Rehabilitation and Management Plan as part of the Water Use License Application process for the United Manganese of Kalahari (UMK) Mine, near Hotazel, Northern Cape Province

Landscape Plans

- Landscape Plan as part of the WUL application and Environmental authorisation for the proposed extension of the Twickenham Mine, Limpopo Province
- Landscape and Plant Species Plan as part of the proposed Avianto Function development, Gauteng Province
- Landscape and Plant Species Plan for the Mokala Mine, near Black Rock, Northern Cape Province
- Landscape Plan as part of the Rehabilitation and Management Plan for the proposed road upgrade near Vlakfontein, Gauteng Province

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist with focus on Freshwater Ecology
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust and emerald Management Trust

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 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

COUNTRIES 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 Leone
Central Africa – Democratic Republic of the Congo

PROJECT EXPERIENCE (Over 2500 projects executed with varying degrees of involvement)

1 Mining: Coal, Chrome, PGM's, Mineral Sands, Gold, Phosphate, river sand, clay, fluorspar
2 Linear developments
3 Energy Transmission, telecommunication, pipelines, roads
4 Minerals beneficiation
5 Renewable energy (wind and solar)
6 Commercial development
7 Residential development
8 Agriculture
9 Industrial/chemical

REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
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  Email: apheiffer@slrconsulting.com

- Marietjie Eksteen
  Managing Director: Jacana Environmental
  Tel: 015 291 4015