SCIENTIFIC AQUATIC SERVICES

Reg No. 2003/078943/23
VAT Reg No. 4020235273
PO Box 751779
Gardenview
2047
Tel: 011 616 7893
Fax: 086 724 3132
Email: admin@sasenvgroup.co.za
www.sasenvironmental.co.za

FRESHWATER ECOLOGICAL ASSESSMENT AS PART OF THE ENVIRONMENTAL AND WATER USE AUTHORISATION PROCESS FOR THE PROPOSED AMENDMENT TO THE EXISTING MINE PLAN OF THE TUMELO COLLIERY, NEAR HENDRINA, MPUMALANGA PROVINCE

Prepared for

Cabanga Environmental

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Prepared by: Scientific Aquatic Services
Report author: A. Mileson
Report reviewer: S. van Staden (Pr. Sci. Nat)
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EXECUTIVE SUMMARY

Tumelo Colliery is an existing underground coal mine with an approved Mining Right and associated Environmental Management Programme (EMPr), and supporting infrastructure is in place. No new infrastructure is required or planned; and the intention is to continue mining the #2 Seam by means of partial pillar extraction (checkerboard layout).

Two wetland systems were identified within the Tumelo Mining Right Area (MRA), specifically a channelled valley bottom (CVB) system to the west, and a depression wetland in the south-eastern corner of the MRA. The CVB wetland is deemed 'largely modified' whilst the depression wetland is considered 'largely natural'. The depression wetland is located approximately 1.7km from the existing and proposed mining activities and separated from the activities by a catchment divide. Thus it is not considered to be at risk from the existing or proposed activities, and the DWS Risk Assessment Matrix was not applied to that wetland.

The results of the Risk Assessment applied to the CVB wetland however indicate that there is potential moderate (and possibly high) significance of indirect risks posed to the CVB wetland, specifically subsidence and possible decant and Acid Mine Drainage formation from underground workings (existing and proposed). The specialist geotechnical study indicates a high risk of subsidence in the vicinity of the CVB wetland (and adjacent surface infrastructure), recommending that pillar extraction does not take place in those areas to protect the surface features. The specialist geohydrological study ascertained the risks pertaining to dewatering, decant post-mining, and the formation of a groundwater pollution plume, and the mitigation measures stipulated by the specialist geohydrologist to manage these risks must be implemented. Possible indirect risks posed by the clean and dirty water separation systems within the existing operational mine area were also identified and assessed.

Notwithstanding the above, it is the opinion of the ecologist that, based on available information, strict adherence to well-developed, site-specific mitigation measures (including those that may be formulated by a suitably qualified geohydrologist to address subsidence and decant risks) is possible. Appropriate implementation of these mitigatory measures will reduce the potential significance of risks to the CVB wetland and may potentially enable complete avoidance of all impacts except for the risk of additional post closure decant.

Therefore, based on the outcome of the study, it is the opinion of the ecologist that the proposed partial pillar extraction of the #2 Seam may be authorised, with the proviso that mitigation measures are strictly implemented throughout the Life of Mine.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental and Water Use Authorisation processes for the proposed amendment to the existing mine plan to include pillar extraction at the Tumelo Colliery, near Hendrina, Mpumalanga Province (hereafter referred to as the Mining Right Area (MRA)). The MRA is located approximately 5.5 km south-south east of the town of Pullens Hope, 15 km north west of the town of Hendrina, and the N11 national highway is located approximately 5.3 km east of the MRA.

Tumelo Colliery is an existing underground coal mine with an approved Mining Right (MP 30/5/1/2/2/10115MR) and associated Environmental Management Programme (EMPr), and supporting infrastructure is in place. Tumelo Colliery was placed under care and maintenance at the end of February 2014, with activities only resuming in the first quarter of 2019.

The approved EMPr addressed the underground mining (bord-and-pillar) of the reserves associated with the #2 Seam. Upon further assessment of the resource, Tumelo now wish to amend the mine plan to include the partial pillar extraction of the #2 Seam (checkerboard layout), thus constituting a change in the approved EMPr and therefore requires the Minister's consent in terms of Section 102 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) prior to effecting the change. No additional infrastructure is required for the project and thus no new Listed Activities in terms of the NEMA; the NEMA EIA Regulations, 2014 (as amended); and/or the National Environmental Management: Waste Act, Act No 59 of 2008 (NEMWA) will be triggered. Further to the above, Tumelo was issued with an Integrated Water Use License (IWUL) (Licence No.24090831) by the Department of Water and Sanitation (DWS) on 1 October 2010, in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA). This was subsequently amended on 4 September 2017. The IWUL was issued for a period of ten (10) years, expiring on 1 October 2020; as such an application to review and amend/renew the IWUL will be compiled for the operations.

The purpose of this report is to define the ecology of the watercourses associated with the MRA in terms of watercourse characteristics, including mapping of the various watercourses, defining areas of increased Ecological Importance and Sensitivity (EIS), defining the Present Ecological State (PES) of the watercourses associated with the MRA, as well as to define the socio-cultural and ecological service provision of the watercourses and the Recommended Ecological Category (REC), Recommended Management Objective (RMO) and Best Attainable State (BAS) for the watercourses. It is a further objective of this study to provide detailed information to guide the proposed project activities in the vicinity of the watercourses, to ensure that the ongoing functioning of the ecosystem, 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.
The assessment took the following approach:

- A desktop study was conducted, in which possible watercourses were identified for on-site investigation, and relevant national and provincial databases were consulted;
- A single field assessment took place in the beginning of November 2019, in order to ground-truth the identified watercourses within the MRA. Two watercourses were identified within the MRA, and were classified according to the Ollis *et al.* (2013) classification system;
- The characteristics of the watercourses were defined including the PES, EIS, REC, RMO and BAS; and
- The results obtained combined with the proposed mine plan were used to assess the impacts of the proposed mine on the watercourses of the region.

The results of the field assessment are presented in Section 5 of this report, and are summarised in the table below:

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

Wetland	PES	Ecoservices	EIS	REC / RMO / BAS
Channelled valley bottom	D	Intermediate	Moderate	D / C / C
Depression	B	Moderately low	Moderate	B / B / B

As shown in the table above, the channelled valley bottom (CVB) wetland has undergone a greater degree of impacts than the depression wetland and is thus deemed to be 'largely modified'. The depression wetland, relatively isolated in the landscape and not in close proximity to any mining or industrial activities, is considered 'largely natural'.

Following the ecological assessment of the wetlands, the Department of Water and Sanitation (DWS) Risk Assessment Matrix (2016) was applied to ascertain the significance of possible impacts which may occur because of the proposed mining activities. The risk assessment was undertaken based on the layout provided by the proponent, which indicates that no new surface infrastructure is required or planned, and that underground mining will take place in the vicinity of the north-eastern portion of the

CVB wetland. No mining activities are planned in the vicinity of the depression wetland. Taking this into consideration, as well as the locality of the depression wetland approximately 1.7km from the existing and proposed mining activities, and the presence of a catchment divide between the depression wetland and the mining activities, the risk assessment was not applied to the depression wetland.
The results of the risk assessment (applied only to the CVB wetland) are presented in Section 6 of this report and are summarised below. It should be noted that since existing adits/shafts are to be utilised and no further construction of supporting infrastructure is required, activities and aspects relating to a construction phase were not assessed.

Table B: Summary of the risk assessment applied to the CVB wetland within the Tumelo MRA.

Phase	No.	Activity	Impact	Significance	Risk Rating
Ongoing Operations Phase (Partial Pillar Extraction)	1	Partial pillar extraction and continued operation of the underground mining area.	*Potential subsidence of surrounding environment if pillars are insufficient to support the ground; *Potential creation of a cone of depression, which may drain water from the adjacent CVB wetland, thus resulting in desiccation of the wetland; *Water entering the underground mining area as a result of ingress into underground mine workings may necessitate dewatering of the underground mining area, which may result in the discharge of dirty water into the adjacent wetland environment; *Potential spillage of oils/hydrocarbons from construction vehicles.	80,5	M
			*As a result of decant, contaminated water may enter the receiving environment leading to altered water quality; and *Alteration (increase) of flow regimes, reduction in water quality (increase in salts and specific contaminants of concern and reduced pH) and subsequent loss of biodiversity of the CVB wetland due to decant of contaminated water.	148	H
			*Potential destabilisation of surrounding environment through the further excavation of underground mining corridors and subsequent potential subsidence of the land.	112	M
	2	Operation and maintenance of the existing stormwater management system associated with the existing mining activities.	Loss of catchment yield due to stormwater containment is expected to occur, which could lead to the following impacts: *Increased flood peaks into the CVB wetland as a result of formalisation and concentration of surface runoff; *Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the CVB wetland; *Reduction in volume of water entering the CVB wetland, leading to loss of recharge (and thus potential desiccation) of the wetland system; and *Further altered vegetation communities due to moisture stress.	98	M
	3		*The potential failure of the PCD infrastructure may result in leakages and possible contamination of surface and groundwater, increased flow into the CVB wetland, and lowered water quality (increase in salts and specific contaminants of concern and reduced pH) within the wetland.	90	M

	4	Post-closure management activities.	*Contamination of water within the receiving environment, and subsequent reduction in water quality (increase in salts and specific contaminants of concern and reduced pH); *Subsequent negative impacts on biota and vegetation; *Altered flow regimes (increased hydroperiod); and *Habitat degradation.	**96**	**M**

Based on the findings of the freshwater ecological assessment, the recommended mitigation measures as provided in Section 6 of this report should be implemented to minimise the impact on the ecology of the CVB wetland within the Tumelo MRA, with specific mention of the following:

- It should not be necessary to encroach on the CVB wetland, since no new surface infrastructure is planned. Therefore, the CVB wetland and applicable zone of regulation as defined by GN704 as it relates to the NWA must be demarcated and marked as a no-go area;
- Underground mining closer to the surface should be carried out with extreme caution to ensure that the subsurface process sustaining the CVB wetland system are not impaired. In this regard, safety factors as determined by the Rock Mechanic Engineer (GeoMech Consulting (Pty) Ltd (2019) must be implemented;
- Any areas where decant points may be determined by the geohydrological assessment, need to be carefully managed throughout the life of the mine;
- Water levels need to be strictly managed to ensure they are kept below any decant level while ensuring that a significant cone of depression impact does not take place;
- If decant does occur, all water is to be treated to the background water quality values prior to release into the receiving environment;
- Notwithstanding the above, the recommendations made by the geohydrological specialist (Shangoni AquiScience, 2020) with regards to managing dewatering, post-closure decant, Acid Mine Drainage (AMD) and the anticipated groundwater pollution plume supersede recommendations made by the freshwater ecologist in this report and must be implemented; and
- Clean and dirty water systems must be kept separate in line with GN704 as it relates to the NWA.

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 mining activities (partial pillar extraction of the remaining #2 Seam) potentially pose an indirect risk to the CVB wetland, and that no risk is posed to the depression wetland. Nevertheless, adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures provided in this report as well as general good practice, is essential if the significance of perceived impacts is to be reduced, particularly cumulative impacts on the CVB wetland. It is also recommended that the proponent strongly consider small-scale rehabilitation of the portion of the CVB wetland within and immediately adjacent to the Tumelo MRA, such as reinstatement of the natural topography (where it has been disturbed by indiscriminate disposal of soil and rubble, and potentially by subsidence in the vicinity of existing underground workings) and revegetation of disturbed areas with indigenous flora.

DOCUMENT GUIDE

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 3.1
cB)	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
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 4, 5, and 6
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	Public consultation is being undertaken by the EAP (Cabanga Environmental)
p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Public consultation is being undertaken by the EAP (Cabanga Environmental)
q)	Any other information requested by the competent authority	No requests received

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, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic 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.
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 occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status according to the International Union for Conservation of Nature (IUCN) Classification.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 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

°C	Degrees Celsius.
BAR	Basic Assessment Report
BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
CSIR	Council of Scientific and Industrial Research
CVB	Channelled Valley Bottom
DHSWS	Department of Human Settlements, Water and Sanitation
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EPL	Ecosystem Protection Level
ES	Ecological Sensitivity
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
EWR	Ecological Water Requirements
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
Ha	Hectares
HGM	Hydrogeomorphic
IAIA	International Association of Impact Assessors
IUCN	International Union for Conservation of Nature
IWUL	Integrated Water Use Licence
LaRSSA	Land Rehabilitation Society of South Africa
mm	Millimetre
m.a.m.s.l	Metres above mean sea level
MAP	Mean Annual Precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
MHW	Mpumalanga Highveld Wetlands
MPRDA	Mineral and Petroleum Resources Development Act
MRA	Mining Right Area
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NEMWA	National Environmental Management: Waste Act
NFEPA	National Freshwater Ecosystem Priority Areas
NOMR	New Order Mining Right
NWA	National Water Act
PCD	Pollution Control Dam
PES	Present Ecological State
PPP	Public Participation Process
RE	Remaining Extent
REC	Recommended Ecological Category
RHP	River Health Program
RoM	Run of Mine
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South Africa Institute of Aquatic Biodiversity
SAIIAE	South Africa Inventory of Inland Aquatic Ecosystems

SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SASSO	South African Soil Surveyors Association
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WULA	Water Use License Application

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecological assessment as part of the Environmental and Water Use Authorisation processes for the proposed amendment to the existing mine plan for the partial pillar extraction at the Tumelo Colliery, near Hendrina, Mpumalanga Province (hereafter referred to as the Mining Right Area (MRA)).

In order to identify all possible watercourses that may potentially be impacted by the proposed project, a 500m “zone of investigation” around the MRA, in accordance with Regulation 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998) (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment. This area – i.e. the 500m zone of investigation around the MRA - will henceforth be referred to as the “investigation area” (Figure 1 and 2).

The purpose of this report is to define the ecology of the area in terms of watercourse characteristics, including mapping of the watercourses, discuss key ecological drivers and to define the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS), as well as the socio-cultural and ecological service provision of the watercourses utilising current industry “best practice” assessment methods, in order to ascertain what, if any, impact the proposed mining activities will have on the watercourses associated with the MRA. Additionally, this report aims to define 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 mining activities in the vicinity of the watercourses, to ensure the ongoing functioning of the ecosystem, 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.

The Department of Water and Sanitation (DWS) (now the Department of Human Settlements, Water and Sanitation [DHSWS]) Risk Assessment Matrix as promulgated in Government Notice 509, published in the Government Gazette 40229 of 2016 as it relates to the NWA was applied to determine the significance of the perceived impacts associated with the proposed mining activities on the receiving environment. In addition, mitigatory measures were developed which aim to minimise the perceived impacts associated with the MRA, followed

by an assessment of the significance of the impacts post-mitigation. This report, after consideration and a description of the ecological integrity of the MRA, must guide the Environmental Assessment Practitioner (EAP) and relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed mining activities from a watercourse management point of view.

Figure 1: A digital satellite image depicting the location of the Tumelo Mining Right Area and investigation area in relation to the surrounding area.

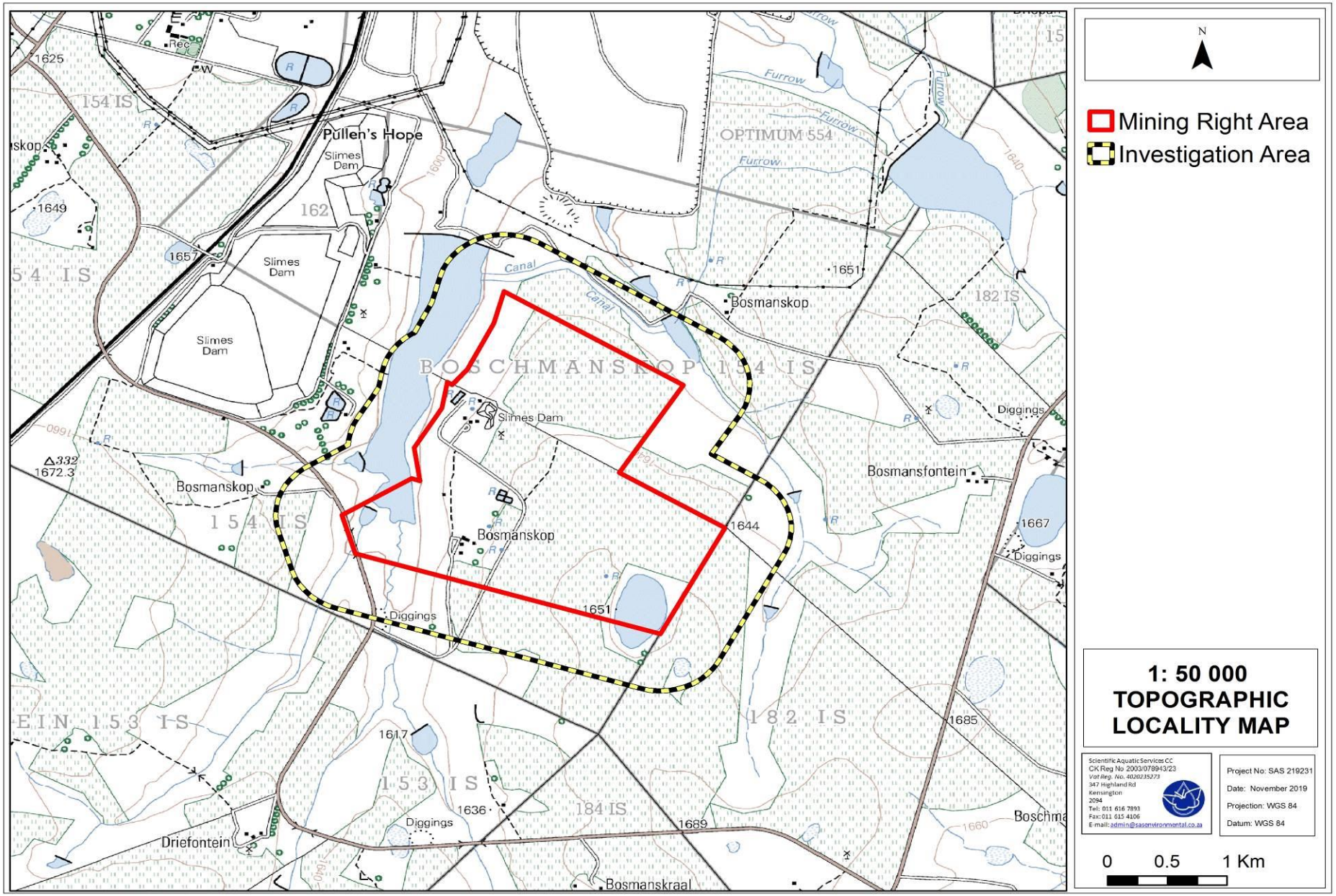


Figure 2: The Tumelo Mining Right Area and investigation area depicted on a 1:50 000 topographical map in relation to the surrounding area.

1.2 Scope of Work

Specific outcomes in terms of this report are outlined below:

- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database; the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database, National Biodiversity Assessment (NBA) 2018, Mpumalanga Highveld Wetlands (2013) and the Mpumalanga Biodiversity Sector Plan (MBSP) 2014 was undertaken to aid in defining the PES and EIS of the watercourses;
- 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 the National Water Act, 1998 (Act No. 36 of 1998) and verified according to the "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 verify the watercourses;
- 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 were determined according to the method described by Rountree & Kotze, (2013);
- The PES of the watercourses was assessed according to the resource directed measures guideline as advocated by Macfarlane *et al.,* (2008);
- The watercourses were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the MRA. 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 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 proposed mining activities, and to aim to quantify the significance thereof; and

[1] The Department of Water Affairs and Forestry (DWAF) was formerly known as the Department of Water Affairs (DWA) and subsequently as the Department of Water and Sanitation (DWS). At present, the Department is known as the Department of Human Settlements, Water and Sanitation (DHSWS). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

[2] Even though an updated manual is available since 2008 (Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas), this is still considered a draft document currently under review.

- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving environment.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The determination of the watercourse boundaries and the assessment thereof, is confined to the MRA. The watercourses within 500m of the MRA were delineated in fulfilment of Regulation GN509 of 2016 as it relates to the NWA using various desktop methods including use of topographic maps, historical and current digital satellite imagery and aerial photographs. The general surroundings were, however, considered in the desktop assessment of the MRA;
- It is important to note that although all data sources used provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the actual site characteristics within the MRA at the scale required to inform the Environmental Impact Assessment (EIA) process. However, this information is considered to be useful as background information to the study and, based on the desktop results, sufficient decision making can take place with regards to the development activities;
- Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required the watercourse will need to be surveyed and pegged according to surveying principles and with survey equipment;
- Watercourse, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the watercourse boundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. It is, however, expected that the watercourses within the MRA have been accurately assessed and considered, based on the field observations undertaken in terms of the watercourse ecology.

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:

- Constitution of the Republic of South Africa, 1996;
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Water Act, 1998 (Act No. 36 of 1998) (NWA);
- Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- Government Notice 704 as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- The National Environmental Management: Biodiversity Act, 2014 (Alien and Invasive Species Regulations, 2014);
- The Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA);
- The Mpumalanga Nature Conservation Act (Act No 10 of 1998); and
- Mpumalanga Biodiversity Sector Plan, 2014 (MBSP).

2 PROJECT BACKGROUND

The MRA extends across various portions of the farm Boschmanskop 154 IS, encompassing an area of approximately 462.21 hectares (Ha). Refer to Table 1 below for details of the affected properties. The MRA falls within the Steve Tshwete Local Municipality (MP313) of the Nkangala District Municipality (DC31), in the Mpumalanga Province of South Africa.

Table 1: Affected Properties

Farm Name	Portion	Surface Right Owner	Extent incl. in MRA (Ha)
Boschmanskop 154 IS	10 Remaining Extent (RE)	Tumelo Exploration (Pty) Ltd	135.0015
Boschmanskop 154 IS	6	Tumelo Coal Mines (Pty) Ltd	145.5447
Boschmanskop 154 IS	Portion 21 (of Portion 6)	Optimum Coal Mine (Pty) Ltd	0.2857
Boschmanskop 154 IS	14 (RE)	Tumelo Coal Mines (Pty) Ltd	150.0259
Boschmanskop 154 IS	Portion 23 (of Portion 14)	Optimum Coal Mine (Pty) Ltd	30.4911
Boschmanskop 154 IS	Portion 26 (of Portion 14)	Jan Hedrik Uys	0.8628

The MRA is located approximately 5.5 km south-south east of the town of Pullens Hope, 15 km north west of the town of Hendrina, and the N11 national highway is located approximately 5.3 km east of the MRA.

2.1 Project History

Tumelo Colliery is an existing underground coal mine with an approved Mining Right (MP 30/5/1/2/2/10115MR) and associated Environmental Management Programme (EMPr) (Digby Wells & Associates, 2006 cited in Cabanga Environmental, 2019). It is understood that construction of the existing operations commenced in 2008 prior to commencement of production in 2010 (GCS Water and Environmental (Pty) Ltd, 2014, cited in Cabanga Environmental, 2019).

Underground mining of the #2 Seam is undertaken using mechanised bord-and-pillar methods. The #2 seam is accessed via a box-cut decline positioned slightly upslope of the Boschmanskop Dam. Coal is conveyed to surface where it is crushed and screened on site before being trucked off site.

Supporting infrastructure on site includes (Figure 3):

- Access and haul roads;
- Workshop area including stores, fuel storage and waste management areas;
- Administrative complex including change house and lamp-room;
- Sewage package plant;
- Crushing and Screening Plant;
- Weighbridge;
- Coal stockpile area (Run of Mine (RoM));
- Clean and dirty water diversion drains;
- Pollution control dam (PCD);
- Overburden stockpile;
- Erikson Dam;
- Substation; and
- Pump station.

Tumelo Colliery was placed under care and maintenance at the end of February 2014 after contract renewal terms could not be agreed between Tumelo Coal Mines (Pty) Ltd (hereinafter referred to as “Tumelo”) and the mining contractor. Activities have only recently resumed in the first quarter of 2019 (Cabanga Environmental, 2019).

2.2 Project Description

The approved EMPr addressed the underground mining (bord-and-pillar) of the reserves associated with the #2 Seam. Upon further assessment of the resource, Tumelo now wish to

amend the mine plan to include the partial pillar extraction of the #2 Seam (checkerboard layout). This constitutes a change in the approved EMPr and Mine Work Programme and Tumelo therefore has to obtain the Minister's consent in terms of Section 102 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA) prior to effecting the change (Cabanga Environmental, 2019).

No additional infrastructure is required for the project and thus no new Listed Activities in terms of the NEMA; the NEMA EIA Regulations, 2014 (as amended); and/or the National Environmental Management: Waste Act, Act No 59 of 2008 (NEMWA) will be triggered (Cabanga Environmental, 2019).

However, as the partial pillar extraction of the #2 Seam will result in a change of Scope and the nature of the environmental impacts, the EMPr will need to be amended as per Regulation 31 of the EIA Regulations, 2014 (as amended) which states (Cabanga Environmental, 2019):

> *"An environmental authorisation may be amended by following the process prescribed in this Part if the amendment will result in a change to the scope of a valid environmental authorisation where such change will result in an increased level or change in the nature of impact where such level or change in nature of impact was not - (a) assessed and included in the initial application for environmental authorisation; or (b) taking into consideration in the initial environmental authorisation; and the change does not, on its own, constitute a listed or specified activity."*

A Part 2 Amendment Process is therefore relevant to the project. The Amendment Process will focus on the impacts associated with the pillar extraction, while the impacts from the current and past mining activities of the #2 Seam will be informative of the baseline conditions of the site and the cumulative nature of some of the potential impacts.

Further to the above, Tumelo was issued with an Integrated Water Use License (IWUL) (Licence No.24090831) by the Department of Water and Sanitation (DWS) on 1 October 2010, in terms of the NWA. This was subsequently amended on 4 September 2017. The IWUL was issued for a period of ten (10) years, expiring on 1 October 2020; as such an application to review and amend/renew the IWUL will be compiled for the operations (Cabanga Environmental, 2019).

The proposed life of mine is four (4) years and the production rate is between 35000 to 44000 RoM tons/month. For further detail please refer to the Mine Works Programme compiled by Metallurgical Resources (2019).

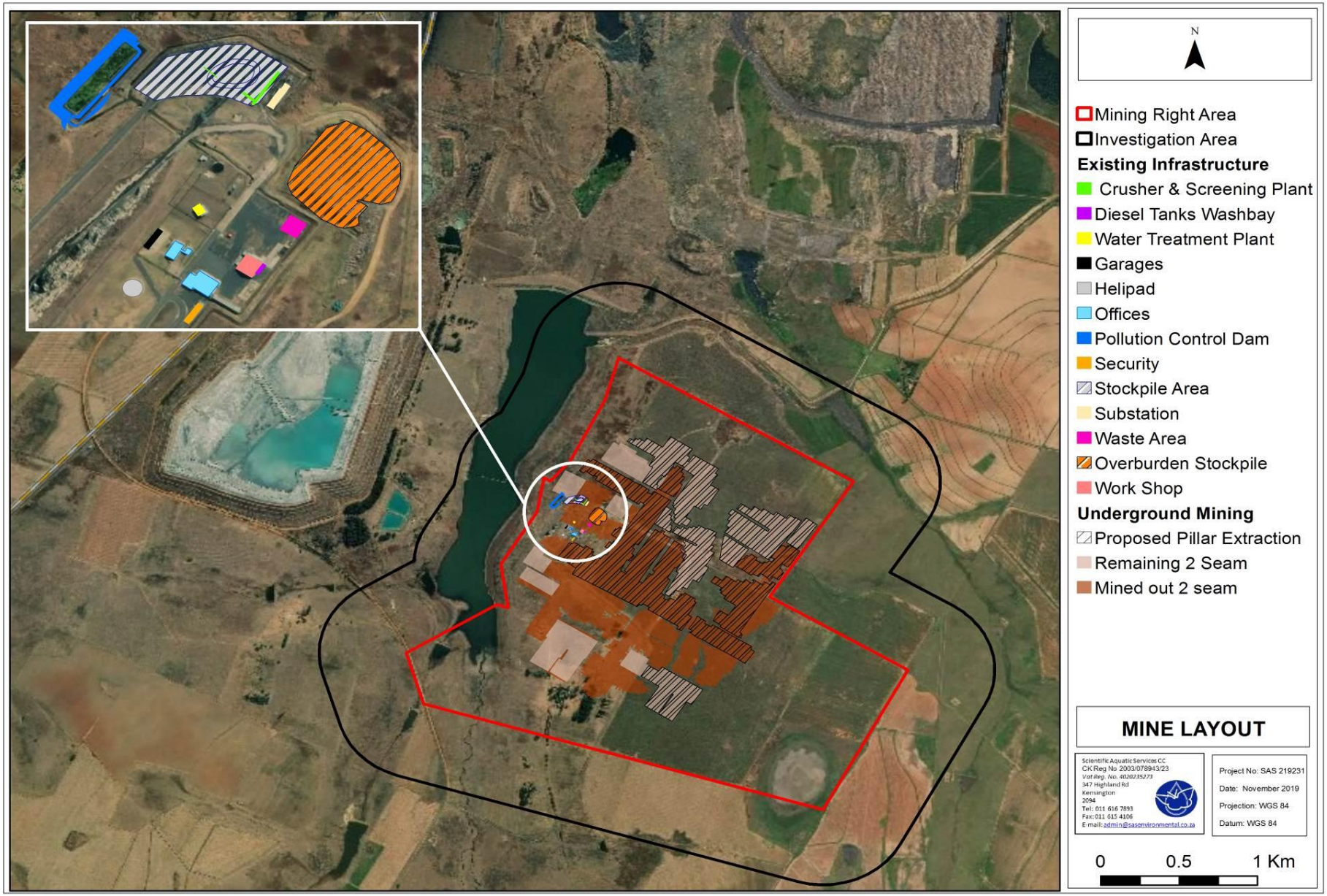


Figure 3: The Tumelo Mining layout in relation to the surrounding area.

3 ASSESSMENT APPROACH

3.1 Watercourse Field Verification

For the purposes of this investigation, the definitions of a watercourse and wetland habitat 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 a watercourse.

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."

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

- Hydrophytic and riparian vegetation: a distinct increase in density, changes in species composition, as well as tree size near watercourses;
- Hue: with riparian areas displaying varying chroma created by varying vegetation cover and soil conditions in relation to the adjacent terrestrial areas; and
- Texture: with riparian areas displaying various textures which are distinct from the adjacent terrestrial areas, created by varying vegetation cover and soil conditions within the watercourse.

A single field assessment was undertaken on the 12th of November 2019 to conduct a watercourse delineation and ecological assessment. The delineation of watercourses took place, as far as possible, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008). The

foundation of the method is based on the fact that watercourses have several distinguishing factors including the following:

- Landscape position;
- 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.

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

3.2 Sensitivity Mapping

The watercourses associated with the MRA were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project the watercourses onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 5.3 should guide the design and layout of the mining expansion activities.

3.3 Risk Assessment and Recommendations

Following the completion of the assessment, a 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 mining activities. These recommendations also include general ‘best practice’ management measures, which apply to the proposed mining related activities as a whole, and 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. 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 in order 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 Mining Right 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 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 watercourses associated with the Tumelo Mining Right Area and surrounding region.

Aquatic ecoregion and sub-regions in which the Mining Right Area (MRA) is located	
Ecoregion	Highveld
Catchment	Olifants North
Quaternary Catchment	B12B
WMA	Olifants
subWMA	Upper Olifants
Dominant characteristics of the Highveld Aquatic Ecoregion Level 2 (11.02) (Kleynhans *et al.,* 2007)	
Dominant primary terrain morphology	Plains; moderate relief, moderately undulating plains and pans
Dominant primary vegetation types	Moist Sandy Highveld Grassland
Altitude (m a.m.s.l)	1300 to 1900
MAP (mm)	500 to 800
Coefficient of Variation (% of MAP)	20 to 29
Rainfall concentration index	55 to 64
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	12 to 18
Winter temperature (July) (°C)	0 – 20
Summer temperature (Feb) (°C)	10 – 26
Median annual simulated runoff (mm)	20 to 80
Importance according to the Mpumalanga Highveld Wetlands (MHW) Database (2014) (Figure 4)	
According to the MHW database various natural wetland features are situated within the MRA and investigation area. The wetland features are classified by the MHW database as a floodplain wetland, seep wetlands (two), a channelled valley bottom wetland and depressions (two). The above-mentioned wetland features are indicated as moderately modified (Class C), with the exception of the small depression feature located within the investigation area, indicated as heavily to critically modified (Class Z). The ecological condition description used for the MHW database is the same categories described by the NFEPA wetland layer.	

Detail of the Mining Right Area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The MRA is located within a subWMA currently not considered important in terms of fish or freshwater resource conservation.
NFEPA Wetlands (Figure 5 – 7)	According to the NFEPA database, there are three natural unchanneled valley bottom wetlands, one artificial unchanneled valley bottom wetland, one natural depression wetland and one artificial channelled valley bottom wetland situated within the MRA. The above-mentioned wetlands are classified as moderately modified (Class C) or heavily to critically modified (Class Z1 – Z3) according to the NFEPA Database. None of the wetlands associated with the MRA are classified as FEPA Wetlands. The field assessment however verified that two of the 'natural' valley bottom wetlands indicated by NFEPA are areas of disturbance, whilst one is a hillslope seep area associated with the valley bottom wetland identified on the western boundary of the MRA (and assessed in this report).
Wetland Vegetation Type	The MRA is situated within the Mesic Highveld Grassland Group 4 Wetland Vegetation Type, considered Least Threatened as provided by Mbona *et al.* (2015).
NFEPA Rivers (Figure 5)	The East Woes-Alleenspruit River traverses the western boundary of the investigation area and MRA. According to the PES 1999 classification the river is largely modified (Class D), and according to the NFEPA Database the river is modelled as not intact (Class Z).
Detail of the Mining Right Area in terms of the Mpumalanga Biodiversity Sector Plan (MBSP, 2014)	
Ecological Support Areas (ESA) Wetlands (Figure 8)	According to the MBSP Aquatics Database, there are four ESA wetlands situated within the MRA. These are wetlands that although not considered FEPA wetlands, still maintain the hydrological functioning of rivers, water tables and freshwater biodiversity, as well as offering various ecosystem services.
Heavily Modified (Figure 9)	The majority of the MRA is indicated by the MBSP to be heavily modified. These include all areas currently modified to such an extent that any valuable biodiversity and ecological function has been lost.
Other Natural Area	The remaining portions of the MRA are situated within an area considered "Other Natural Areas". These are areas that have not been identified as priority areas in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.
Dams	Two dams are indicated within the MRA. Dams are artificial impoundments that are not considered typical wetlands.

National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 10)
According to the NBA 2018: SAIIAE there are two open reservoirs and two dams situated within the MRA. The database further indicates two artificial channelled valley bottom wetlands (CVB) located within the western portion of the MRA as well as an artificial depression feature within the south eastern portion of the MRA, correlating with the NFEPA database. The NBA 2018: SAIIAE does not however identify the areas of disturbance as valley bottom wetlands. The ecosystem protection level (EPL) of the channelled valley bottom wetlands are not protected while the ecosystem threat status (ETS) thereof is critically endangered. The eastern CVB has further been affected by both roads and a degraded river system and the western CVB is only affected by roads, and both CVBs are currently considered heavily to critically modified according to the NBA 2018: SAIIAE database. The EPL of the depression feature is poorly protected and the ETS is least concerned. Furthermore, the NBA 2018: SAIIAE also indicates the East Woes-

Alleenspruit River within the western portion of the MRA and investigation area. The East Woes-Alleenspruit River's EPL is poorly protected and the ETS is critically endangered. According to the NBA 2018: SAIIAE database the East Woes-Alleenspruit River is critically modified (Class F).

Importance according to the Mining and Biodiversity Guidelines (2013) (Figure 11)

According to the Mining and Biodiversity Guidelines Database the western portion of the MRA is considered of Highest and Moderate Biodiversity Importance, while the majority of the MRA is currently not ranked.

- **Highest Biodiversity Important** areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive necessary authorisations. Highest risk for mining. Implications for mining: Environmental screening, EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision making for mining, water use licences, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining projects is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services.
- **Moderate biodiversity important** areas, include ESAs, vulnerable ecosystems as well as focus areas for protected area expansion. These areas are of moderate biodiversity value and therefore pose a moderate risk to mining. Environmental Impact Assessments (EIAs) and associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets, and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations.

Ecological Status of the most proximal sub-quaternary reach (DWS, 2014) (Figure 12)

Sub-quaternary reach	B12B – 01233 (East Woes-Alleenspruit River) located downstream of the MRA
Proximity to Welstand Mining Area	Traverses the western portion of the MRA and investigation area.
Assessed by expert?	Yes
PES Category Median	Seriously Modified (Class E)
Mean Ecological Importance (EI) Class	Low
Mean Ecological Sensitivity (ES) Class	Moderate
Stream Order	1
Default Ecological Class (based on median PES and highest EI or ES mean)	Moderate (Class C)

CVB = Channelled Valley Bottom; DWS = Department of Water and Sanitation; EI = Ecological Importance; EPL = Ecosystem Protection Level; ES = Ecological Sensitivity; ESA = Ecological Support Area; ETS = Ecosystem Threat Status; FEPA = Freshwater Ecosystem Priority Area; m.a.m.s.l = Metres above Mean Sea Level; MAP = Mean Annual Precipitation; MHW = Mpumalanga Highveld Wetlands; NBA = National Biodiversity Assessment; NFEPA = National Freshwater Ecosystem Priority Areas; PES = Present Ecological State; SAIIAE = South Africa Inventory of Inland Aquatic Ecosystems; WMA = Water Management Area

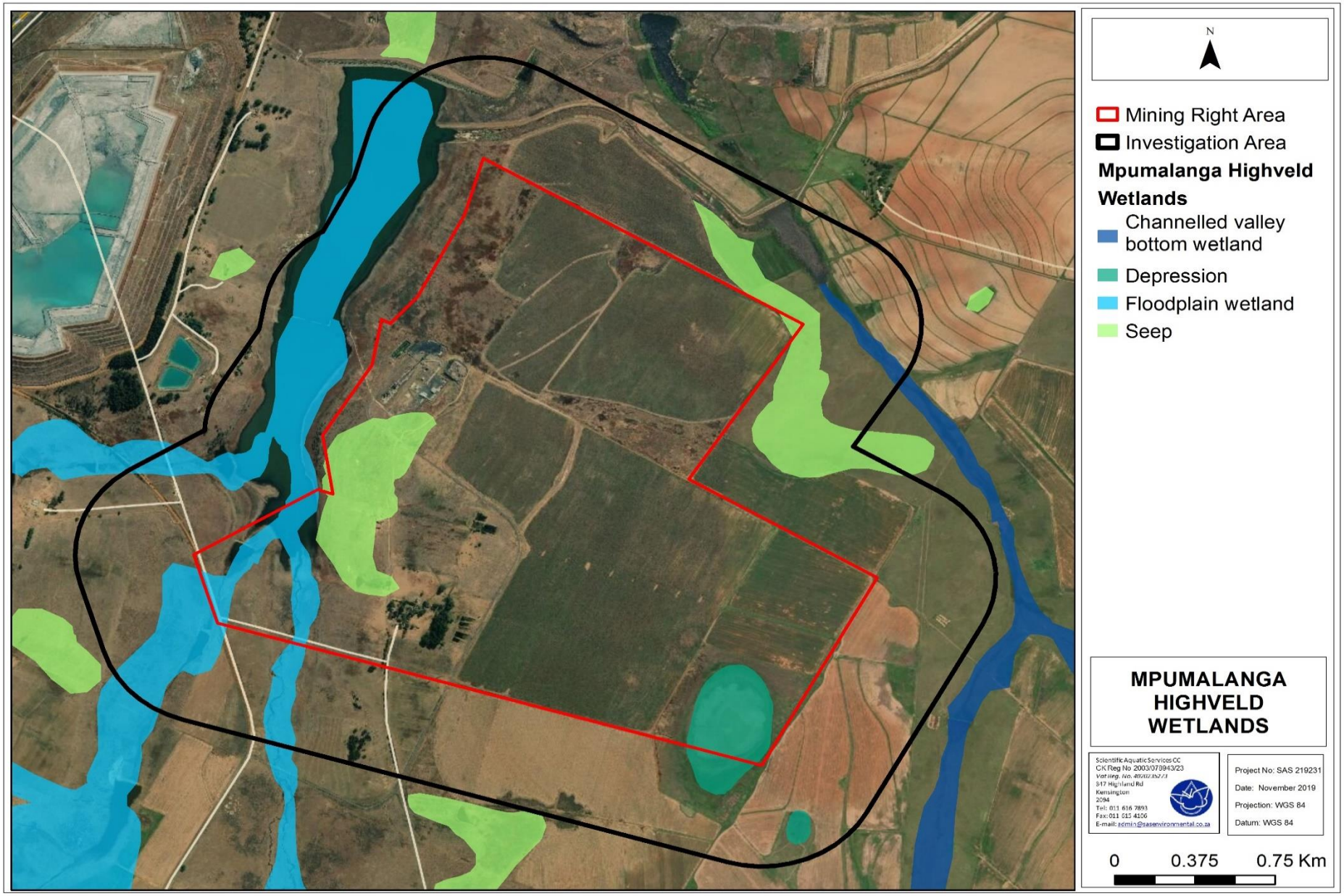


Figure 4: Various HGM units situated within the Tumelo Mining Right Area according to the Mpumalanga Highveld Wetlands Database (2014).

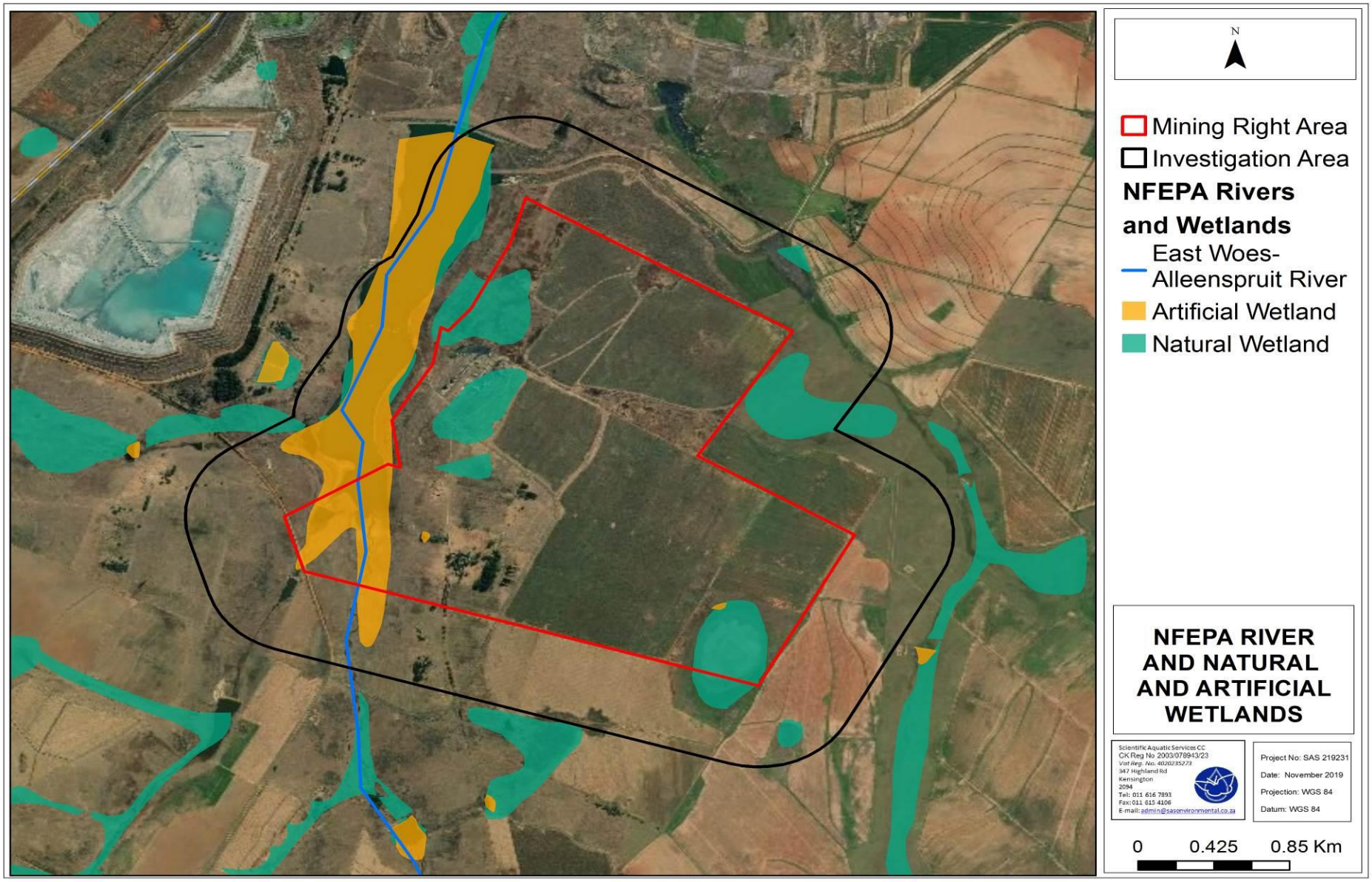


Figure 5: The East Woes-Alleenspruit River and natural and artificial wetland features associated with the Tumelo Mining Right Area and investigation area as indicated by NFEPA, 2011.

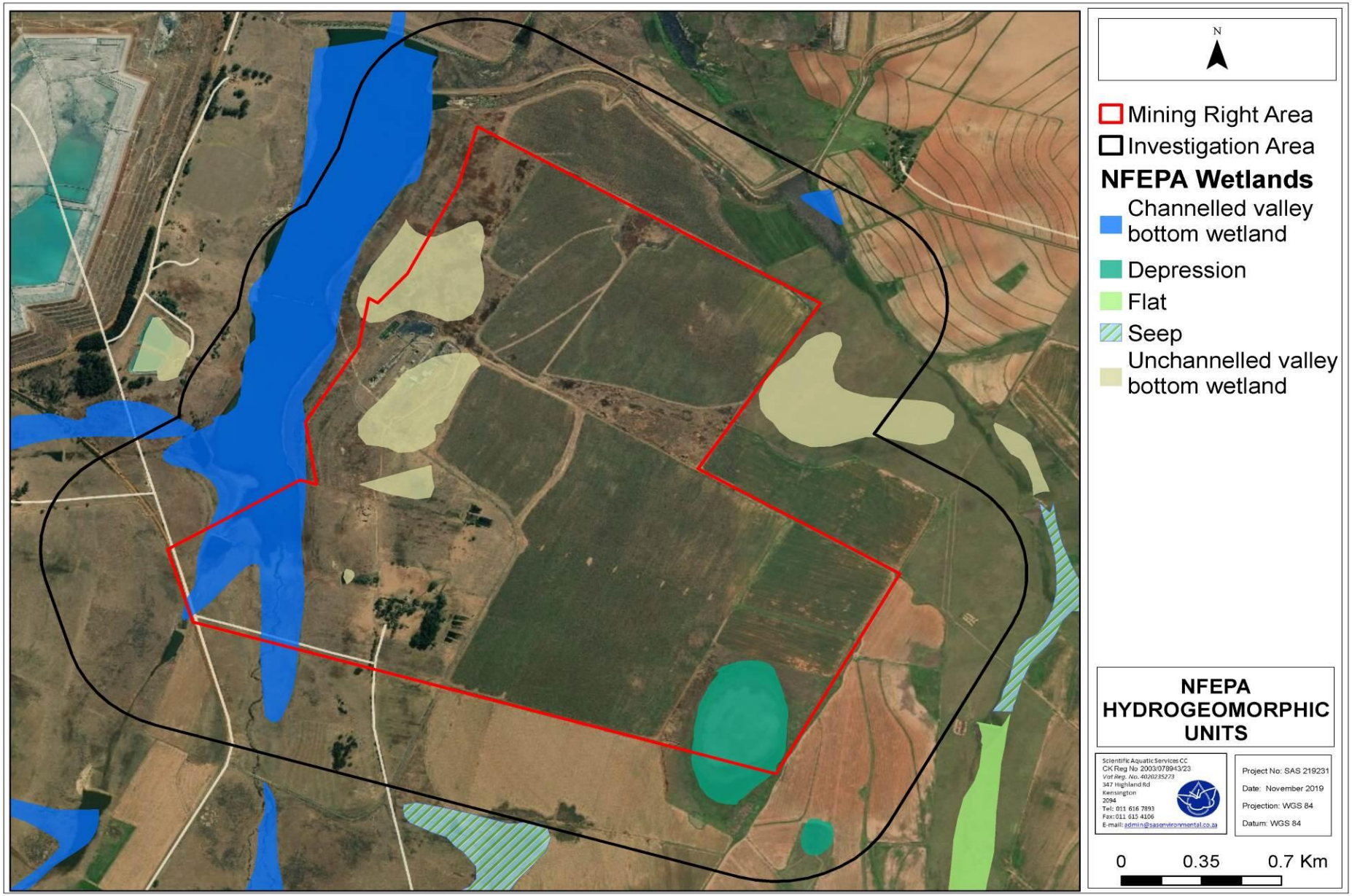


Figure 6: HGM Units of the wetland features associated with the Tumelo Mining Right Area and investigation area according to NFEPA (2011).

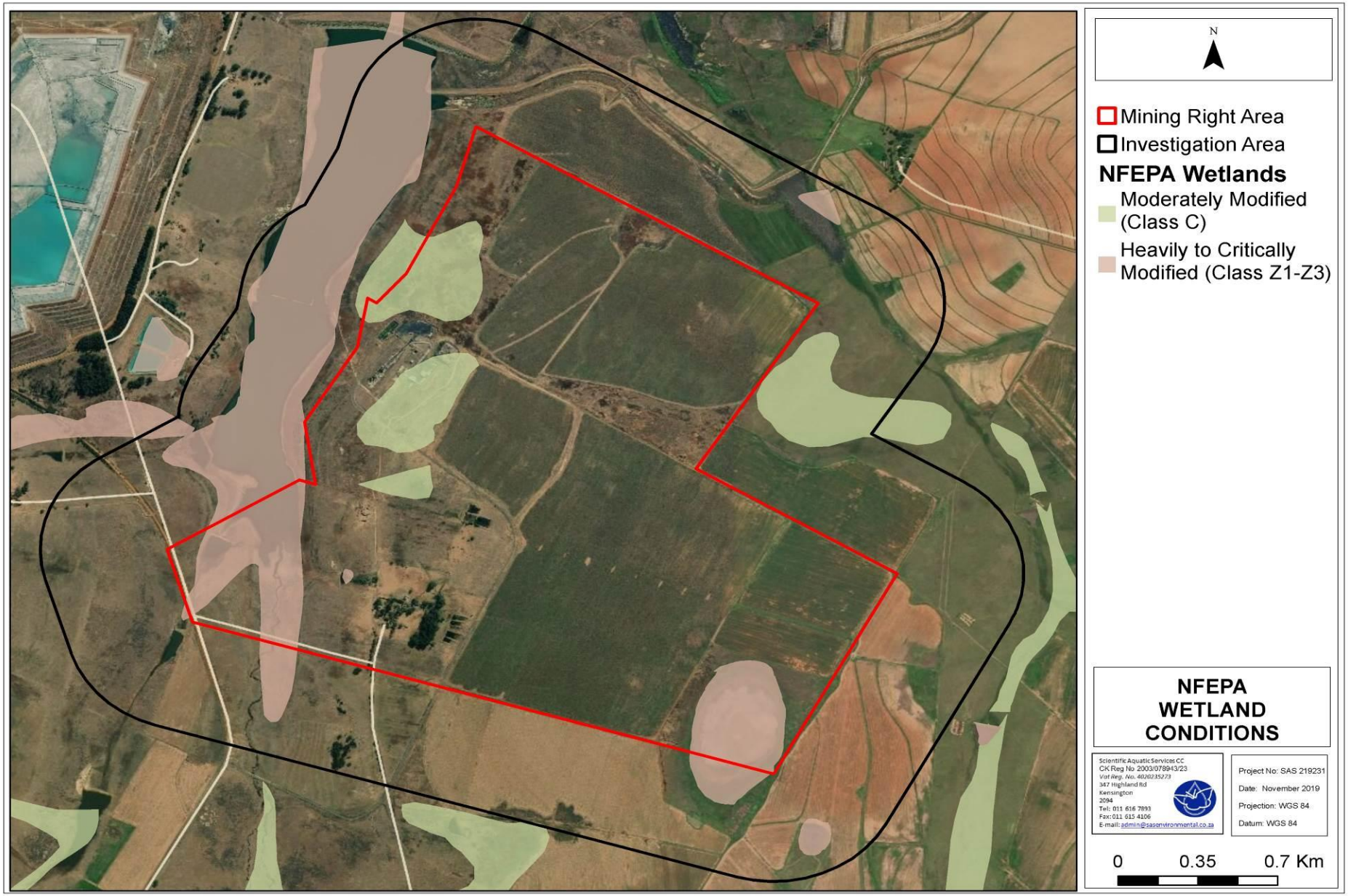


Figure 7: Condition of wetland features associated with the Tumelo Mining Right Area according to NFEPA (2011).

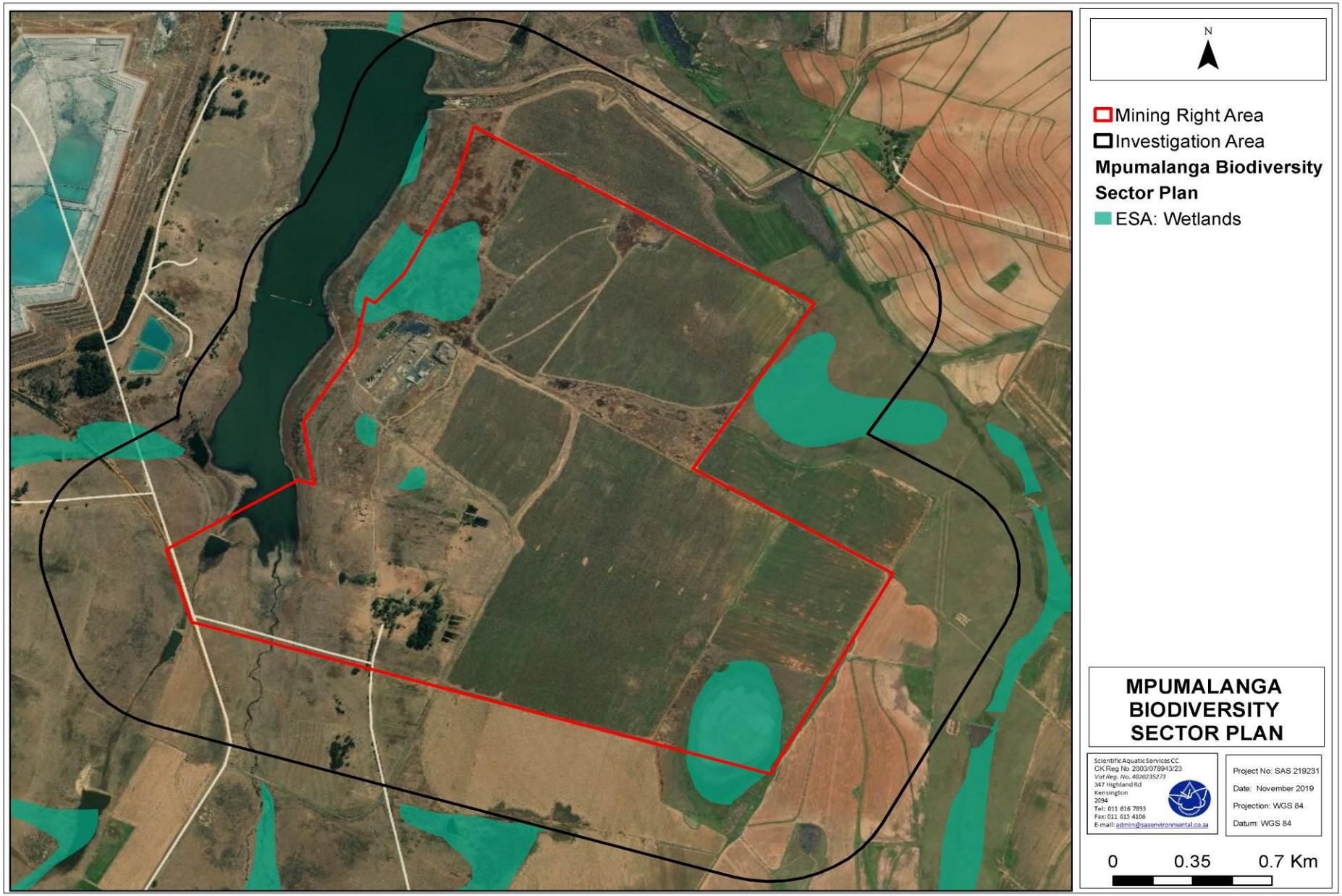


Figure 8: Ecological Support Area (ESA) Wetlands situated within the Tumelo Mining Right Area according to the MBSP Aquatic Database (2014).

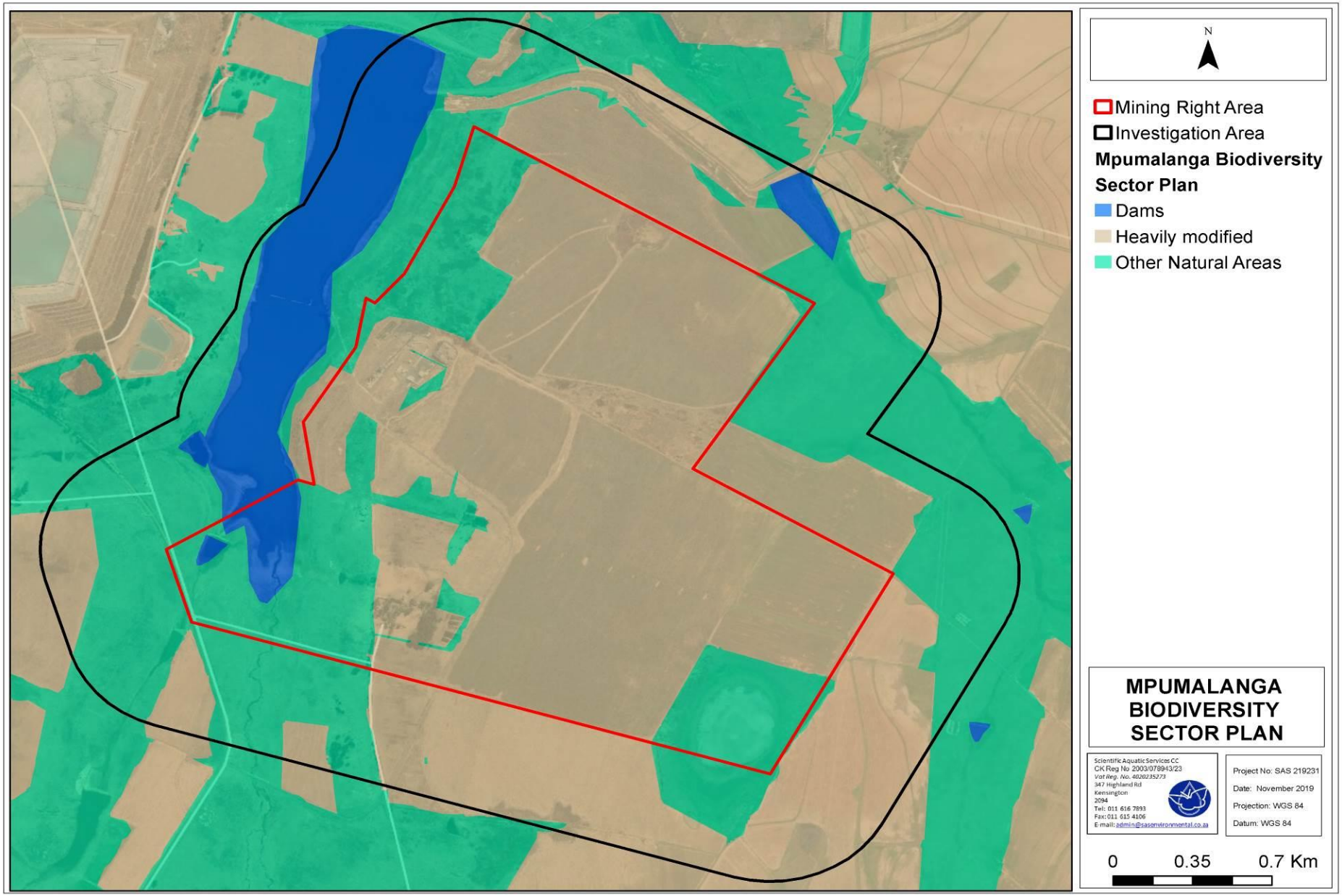


Figure 9: Importance of the Tumelo Mining Right Area according to the MBSP Aquatic Database (2014).

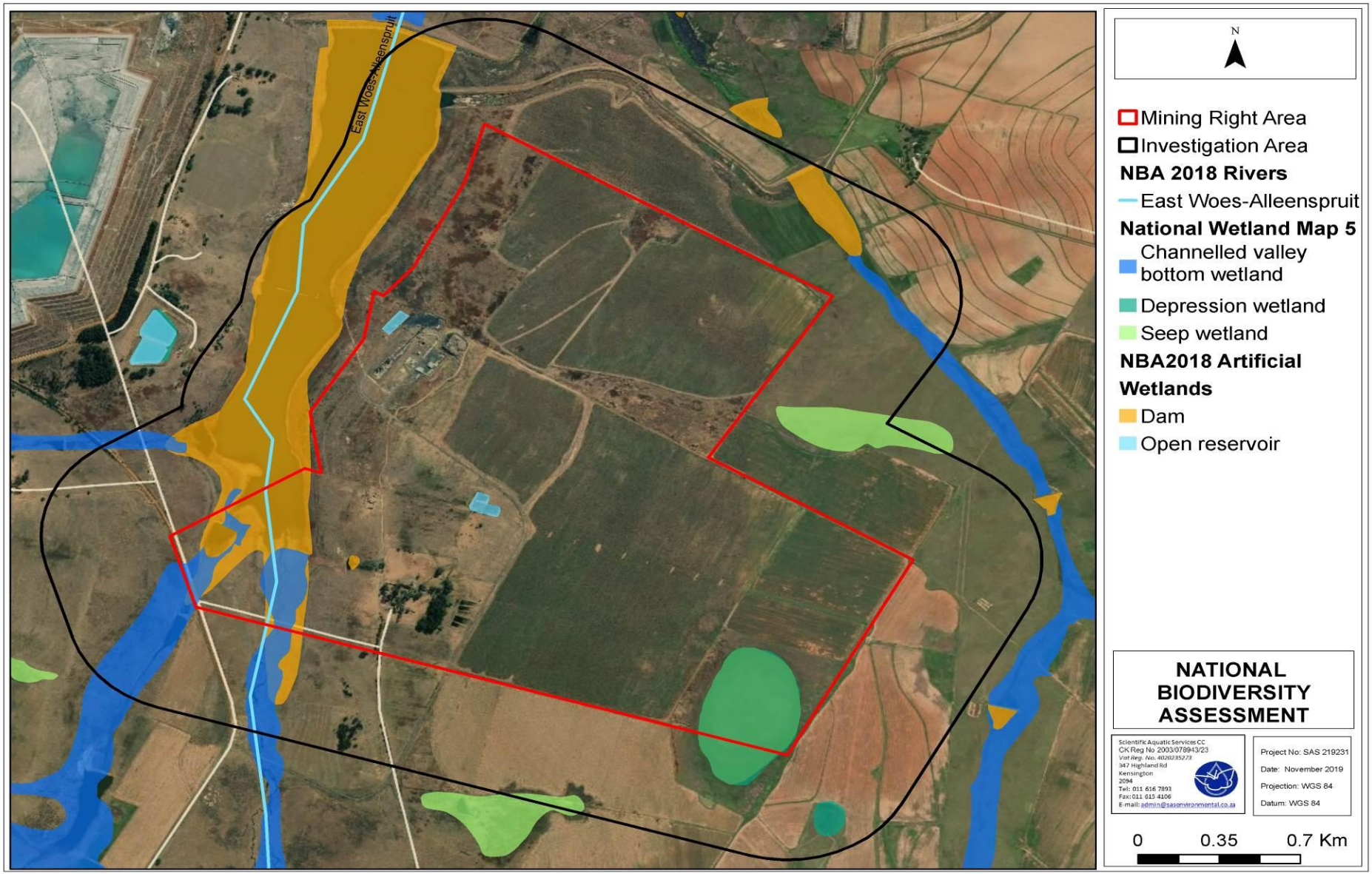


Figure 10: Wetland and river features associated with the Tumelo Mining Right Area and investigation areas, according to the National Biodiversity Assessment: South African Inventory of Inland Aquatic Ecosystems (NBA: SAIIAE, 2018).

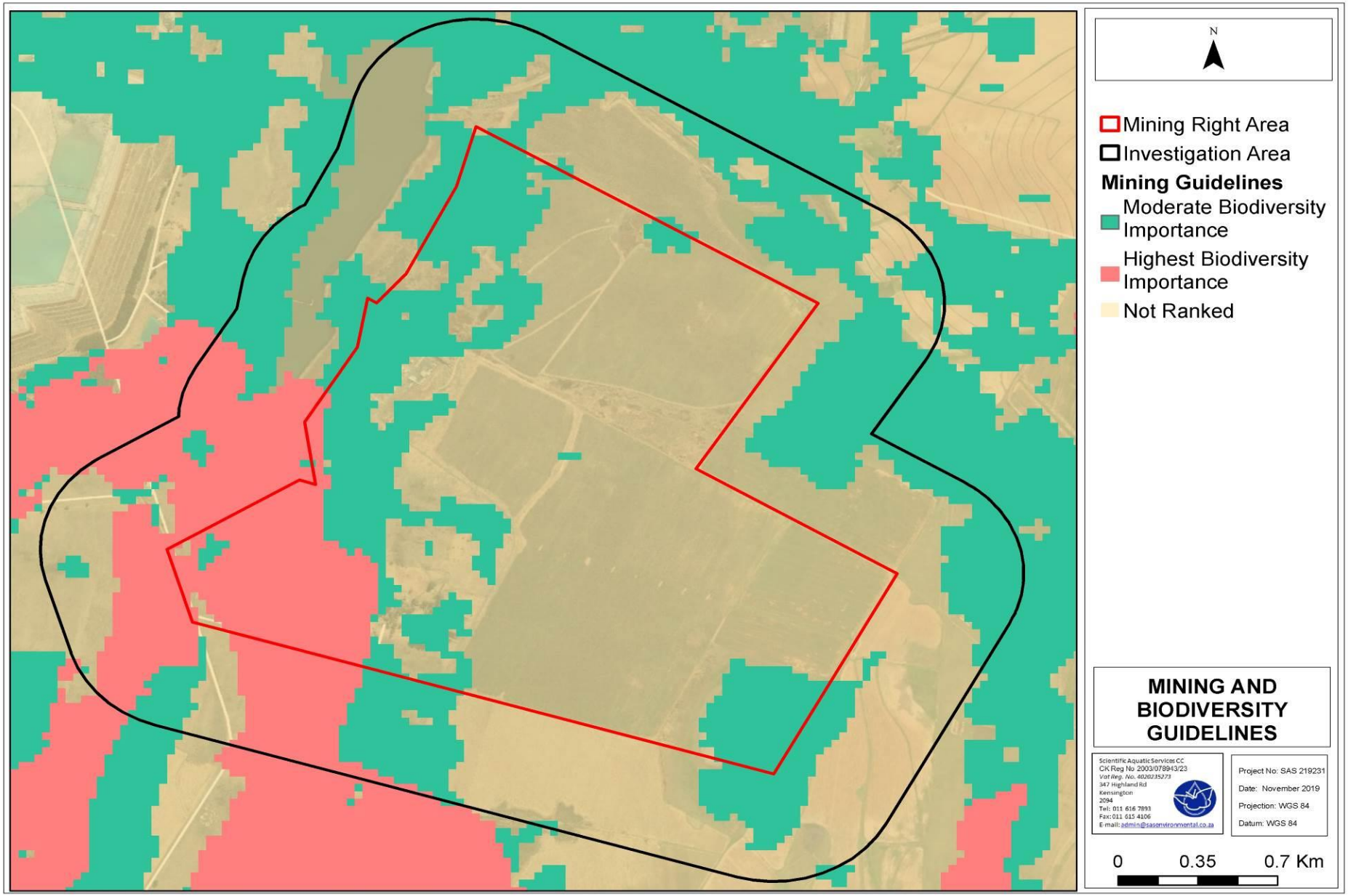


Figure 11: Biodiversity importance associated with the Tumelo Mining Right Area, in terms of the Mining and Biodiversity Guidelines (2013).

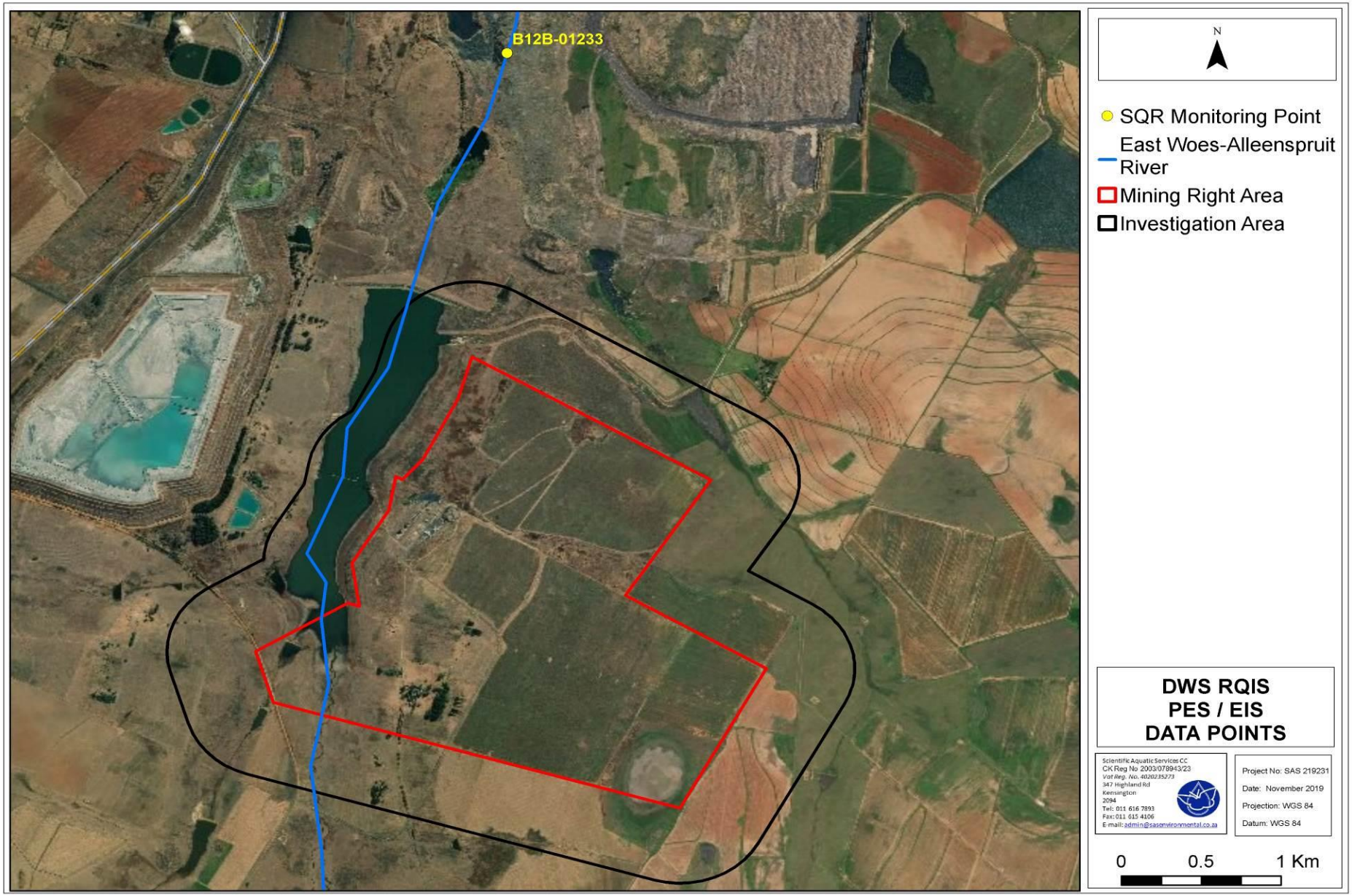


Figure 12: Relevant Sub-Quaternary Catchment Reach (SQR) associated with the Tumelo Mining Right Area and investigation area.

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 RQIS department, was utilised to obtain additional background information for the proposed partial pillar extraction activities at Tumelo Colliery. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as SA River Health Programme (RHP) sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites.

Key information on background conditions associated with the proposed activities at Tumelo Colliery, as contained in this database and pertaining to the PES, Ecological Importance (EI) and Ecological Sensitivity (ES) for the SQR (B12B – 01233) East Woes-Alleenspruit River is tabulated in Table 3 and indicated in Figure 4.

The following fish species have previously been collected from or are expected at the SQR monitoring point (B12B – 01233) East Woes-Alleenspruit River;

- *Clarias gariepinus*
- *Pseudocrenilabrus philander*
- *Tilapia sparrmanii*

The EI data for SQR the East Woes-Alleenspruit River (B12B – 01233) indicates that the following macro-invertebrate taxa are expected to occur at this site:

Aeshnidae	Gyrinidae	Oligochaeta
Ancylidae	Hirudinea	Physidae
Baetidae 1 sp	Hydrometridae	Planorbinae
Belostomatidae	Hydrophilidae	Pleidae
Caenidae	Hydropsychidae 1 sp	Potamonautidae
Ceratopogonidae	Hydroptilidae	Psychodidae
Chironomidae	Leptoceridae	Simuliidae
Coenagrionidae	Libellulidae	Sphaeriidae
Corbiculidae	Lymnaeidae	Tabanidae
Corixidae	Muscidae	Tipulidae
Culicidae	Naucoridae	Turbellaria
Dytiscidae	Nepidae	Veliidae/mesoveliidae
Gerridae	Notonectidae	

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reach East Woes-Alleenspruit River (B12B – 01233) based on the DWS RQS PES/EIS database.

Synopsis (SQ reach East Woes-Alleenspruit River (B12B – 01233))					
PES[1] category median	**Mean EI[2] class**	**Mean ES[3] class**	**Length**	**Stream order**	**Default EC[4]**
E (Seriously Modified)	Low	Moderate	24.00	1	C (Moderate)
PES details					
Instream habitat continuity MOD		Serious	**Riparian/wetland zone MOD**		Serious
RIP/wetland zone continuity MOD		Serious	**Potential flow MOD activities**		Serious
Potential instream habitat MOD activities		Serious	**Potential physico-chemical MOD activities**		Serious
EI details					
Fish spp/SQ		3.00	**Fish average confidence**		1.00
Fish representivity per secondary class		Very Low	**Fish rarity per secondary class**		Very Low
Invertebrate taxa/SQ		39.00	**Invertebrate average confidence**		1.38
Invertebrate representivity per secondary class		High	**Invertebrate rarity per secondary class**		High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating		Very Low	**Habitat diversity class**		Low
Habitat size (length) class		Moderate	**Instream migration link class**		Low
Riparian-wetland zone migration link		Low	**Riparian-wetland zone habitat integrity class**		Low
Instream habitat integrity class		Low	**Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m**		Moderate
Riparian-wetland natural vegetation rating based on expert rating					High
ES details					
Fish physical-chemical sensitivity description		Low	**Fish no-flow sensitivity**		Low
Invertebrates physical-chemical sensitivity description		Moderate	**Invertebrates velocity sensitivity**		Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description					Very Low
Stream size sensitivity to modified flow/water level changes description					Very High
Riparian-wetland vegetation intolerance to water level changes description					High

[1] PES = Present Ecological State; confirmed in database that assessments were performed by expert assessors;
[2] EI = Ecological Importance;
[3] ES = Ecological Sensitivity

5 RESULTS: WATERCOURSE ASSESSMENT

5.1 Delineation

As noted in Section 1.3, the watercourse delineation was limited to the MRA, although due to some access restrictions in the south-west of the MRA due to property ownership, and site conditions due to recent fires in the south-east of the MRA, field-verified delineations were refined and augmented with the use of aerial photographs, digital satellite imagery and topographical maps. The delineations as presented in this report are nevertheless regarded as a best estimate of the wetland temporary zone boundaries based on the site conditions present at the time of the assessment undertaken in November 2019.

During the field assessment, the following indicators were used to delineate the boundaries of the wetland systems:

- Terrain units were used as the primary indicator, as the terrain of the MRA has well-defined low-lying areas where water is likely to collect and/or move through the landscape;
- Soil morphological characteristics (Figure 13) typically associated with wetland conditions, such as gleying or mottling were utilised as the secondary indicator, as these were generally well-developed and were especially useful in areas which had recently undergone burning to confirm the presence of wetland conditions;
- Vegetation (Figure 14) was utilised as a tertiary indicator, particularly in the hillslope seep areas associated with both wetland systems. The distinction between obligate, facultative and terrestrial vegetation was mostly very clear, except in areas associated with historical disturbances such as earthworks and intensive crop cultivation; and
- Soil wetness was not a dominant indicator, with the soils generally displaying weak signs of increased moisture and water table fluctuation.

Figure 13: Representative soil samples taken within the hillslope seep associated with the depression wetland (left) and the channeled valley bottom wetland (right), indicating mottling, a key indicator of a fluctuating water table.

Figure 14: Two of the facultative species utilized as indicators of the wetland boundary. Left: *Faurina sp.* and right; *Haplocarpha lyrata.*

5.2 Watercourse System Characterisation

Two wetland systems were identified with the Tumelo MRA during the field assessment in November 2019; specifically a channelled valley bottom wetland partially within and adjacent to the western boundary of the MRA, and depression wetland in the south-eastern corner of the MRA. In addition, a relict wetland was identified along the northern boundary of the MRA. These are illustrated in Figure 16 following the discussion below.

The relict wetland (Figure 15) displayed soil morphological characteristics indicative of a fluctuating water table, i.e. mottling and gleying, but no hydrophilic vegetation was present at the time of the assessment, indicating that the soil within this area is not sufficiently saturated to support vegetation adapted to such conditions. Furthermore, it was clear that farm roads have caused hydraulic isolation from surrounding areas, thus it was concluded that it is a relic

of a previously existing hillslope seep wetland, which no longer functions as a wetland due to the altered geomorphological and hydraulic processes as well as a completely transformed vegetation community which now comprises dry grassland species. Therefore, the relict wetland was mapped but excluded from further assessment, as it no longer contributes to wetland conservation targets provincially nor within the immediate area. In addition, no activities are planned in the immediate vicinity thereof, nor is undermining planned in this area, therefore it is the specialist's opinion that at this time, no further assessment is required.

Figure 15: (Left): a spoil sample taken within the outer boundary of the relict wetland, indicating mottling and (right): a representative photograph of the relict wetland, illustrating the lack of hydrophilic vegetation and hydraulic disconnect from the surrounding landscape.

The aforementioned channelled valley bottom and depression wetlands identified in the MRA were classified according to the Classification System (Ollis *et al.*, 2013) as Inland Systems, falling within the Highveld Aquatic Ecoregion, and the Mesic Highveld Grassland Group 4 WetVeg (wetland vegetation) group, classified by Mbona *et al.* (2015) as "Least Threatened". At Levels 3 (Landscape Unit) and 4 (HGM Type) of the Classification System, the systems were classified as per the summary in Table 4 below.

Table 4: Characterisation at Levels 3 and 4 of the Classification System of the wetlands identified within the Tumelo MRA.

Level 3: Landscape unit	Level 4: HGM Type
Valley floor: The base of a valley, situated between two distinct valley side-slopes.	**Channelled valley bottom:** A valley bottom wetland with a river channel running through it.
	Depression: a landform 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.
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.	**Hillslope 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 identified hillslope seep wetlands were associated with the depression wetland and were not delineated nor assessed separately

The wetlands located within the Tumelo MRA have been historically impacted upon, with specific mention of the historical and ongoing surrounding agricultural and mining activities, particularly in the vicinity of the channelled valley bottom wetland. Agricultural fields have encroached on wetland boundaries, and the desiccation of the aforementioned relict wetland is attributed to historical crop cultivation within and surrounding the delineated area (as depicted in Figure 13). Generally, the conversion of natural areas to largely agricultural and mining-related land-uses have impacted on the overall hydrological and geomorphological functioning of both the channelled valley bottom and depression wetlands identified in the MRA.

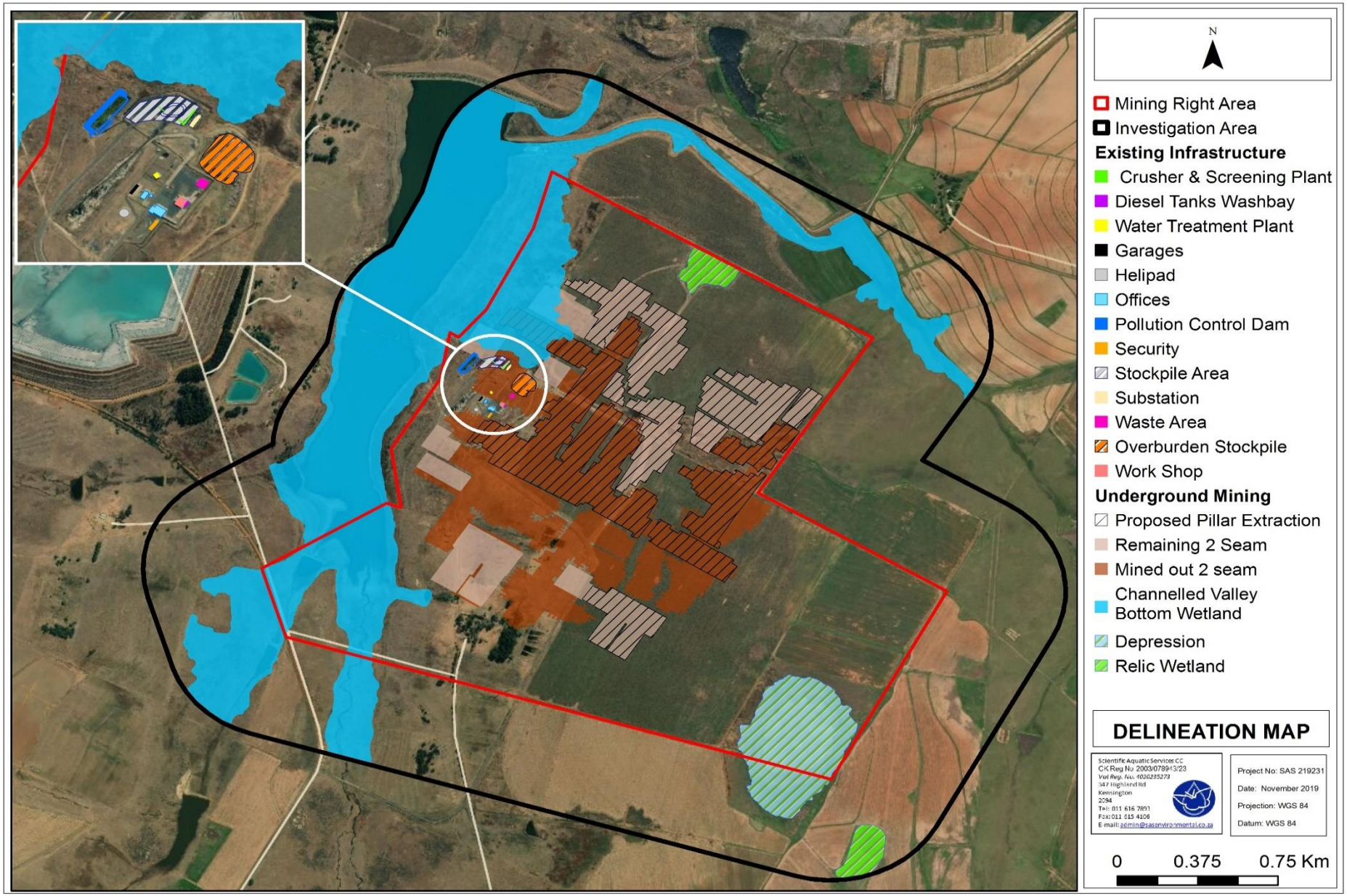


Figure 16: Location of the watercourses within the Tumelo Mining Right Area, in relation to the underground mining area and infrastructure.

5.3 Field Verification Results

Following the site visit, various assessments were undertaken in order to determine the following:

- PES, incorporating aspects such as hydrology, vegetation and geomorphology;
- Service provision of the wetlands, which incorporates biodiversity maintenance, flood attenuation, streamflow regulation and assimilation, to name a few;
- The EIS is guided by the results obtained from the assessment of PES and service provision of the wetlands;
- An appropriate REC to guide the management of the wetlands with the intent of enhancing the ecological integrity of the wetlands where feasible; and
- Assessment of impacts of the ongoing operation of the Tumelo Colliery on the wetland systems.

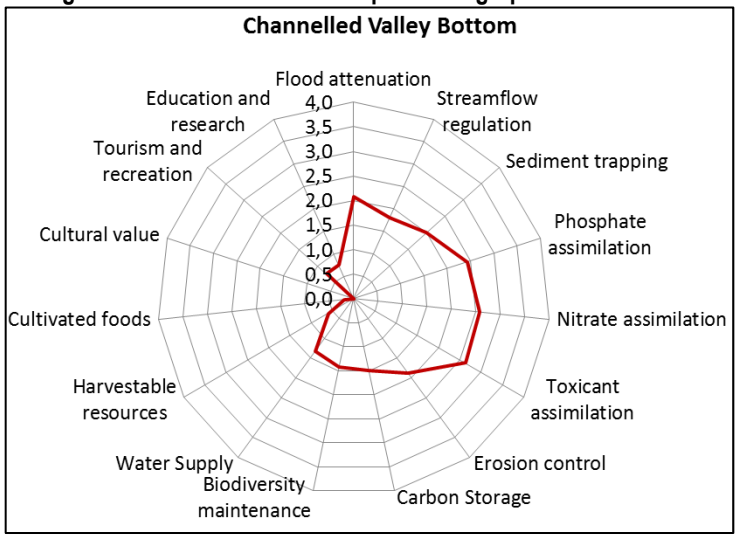
The results of the assessments are presented in the dashboard reports below.

Table 5: Summary of the assessment of the channelled valley bottom wetland.



Photograph notes: (Left): a portion of the channelled valley bottom (CVB) wetland in the north-west of the MRA. The Hendrina power station is visible in the background. (Centre): representative photograph of the CVB wetland, depicting some of the disturbances to soils in the foreground of the photograph. (Right): the southern-most impoundment within the CVB wetland, situated approximately 220m due west of the existing Tumelo mine infrastructure. The effect of recent seasonal fires on the vegetation is apparent in all three photographs.

Ecological & socio-cultural service provision graph:



PES discussion	**PES Category: D** The CVB wetland has been subjected to numerous historical and current impacts relating to agriculture and historical mining practices. A notable impact is the impoundment of a large section of the wetland, not only altering flow patterns and affecting recharge of the downstream areas, but also contributing to loss of vegetation and therefore reduced surface roughness, which will in turn cause a reduction in the capacity and potential for the wetland to provide a variety of ecological services. At the time of the assessment, the vegetation community composition and structure could not be fully assessed due to the effects of seasonal burning; however it is likely that remaining vegetation (i.e. that which has not been inundated) remains in a largely natural condition with few alien floral species. Geomorphological processes have also been influenced by the impoundment, and potentially by subsidence caused by historical underground mining, and by increased sediment inputs due to denuding of surrounding areas for agricultural purposes.
Ecoservice provision	**Intermediate** The decreased ecological integrity of the wetland has resulted in a diminished capacity to provide ecological services usually provisioned by valley bottom wetlands. However, despite the modifications to the system, the wetland is nevertheless likely to provide a level of flood attenuation, assimilation of nutrients and toxicants and erosion control. Whilst no abstraction for industrial purposes was apparent within the MRA, local residents utilise the wetland for watering of livestock, and it is possible that the water in the impoundment is used for agricultural purposes from time to time. Due to the level of disturbance in and directly around the wetland, it has decreased capacity for biodiversity maintenance, although it still provides habitat for a number of floral species, some of which may be of conservation importance.

REC, RMO and BAS	**REC Category: D RMO: C and BAS: C** Due to the existing impacts and ecological degradation of the CVB wetland, no further impacts should be permitted, and at minimum, the wetland should be maintained in its current ecological state. However, it is preferable that where possible, the proponent make provision for small-scale rehabilitation of the portion of the wetland within the MRA, such as restoring surrounding topography to allow for water in the landscape to move in accordance with natural drainage patterns, and re-seeding of areas affected by encroachment of alien vegetation with indigenous floral species. Should all stakeholders in the catchment work together to restore the ecological functions and processes of the wetland, it is expected that the BAS could potentially be a Category C.	**EIS discussion**	**EIS Category: Moderate** The EIS of the CVB wetland was ascertained to be 'moderate', largely due to the hydro-functional importance (i.e. provisioning of services such as flood attenuation, sediment trapping and so forth). It is also considered important on a local scale, since it is a fairly extensive wetland located in a quaternary catchment subjected to cumulative loss of wetlands. However, due to the ecological degradation of the system, it may not necessarily be important on a regional scale.

Watercourse drivers:

a) Hydrology

Hydraulic processes of this wetland have been significantly altered, most significantly by the impoundment thereof in several locations, as well as by the canalisation of the valley bottom wetland situated in the northern portion of the investigation area, which confluences with the CVB wetland. Road crossings were noted in the south-western corner of the MRA and investigation area. These impacts have altered the timing, distribution and flow of water through the wetland. In addition to these impacts, runoff patterns in the catchment have been altered by mining (and mining-related industry) and agriculture. These activities have collectively resulted in hardening of the catchment and loss of vegetation, both of which are likely to result in increased runoff entering the wetland system leading to changes in pattern flow and timing of water in the landscape. Although no abstraction was noted on site, the possibility of this impact occurring on the system could not be discounted, particularly given the nature of the surrounding landuses.

b) Water quality

Much of the portion of the CVB wetland adjacent to the Tumelo MRA is impounded; therefore, although *in situ* water quality readings were taken at one point immediately west of the mine, the results are not likely to be representative of the water quality within the entire system. The water quality parameters measured at the time of the assessment indicated that pH was within normal parameters (7.2) and Electrical Conductivity (EC) was 157mS/m, three times the recommended 55mS/m according to the Target Water Quality Range (TWQR) for the B12B Klein-Olifants quaternary catchment (DWS, 2018) indicating that significant salinization of the system has occurred and that some introduction of contaminants is likely.

c) Topography: Geomorphology and sediment balance

Several impacts to topography and geomorphological processes were noted during the site assessment, including small soil stockpiles and piles of rubble located on the eastern boundary of the northern portion of the wetland (i.e. north-east of the existing infrastructure). The proximity of ploughed fields and gravel roads, many of which are upgradient of the wetland, are likely to contribute to increased sediment loads entering the wetland via stormwater runoff and agricultural return flows. Based on the information provided by the EAP, underground mining has previously taken place immediately north of the existing mine infrastructure. Although it could not be definitively ascertained during the site assessment, it is possible that subsidence in the vicinity of historical underground mining could have resulted in ponding of water, causing an increased hydroperiod and increasing the extent of the wetland boundary.

d) Habitat and biota

Much of the temporary zone on the eastern side of the wetland had undergone seasonal burning in the weeks prior to the assessment, and the vegetation had not fully recovered at the time. The western portion falls outside of the mine property (and outside of the 500m investigation area) and could not be accessed to provide a comparison. However, the majority of floral species that could be identified are indigenous species such as *Haplocarpha lyrata, Monopsis decipiens,* and *Eucomis sp.* Graminoid species could not be identified due to conditions at the time of the assessment. Habitat diversity is low, and since it is likely that the temporary zone is dominated by short graminoid and forb species whilst the permanent zone is impounded, breeding and foraging habitat for fauna is likely to be limited. Nevertheless, the wetland may provide a degree of connectivity to surrounding natural areas and therefore must be protected from further impacts.

Possible significant impacts, Business case, Conclusion and Mitigation Requirements:

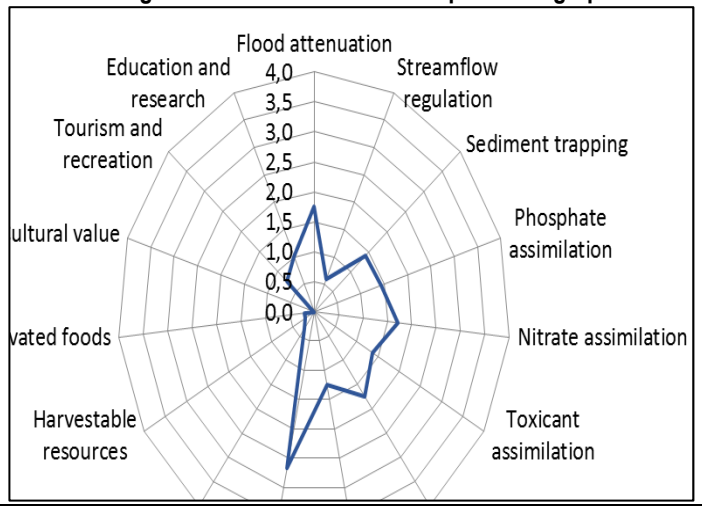
Although some of the remaining #2 seam is located under the CVB wetland, the targeted area is located outside of the delineated boundary thereof. Nevertheless, the risk of subsidence as determined by GeoMech Consulting (Pty) Ltd (2019) in the vicinity of the CVB wetland was determined to be high, thus it was recommended by GeoMech that this area be excluded from the partial pillar extraction. The freshwater specialist concurs with this recommendation, to prevent any further impacts on the wetland due to changes in recharge patterns including surface runoff and hillslope processes.

The northern area of the existing mine infrastructure, specifically the overburden stockpile, ROM stockpile, PCD and crusher and screening plant, encroaches marginally on the 100m regulated zone in terms of GN704 as it relates to the NWA. According to the project description supplied by the EAP, the existing PCD has been designed to cater for a 1:50 year flood event and to maintain a 0.8m freeboard (GCS Water and Environmental Services (Pty) Ltd, 2018, in Cabanga Environmental, 2019) in line with GN704 as it relates to the NWA. Furthermore, a diversion berm has been constructed upslope of the mine infrastructure area to divert clean water around the dirty footprint area. Water falling within the dirty footprint area is channelled via a system of berms and trenches to the existing PCD (Cabanga Environmental, 2019). Since the existing mine infrastructure is located upgradient of the CVB wetland, it is imperative that clean and dirty water separation continues to take place, and that the relevant systems are regularly monitored and maintained to ensure that no dirty water (as defined by GN704 of the NWA) reaches the wetland or surrounding environment. Although no new surface infrastructure is currently planned (Cabanga Environmental, 2019), any future planning must take into consideration the delineated boundary of the wetland, and the applicable zones of regulation (as detailed in Section 5.4 of this report) to ensure that the necessary authorisations are obtained. Furthermore, should additional infrastructure be planned in future, an impact assessment specific to that infrastructure must be undertaken by a suitably qualified wetland/aquatic specialist to ensure that all possible risks are identified and appropriate mitigation measures developed.

Table 6: Summary of the assessment of the depression wetland.

Photograph notes: Composite photograph illustrating the depression wetland located in the south-eastern corner of the Tumelo MRA. At the time of the assessment the wetland and parts of the surrounding areas had been subjected to recent seasonal burning, thus vegetation was not always a reliable indicator of the wetland boundary, although it did prove useful along the eastern boundary.

Ecological & socio-cultural service provision graph:



PES discussion	**PES Category: B** The topography and small catchment area of the depression wetland has protected it from potential impacts relating to agricultural practices in the vicinity. Although surrounding lands are cultivated, sediment-laden runoff is unlikely to reach the wetland except potentially on the eastern side of the wetland. No serious impacts to the hydraulic or geomorphological processes were discerned, with the exception of a small impoundment on the north-western hillslope seep associated with the depression, and a small erosion gully on the western side which may convey water during rainfall events from the adjacent cultivated area to the depression. Vegetation, although recovering from seasonal burning at the time of the assessment, seemed to be in a largely natural condition in terms of composition and structure.
Ecoservice provision	**Moderately low** Being hydrologically isolated, the depression wetland is not able to perform functions such as streamflow regulation and has limited capacity to perform other ecological services. However, it is nevertheless considered important in terms of potential for sediment trapping, assimilation of excess nutrients and toxicants, and flood attenuation. Given the largely natural ecological state of the depression wetland however, it is considered moderately important for biodiversity support, as it may potentially harbour floral species of conservation concern and provides niche habitat for certain amphibian species as well as providing foraging habitat when surface water is present for various faunal species.

<table>
<tr><td>REC, RMO and BAS</td><td>REC Category: B
RMO: B and BAS: B
The largely natural ecological state of the depression wetland must be maintained, and should any mining-related activities be planned in the vicinity in future, the management objective should be to retain the PES as determined during this assessment.</td><td>EIS discussion</td><td>EIS Category: Moderate
The depression wetland is considered ecologically important on a local scale, particularly in the context of the largely natural ecological state, but also in terms of the possible occurrence of protected species (if not necessarily threatened species) and overall biodiversity maintenance. It is also considered important for the provision of various functions relating to hydraulic processes, such as flood attenuation and assimilation of excess nutrients.</td></tr>
<tr><td colspan="4">Watercourse drivers:</td></tr>
<tr><td colspan="2">a) Hydrology
The depression wetland is endorheic (inward draining). Whilst some recharge by groundwater may occur during the wet season, the desiccation evident at the time of the assessment (attributed to the relatively recent fire through the wetland) indicate that the primary source of recharge is precipitation and surface runoff, although some recharge from the vadose zone hillslope processes associated with the hillslope seep wetlands surrounding the depression is possible. Due to the topography of the surrounding landscape, runoff from the adjacent agricultural fields is likely to be limited. An artificial impoundment on the eastern slope was noted however, and this will intercept surface runoff to the wetland.</td><td colspan="2">c) Topography: Geomorphology and sediment balance
The primary modifier of the geomorphology of this wetland is the artificial impoundment created on the eastern slope of the wetland. No discernible function of this impoundment was identified at the time, although it could be intended for watering of livestock. Although some sediment originating from the surrounding ploughed fields may reach the wetland in runoff, the topography surrounding the wetland reduces this possibility.</td></tr>
<tr><td colspan="2">b) Water quality
No surface water was present at the time of the assessment; thus an analysis of water quality was not possible. Based on observations of the surrounding landuse and the topography, impaired water quality is unlikely. Whilst it is possible that some nutrient-enriched runoff may reach the wetland during significant rainfall events, it was not possible to definitively confirm this during the site visit, and it was thus concluded that when present, water quality is likely to be relatively unimpaired.</td><td colspan="2">d) Habitat and biota
The depression wetland is likely to provide seasonally important refugia, foraging and breeding habitat for various faunal species, notably amphibians and avifauna. Whilst not observed during the site assessment (possibly due to seasonality) the depression wetland presents ideal habitat for Pyxicephalus adspersus (Giant Bullfrog), thus, if any mining activities are planned in the vicinity of this wetland in future, a specialist assessment to confirm the presence of P. adspersus should be undertaken.

In addition to faunal habitat, the depression wetland – specifically the associated hillslope seeps – may provide habitat for protected floral species. Although no floral Species of Conservation Concern (SCC) were specifically noted during the site assessment, conditions at the time were not necessarily conducive; the observation of an individual of Eulophia ovalis var. ovalis and Eucomis sp. indicates that other unique floral species, including potential SCC, may be present.</td></tr>
<tr><td colspan="4">Possible significant impacts, Business case, Conclusion and Mitigation Requirements:</td></tr>
<tr><td colspan="4">At the time this study was undertaken, no activities were planned in the vicinity of the depression wetland, therefore, a risk assessment was not undertaken, and activity-specific mitigation measures were not developed. However, should activities be planned in the area in future, the delineation and the zones of regulation provided in this report must be taken into account. Should total avoidance of the wetland not be feasible, then appropriate specialist studies must be conducted, including (but not limited to) floral, faunal, hydropedological and hydrological studies.</td></tr>
</table>

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

Legislative requirements were first taken into consideration when determining a suitable buffer zone for the wetland resources. The definition and motivation for a regulated zone of activity as well as buffer zone for the protection of the wetlands are summarised in Table 7 below. As no new surface infrastructure or activities are planned at this stage, the EAP must determine, in consultation with the relevant competent authorities, the applicability of these zones of regulation, and ensure that where necessary the applicable approvals are obtained.

Table 7: Articles of Legislation and the relevant zones of regulation applicable to each article.

Regulatory authorisation required	Zone of applicability
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998).	**General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998)** In accordance with GN509 of 2016 as it relates to the National Water Act, 1998 (Act 36 of 1998), a regulated area of a watercourse in terms of water uses as listed in Section 21c and 21i is defined as: • the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; • in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or • a 500m radius from the delineated boundary (extent) of any wetland or pan in terms of this regulation, as well as General Notice no. 509 of 2016 as it relates to the NWA.
	Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act 36 of 1998) regarding the use of water for mining and related activities aimed at the protection of water resources. These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the National Water Act, 1998 (Act no. 36 of 1998) which contains regulations on use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(a) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA Regulations (2014), as amended must be taken into consideration if any activities (for example, access roads) are to take place within the applicable zone of regulation. This must be determined by the EAP in consultation with the relevant authorities.	**Activity 12** of Listing Notice 1 (GN 327) of the National Environmental Management Act, 1998 (Act 107 of 1998) EIA regulations, 2014 (as amended) states that: *The development of:* *(xii) Infrastructure or structures with a physical footprint of 100 square meters or more;* *Where such development occurs—* *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.*

These zones of regulation must be taken into consideration during any future planning processes, in line with the mitigation hierarchy as advocated by the Department of Environmental Affairs (DEA) *et. al*, 2013, and should they be encroached upon then the relevant authorisations will need to be obtained prior to the commencement of any activities. The delineated wetlands and their applicable zones of regulation in terms of NEMA and the NWA (GN704 and GN509) are conceptually depicted in Figure 14 below.

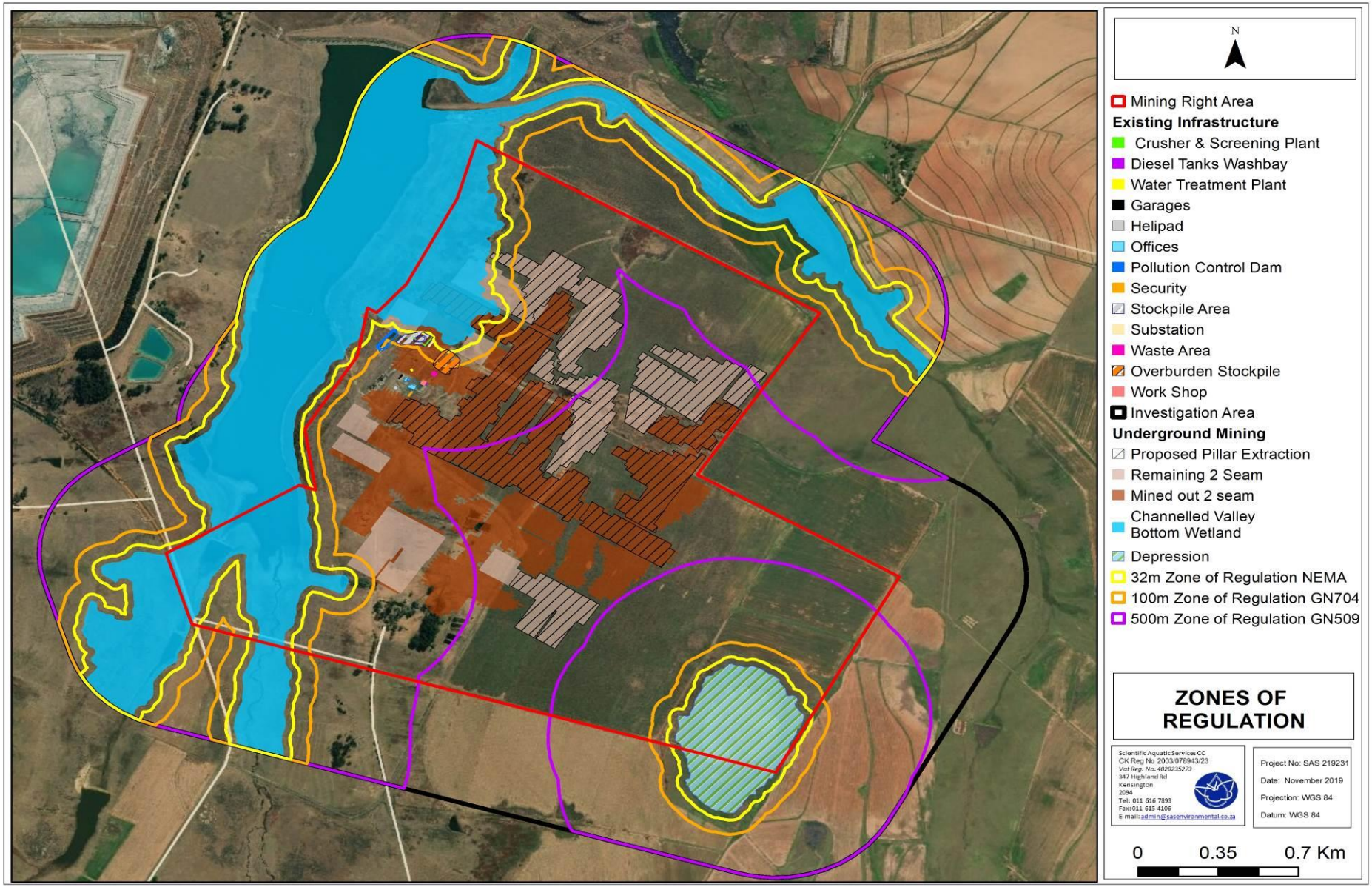


Figure 17: Conceptual presentation of the zones of regulation in terms NEMA and GN704 and GN509 as they relate to the NWA in relation to the wetlands.

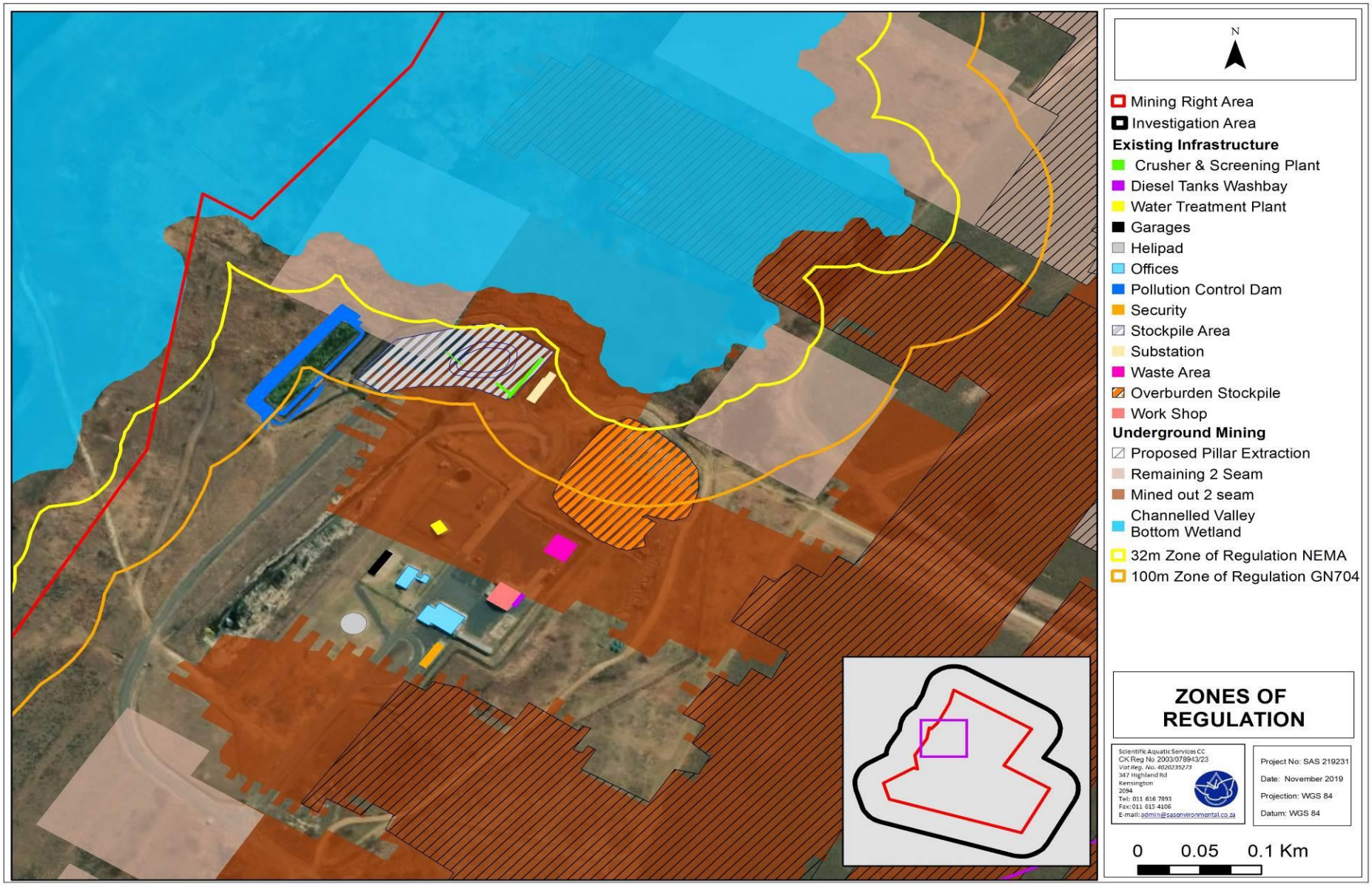


Figure 18: Conceptual presentation of the zones of regulation in terms NEMA, GN704 and GN509 of 2016 as it relates to the NWA in relation to the watercourses and infrastructure of the Tumelo Mine.

6 RISK ASSESSMENT

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

The risk assessment was based on the proposed mine plan as provided by the proponent (refer to Figure 3), which indicates the following:

- The proposed underground mining and partial pillar extraction will take place in the vicinity of the north-eastern portion of the identified CVB wetland;
- No new surface infrastructure is indicated; and
- No mining is planned in the vicinity of the depression wetland.

6.1 Risk Analyses

6.1.1 Consideration of impacts and application of mitigation measures

Following the assessment of the wetlands within the Tumelo MRA, the DWS prescribed Risk Assessment Matrix (2016) was applied to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat and biota) of these wetlands. These results are summarised in Table 8 presented at the end of Section 6.1.2 of this report.

The points below summarise the considerations undertaken when applying the DWS Risk Assessment:

- Since Tumelo is already an operational mine with an existing Integrated Water Use Licence (IWUL), and no new infrastructure is required or planned at this time, it was not deemed necessary to assess existing infrastructure, with the exception of highlighting potential risks posed by the existing clean and dirty water management systems in the event of failure. Similarly, since no new infrastructure will be required and the #2 seam is already accessible via the existing decline, a risk assessment for a construction phase was not deemed necessary;
- The risk assessment was applied assuming that a high level of mitigation is implemented, thus the results of the risk assessment provided in this report present the perceived impact significance *post-mitigation*;

- In applying the risk assessment, it was assumed that the mitigation hierarchy as advocated by the DEA *et al* would be followed, i.e. the impacts would first be avoided, minimised if avoidance is not feasible, rehabilitated as necessary and offset if required;
- 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;
- The risk of subsidence due to partial pillar extraction was determined by GeoMech Consulting (Pty) Ltd (2019) to be 'high' in the vicinity of the CVB wetland and the existing surface infrastructure. It was therefore recommended by GeoMech that partial pillar extraction does not take place in those areas to protect the integrity of surface features. Thus, the risk of subsidence was not assessed as part of this study as it is presumed that the recommendations made by GeoMech will be followed;
- The geohydrological study (Shangoni AquiScience, 2020) determined that there is some risk of decant, which, although likely to be circum-neutral (non-acid forming), it is likely to be saline with high to elevated SO_4 as well as other elements. The mitigation measures provided by the specialist geohydrologist must be implemented to minimise the impacts of decant on the receiving environment;
- The risk assessment was not applied to the depression wetland, since it is located to the east of the catchment divide between it and the existing and proposed mining activities. Further, it is situated approximately 1.7km from the proposed underground workings, and therefore the quantum of risk posed by the existing and proposed mining activities to the depression wetland is negligible.

6.1.2 Impact discussion and essential mitigation measures

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

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

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

A summary of the risk assessment is provided in the table below, followed by a discussion of the outcome thereof.

Table 8: Summary of the results of the risk assessment applied to the wetlands associated with the Tumelo Colliery MRA.

Phase	No.	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
	1	Partial pillar extraction and continued operation of the underground mining area	*Operation of mine vehicles on site.	ntial spillage of oils/hydrocarbons from mine vehicles.	12	**63**	**M**	**80**	*All vehicles must be regularly inspected for leaks. Re-fuelling must take place 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.
			Continued mining of coal	*Potential destabilisation of surrounding environment through the further excavation of underground mining corridors and subsequent potential subsidence of the land; *Potential creation of a cone of depression, which may drain water from the adjacent CVB wetland, thus resulting in desiccation of the wetland; and *Water entering the underground mining area as a result of ingress into underground mine workings may necessitate dewatering of the underground mining area, which may result in the discharge of dirty water into the adjacent wetland environment.	16	**112**	**M**	**80**	*Excavated materials should not be contaminated, and it should be ensured that the minimum surface area is taken up, however the topsoil and overburden stockpiles may not exceed 2m in height. Mixture of the lower and upper layers of the excavated soil should be kept to a minimum, so as for later usage as backfill material; *All exposed soil must be protected for the duration of the construction phase in order to prevent erosion and sedimentation of the downgradient CVB wetland.*Underground mining closer to the surface should be carried out with extreme caution to ensure that the subsurface process sustaining the CVB wetland system are not impaired; *Ensure that the shallow underground mining areas are located outside of the wetland recharge soils; *Any areas where decant points may be determined by a geohydrological assessment, need to be carefully managed throughout the life of the mine; *Water levels need to be strictly managed to ensure they are kept below any decant level while ensuring that a significant cone of depression impact does not take place; and *If decant does occur, all water is to be treated to the background water quality values prior to release into the receiving environment; and *All measures as stipulated by the Rock Mechanic Engineer (GeoMech Consulting (Pty) Ltd, 2019) and the geohydrologist (Shangoni AquiScience, 2020) to mitigate against subsidence and dewatering, formation of a pollution plume and decant respectively, must be implemented.

Phase	No.	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
			*Possible decant from the underground mining area to the receiving environment.	*As a result of decant, contaminated water may enter the receiving environment leading to altered water quality; and *Alteration (increase) of flow regimes, reduction in water quality (increase in salts and specific contaminants of concern and reduced pH) and subsequent loss of biodiversity of the CVB wetland due to decant of contaminated water.	16	**148**	**H**	**80**	*Manage the water level of the underground mining area indefinitely to prevent decant; *The decant water should either be passively or actively treated; and *A specialist geohydrological study must be undertaken (if not already comissioned) and the risk of decant from the underground workings determined. The recommendations made by such qualified specialist supersede recommendations made by the freshwater ecologist in this report, and must be implemented.
	2	Operation and maintenance of the existing stormwater management system associated with the existing mining activities.	*Containment/diversion of all runoff into the clean and dirty water system; and *Potential of malfunctioning of the dirty water system.	Loss of catchment yield due to stormwater containment is expected to occur, which could lead to the following impacts: *Increased flood peaks into the CVB wetland as a result of formalisation and concentration of surface runoff; *Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the CVB wetland; *Reduction in volume of water entering the CVB wetland, leading to loss of recharge (and thus potential desiccation) of the wetland system; and *Further altered vegetation communities due to moisture stress.	14	**98**	**M**	**80**	*Clean and dirty water systems must be kept separate in line with GN704 as it relates to the NWA; *Runoff from areas within the dirty water area should be captured in the sump and continue to be pumped to the PCD, before being re-used as process water of the mine; and *All clean water diversions should be maintained to accommodate the peak flow expected for at least a 1:50 year event as they are at present.

Phase	No.	Activity	Aspect	Impact	Likelihood	Significance	Risk Rating	Confidence level	Mitigation Measures to be implemented
	3		Continued operation of the PCD.	*The potential failure of the PCD infrastructure may result in leakages and possible contamination of surface and groundwater, increased flow into the CVB wetland, and lowered water quality (increase in salts and specific contaminants of concern and reduced pH) within the wetland.	15	**90**	**M**	**80**	*Proactive monitoring to ensure structural integrity is maintained; *It is recommended that the infrastructure be regularly inspected for leaks, or more often should there be any sign or reports of a leak; *Should leakage occur all possible steps are to be taken to prevent the pollution of the downgradient CVB wetland system during repair; and *All discharges should be managed according to the Direct Estimation of Ecological Effect Potential (DEEEP) method if unavoidable.
	4	Post-closure management activities.	Decant of contaminated water from the rehabilitated mine area into the receiving environment.	*Contamination of water within the receiving environment, and subsequent reduction in water quality (increase in salts and specific contaminants of concern and reduced pH); *Subsequent negative impacts on biota and vegetation; *Altered flow regimes (increased hydroperiod); and *Habitat degradation.	12	**96**	**M**	**80**	The management and mitigation measures as recommended in the geohydrological study should be implemented to mitigate the potential impacts arising from decant of contaminated water from the mine into the receiving environment.

As can be seen in Table 8 above, the majority of assessed activities and aspects are expected to pose a moderate risk to the CVB wetland, which is located to the west and downgradient of surface infrastructure, and to the west of the existing and proposed underground mining activities. Although the risk assessment was applied assuming that a high level of mitigation will take place, it must be noted that the risk significance can be reduced by continued application of mitigation measures, regular monitoring of infrastructure (especially the clean and dirty water management systems) and proactive management to prevent possible infrastructure failure.

However, the potential for cumulative impacts as a result of the proposed extraction must also be considered. The assessed portion of the CVB wetland has already undergone numerous impacts associated with historical mining (and agricultural) activities, resulting in decreased ecological integrity of the wetland system. Analysis of digital satellite imagery of the adjacent areas indicates that the wetland is under threat from other mining and industrial activities in the catchment, in particular, a large tailings facility approximately 1.1km west of the Tumelo Colliery. In the context of surrounding threats to the wetland, Tumelo has a duty of care (as enshrined in the Constitution of South Africa) to ensure that activities within the MRA do not contribute to the further degradation of this wetland system. In this regard, special mention is made of the possibility of subsidence caused by the underground mining, as well as the potential of decant from the underground workings as determined by GeoMech Consulting (Pty) Ltd (2019) and Shangoni AquiScience (2020) respectively.

7 CONCLUSION

Two wetland systems, comprising two HGM types, were identified within the Tumelo MRA, specifically a channelled valley bottom (CVB) wetland in the west, and a depression wetland in the south-eastern corner. The PES, EIS and contribution to ecological and socio-cultural functioning were assessed during a single site visit undertaken at the beginning of November 2019, prior to the area receiving any significant rainfall, and following prolonged dry conditions. The results of the assessment are summarised in the table below:

Table 9: Summary of results of the field assessment as discussed in Section 5.

Wetland	PES	Ecoservices	EIS	REC / RMO / BAS
Channelled valley bottom	D	Intermediate	Moderate	D / C / C
Depression	B	Moderately low	Moderate	B / B / B

The CVB wetland has been impacted on to a greater degree than the depression wetland, primarily as a result of historical and current mining activities (not only by Tumelo), and

historical (and to a lesser degree, ongoing) agricultural activities. The increased extent of mining and industrial activities within the catchment poses an ongoing risk to this system, and therefore Tumelo has a duty of care to minimise the mine's contribution to the degradation of the ecological integrity of the CVB wetland. The depression wetland, although having been impacted by agricultural activities, is largely isolated and as such, is of increased ecological integrity. According to available information, no mining activities are planned in the vicinity of the depression wetland and it is therefore currently not at risk of impacts due to Tumelo's planned activities. However, should this *status quo* change in future, further specialist studies may be required, specifically faunal and floral assessments, to ascertain whether any SCC occur in association with the depression wetland.

Following the assessment of the wetlands, the DWS risk assessment matrix was applied to ascertain the significance of possible impacts which may occur because of the proposed mining activities. The results of this assessment are presented in Section 6 of this report, and show that, assuming mitigation measures are strictly enforced, risk significance is predominantly of Moderate level, although the potential for decant may be of High significance. However, it should be noted that the risk significance of decant was considered in the absence of detailed geohydrological data, and this risk should therefore be fully established by a suitably qualified geohydrologist. Nevertheless, it is considered imperative that suitable mitigation measures, as provided for in Section 6 and Appendix F of this report, are strictly adhered to in order to minimise the impacts associated with the proposed mining activities and decrease the significance of cumulative impacts on the freshwater resources of the region.

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 change in mine plan (to include partial pillar extraction of the #2 seam) potentially poses an indirect risk to the CVB wetland, and that no risk is posed to the depression wetland. Nevertheless, adherence to cogent, well-conceived and ecologically sensitive site development plans, and the mitigation measures provided in this report as well as general good practice, is essential if the significance of perceived impacts is to be reduced, particularly cumulative impacts on the CVB wetland. It is also recommended that the proponent strongly consider small-scale rehabilitation of the portion of the CVB wetland within and immediately adjacent to the Tumelo MRA, such as reinstatement of the natural topography (where it has been disturbed by indiscriminate disposal of soil and rubble, and potentially by subsidence in the vicinity of existing underground workings) and revegetation of disturbed areas with indigenous flora.

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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, at their sole discretion, to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B – Legislation

LEGISLATIVE REQUIREMENTS

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

	iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Government Notice 704 Regulations as published in the Government Gazette 20119 of 1999 as it relates to the National Water Act, 1998 (Act No. 36 of 1998)	These Regulations were put in place in order to prevent the pollution of water resources and protect water resources in areas where mining activity is taking place from impacts generally associated with mining. It is recommended that the proposed project complies with Regulation GN 704 of the NWA which contains regulations on the use of water for mining and related activities aimed at the protection of water resources. GN 704 states that: *No person in control of a mine or activity may:* *(b) locate or place any residue deposit, dam, reservoir, together with any associated structure or any other facility within the 1:100 year floodline or within a horizontal distance of 100 metres from any watercourse or estuary, borehole or well, excluding boreholes or wells drilled specifically to monitor the pollution of groundwater, or on waterlogged ground, or on ground likely to become waterlogged, undermined, unstable or cracked;* According to the above, the activity footprint must fall outside of the 1:100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an EIA, an Environmental Management Programme (EMP), and a Public Participation Process (PPP).
Mpumalanga Nature Conservation Act (Act No 10 of 1998)	The aim of the Mpumalanga Conservation Act is to consolidate and amend laws relating to nature conservation within the Province and to provide for matters connected therewith. The proposed activities must comply with the Mpumalanga Nature Conservation Act (Act No 10 of 1998) and associated regulations which contain regulation 67 on *pollution of waters*. The Act states that: 1. *Any person who:* a) *dumps or deposits in, allows to be dumped or to be deposited in, or in any other manner allows to enter or percolate into waters any substance or thing, whether solid, liquid or gaseous, that is or is likely to be or to become injurious to aquatic and associated biota;* b) *carries on a business or follows an occupation having the effect that any substance or thing contemplated in paragraph (a) is used or produced and does not take the necessary steps to prevent such substance or thing from entering or percolating into waters;* shall be guilty of an offence and liable on conviction to a fine or to imprisonment for a period not exceeding 10 years or to both a fine and such imprisonment and to a fine not exceeding R10 000 for every day the offence continues. 2. *For the purpose of subsection (1) "aquatic biota" includes all live organisms that are limited to or dependent upon the environment within or adjacent to waters for critical life stages or necessaries of life and "day" means a period of twenty-four hours.*

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 features present in the vicinity of or within the proposed study area.

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

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

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

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

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

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

Level 1: Inland systems

From the Classification System, Inland Systems are defined as aquatic ecosystems that have no existing connection to the ocean[3] (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.

[3] 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.

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 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

Impact category	Description	Impact score range	Present State category
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. 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".[4] 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;

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

- 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 C5: 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

5. 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 C8) of the wetland system being assessed.

Table C8: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

EIS Category	Range of Mean	Recommended Ecological Management Class
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications.	>3 and <=4	A
High	>2 and <=3	B

EIS Category	Range of Mean	Recommended Ecological Management Class
Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications.		
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

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

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

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

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

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

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

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

Table C10: Description of Recommended Ecological Category (REC) classes.

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

APPENDIX D – Risk Assessment Methodology

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[5]. 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[6].

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

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

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

Environmental Management Act (No. 108 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. 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 develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
  - Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[7] 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

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

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

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 WET-Health PES assessment applied to the Channelled Valley Bottom and Depression Wetlands.

Wetland	Hydrology		Geomorphology		Vegetation		Overall Score	Overall PES Category
	Impact Score & (PES Category)	Trajectory of Change	Impact Score & (PES Category	Trajectory of Change	Impact Score & (PES Category	Trajectory of Change		
CVB	6.0 €	0 (→)	4.0 (D)	-1 (↓)	4.8 (D)	-1 (↓)	5.09	D
Depression	1 (B)	0 (→)	0.1 (A)	0 (→)	2.6 (C)	-1 (↓)	1.21	B

Table E3: Presentation of the results of the Ecoservices assessment applied to the CVB and Depression Wetlands.

Ecosystem service	CVB	Depression
Flood attenuation	2,1	1,8
Streamflow regulation	1,8	0,6
Sediment trapping	2,0	1,4
Phosphate assimilation	2,4	1,4
Nitrate assimilation	2,6	1,7
Toxicant assimilation	2,6	1,4
Erosion control	1,9	1,8
Carbon Storage	1,5	1,3
Biodiversity maintenance	1,4	2,7
Water Supply	1,3	0,3
Harvestable resources	0,6	0,2
Cultivated foods	0,2	0,2
Cultural value	0,0	0,0
Tourism and recreation	0,8	0,8
Education and research	0,8	1,0
SUM	**21,9**	**16,4**
Average score	**1,5**	**1,1**
Class	**Intermediate**	**Moderately Low**

Table E5: Presentation of the results of the EIS assessment applied to the CVB and Depression Wetlands.

	CVB Wetland	Depression Wetland	
Ecological Importance and Sensitivity	Score (0-4)		*Confidence (1-5)*
Biodiversity support	A (average)	A (average)	(average)
	0,67	0,67	3,00
Presence of Red Data species	0	1	3
Populations of unique species	0	0	3
Migration/breeding/feeding sites	2	1	3
Landscape scale	B (average)	B (average)	(average)
	1,60	1,80	3,00
Protection status of the wetland	2	3	3
Protection status of the vegetation type	2	2	3
Regional context of the ecological integrity	1	2	3
Size and rarity of the wetland type/s present	2	1	3
Diversity of habitat types	1	1	3
Sensitivity of the wetland	C (average)	C (average)	(average)
	1,67	1,00	3,00
Sensitivity to changes in floods	2	1	3
Sensitivity to changes in low flows/dry season	1	0	3
Sensitivity to changes in water quality	2	2	3
ECOLOGICAL IMPORTANCE & SENSITIVITY	**(max of A,B or C)**	**(max of A,B or C)**	*(average of A, B or C)*
Fill in highest score:	**C**	**B**	**1,70**

Moderate: Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.

			CVB	Depression	
Hydro-Functional Importance			Score (0-4)	Score (0-4)	*Confidence (1-5)*
Regulating & supporting benefits	**Flood attenuation**		2	2	3
	Streamflow regulation		2	0	3
	Water Quality Enhancement	***Sediment trapping***	2	1	3
		Phosphate assimilation	2	1	3
		Nitrate assimilation	3	2	3
		Toxicant assimilation	3	1	3
		Erosion control	2	2	3
	Carbon storage		1	1	3
HYDRO-FUNCTIONAL IMPORTANCE			2	1	3

		CVB	Depression	
Direct Human Benefits		Score (0-4)	Score (0-4)	*Confidence (1-5)*
Subsistence benefits	***Water for human use***	1	0	3
	Harvestable resources	0	0	3
	Cultivated foods	0	0	3
Cultural benefits	***Cultural heritage***	0	0	3
	Tourism and recreation	1	1	3
	Education and research	1	1	3
DIRECT HUMAN BENEFITS		0,50	0,33	3

APPENDIX F – Risk Assessment and Mitigation Measures

General construction management and good housekeeping practices

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

Development footprint

- Where applicable, all surface footprint areas should remain as small as possible and should not encroach into the CVB wetland or the depression wetland unless absolutely essential and part of the proposed development. 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;
- Should any additional temporary roads or access routes be required, these should avoid freshwater areas and be restricted to existing roads where possible;
- All hazardous chemicals as well as stockpiles should be stored on bunded surfaces and have facilities constructed to control runoff from these areas. No runoff from these areas must be permitted to reach the CVB wetland or the depression wetland;
- It must be ensured that all hazardous storage containers and storage areas comply with the relevant SABS standards to prevent leakage and that no leaks are permitted to reach the freshwater habitats; and
- Continuing to ensure that an adequate number of waste and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills.

Vehicle access

- All vehicles must be regularly inspected for leaks. Re-fuelling must take place 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. Whilst not considered severe at this time, the vegetation component within the freshwater environment is already transformed to an extent as a result of alien plant invasion most likely related to historical disturbances; 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, has to be controlled;
- Removal of the alien and weed species encountered within the freshwater resources must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 and Section 28 of the National Environmental Management Act, 1998). Removal of species should take place throughout the remaining operational and maintenance phases, as well as during closure and post-closure rehabilitation; 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 wetland areas (i.e. the CVB wetland and depression wetland) during the eradication of alien and weed species.

Soils

- Sheet runoff from access roads should be slowed down by the strategic placement of berms where deemed necessary;
- As much vegetation growth as possible (of indigenous floral species) should be encouraged to protect soils;
- No stockpiling of topsoils is to take place within close proximity to the CVB wetland or depression wetland, and all stockpiles must be protected with a suitable geotextile to prevent sedimentation of the freshwater habitat; and
- All soils compacted as a result of the historical construction activities as well as ongoing operational activities falling outside of project footprint areas should be ripped and profiled.

Rehabilitation

- It is strongly recommended that any construction rubble remaining on site (as observed adjacent to the CVB wetland during the site assessment) must be collected and disposed of at a suitable landfill site; and
- All alien vegetation in the footprint area as well as immediate vicinity thereof should be removed. Alien vegetation control should take place for a minimum period of two growing seasons after rehabilitation is completed.

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)

Amanda Mileson NDip Nature Conservation (UNISA)

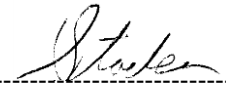
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Stephen van Staden		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	1401	Cell:	083 415 2356
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	stephen@sasenvgroup.co.za		
Qualifications	MSc (Environmental Management) (University of Johannesburg) BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg) BSc (Zoology, Geography and 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		

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

I, Stephen van Staden, declare that -

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



Signature of the Specialist

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 pf 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

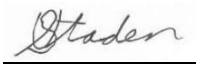
REFERENCES

- Terry Calmeyer (Former Chairperson of IAIA SA)
  Director: ILISO Consulting Environmental Management (Pty) Ltd
  Tel: +27 (0) 11 465 2163
  Email: terryc@icem.co.za

- Alex Pheiffer
  African Environmental Management Operations Manager
  SLR Consulting
  Tel: +27 11 467 0945
  Email: apheiffer@slrconsulting.com

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

Yours faithfully



STEPHEN VAN STADEN

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	15 February 1978
Nationality	Zimbabwean
Languages	English
Joined SAS	2013

MEMBERSHIP IN PROFESSIONAL SOCIETIES

South African Wetland Society

Gauteng Wetland Forum

EDUCATION

Qualifications

N.Dip Nature Conservation (UNISA)	2017
Wetland Management: Introduction and Delineation (University of the Free State)	2018
Tools for Wetland Assessment (Rhodes University)	2017
Wetland Rehabilitation (University of the Free State)	2015

COUNTRIES OF WORK EXPERIENCE

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

Zimbabwe, Zambia

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline Aquatic and Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for the N11 Ring Road, Mokopane, Limpopo Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Upgrades to the Klippan Pump Station Near Welkom, Free State Province.
- Freshwater Resource Ecological Assessment as part of the Water Use License Application Requirements for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Freshwater Assessment for the Proposed Rietrug, Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Rietrug Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater Assessment for the Proposed Sutherland 2 Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland 2 Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.

- Freshwater Assessment for the Proposed Sutherland Distribution Line: Basic Assessment for the proposed Construction of Electrical Grid Infrastructure to support the proposed (split) Sutherland Wind Energy Facility, near Sutherland, in the Northern Cape and Western Cape Provinces.
- Freshwater resource delineation and ecological assessment as part of the proposed expansion of the Kudumane Mining Project, Northern Cape Province.
- Freshwater assessment as part of the environmental assessment and authorisation process for associate electrical infrastructure and a proposed pipeline for the Rooipunt Solar Thermal Power Park Project near Upington, Northern Cape.
- Present Ecological State of the Wetlands Report: Jukskei and Klip River Catchments: Monitoring and Managing the Ecological State of the Wetlands in the City of Johannesburg Metropolitan Area.
- Wetland assessment as part of the environmental assessment and authorisation process for the proposed Leandra underground coal mine.
- Freshwater ecological assessment as part of the water use licence application process for the proposed waste rock dump expansion for Impala Platinum Mine in Rustenburg, North-West Province.
- Wetland assessment as part of the water use licence application process for the Marula Platinum Mine, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the Anglo Platinum Der Brochen Project, Limpopo Province.
- Wetland assessment as part of the environmental authorisation process for the proposed Yzermyn Coal Mining Project near Dirkiesdorp, Mpumalanga.
- Wetland assessment as part of the environmental authorisation process for the Mzimvubu Water Project, Eastern Cape.
- Wetland assessment as part of the proposed water management process at the Assmang Chrome Machadodorp Works, Mpumalanga.
- Wetland ecological assessment as part of the Section 24G application process for the Temba Water Purification Plant.

Terrestrial Assessments

- Investigation of specialist biodiversity aspects required by GDARD in the vicinity of the Apies River, downstream of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for three proposed bridge upgrades near Edenvale, Gauteng
- Terrestrial Ecological Scan as part of the environmental authorisation process for the proposed Dalpark Ext 3 filling station development, Gauteng

Rehabilitation Projects

- Freshwater Resource Rehabilitation and Management Plan as part of the Environmental Authorisation Process for the Proposed Urania-Bronville 11kv and 132kv Powerline Corridor Near Welkom, Free State Province.
- Rehabilitation Plan as part of the Water Use License Application Requirements for the Proposed Upgrade of the Thabazimbi Wastewater Treatment Works (WWTW) Sewer Line, Limpopo Province.
- Wetland rehabilitation and management plan for The Hills EcoEstate, Midrand, Gauteng.
- Riparian rehabilitation and management plan for The Diepsloot River, Riversands, Gauteng.
- Riparian rehabilitation and management plan for the Apies River in the vicinity of the proposed construction of new outlet works at the Kudube (Leeuwkraal) Dam in Temba, Gauteng.

Environmental Control Officer

- Monthly specialist Environmental Control Officer (ECO) function for the monitoring of riparian crossings at Riversands Country Estate Development, Gauteng province.
- Weekly specialist Environmental Control Officer (ECO) function for the monitoring of emergency desilting and rehabilitation of existing stormwater retention dams on ERF 836 Kosmosdal ext 1, and portion 5 of ERF 115 Kosmosdal ext 4, near Centurion, Gauteng Province.