SCIENTIFIC AQUATIC SERVICES

FRESHWATER ECOLOGICAL ASSESSMENT FOR THE PROPOSED EXPANSION OF TWO WASTE ROCK DUMPS WITHIN THARISA MINE NEAR MARIKANA, NORTH WEST PROVINCE

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EXECUTIVE SUMMARY

Three freshwater ecosystems were identified within a 500 m zone of investigation (hereafter the investigation area) around the proposed West and East Above Ground Waste Rock Dumps (WRDs) within the existing Tharisa Mine Mining Right Area (MRA) near Marikana, North West Province. These included a channelled valley bottom (CVB) wetland and an unchanneled valley bottom (UCVB) wetland immediately north and within 50 m of the West Above Ground WRD, and the Sterkstroom River which drains in a northerly direction through the centre of the Tharisa Mine Mining Right Area (MRA), approximately 200 m west of the East Above Ground WRD.

The outcome of the ecological assessment of these freshwater ecosystems indicate that the assessed reach of the Sterkstroom River is in a moderately modified ecological state, and is moderately ecologically important and sensitive. The CVB wetland is considered seriously modified whilst the UCVB is considered critically modified, and a remnant of a larger drainage system. Both wetlands are considered marginally ecologically important and sensitive due to the decreased ecological integrity thereof.

Both WRDs are considered an extension of previously approved WRDs, and the majority of the footprint of each will be limited to a backfilled area of the West and East open pits respectively. Thus both WRDs will be located within existing disturbed areas, with the exception of 1 hectare of the West Above Ground WRD which will encroach into a relatively undisturbed area. Neither WRD will encroach directly on any freshwater ecosystem therefore no direct impacts are expected. However, indirect impacts, some of which may contribute to residual and/or cumulative impacts, may potentially occur, although the significance thereof ranges from negligible to low, depending on the nature of the indirect impact and the distance from the respective freshwater ecosystem that would be affected.

Considering that the majority of both WRD footprints will be located within existing disturbed areas, specifically within backfilled areas of existing opencast pits, it is the opinion of the specialist that the proposed activities may be considered for authorisation provided that appropriate mitigation measures are implemented to minimise the potential indirect,

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater ecosystem delineation and assessment as part of the Environmental Authorisation (EA) process for the proposed expansion of previously authorised Waste Rock Dumps (WRDs), namely the West Above Ground WRD and the East Above Ground WRD, within the existing Tharisa Mine Mining Right Area (MRA) near Marikana, North West Province. The footprints of both WRDs will predominantly be within backfilled areas of existing opencast pits, with the exception of 1 ha of the West Above Ground WRD which will encroach on a relatively undisturbed area. However, neither WRD will encroach directly on any of the identified freshwater ecosystems.

The purpose of this report is to provide detailed information to guide the activities associated with the proposed expansion activities, to ensure the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and water resource management initiatives and the provision of ecological services in the local area. The study also aimed to identify and quantify any impacts on the freshwater ecosystems associated with the two WRDs and to present a set of mitigatory measures which could be employed to minimise impacts on the receiving freshwater environment.

The assessment took the following approach:

- A desktop study was conducted, and relevant national and provincial databases were consulted. The results of the desktop study are contained in Section 3 of this report;
- A field assessment took place in May 2022, to ground-truth pre-defined points of interest and delineate the reach of the freshwater ecosystems associated with the project area. During the

site assessment, factors influencing the habitat integrity of the freshwater ecosystems were noted, and the functioning and the environmental and socio-cultural services provided by the river were determined;
- Three freshwater ecosystems, specifically one channelled and one unchannelled valley bottom wetland and the Sterkstroom River – were identified within 500 m of each WRD and were classified according to the Classification System (Ollis *et. al.,* 2013). The results of this classification are presented in Section 4.1 of this report;
- The characterisation of the freshwater ecosystems is contained in Section 4.2 of this report whilst the outcome of the ecological assessment is presented in Section 4.4 and summarised in the table below.

Summary of results of the ecological assessment of the freshwater ecosystems.

Freshwater Ecosystem	PES	EIS	Ecoservices
Sterkstroom River	B/C (IHI) / C (VEGRAI)	Moderate	Low to moderate
Unchannelled Valley Bottom Wetland	F	Low/marginal	Low to moderate
Channelled Valley Bottom Wetland	D	Low/marginal	Low to moderate

Following the assessment of the watercourse, the SLR Consulting (South Africa) (Pty) Ltd impact assessment method and the DWS Risk Assessment Matrix (2016) were applied to ascertain the significance of perceived impacts on the receiving environment, should the proposed WRD expansion activities proceed. The results of the impact and risk assessments are contained in Section 6 of this report, and key mitigation measures are provided in Section 6.1 and general mitigation measures in Appendix F.

Mitigation measures were developed to aid in minimising potential direct, indirect, and cumulative impacts on the receiving freshwater environment. These measures are outlined in Section 5 of this report, however the key mitigation measures are summarised below:
- Additional stormwater management and clean and dirty water systems are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation;
- The majority of the WRD footprints are planned within existing opencast mining and disturbed areas. Where there is marginal encroachment into areas not already cleared (1 ha of the West Above Ground WRD), then clearing must be limited to the approved footprint, and as much indigenous vegetation as possible retained;
- The proposed 4 m wide waste rock road around the perimeter of each WRD must take into consideration the delineations of the watercourses and be planned to avoid these, as much as feasible;
- Topsoil stockpiling must be undertaken in accordance with the mine's existing topsoil conservation guide. Any soil stockpiles may not exceed the height recommended by the topsoil conservation guide;
- The structures must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure;
- Monitoring of seepage water contained in the perimeter toe paddocks and of boreholes around the perimeter of each WRD must be undertaken to allow for proactive management;
- Although the geochemical work undertaken for waste rock samples at Tharisa indicate that the waste rock is non-acid generating, based on leachate tests chemicals of concern that are likely to leach from the WRDs when compared to water quality standards include: Elevated concentrations of Al, Chromium (Cr), Iron (Fe), Manganese (Mn), Lead (Pb). Thus the WRDs must be appropriately lined with a Class D liner to prevent pollution of groundwater.
- Clean and dirty water systems must be kept separate in line with Regulation GN704;
- The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event; and
- Clean water may be discharged into the watercourses, however the discharge outlet must be equipped with energy dissipating structures (such as Armorflex or reno mattresses) to attenuate the velocity of water inflow into the watercourses and to control erosion and incision.

Neither of the proposed WRDs will encroach directly on any of the freshwater ecosystems, and are therefore deemed to pose no direct risk to the freshwater ecosystems. The quantum of significance of potential indirect impacts is deemed to be low to very low/negligible. Notwithstanding this, edge effects, some of which could potentially contribute to cumulative or residual impacts to the freshwater

ecosystems, may potentially occur and therefore the strict implementation of mitigation measures (provided in Section 6.1 of this report) must take place.

Considering that the majority of the WRD footprints will be located within existing disturbed areas, specifically within backfilled areas of existing opencast pits, it is the opinion of the specialist that the proposed activities may be considered for authorisation provided that appropriate mitigation measures are implemented to minimise the potential indirect, cumulative and latent risks potentially associated with the proposed development activities.

DOCUMENT GUIDE

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

No.	Requirements	Section in report/Notes
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Cover Page and Appendix I.
2.2	Description of the preferred development site , including the following aspects-	
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Section 4
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Section 3: Table 1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Section 3: Table 1
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Section 3: Table 1 Section 4: Tables 7 and 8
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	None.
2.4	Assessment of impacts – a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Section 6
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	No direct impacts perceived.
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.) and d. Assessment of the risks associated with water use/s and related activities.	Sections 4 and 6
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over abstraction or instream or off-stream impoundment of a wetland or river);	Sections 4 and 6

	c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchanneled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); and f. Loss or degradation of all or part of any unique or important features associated with or within the aquatic ecosystem (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc).	
2.4.5	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Sections 4 and 6
2.4.6	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	N/A
2.4.7	In addition to the above, where applicable, impacts to the frequency of estuary mouth closure should be considered, in relation to: size of the estuary; availability of sediment; wave action in the mouth; protection of the mouth; beach slope; volume of mean annual runoff; and extent of saline intrusion (especially relevant to permanently open systems).	N/A
3.	The report must contain as a minimum the following information:	
3.1	Contact detail of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae.	Appendix I
3.2	A signed statement of independence by the specialist.	Appendix G
3.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment.	Section 1
3.4	The methodology used to undertake the site inspection and the specialist assessment, including equipment and modelling used, where relevant.	Section 2, Appendix C
3.5	A description of the assumptions made, any uncertainties or gaps in knowledge or data.	Section 1.3
3.6	The location of areas not suitable for development, which are to be avoided during construction and operation, where relevant.	N/A
3.7	Additional environmental impacts expected from the proposed development.	Section 6
3.8	Any direct, indirect and cumulative impacts of the proposed development on site.	Section 6
3.9	The degree to which impacts and risks can be mitigated.	Section 6
3.10	The degree to which impacts and risks can be reversed.	Section 6
3.11	The degree to which the impacts and risks can cause loss of irreplaceable resources.	Section 6
3.12	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted methodologies.	N/A
3.13	Proposed impact management actions and impact management outcomes for inclusion in the Environmental Management Programme (EMPr).	Section 6
3.14	A motivation must be provided if there were development footprints identified as per paragraph 2.3 for reporting in terms of Section 24(5)(a) and (h) of the National Environmental Management Act, 1998 (Act No. 107 of 1998) that were identified as having a “low” aquatic biodiversity and sensitivity and that were not considered appropriate.	N/A
3.15	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability or not of the proposed development and if the proposed development should receive approval or not.	Section 7
3.16	Any conditions to which this statement is subjected.	Section 7

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

GLOSSARY OF TERMS

Alien vegetation / alien invasive plants:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil:	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow:	Long-term flow in a river that continues after storm flow has passed.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, 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.
Chroma:	The relative purity of the spectral colour which decreases with increasing greyness.
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.
Hydromorphy:	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Intermittent flow:	Flows only for short periods.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of 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.
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
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DD	Data Deficient
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and Environment
DMR	Department of Mineral Resources
DMRE	Department of Mineral Resources and Energy
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Program
EN	Endangered
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IWUL	Integrated Water Use Licence
LC	Least Concern
m	Meter
MPRDA	Mineral and Petroleum Resources Development Act
NBA	National Biodiversity Assessment
N/A	Not Applicable
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SAS	Scientific Aquatic Services
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WML	Waste Management Licence
WRC	Water Research Commission
WULA	Water Use Licence Application

1. INTRODUCTION AND BACKGROUND SETTING

Scientific Aquatic Services (SAS) has previously undertaken various freshwater ecological assessments for the existing Tharisa Mine and was thus appointed to undertake an assessment of freshwater ecosystems associated with the proposed expansion of two existing Waste Rock Dumps (WRDs) as part of the Environmental Authorisation (EA) process. Previous studies encompassed the entire Mining Right Area (MRA), with the most recent study relevant to this project being undertaken in 2013 (SAS, 2013)[1]. Tharisa Mine is situated, south of Marikana Town on farms 342 JQ and Elandsdrift 467 JQ. immediately to the north of the N4 roadway within the North West Province.

Existing infrastructure within the Tharisa Mining Rights Area (MRA) include three open pit areas, various waste rock dumps, a plant and office area, return and raw water dams, a storm water dam, a Sewage Treatment Plant (STP), a Run-of-Mine (ROM) pad and Tailings Storage Facilities (TSFs), while proposed infrastructure, which forms the focus of this study, includes the following, which hereafter will be collectively referred to as the study area:

- Extending a previously approved waste rock dump (WRD) – referred to as the "**West Above Ground WRD**"; and
- Establishing a WRD above backfilled portions of the East and West pits – referred to as the "**East Above Ground WRD**".

In order to identify all potential freshwater ecosystems that may potentially be impacted by the proposed expansion activities, a 500m "zone of investigation" around the study area, in accordance with Regulation 509 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), was used as a guide in which to assess possible sensitivities of receiving environment. This area – i.e. the 500m zone of investigation around the study area – will henceforth be referred to as the "investigation area". The study and investigation areas are depicted in Figures 1 to 3.

1.1 Project Description

Tharisa Minerals (Pty) Ltd (Tharisa) is an opencast mining operation that produces chrome and platinum group metal (PGMs) concentrates. The mine has been operational since 2008.

[1] *Faunal, Floral, Wetland and Aquatic Assessment As Part Of The Environmental Assessment And Authorisation Process For The Proposed Waste Rock Dump Footprints Of The Tharisa Mine, North West Province*. Unpublished specialist report prepared for SLR Consulting (Africa) (Pty) Ltd. SAS Report Reference SAS 213199. November 2013.

The opencast mine is located on farms 342 JQ and Elandsdrift 467 JQ, south of the Marikana Town, in the North West Province.

Mining is undertaken in two mining sections, namely the East Mine and West Mine, using conventional open pit truck and shovel methods. The two mining sections are separated by the perennial Sterkstroom River and the D1325 (Marikana Road). Waste rock from the open pit areas is stockpiled on Waste Rock Dumps (WRDs) and some in-pit dumping of waste rock has taken place at the East Mine. Key existing mine infrastructure includes haul roads, run-of-mine, a concentrator complex, various product stockpiles, topsoil stockpiles, WRDs, tailings storage facilities (TSFs) and supporting infrastructure such as offices, workshops, change house and access control facilities.

Tharisa holds the following environmental authorisations (EAs) and licenses:

- A Mining Right (MR) (Reference No.: 358 MR) issued by the Department of Minerals and Energy (DME) (currently the Department of Mineral Resources and Energy (DMRE)) on 19 September 2008 and amended in July 2011;
- An approved EMPr (Reference No.: NW 30/5/1/2/3/2/1/358EM) issued by the DME (currently the DMRE) on 19 September 2008;
- An EA (Ref No.: NWP/EIA/159/2007) issued by the Northwest Department of Agriculture, Conservation and Environment (DACE) (currently the North West Department of Economic Development, Environment, Conservation and Tourism (DEDECT) on 23 October 2009;
- An EA (Ref No.: 14/12/16/3/3/2/408) issued by the Department of Environmental Affairs on 15 November 2012;
- An EA (Ref No.: NWP/EIA/50/2011) issued by the Northwest DACE (currently the DEDECT) on 29 April 2015;
- An addendum to the EIA and EMPr (Ref No.: NW/30/5/1/2/3/2/1/358EM) issued by the Department of Mineral Resources (DMR) (currently the DMRE) on 24 June 2015;
- An addendum to the EIA and EMPr (Ref No.: NW/30/5/1/2/3/2/1/358EM) issued by the DMR (currently the DMRE) on 14 Aug 2020 - Waste Water Treatment Plant;
- An addendum to the EIA and EMPr (Ref No.: NW/30/5/1/2/3/2/1/358EM) issued by the DMR (currently the DMRE) on 08 Aug 2021 – Fuel & Waste storage capacity increase;
- A Section 24G EA (Ref No.: NW/30/5/1/2/3/2/1/358EM) issued by the DMRE on 10 AUG 2021; and

- An amended Integrated Water Use Licence (IWUL) ((Licence No. 03/A21K/ABCGIJ/1468) issued by the Department of Water and Sanitation (DWS) in November 2020.

As part of its on-going mine planning, Tharisa has identified the need for additional waste rock storage on site (referred to as the Proposed Project). In this regard, Tharisa is making an application to the Department of Mineral Resources and Energy (DMRE) for an integrated EA and update of the mine's current EMPr. The following activities are now proposed:

- The expansion of the existing and approved Far West WRD 1 by a footprint of 109 ha. The expanded area will be referred to as the West Above Ground (OG) WRD. Portions of the West OG WRD will be located on backfilled areas of the West Pit; and
- The establishment of a waste rock dump (referred to as the East OG WRD) on backfilled portions of the East Pit. The proposed East OG WRD will cover an area of approximately 72 ha.

1.1.1 Description of Proposed Project

Overview of Proposed Project

The nature of the pits at Tharisa is such that there is continually more waste rock generated than capacity available in the worked-out areas of the pits and the balance must be dumped on surface WRDs. Additional waste rock handling and storage capacity is therefore required to accommodate the waste rock from the open pit operations. As part of its on-going mine planning, Tharisa has identified the need for additional WRD storage on site. In this regard, Tharisa is making application to the DMRE for an integrated EA and update of the mine's EMPr and is proposing the following:

- The expansion of the existing and approved Far West WRD 1 by a footprint of 109 ha. The expanded area will be referred to as the West Above Ground (OG) WRD. Portions of the West OG WRD will be located on backfilled areas of the West Pit; and
- The establishment of a waste rock dump (referred to as the East OG WRD) on backfilled portions of the East Pit. The proposed East OG WRD will cover an area of approximately 72 ha.

1.1.2 Description of Activities

Overview of Existing Mining and Processing Operations

Information in the following section was sourced from the approved 2008 EIA and EMPr (Metago, 2008) and 2014 EIA and EMPr (SLR, 2014).

The mining method at Tharisa comprises a standard open pit truck and shovel method. Access to the mining face is by means of haul roads and boxcuts with ramps. Steady state open pit dimensions will differ between the east and west sections because of the varying dip of the target ore body. In the western section, the dimensions are expected to be 360 m wide, 1 km in length along the outcrop with a final high wall averaging at approximately 180 m. On the eastern section, the dimensions are expected to be 580 m wide, 1 km in length along the outcrop with a final high wall averaging at approximately 180 m. The general mining direction is north.

The mineral processing operation comprises a concentrator complex. The concentrator complex caters for two streams, namely PGM's and chrome, to accommodate the different characteristics of the ore seams that are mined. The target production figures for the plants are approximately 40 000 tonnes of PGM concentrate per year; and approximately 1.5 million tonnes of chrome concentrate per year.

1.1.3 Description and Location of Activity

This Section provides details of the project location and properties. A description of the properties on which the Tharisa Mine and Proposed Project are located is provided in Table 1 below.

Table 1: Description of the property.

Description	Details
Farm name	• Existing mining operations - 342 JQ and Elandsdrift 467 JQ. • Proposed Project - 342 JQ, within boundary of existing Mining Right Area.
Application area (ha)	• The existing Mining Right Area covers an area of approximately 5 516 ha. • The total application area is approximately 181 ha. Of the total application area approximately 1 ha will be located on undisturbed mining areas. The remaining application area will be located within existing disturbed areas.
Magisterial district	The Proposed Project is located within Bojanala District Municipality, the Rustenburg Magisterial District and the Rustenburg Local Municipality.
Distance and direction from nearest town	Tharisa Mine is located approximately 4 km to the south of Marikana Town, in the North West Province.
Distance and direction from nearest communities	• Bokamoso community settlement located east of the Tharisa mine. • Mmaditlhokwa is located immediately north of the West Pit. • Lapologang is located 480 m south of the West Pit. • Private landowners (Buffelspoort) are located approximately 450 m south of the N4.
Co-ordinates	The co-ordinates of the relevant project components are: West OG WRD: 25°43'35.29"S 27°27'17.56"E — 25°43'45.41"S 27°28'35.84"E East OG WRD: 25°44'11.20"S 27°29'22.47"E — 25°44'3.75"S 27°30'40.99"E

Description	Details
Water catchment and management area	• Crocodile River Basin: lower Sterkstroom of the Upper Crocodile Sub-Water Management Area (Sub-WMA). • A21K quaternary catchment.

Table 2: Activity and Extent

Main project activity	Aerial extent of the activity (ha)
Extension of a previously approved WRD (West OG WRD)	Approximately 109 ha (108 ha within a disturbed area)
Establishing waste rock over backfilled portions of the East (East OG WRD)	Approximately 72 ha
Extension of a previously approved WRD (West OG WRD)	Approximately 109 ha
Establishing waste rock over backfilled portions of the East (East OG WRD)	Approximately 72 ha
Extension of a previously approved WRD (West OG WRD)	Approximately 109 ha
Establishing waste rock over backfilled portions of the East (East OG WRD)	Approximately 72 ha

1.1.4 Design of the proposed WRD's

The management of residue stockpiles and deposits must be undertaken in accordance with Regulations regarding the Planning and Management of Residue Stockpiles and Residue Deposits (GN 632 of 2015, as amended). In this regard, the design features of the proposed WRD's are presented in Table 3. The detailed design report and drawings of the proposed WRD's will be provided as part of the EIA and EMPr phase.

Table 3: Design features of the WRDs.

Feature	Detail
Physical dimensions	**Height:** Approximately 70 m (applies to all proposed WRD's) **Bench height:** Approximately 15 m **Footprint:** West OG WRD: Approximately 109 ha; and East OG WRD: Approximately 72 ha. **Maximum storage capacity:** West OG WRD: Approximately 35.31 million m^3; and East OG WRD: Approximately 26.26 million m^3.
Chemical properties	The waste rock material comprises pyroxenite, anorthosite and norite. The geochemical work undertaken for waste rock samples at Tharisa indicate that the waste rock is non-acid generating and based on leachate tests chemicals of concern that are likely to leach from the WRD's when compared to water quality standards include: Elevated concentrations of Al, Chromium (Cr), Iron (Fe), Manganese (Mn), Lead (Pb).
Waste rock transport and deposition	Excess open pit waste rock loaded onto mine dump trucks and transported to WRDs. Waste rock access ramps constructed with a maximum gradient of 1V:7H (8°) for mine dump trucks. Waste rock is then dumped and spread / flattened with a bulldozer.
Control of seepage and dirty water run-off	The control of seepage from the toe of the WRDs as well as run-off from the side slopes will be achieved by the construction of a series of toe paddocks and secondary toe paddock cross walls around the perimeter of the WRDs, from where it will seep into the unsaturated soil or evaporate.

Feature		Detail
Diversion of clean water		Stormwater diversion trenches will be established to divert clean surface run-off from the surrounding area away from the WRD in order to prevent the contamination of clean water.
Topsoil stripping		Topsoil in WRD footprint areas will be stripped and stockpiled in accordance with the topsoil conservation guide. A stripping depth of 500 mm has been recommended by the soils study. Stripping and stockpiling of topsoil will be done in advance of dumping.
Lining		A Class D liner is required.
Side slopes		Average slope: 1V:3H
Access and access control		A 4m wide waste rock road will be constructed around the perimeter of each dump for routine inspections and maintenance. A perimeter fence around each WRD is planned.
Monitoring		Monitoring of seepage water retained in the perimeter toe paddocks and of boreholes around the perimeter of each WRD.
Dust control		Operational Phase: Watering of roads for dust suppression. Post Operational Phase: No measures necessary due to the coarse particle size distribution.
Closure		The WRD should be shaped to ensure the area is free draining (i.e no ponding of water on the top surface post closure). The WRD side slopes to be confirmed through on-going field trails. The WRD should be capped with a minimum of 300 mm soil/growth medium material. The capping thickness should be confirmed through on-going field trails. No active groundwater protection measures are envisaged during closure given the relatively low pollution potential of the residual waste rock material. In the event that water quality monitoring around any WRD indicates that the WRDs are causing pollution, additional management measures will be investigated in consultation with a qualified specialist.
Rehabilitation	Revegetation	The WRD is to be revegetated using a mix of indigenous grasses (i.e. dry seeding) and trees/shrubs (i.e. hand planting of seedlings). The vegetation species will be confirmed through ongoing field trials.
	Erosion control	The erosion management measures and/or mitigation measures to be confirmed through ongoing field trials.
	Maintenance and aftercare	Maintenance and aftercare period to be confirmed through ongoing field trials.
	Rehabilitation success criteria	Rehabilitation success will be determined by monitoring trends in soil nutrient levels, soil microbial levels, vegetation cover and vegetation biodiversity levels and comparing data and temporal trends in the data to numerical targets.

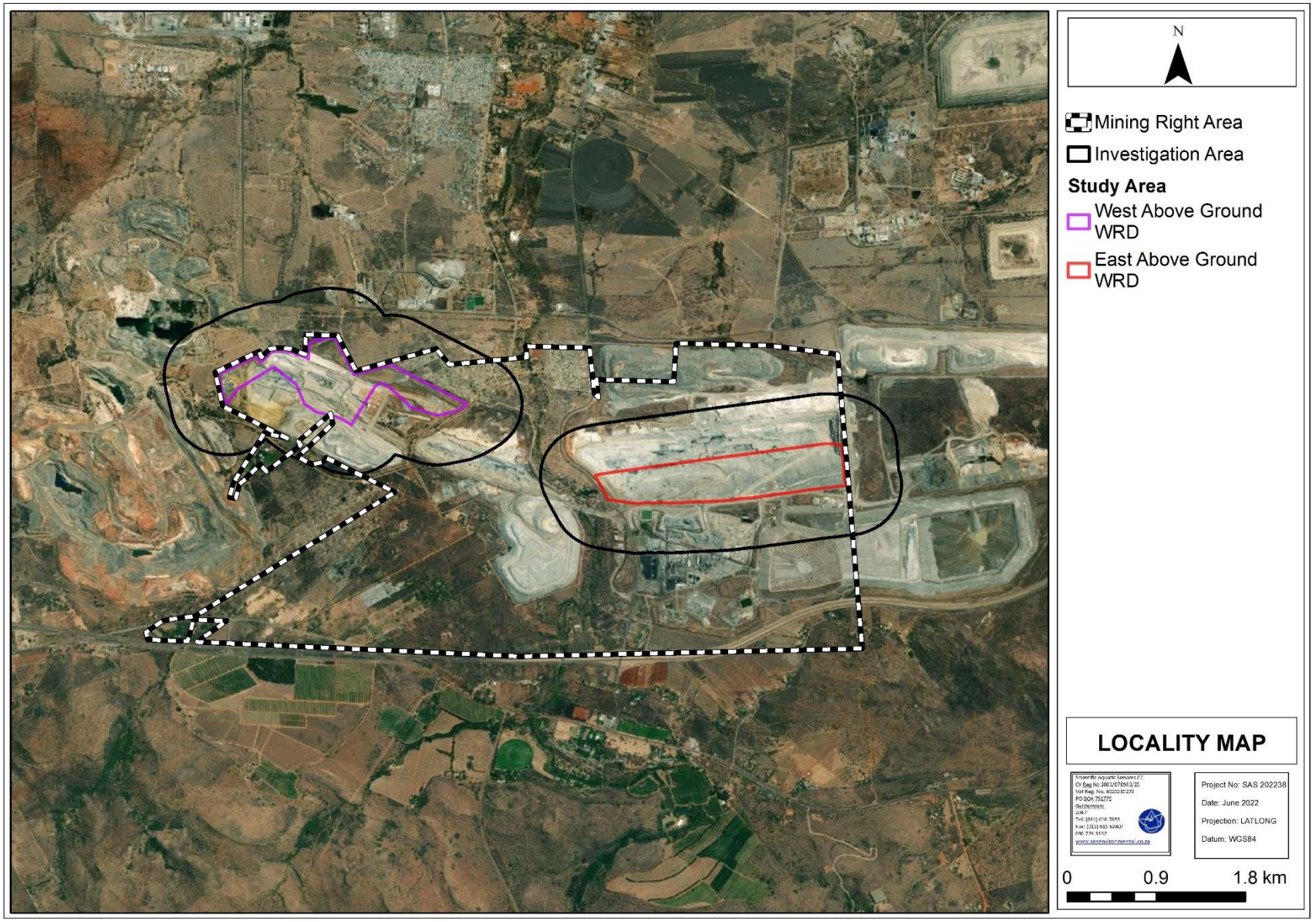


Figure 1: The study and investigation areas in relation to the MRA and surrounding areas depicted on digital satellite imagery.

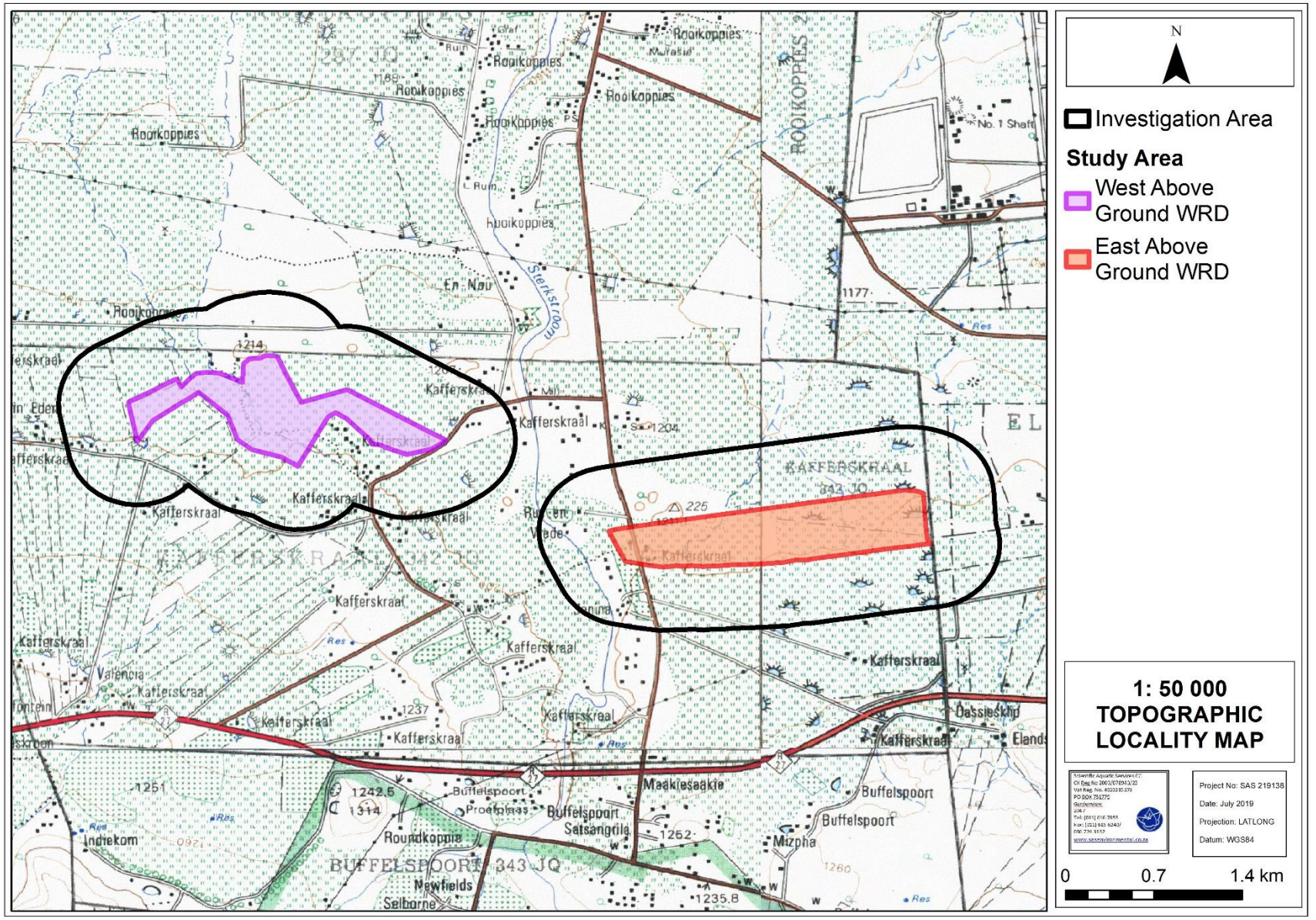


Figure 2: The study and investigation areas depicted on a 1:50,000 topographic map.

1.2 Project Scope

Specific outcomes in terms of this report are outlined below:

- To verify the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of previously identified freshwater ecosystems within 500 m of the study area according to current best practice methods i.e. according to the resources directed measures guidelines as advocated by Macfarlane *et al* (2008) and the method described by Rountree and Kotze (2013) respectively ;
- A background study of relevant national, provincial and municipal datasets (such as the National Freshwater Ecosystem Priority Areas [NFEPA] 2011 database, the National Biodiversity Assessment (2018), Mpumalanga Biodiversity Sector Plan (2019) and the Department of Water and Sanitation Research Quality Information Services [DWS RQIS PES/EIS], 2014 database was undertaken to ensure that all relevant background information is updated and meets current legislative requirements;
- Allocation of a suitable Recommended Ecological Category (REC) and Recommended Management Objective (RMO) to the watercourse 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 cryptic wetland as a result of the proposed waste tyre mechanical downsizing activities, and to aim to quantify the significance thereof; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimising the impact on the receiving watercourse environment.

1.3 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The watercourse assessment is confined to the study area as illustrated in Figures 1 and 2 and does not include the neighbouring and surrounding properties outside of the study area. The general surroundings and important catchment characteristics were, however, considered in the desktop assessment of the study area;
- During the site assessment undertaken in April 2022, three freshwater ecosystems were identified in relation to the study area. Where access was possible the delineations and ecological status were ground-truthed. However, where access was prevented (taking into consideration mine safety protocols and sensitivities of the surrounding communities to mine activities), sections of the identified freshwater ecosystems were delineated on a desktop basis using topographic maps and digital satellite imagery, in line with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it

relates to the National Water Act, 1998 (Act No. 36 of 1998). Furthermore, relevant data obtained during the assessment undertaken in 2013 was utilised;

- Notwithstanding the above, changes to the landscape driven by the expansion of mining activities in the catchments of the valley bottom wetlands associated with the West Above Ground WRD have altered the functional extents and hydroperiods of the wetlands;
- Wetland, riparian, and terrestrial ecosystem zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater ecosystem boundary may occur. However, if the DWAF (2008) method is followed, all assessors should get largely similar results;
- With regards to data sources used to provide background information on the sensitivity of the assessed areas, it is important to note that although all data sources provide useful and often verifiable, high-quality data, the various databases used do not always provide an entirely accurate indication of the study area's actual site characteristics at the scale required to inform the environmental authorisation processes; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. A more reliable assessment of the biota would require seasonal sampling, with sampling being undertaken under both low and high rainfall conditions. However, it is expected that the proposed activities have been accurately assessed and considered, based on the field observations.

2. ASSESSMENT APPROACH

2.1 Freshwater Site Selection and Field Verification

For the purposes of this investigation, the following definitions as per the National Water Act, 1998 (Act No. 36 of 1998) are of relevance:

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.

Riparian habitat includes-

"The physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterized by alluvial soils, and which are inundated or flooded to an

extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent areas".

Regulated Area of a Watercourse means -

(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 100m 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.

Where the site characteristics had been significantly transformed (for example, complete loss of riparian vegetation in the vicinity of road crossings) 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 watercourse following the field assessment. The following were taken into consideration when utilising the above desktop methods:

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

A field assessment was undertaken in April 2022 to conduct a freshwater ecosystem delineation and ecological assessment. The delineation of the identified freshwater ecosystems took place, as far as possible, according to the method presented in the "Updated manual for the identification and delineation of wetland and riparian resources" (DWAF, 2008).

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

- Landscape position;
- The presence of water at or near the ground surface;
- Distinctive hydromorphic 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 freshwater ecosystems was undertaken, at which time factors affecting the integrity of the freshwater ecosystems were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater ecosystems. A detailed explanation of the methods of assessment undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

All the freshwater ecosystems associated with the study area were considered, and sensitive areas were delineated with the use of a GPS. A Geographic Information System (GIS) was used to project the watercourse onto digital satellite imagery and topographic maps. The sensitivity map provided in Section 4.4 should guide the design and layout of the proposed prospecting activities.

2.3 Impact and Risk Assessments and recommendations

Following the completion of the assessment, a pre-defined impact assessment methodology, provided by the EAP and the DWS Risk Assessment Matrix (2016) were applied (please refer to Appendix D for the methods of approach) and recommendations were developed to address and mitigate impacts associated with the proposed activities. These recommendations also include general management measures which apply to the proposed expansion activities as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the proposed activities. The detailed mitigation measures are outlined in Section 5 of this report, whilst the general management measures which are considered to be best practice mitigation applicable to a project of this nature, are outlined in Appendix F.

3. DESKTOP INVESTIGATION FINDINGS

3.1 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 1). The dashboard report aims to present concise summaries of the data on as few pages as possible to allow for integration of results by the reader to take place. It is important to note that although all data sources used provide useful and often verifiable, high quality data, the various databases used do not always provide an entirely accurate indication of the study area’s actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. Given these limitations, this information is considered useful as background information to the study. It must however be noted that site verification of key areas may potentially contradict the information contained in the relevant databases, in which case the site verified information must carry more weight in the decision-making process. Thus, this data was used as a guideline to inform the watercourse assessment and to focus on areas and aspects of increased conservation importance during the site assessment.

Table 4: Desktop data relating to the characteristics of the freshwater ecosystems associated with the study and investigation areas.

Aquatic ecoregion and sub-regions in which the study areas are located	
Ecoregion	Bushveld Basin
Catchment	Limpopo
Quaternary Catchment	A21K
WMA	Crocodile (West) and Marico
SubWMA	Upper Crocodile
Dominant characteristics of the Bushveld Basin Ecoregion Level II (8.05) (Kleynhans *et al.*, 2007a)	
Dominant primary terrain morphology	Plains, low relief, slightly undulating plains
Dominant primary vegetation types	Mixed Bushveld
Altitude (m a.m.s.l)	900 to 1500
MAP (mm)	400 to 700
Coefficient of Variation (% of MAP)	25 to 29
Rainfall concentration index	60 to >65
Rainfall seasonality	Early to Mid-summer
Mean annual temp. (°C)	16 to 20
Winter temperature (July)	2 to 22
Summer temperature (Feb)	14 to 32
Median annual simulated runoff (mm)	20 to 40 (limited); 40 to 100
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)	
Sub-quaternary reach	A21K - 01023
Assessed by expert?	Yes
PES Category Median	Largely Modified (Class D)
Stream Order	2
Mean Ecological Importance (EI) Class	High
Mean Ecological Sensitivity (ES) Class	High
Default Ecological Class (based on median PES and highest EI or ES mean)	High (Class B)
Importance of the study areas according to the Mining and Biodiversity Guidelines (2013)	
Most of the study area is located within areas identified as **High Biodiversity Importance** and according to the Mining and Biodiversity Guidelines (2013). A small section of the study area (within the East Above Ground WRD) is located within an area considered to be of **Moderate Biodiversity Importance,** and the remaining portions of the study area is currently not ranked**.** *** Areas of High Biodiversity Importance**	

Detail of the study areas in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The entire West Above Ground WRD falls within a sub-catchment classified as a **Phase2FEPA,** while the majority of the East Above Ground WRD falls within a sub-catchment classified as a **Fish Support Area** considered important for the threatened fish species *Barbus motebensis* (VU) and the remaining portion of the East Above Ground WRD falls within a **Phase2FEPA** sub-catchment. *** Phase2FEPAs** were identified in moderately modified rivers (Class C), only in cases where it was not possible to meet biodiversity targets for river ecosystems in rivers that were still in good condition (Class A or B). The condition of these Phase2FEPAs should not be degraded further, as they may in future be considered for rehabilitation once FEPAs in good condition are considered fully rehabilitated and well managed. *** Fish Support Areas** are the remaining fish sanctuaries in lower than an A or B ecological condition, which also include sub-quaternary catchments that are important for migration of threatened fish species.
NFEPA Wetlands	According to the NFEPA Database there are **no wetland features** associated with the **East Above Ground WRD**, only one artificial unchanneled valley bottom wetland located within the investigation area. The NFEPA Database further indicates there is **one natural flat** wetland located within the **West Above Ground WRD,** one natural valleyhead seep wetland within the investigation area along with three artificial flat wetlands, three artificial unchanneled valley bottom wetlands and three valleyhead seep wetlands. With exception of the natural valleyhead seep wetland which is considered moderately modified (Class C), the wetlands are considered heavily to critically modified (Class Z1-Z3). None of the wetlands associated with the study and investigation areas are considered FEPA wetlands.
Wetland vegetation Type	The entire East Above Ground WRD and the majority of the West Above Ground WRD falls within the **Central Bushveld Group 2 Wetland Vegetation Type** considered **vulnerable,** while the remaining western portion of the West Above Ground WRD falls within the **Central Bushveld Group 5 Wetland Vegetation Type** also considered **vulnerable** (Mbona *et al.,* 2015).
NFEPA Rivers	The **Sterkstroom River** traverses the western portion of the investigation area of the East Above Ground WRD. According to the NFEPA Database and the PES 1999 Classification the Sterkstroom River is **moderately modified (Class C)** and classified as a **Phase2FEPA river.**
National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	

Risk for mining: High risk for mining. Implications for mining: These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, for maintaining important ecosystem services for communities or the country. An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on spatial biodiversity. *** Areas of Moderate Biodiversity Importance** Risk for mining: Moderate risk for mining. Implications for mining: EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity 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.	According to the NBA:SAIIAE Database there are no natural wetland features associated with the study and investigation areas. Several dams are located within the investigation area, according to the NBA:SAIIAE artificial database. The NBA Database further indicates the Sterkstroom River to be largely modified (Class D), and is currently not protected (Ecosystem Protection Level (EPL)) and therefore considered a **critically endangered ecosystem** (Ecosystem Threat Status (ETS)).

Detail of the study area in terms of the North West Biodiversity Sector Plan (2015)	
CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses.	
ESAs are terrestrial and aquatic areas that are not essential for meeting biodiversity representation targets (thresholds), but which nevertheless play an important role in supporting the ecological functioning of Critical Biodiversity Areas (CBAs) and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree or extent of restriction on land use and resource use in these areas may be lower than that recommended for CBAs.	
Critical Biodiversity Area (CBA) Category 1	**The Sterkstroom River** is identified as a **CBA1**. **CBA1s** need to be maintained in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process: • Ecosystems and species fully or largely intact and undisturbed; • These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met; and • These are biodiversity features that are at, or beyond, their limits of acceptable change.
Critical Biodiversity Area Category 2	**A buffer** surrounding the Sterkstroom River is identified as a **CBA2.** **CBA2s** need to be maintained in a natural or near-natural state that maximises the retention of biodiversity pattern and ecological process: • Ecosystems and species fully or largely intact and undisturbed; • Areas with intermediate irreplaceability or some flexibility in terms of meeting biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve biodiversity targets, although loss of these sites would require alternative sites to be added to the portfolio of CBAs; and • These are biodiversity features that are approaching but have not passed their limits of acceptable change.
Ecological Support Area (ESA) Category 1	Small portions of the West Above Ground WRD is located within a **category 1 ESA**. **ESA1s** need to be maintained in at least a semi-natural state as ecologically functional landscapes that retain basic natural attributes: • Ecosystem still in a natural, near-natural state or semi-natural state, and has not been previously developed; • Ecosystems moderately to significantly disturbed but still able to maintain basic functionality; • Individual species or other biodiversity indicators may be severely disturbed or reduced; and • These are areas with low irreplaceability with respect to biodiversity pattern targets only.

Ecological Support Area Category 2	**The majority of East Above Ground WRD** and **small portions of West Above Ground WRD** is identified as an **ESA2.** **ESA2s** need to maintain as much ecological functionality as possible (generally these areas have been substantially modified): • Maintain current land use or restore area to a natural state; • Ecosystem NOT in a natural or near-natural state, and has been previously developed (e.g. ploughed); • Ecosystems significantly disturbed but still able to maintain some ecological functionality; • Individual species or other biodiversity indicators are severely disturbed or reduced and these are areas that have low irreplaceability with respect to biodiversity pattern targets only; and • These are areas with low irreplaceability with respect to biodiversity pattern targets only. These areas are required to maintain ecological processes especially landscape connectivity.

Strategic Water Source Areas for Surface Water (2017)	National Web-based Screening Tool
According to the Strategic Water Source Areas (SWSA) Database (2017) the study and investigation areas are located within the **Kroondal/Marikana groundwater SWSA.** The **Strategic Water Source Areas for groundwater (SWSA-gw)** reflect areas that have high groundwater recharge and where the groundwater forms a nationally important resource. The areas are delineated for the purposes of research, and the outcomes are useful to national level planners and decision makers as an indication of the location of strategic groundwater sources and resources. Sub-national WSAs for groundwater were also identified.	The screening tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the EA process. this assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas. For the aquatic biodiversity theme, the study area is considered to have an overall aquatic sensitivity of **very high**, due to aquatic CBAs and the study area being in a strategic water source area as confirmed by the SWSA database (2017). According to the NWBSP (2015) the study area falls within areas identified as ESAs, while only the Sterkstroom River and an associated buffer is identified as a CBA.

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

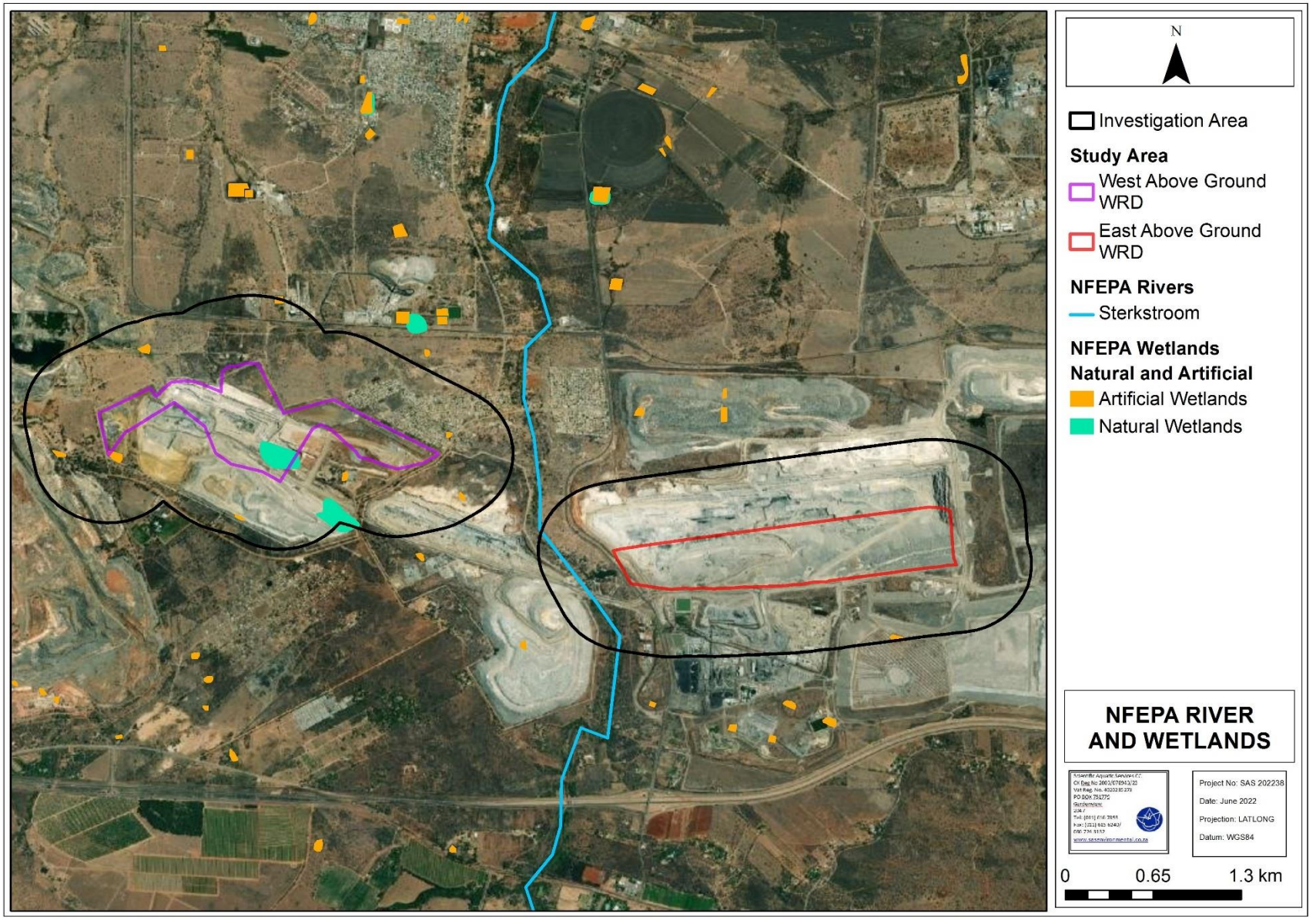


Figure 3: Wetlands and rivers associated with the study and investigation areas according to the NFEPA (2011) database.

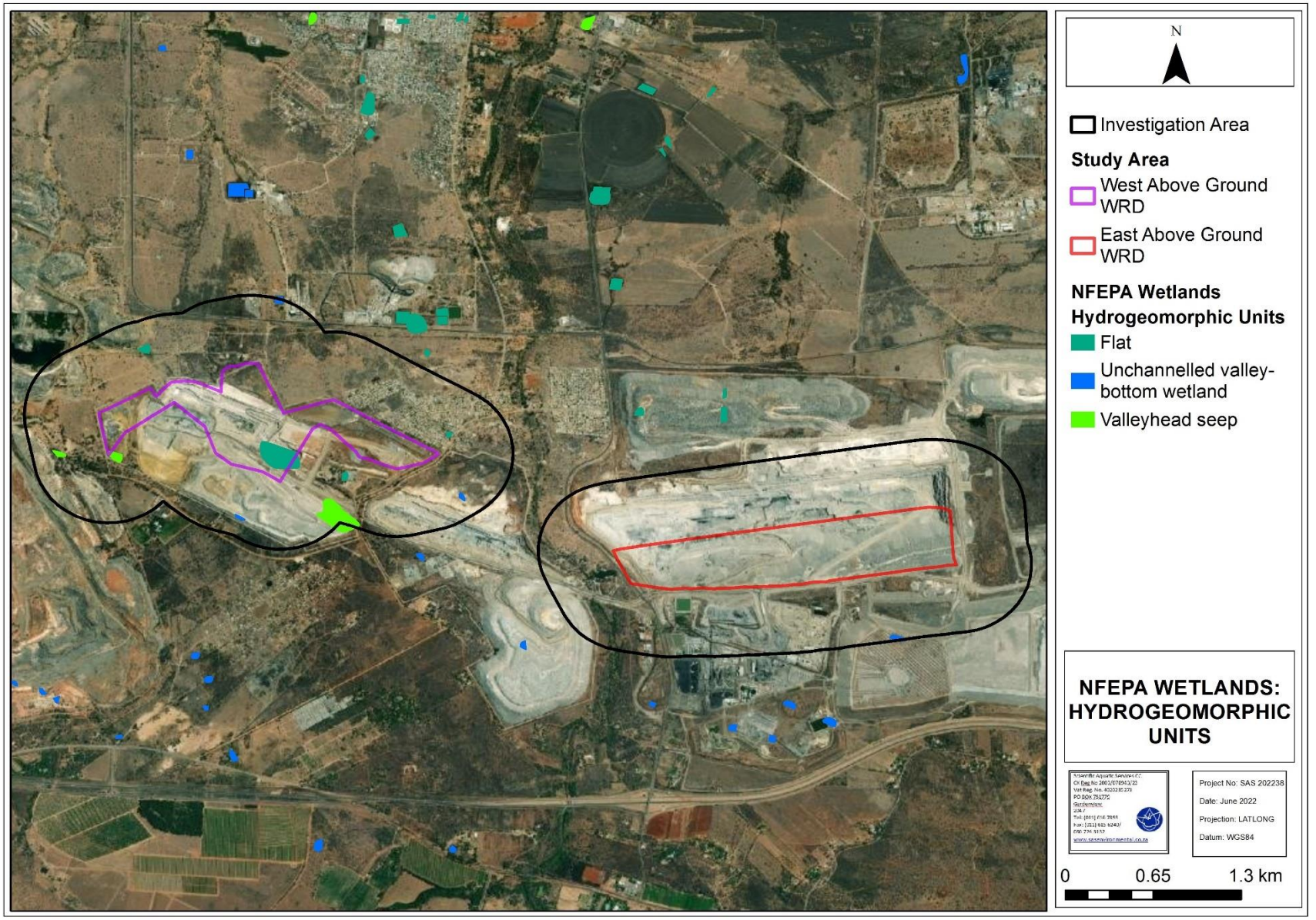


Figure 4: Wetland hydrogeomorphic (HGM) units associated with the study and investigation areas according to the NFEPA (2011) database.

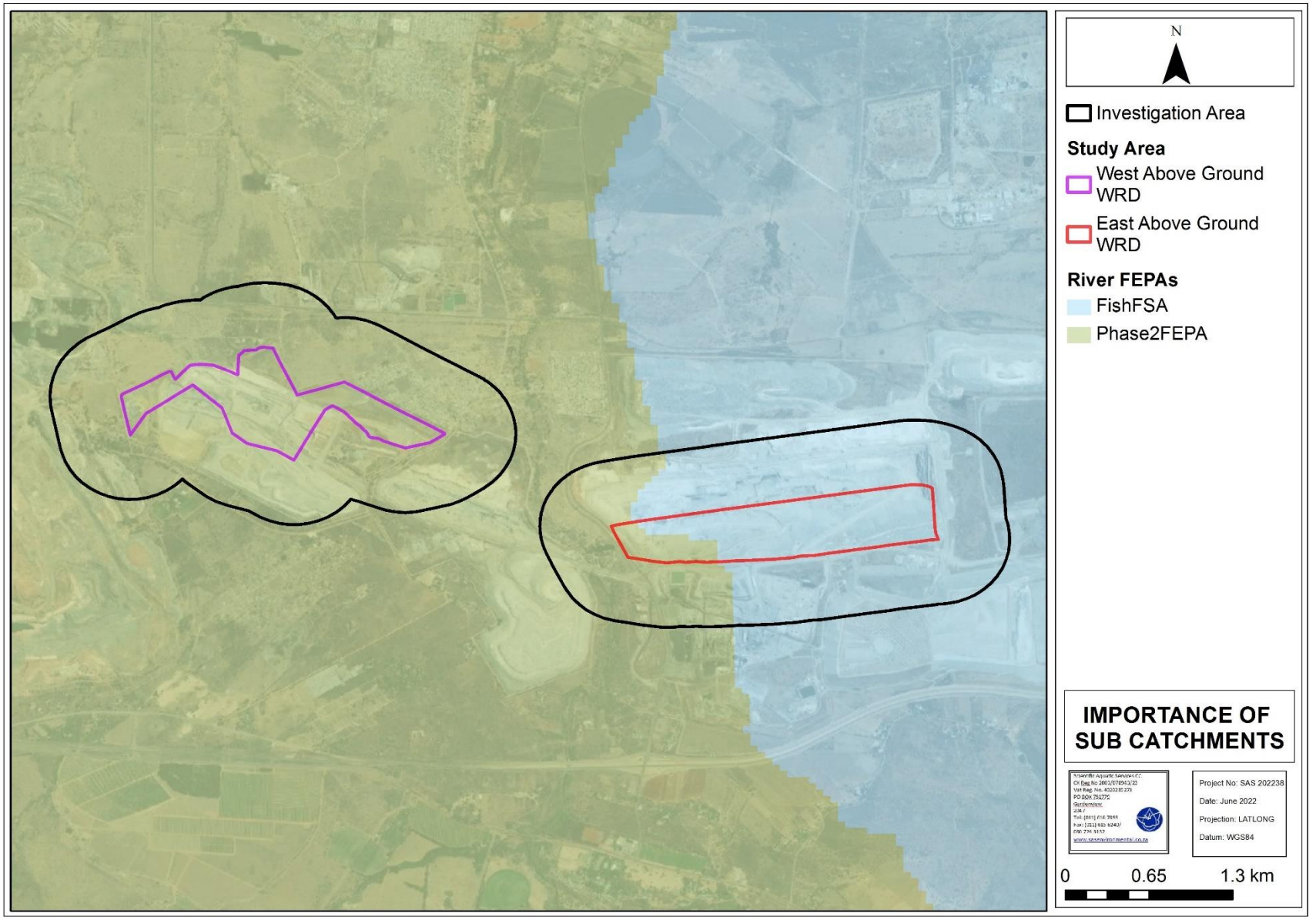


Figure 5: River Freshwater Ecosystem Priority Areas (FEPAs) applicable to the study area according to the NFEPA (2011) database.

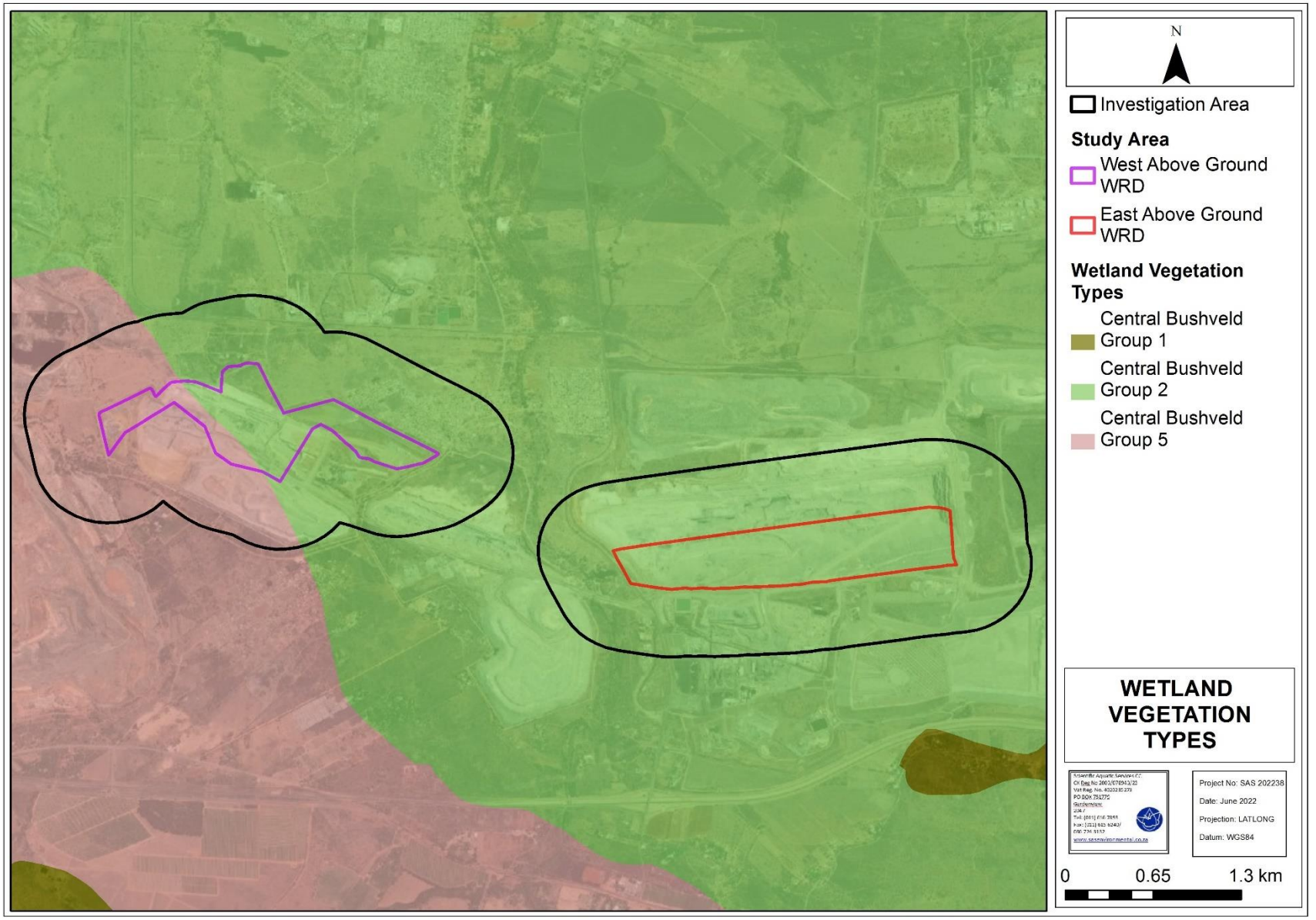


Figure 6: Wetland Vegetation (WetVeg) groups applicable to the study area according to the NFEPA (2011) database.

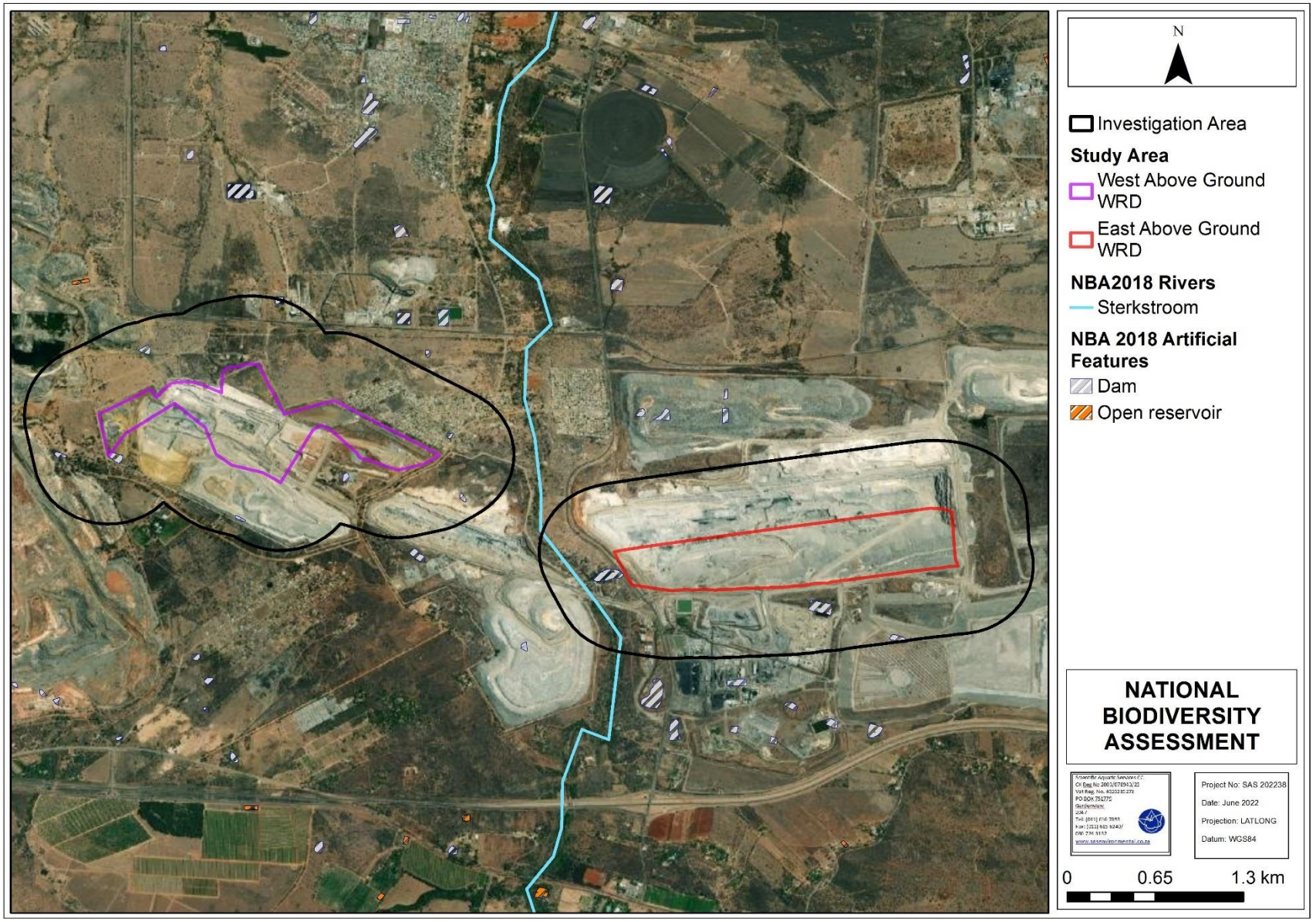


Figure 7: Wetlands associated with the study and investigation areas according to the National Biodiversity Assessment (2018).

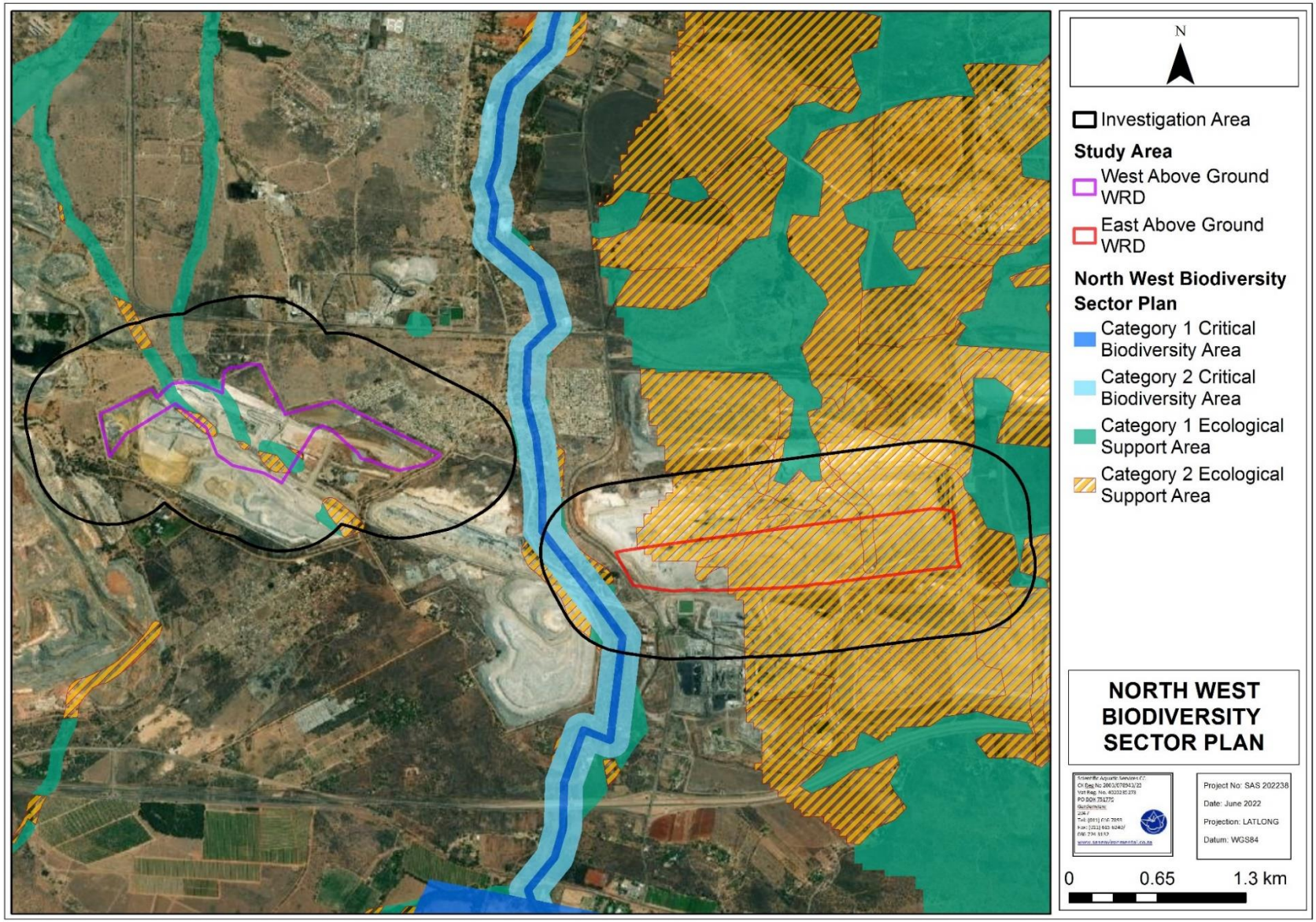


Figure 8: Critical Biodiversity Areas (CBAs) and Ecological Suipport Areas (ESAs) according to the North West Biodiversity Sector Plan (NWBSP) 2015.

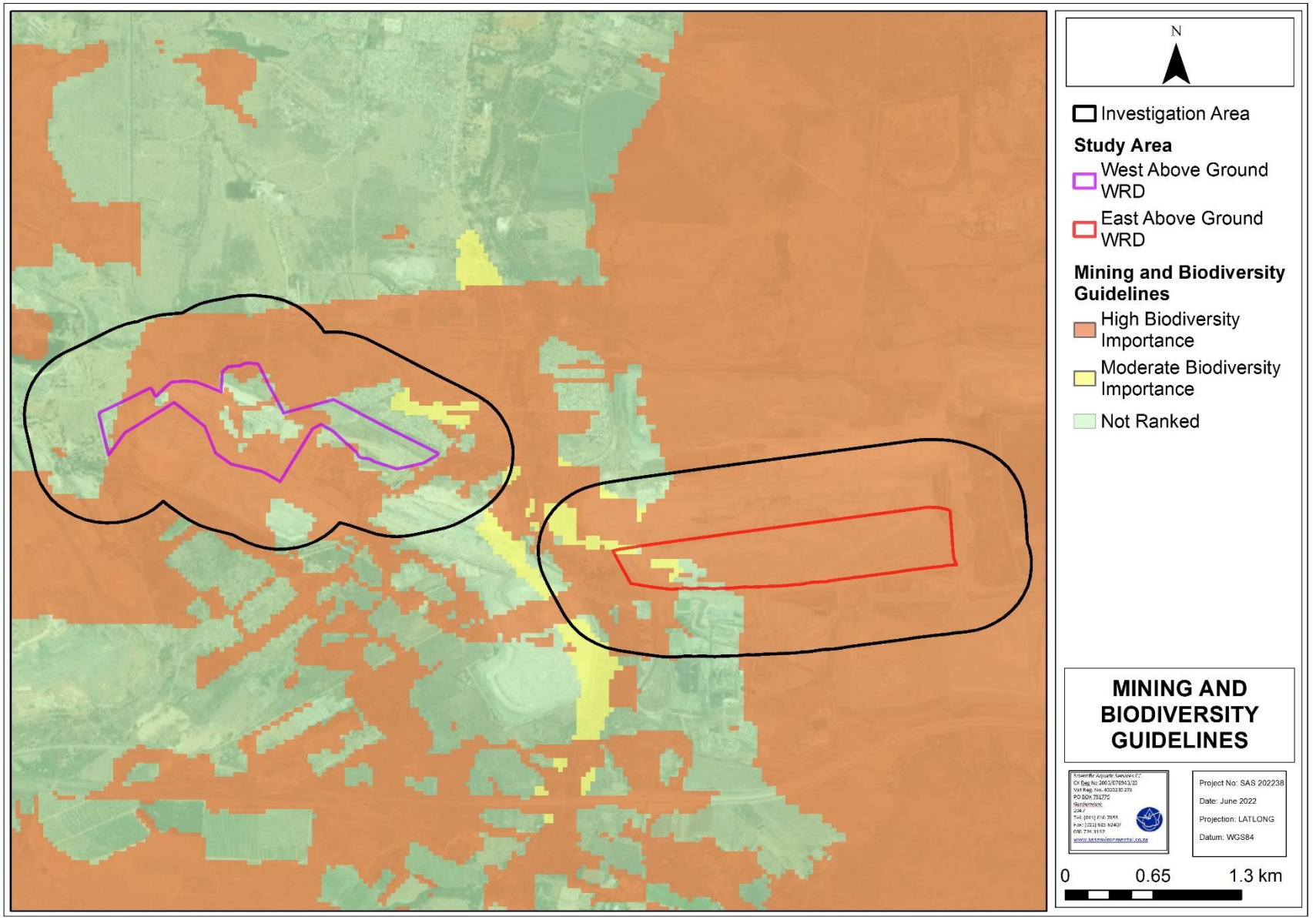


Figure 9: Importance of the study area according to the Mining and Biodiversity Guidelines (2013).

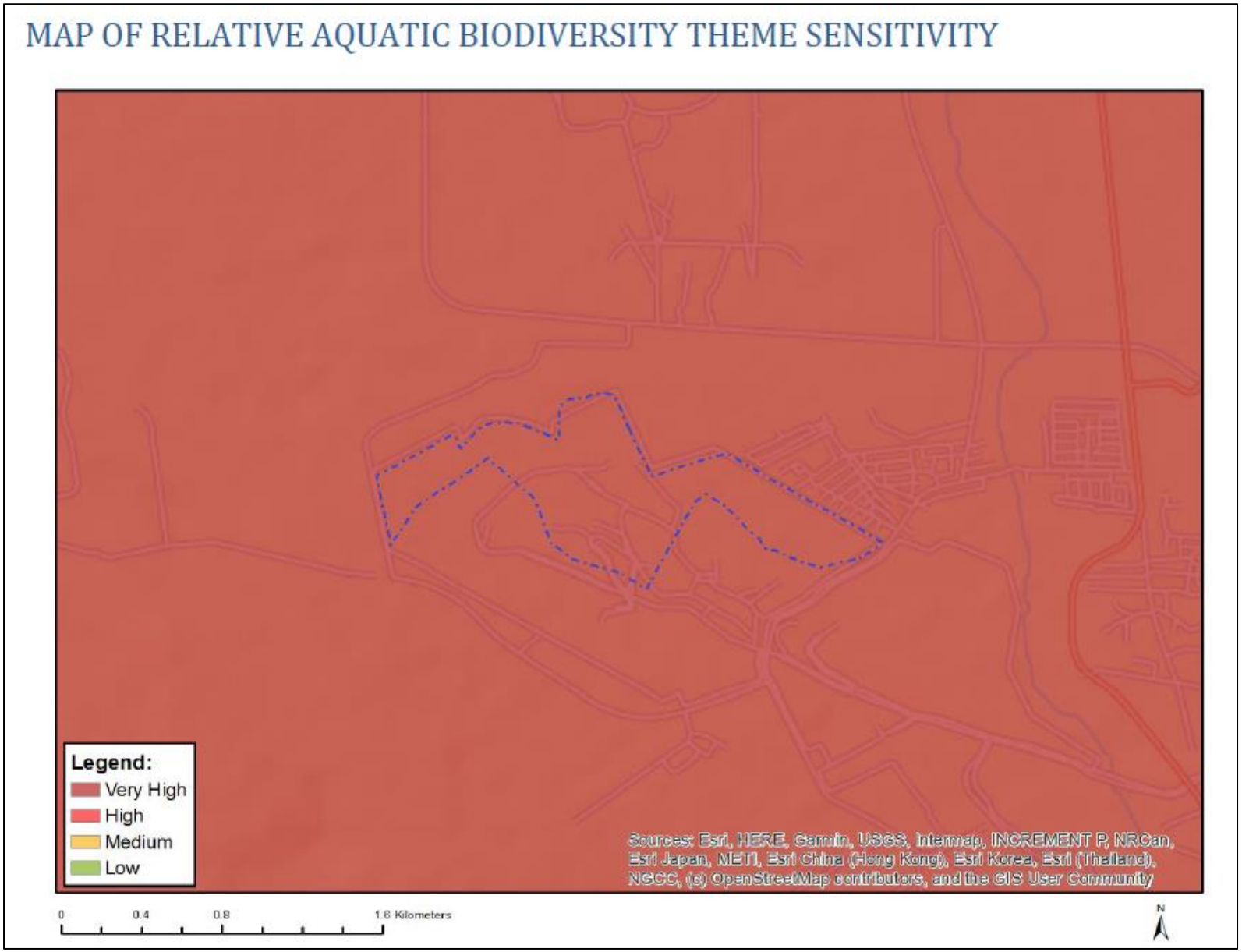


Figure 10: Map of relative aquatic sensitivity according to the DFFE Screening Tool (2020) Assessment.

3.2 Ecological Status of Sub-Quaternary Catchments [Department of Water and Sanitation (DWS) Resource Quality Services (RQS) PES/EIS Database]

The PES/EIS database, as developed by the DWS RQS department, was utilised to obtain additional background information on the project area. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level with the descriptions of the aquatic ecology based on the information collated by the DWS RQIS department from all reliable sources of reliable information such as South Africa River Health Programme (SA RHP) sites, Ecological Water Requirement (EWR) sites and Hydro Water Management System (WMS) sites.

In this regard, information for sub-quaternary catchment reach (SQR) for the Sterkstroom River (A21K - 01023) is applicable. Key information on background conditions associated with the study area, as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the River, is tabulated in Table 3.

According to the EI data for the Sterkstroom River (A21K - 01023) is the following fish species are expected to occur at this site:

- *Clarias gariepinus*
- *Enteromius anoplus*
- *Enteromius trimaculatus*
- *Enteromius unitaeniatus*
- *Labeobarbus marequensis*
- *Labeo cylindricus*
- *Lebeo molybdinus*
- *Mesobola brevianalis*
- *Marcusenius pongolensis*
- *Pseudocrenilabrus philander*
- *Tilapia sparrmanii*

The Ecological Importance (EI) data for SQR Sterkstroom River (A21K - 01023) indicate that the following macro-invertebrate taxa are expected to occur at this site:

Aeshnidae	Gomphidae	Naucoridae
Ancylidae	Gyrinidae	Nepidae
Atyidae	Haliplidae	Notonectidae
Baetidae > 2 sp	Hirudinea	Oligochaeta
Belostomatidae	Hydracarina	Physidae
Caenidae	Hydrometridae	Pleidae
Ceratopogonidae	Hydrophilidae	Potamonautidae
Chironomidae	Hydropsychidae > 2 sp	Simuliidae
Coenagrionidae	Hydroptilidae	Tabanidae
Corixidae	Leptoceridae	Tipulidae
Culicidae	Leptophlebiidae	Tricorythidae
Dytiscidae	Libellulidae	Turbellaria
Ecnomidae	Lymnaeidae	Veliidae/mesoveliidae
Gerridae	Muscidae	

Table 5: Summary of the ecological status of the sub-quaternary catchment (SQ) reach Sterkstroom River (A21K – 01023) based on the DWS RQS PES/EIS database.

Synopsis (SQ reach Sterkstroom River (A21K – 01023))					
PES[1] category median	**Mean EI[2] class**	**Mean ES[3] class**	**Length**	**Stream order**	**Default EC[4]**
D (Largely Modified)	High	High	27.14	2	B (High)
PES details					
Instream habitat continuity MOD		Moderate	**Riparian/wetland zone MOD**		Large
RIP/wetland zone continuity MOD		Moderate	**Potential flow MOD activities**		Large
Potential instream habitat MOD activities		Large	**Potential physico-chemical MOD activities**		Large
EI details					
Fish spp/SQ		11.00	**Fish average confidence**		4.27
Fish representativity per secondary class		Moderate	**Fish rarity per secondary class**		Very High
Invertebrate taxa/SQ		41.00	**Invertebrate average confidence**		4.37
Invertebrate representativity per secondary class		High	**Invertebrate rarity per secondary class**		Very High
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating		Very High	**Habitat diversity class**		Low
Habitat size (length) class		Low	**Instream migration link class**		High
Riparian-wetland zone migration link		High	**Riparian-wetland zone habitat integrity class**		Moderate
Instream habitat integrity class		Moderate	**Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m**		Very High
Riparian-wetland natural vegetation rating based on expert rating					High
ES details					
Fish physical-chemical sensitivity description		High	**Fish no-flow sensitivity**		High
Invertebrates physical-chemical sensitivity description		Very High	**Invertebrates velocity sensitivity**		Very High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description					Very High
Stream size sensitivity to modified flow/water level changes description					High
Riparian-wetland vegetation intolerance to water level changes description					High

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

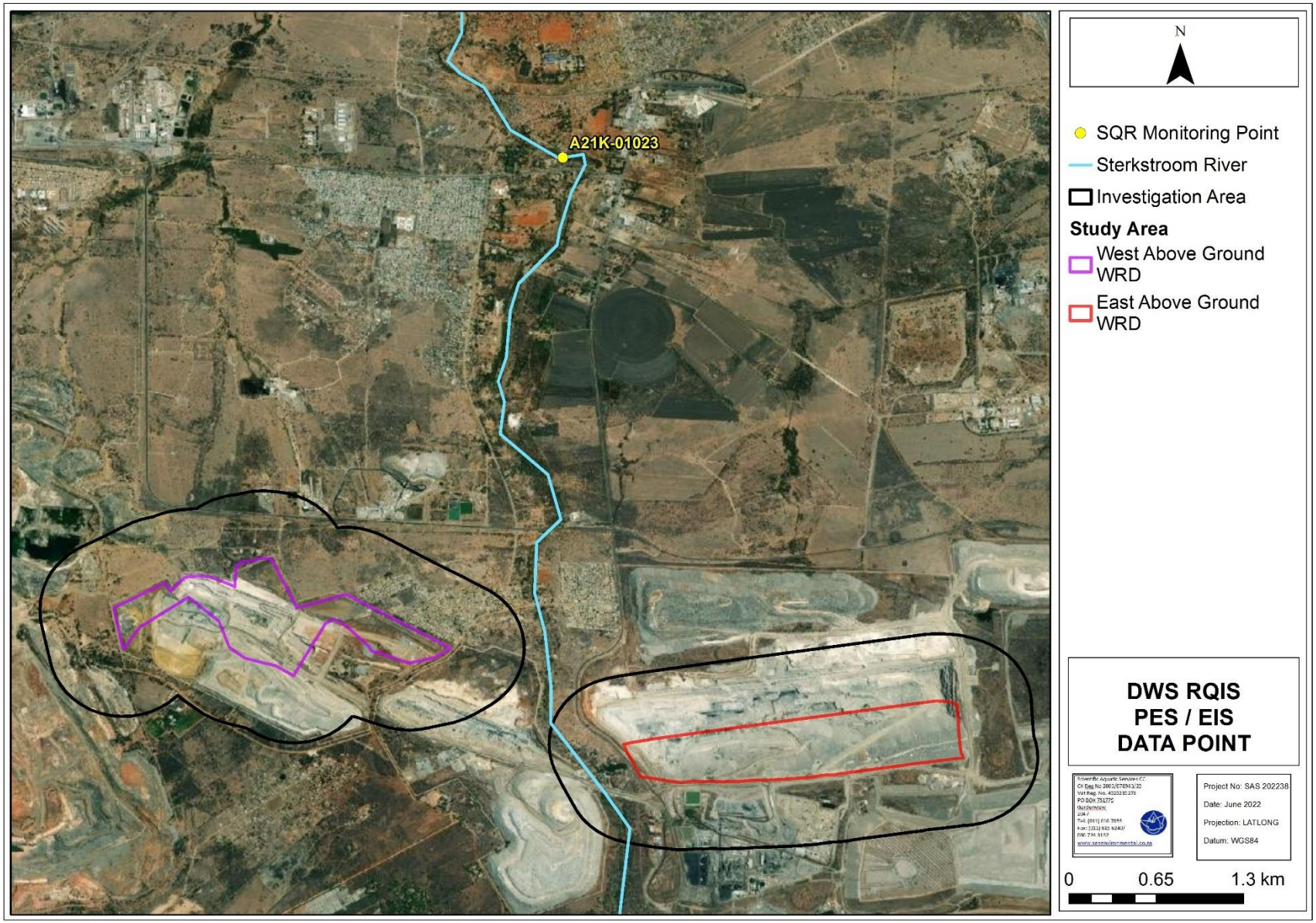


Figure 11: SQR Sterkstroom River (A21K - 01023) in relation to the study area (i.e. downstream of the study area)

4. RESULTS: FRESHWATER ECOSYSTEM ASSESSMENT

4.1 Delineation of freshwater ecosystems

A site assessment was undertaken on 26th April 2022 towards the end of the summer rainfall period to verify the Ecostatus of the identified freshwater ecosystems within 500 m of the study area, and to confirm the absence of freshwater ecosystems within the study area. The proposed WRDs will be within existing disturbed (open cast mining) areas, and therefore no freshwater ecosystems occur directly within the study area. However, two valley bottom wetlands are located immediately north of the proposed West Above Ground WRD, and an estimated 1 km reach of the Sterkstroom River is located approximately 235 m west of the East Above Ground WRD (please refer to Section 4.2 for the characterisation of these freshwater ecosystems).

The identified freshwater ecosystems were initially delineated by SAS (2013) using a combination of desktop methods (use of aerial photographs, digital satellite imagery and topographical maps) and ground-truthing, although mining operations at the time hindered access to portions of the freshwater ecosystems. Subsequently, the delineations undertaken in 2013 were ground-truthed where possible during the April 2022 assessment, and where necessary, refined with the aid of digital satellite imagery. The delineations as presented in this report are thus regarded as a best estimate of the freshwater habitat boundaries based on the site conditions present at the time of assessment. The following indicators were used to delineate the boundaries of the temporary zones associated with the wetlands and the riparian zone of the Sterkstroom River:

- Terrain units were used as the primary indicator. Despite extensive transformation of the landscape associated with the investigation area, the terrain provided an indication of low-lying areas where water is likely to collect and/or move through the landscape and areas in the landscape where wetlands could potentially be expected to occur;
- Vegetation was utilised in conjunction with terrain as the secondary indicator, where feasible. Due to the extensive transformation particularly along the valley bottom wetlands, the vegetation indicator was not always reliable, particularly within the active mining areas;
- The soil wetness indicator, duration and frequency of saturation in the soil profile provides a diagnostic indicator since it influences the colour change in the soil. Low chroma (grey and muted colours) as well as mottles are more prominent in soil which is associated with fluctuating water table; and

- Similarly, the soil morphological characteristic indicator was also utilised especially in areas where no significant disturbance of soil has taken place. In unimpacted sites, the soil morphological characteristics typically associated with wetland conditions display gleying or mottling.

4.2 Characterisation of the Freshwater Ecosystems

The two freshwater ecosystems located immediately north of the proposed West Above Ground WRD were previously characterised by SAS (2013) as an unchanneled valley bottom wetland and a channelled valley bottom wetland. Both have been impacted by mining activities, with the unchanneled valley bottom wetland, situated north-west of the proposed West Above Ground WRD having been impacted to such an extent that it could be considered a ”remnant wetland”, although marginal functionality remains. The channelled valley bottom wetland is located north-east of the proposed West Above Ground WRD, and based on inspection of digital satellite imagery, appears to retain connectivity to the lower reaches of the wetland, confluencing with the Brakspruit River approximately 3km north of the proposed West Above Ground WRD.

The Sterkstroom River flows south to north through the centre of the Tharisa Mining Right Area (MRA), and open cast mining operations have encroached within 50 m of sections of the river.

Classification of these ecosystems was undertaken at Levels 1-4 of the Classification System (Ollis *et al*, 2013). All three were classified as Inland Systems falling within Bushveld Basin Aquatic Ecoregion, and the Central Bushveld Group 5 and the Central Bushveld Group 2 Wetland Vegetation (WetVeg) groups, both considered “Vulnerable” and “not protected” and “moderately protected” respectively according to Mbona *et al* (2015). The table below presents the further classification of these freshwater ecosystems at Levels 3 and 4 of the Classification System (Ollis *et al*, 2013).

Table 6: Characterisation of the freshwater ecosystems identified within the investigation area, according to the Classification System (Ollis *et al*, 2013).

Drainage system	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: Hydrogeomorphic Unit
			HGM Type
Unchannelled valley bottom wetland	Central Bushveld Group 5 WetVeg Group	**Valley floor:** The typically gently sloping, lowest surface of a valley.	**Unchannelled valley-bottom:** A valley-bottom wetland without a river channel running through.
Channelled valley bottom wetland	Central Bushveld Group 2 WetVeg Group	**Valley floor:** The typically gently sloping, lowest surface of a valley	**Channelled valley-bottom:** A valley-bottom wetland with a river channel running through.
Sterkstroom River	Central Bushveld Group 2 WetVeg Group	**Valley floor:** The typically gently sloping, lowest surface of a valley	**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water.

The freshwater ecosystems as described above are presented in relation to the study and investigation area in Figure 7 below.

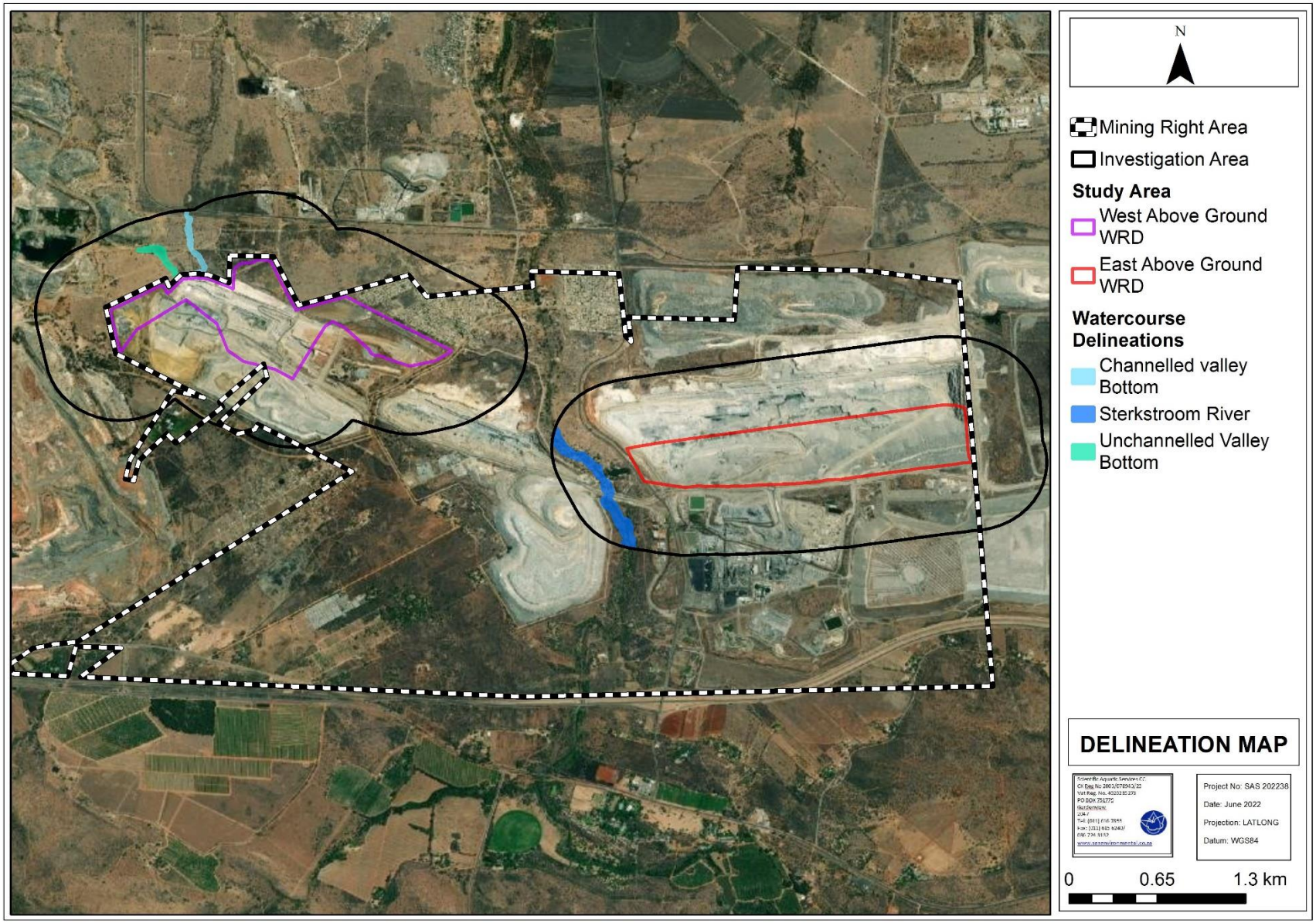


Figure 12: Conceptual representation of the freshwater ecosystems in relation to the study and investigation areas.

4.3 Analysis of Historical Aerial Imagery

Aerial photographs associated with the project were obtained from the Department of Rural Development and Land Reform's (DRDLR) National Geo-spatial Information database (http://cdngiportal.co.za/cdngiportal/) to further aid in the assessment of the of the freshwater ecosystems identified during the site assessment. In addition, historical aerial photography and digital satellite imagery are considered useful tools in showing how land has been transformed due to anthropogenic activities within a landscape. Whilst few photographs of the study area specifically could be accessed, photographs of the areas surrounding Tharisa Mine were accessed which indicate extensive agricultural activities prior to mining in the catchment (Figures 8 to 10). Therefore it is surmised that the identified freshwater ecosystems have been subjected to several decades of disturbances, causing altered ecological functioning and reduced ecological integrity. It should be noted that the photographs are not georeferenced and the extent and location of the Tharisa Mine MRA depicted on the figures below is not accurate and is intended only to provide context.

Figure 13: Aerial photograph dated 1932 of the approximate and partial Tharisa MRA (indicated by the red polygon). The Sterkstroom River is indicated by the blue dashed line, whilst the channelled valley bottom wetland is indicated by the green dashed line.

Figure 14: A portion of the reach of the Sterkstroom River (dashed blue line) within the Tharisa Mine MRA, in 1932 (left) and 2022 (right). The red polygon indicates the Hernic Discharge Quarry, indicated here to its anthropogenic origin.

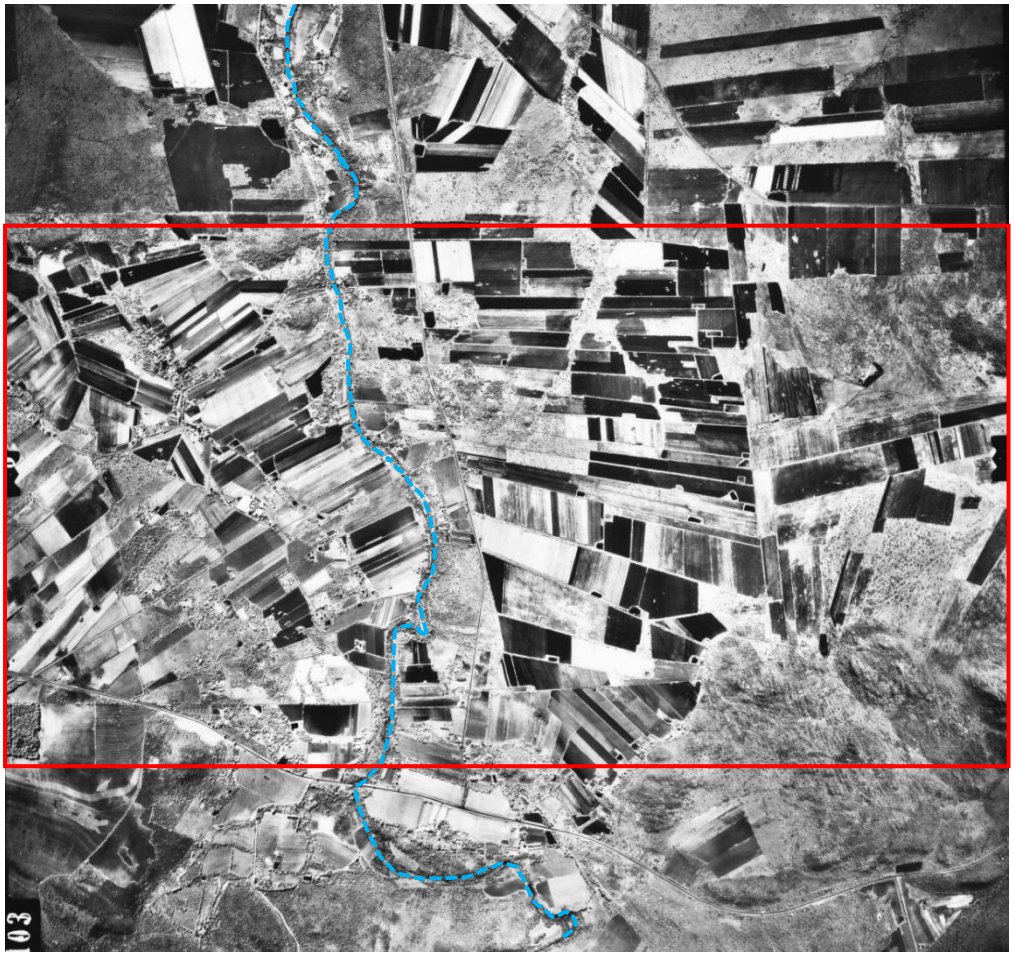


Figure 15: The approximate Tharisa Mine MRA (red polygon) and Sterkstroom River (blue dashed line) in 1968, illustrating extensive agricultural activities in the catchment of the river.

4.4 Field Verification Results

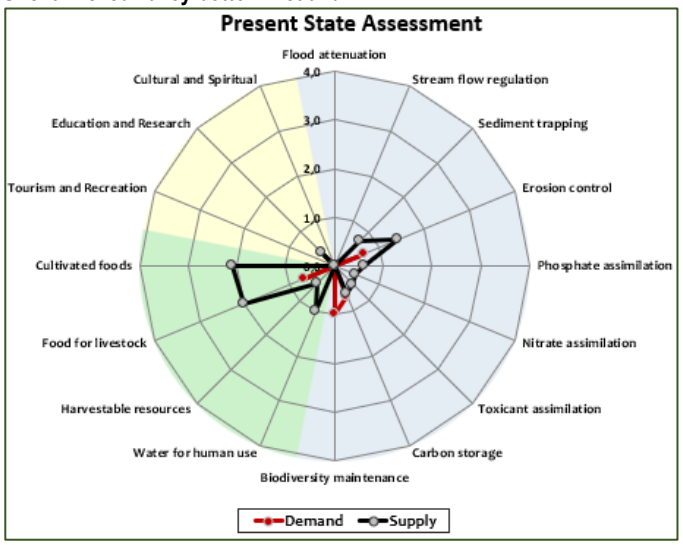
Following the site visit, various assessments were undertaken in order to determine the PES, EIS, and ecological service provision as well as to assign an appropriate REC, RMO and BAS as described in Section 1.2 of this report. The detailed assessment results are presented in Appendix D of this report and summarised in the dashboard style reports below.

Although the two valley bottom wetlands were assessed separately, they are discussed collectively in a single dashboard, since they are located within 175 m of each other, possess similar characteristics, and have been subjected to similar impacts, although the extents and severity thereof vary.

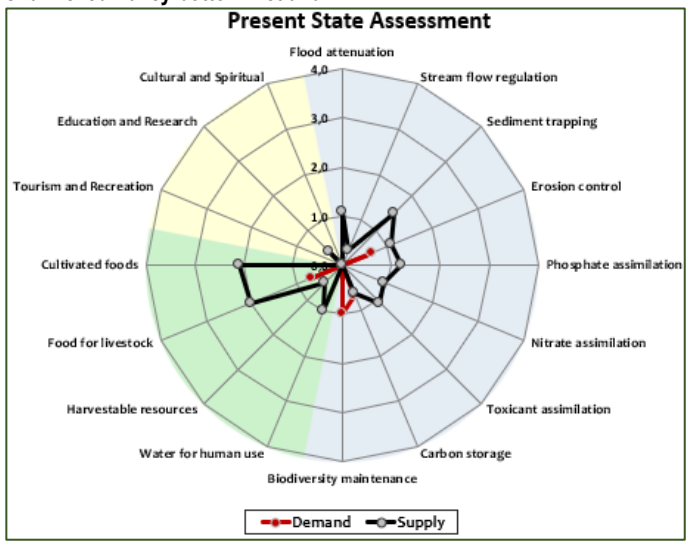
Table 7. Summary of the assessments applied to the unchanneled and channelled valley bottom wetlands located immediately north of the proposed Above Ground West WRD.

Ecological & socio-cultural service provision graphs:

Unchannelled valley bottom wetland:



Channelled Valley bottom wetland:



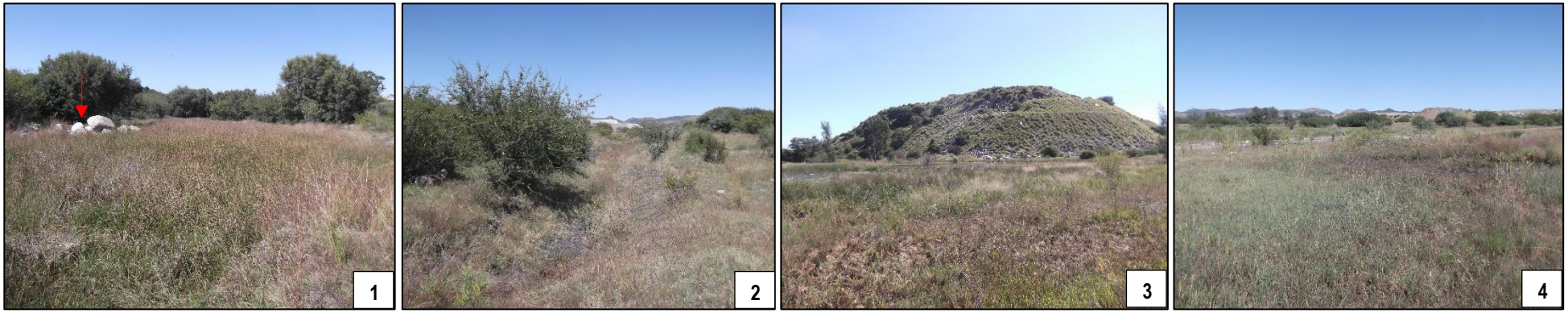


Figure 16: Representative photographs of the channelled valley bottom (1 and 2) and unchanneled valley bottom (3 and 4) wetlands, depicting indiscriminate disposal of rocks within the CVB (red arrow) as well as channel straightening (Photo 2). A WRD (associated with a neighbouring mine) has caused hydraulic isolation of the upper reach of the UCVB wetland and ponding (Photo 3).

PES discussion	**PES Categories:** **Unchannelled Valley Bottom (UCVB): F (critically modified)** **Channelled Valley Bottom (CVB): D (seriously modified)** Both wetlands have undergone serious modification, initially due to impacts associated with agricultural activities, and subsequently as a result of mining-related impacts. The UCVB wetland in particular is considered a 'remnant' wetland due to the hydraulic isolation from the downstream reaches arising from the placement of a WRD (associated with a neighbouring mine) over a portion of the wetland. The headwaters of both systems have been destroyed by opencast mining within the Tharisa Mine MRA, although according to SAS (2013) these headwaters of the wetlands were already moderately modified and of reduced EIS prior to being mined out. Disturbances to soil, increased availability of sediment and removal of natural vegetation over the course of decades have contributed to the proliferation of alien invasive and encroacher plant species, affecting habitat integrity and provision as well as ecological service provision.	**Ecoservice provision**	**Moderate to Low (both wetlands)** The reduced ecological integrity of both wetlands has led to decreased provision of ecological services. Although the demand for services such as assimilation of nutrients and toxicants may be relatively high due to mining and small-scale subsistence agriculture in the catchment, the capacity of the wetlands to provide such services is diminished. Both wetlands are located outside of the Tharisa Mine MRA and as such, may provide limited socio-cultural benefits such as livestock grazing. However it is unlikely that they are important to the local community for other potential benefits such as harvestable goods, water (when present, surface water is likely to be contaminated), or recreation.
EIS discussion	**Low/Marginal (both wetlands)** The reduced ecological integrity of both wetlands, as well as the nature and extent of disturbances in the immediate vicinity thereof, have led to the severely reduced EIS of the wetlands. Neither wetland is considered important for the provision of key ecological services, biodiversity maintenance or socio-cultural services.	**REC, RMO & BAS Category**	**REC Category: D*** **BAS: D (Maintain)** **RMO: D (Maintain)** *PES Categories E and F are considered ecologically unacceptable (Malan and Day, 2012) and therefore, the lowest accepted REC category is Category D. However, the rehabilitation of these wetlands requires a focused and ongoing approach by all neighbouring stakeholders (including mines and communities). It is considered very unlikely that the remaining extent of the UCVB wetland located within 500 m of the proposed Western Above Ground WRD can be successfully rehabilitated to a PES D due to the nature and extent of impacts that have occurred.

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

The primary modifiers of the hydraulic regime of the UCVB wetland is the WRD which has not only isolated the upper reach from the downstream reach of the wetland, but also leads to ponding of water which in turn has most likely altered the hydroperiod and extent of the remaining upper reach of the wetland. Based on observations on site, inspection of historical digital satellite imagery and comparison with historical aerial images (Section 4.3) a portion of the CVB wetland was historically straightened. Both wetlands have been affected by an informal gravel road which traverses the wetlands. Inadequate hydraulic connectivity was maintained when the road was constructed, leading to ponding in the upper reaches of both wetlands, whilst insufficient recharge reaches the lower reach of the CVB wetland in particular (Figure A).

Figure A: The informal gravel road (blue arrow) has led to ponding upgradient of the road (green arrows) and desiccation and channel straightening downgradient thereof (orange arrow). Ponding (yellow) in the UCVB wetland is also caused by the WRD.

Both wetlands have been affected by erosion, although the extent and severity thereof was more notable in the CVB wetland. Additionally, the geomorphological regimes of both wetlands have been modified by historical earthworks, potentially related to the mining activities but which may also be related to activities in the surrounding informal settlements, such as the creation of small drainage trenches. Increased sediment inputs to both wetlands is expected due to the extensive mining operations in the catchment contributing to availability of windborne sediment, as well as runoff from the gravel road and the WRD (the latter likely only into the UCVB wetland). Whilst some surface water was present at the time of assessment, testing of basic water quality parameters was not undertaken as insufficient quantities were present to provide meaningful results. However, the water was stagnant in both systems, and the water in the UCVB wetland was malodourous, with visible algae on the surface. The habitat integrity of both systems is considered severely modified and inadequate for fauna except for less sensitive avifauna, insects and amphibians. It is considered very unlikely that any floral or faunal Species of Conservation Concern occur within either system, although this expected absence is also attributable to the nature and extent of anthropogenic disturbances surrounding the wetlands.	
Extent of modification anticipated	**Very low to none.** The proposed West Above Ground WRD is planned predominantly within the footprint of the existing opencast pit, therefore no direct encroachment on the wetlands is expected. However, additional indirect impacts could potentially occur, such as increased sediment availability and ingress of contaminated runoff from the WRD to the wetlands. These can be successfully mitigated to prevent or minimise the potential significance thereof (see below and Section 6).
Impact Significance & Business Case:	
Low	The West Above Ground WRD will not encroach directly on either wetland but is located within 50 m thereof, therefore although direct impacts are not expected, edge effects, some of which may contribute to cumulative or residual impacts could occur. Whilst the risk significance was determined to be low or very low depending on the nature of the activity, the following key mitigation measures are strongly recommended to prevent or minimise the significance of potential indirect impacts: ➢ Additional stormwater management and clean and dirty water systems are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation; ➢ The majority of the WRD footprints are planned within existing opencast mining and disturbed areas. Where there is marginal encroachment into areas not already cleared (1 ha of the West Above Ground WRD), then clearing must be limited to the approved footprint, and as much indigenous vegetation as possible retained; ➢ The proposed 4 m wide waste rock road around the perimeter of each WRD must take into consideration the delineations of the watercourses and be planned to avoid these, as much as feasible; ➢ Topsoil stockpiling must be undertaken in accordance with the mine's existing topsoil conservation guide. Any soil stockpiles may not exceed the height recommended by the topsoil conservation guide; ➢ The structures must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure; ➢ Monitoring of seepage water contained in the perimeter toe paddocks and of boreholes around the perimeter of each WRD must be undertaken to allow for proactive management; ➢ Although the geochemical work undertaken for waste rock samples at Tharisa indicate that the waste rock is non-acid generating, based on leachate tests chemicals of concern that are likely to leach from the WRDs when compared to water quality standards include: Elevated concentrations of Al, Chromium (Cr), Iron (Fe), Manganese (Mn), Lead (Pb). Thus the WRDs must be appropriately lined with a Class D liner to prevent pollution of groundwater. ➢ Clean and dirty water systems must be kept separate in line with Regulation GN704; ➢ The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event; ➢ Clean water may be discharged into the watercourses, however the discharge outlet must be equipped with energy dissipating structures (such as Armorflex or reno mattresses) to attenuate the velocity of water inflow into the watercourses and to control erosion and incision; and ➢ Provision must be made for the development of an integrated freshwater ecosystem rehabilitation plan to be implemented during closure.

Table 8: Summary of the assessments applied to the Sterkstroom River.

Ecological & socio-cultural service provision graph:

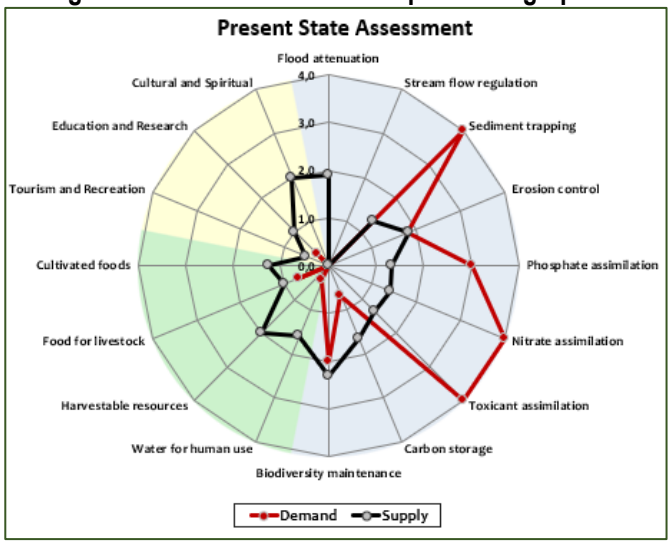


Figure 17: (Left) A road crossing over the Sterkstroom River within the Tharisa Mine MRA and (right) a section of the river located within the MRA but outside of active mining areas (and approximately 1 km from the proposed East Above Ground WRD). Transformation of the riparian zone is apparent in the photograph on the left.

PES discussion	**PES Category:** **Riparian IHI: B/C** **VEGRAI: C** The Sterkstroom River has been subjected to numerous impacts associated with agriculture, expansion of informal settlements and mining over the course of several decades. Whilst many of these impacts are localised, such as road crossings, cumulative impacts associated with changing landuses and particularly high significance impacts such as altered water quality and changes to riparian zone composition are expected. Nevertheless, the results obtained in this study indicate that the assessed reach of the river, i.e. within the Tharisa Mine MRA, can be considered moderately modified.	**Ecoservice provision**	**Moderate to low** Although the demand for specific ecological services such as sediment trapping and assimilation of nitrates and toxicants in particular is high, the capacity of the instream and riparian habitat of the river to do so is limited, largely due to the dominance of tall woody species which are less effective at retaining surface water runoff for a sufficient period to enable the assimilation of nutrients and toxicants. The river provides important connectivity to less disturbed areas outside of the MRA, as well as providing ample refugia and cover for fauna. Provision of certain socio-cultural services such as water for domestic purposes and livestock grazing is expected, although this is likely to be minimal, depending on access to alternative options by local communities.

EIS discussion	**Moderate** The Sterkstroom River is considered moderately ecologically important in terms of biodiversity support, hydro-functional importance and contribution to the ecological functioning of the downstream system (the Gwathle River).	**REC, RMO & BAS Category**	**REC Category: C** **BAS: C (Maintain)** **RMO: C (Maintain)** Whilst no direct impacts associated with the proposed East Above Ground WRD are expected, measures to prevent or minimise indirect and cumulative impacts which may lower the PES and EIS of the river must be implemented. Please refer to the discussions below and Section 6.

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

Primary modifiers of the hydraulic regime of the assessed reach of the Sterkstroom River are largely isolated in extent and include instream infrastructure such as bridge crossings, and occasional additional water inputs in the form of stormwater runoff from impermeable surfaces. However, the overall hydraulic regime of the river has been subjected to impacts outside of the Tharisa Mine MRA, including impoundment (most notably the Buffelspoort Dam approximately 3.2 km upstream of the MRA), increased water inputs from agricultural return flows and mining activities, and potential abstraction for agriculture (although this is unconfirmed).

Very little erosion was observed, although increased sediment inputs are expected due to the extent of mining activities in the catchment. Sediment inputs are likely to be predominantly windborne since dust suppression within the mine takes place, however stormwater runoff will contribute sediment to the river. No channel straightening was observed, thus within the assessed reach of the river, geomorphological processes are considered largely natural.

Basic water quality parameters were measured at a point upstream of the Tharisa mining activities. The pH of 8.22 is in line with the Target Water Quality Range (TWQR) for Aquatic Ecosystems (DWAF, 1996) and was marginally lower than the pH measured during the high flow assessment undertaken in March 2021 by TBC (2022). The Electrical Conductivity (EC) measured 7 mS/m, which was marginally higher than the March 2021 high flow assessment (TBC, 2022) but lower than that recorded in the low flow (July 2021) assessment (TBC, 2022). Although water quality parameters were not measured downstream of the Tharisa Mine MRA due to access constraints at the time of assessment, according to TBC (2022), EC increased in a downstream direction during both the low and high flow assessments, "indicating an increasing in the concentration of dissolved solids" (TBC, 2022) as well as potentially presenting limiting conditions to aquatic biota (TBC, 2022).

Based on analysis of historical aerial photographs, the riparian zone associated with the Sterkstroom River historically comprised woody and graminoid / forb layers. It is likely though that the abundance of woody species has increased, and this is largely due to the encroachment of alien invasive species such as *Eucaplyptus sp* (blue gum) and *Melia azedarach* (Syringa). Nevertheless, indigenous species such as *Searsia spp.* remain dominant in the riparian zone, and good graminoid cover was observed except where vegetation has been extensively disturbed within the active mining area. The vegetation cover provides ample refugia and foraging habitat for various faunal species although faunal activity is likely to be partially influenced by the extent of anthropogenic activity around the river.

Extent of modification anticipated	Little to none. The proposed East Above Ground WRD is anticipated to be located almost wholly within an existing open cast pit and will not encroach on the river nor within 100 m thereof. Some edge effects may occur such as runoff from the WRD, however this can be successfully mitigated by means of clean and dirty water separation systems.

Impact Significance & Business Case:

Low to Negligible	The Sterkstroom River is located approximately 215 m from the East Above Ground WRD, and therefore no direct impacts associated with the WRD are expected. The risk significance of potential indirect impacts is deemed negligible, owing to the distance of the WRD from the river. Nevertheless, implementation of the mitigation measures provided in Table 7 above and in Section 6.1 of this report will ensure that potential impacts, whether direct or indirect, are prevented or minimised.

4.5 Summary of Results of SAS (2013) and The Biodiversity Company (2022)

SAS (2013) undertook an assessment of the two valley bottom wetlands and the Sterkstroom River in 2013. As the methods of assessment utilised have been refined subsequent to that study, the results obtained during this assessment are not necessarily directly comparable to those obtained in 2013, with the exception of the PES. Similarly, The Biodiversity Company (TBC) (2022) undertook an aquatic assessment of the Sterkstroom River only, utilising specific methods predominantly applicable to the instream habitat which are not directly comparable to the methods utilised in this study, which focused on the ecological state of the riparian zone. Nevertheless, the results obtained by SAS (2013) and TBC (2022) are summarised here to provide context to those obtained during the course of this study.

Assessment parameter	Assessment year	Freshwater Ecosystem		
		Sterkstroom River	Unchannelled Valley Bottom Wetland	Channelled Valley Bottom Wetland
PES	(SAS, 2013)	C	C	C
	(TBC, 2022)	C	N/A	N/A
	(SAS, 2022)	B/C (IHI) / C (VEGRAI)	F	D
EIS	(SAS, 2013)	C	C	C
	(TBC, 2022)	N/A	N/A	N/A
	(SAS, 2022)	Moderate	Low/Marginal	Low/Marginal
Ecoservices	(SAS, 2013)	Intermediate	Moderately low	Moderately low
	(SAS, 2022)	Low to moderate	Low to moderate	Low to moderate

Although not directly comparable, these results demonstrate a steady decline of the ecological integrity of the valley bottom wetlands in particular. This is attributed primarily to the expansion of mining activities in the catchment of the wetlands and should appropriate management measures not be implemented (refer to Section 6), the cumulative and latent impacts on these freshwater ecosystems (including the Sterkstroom River) could lead to an overall reduction in freshwater ecosystem biodiversity in the immediate region. It is considered imperative therefore that the mitigation measures provided in this report be implemented as part of the EMPr to minimise the overall impact significance of activities on the receiving freshwater environment.

5. LEGISLATIVE REQUIREMENTS

The following legislative requirements were considered during the assessment:

- The 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) and
- The North West Biodiversity Sector Plan (2015).

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 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 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). Therefore, it is highly recommended that a specialist hydrologist be appointed (if a study has not already been undertaken) to determine the risk of contamination of groundwater which could in turn manifest as surface water impacts. Mitigation measures contained in such an assessment must then be implemented.

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

Table 9: 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 No. 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).	**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 are conceptually depicted in the figures below.

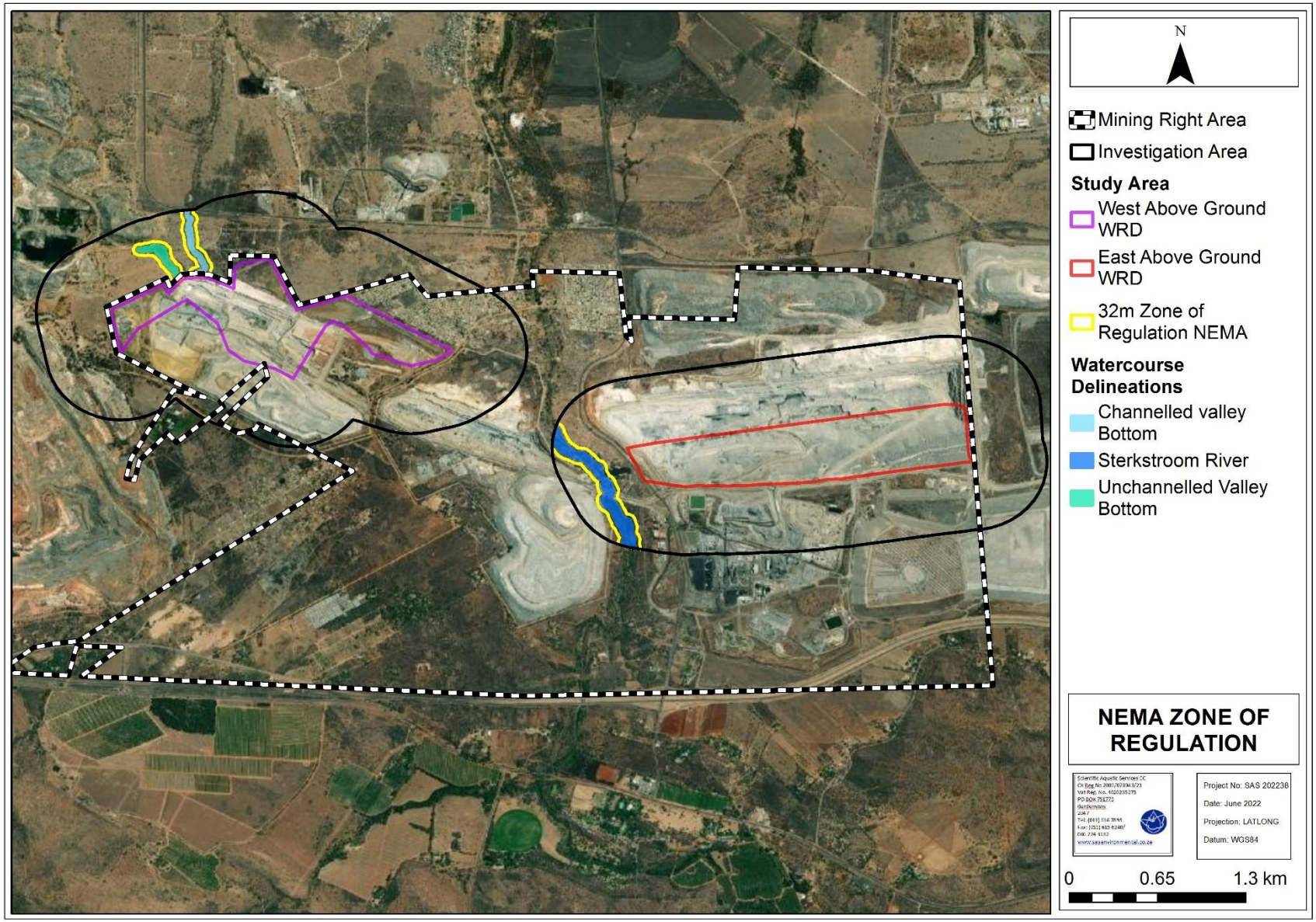


Figure 18: Conceptual representation of the zone of regulation (32 m) in terms of the NEMA in relation to the study and investigation area.

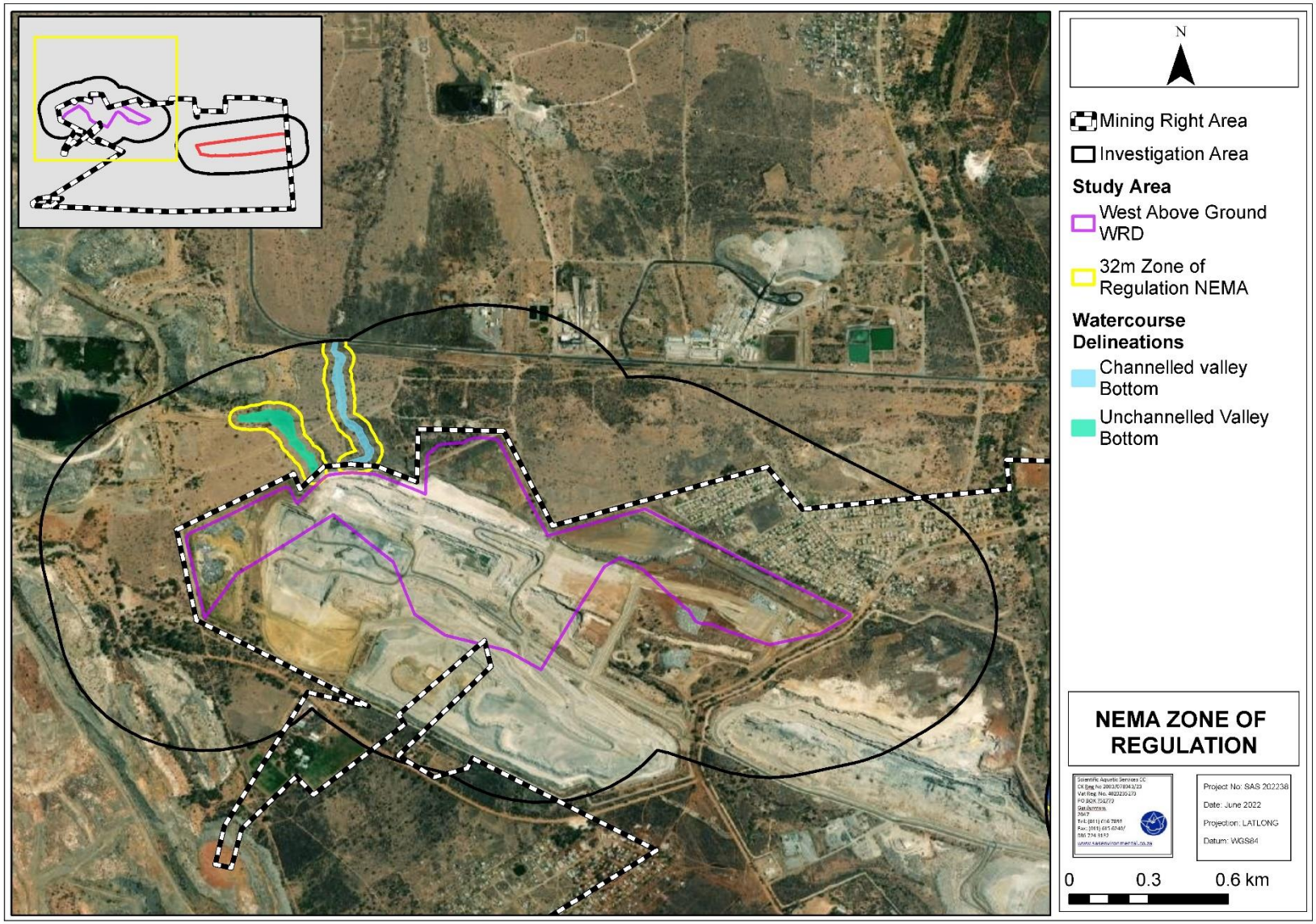


Figure 19: Conceptual representation of the zone of regulation (32 m) in terms of the NEMA in relation to the West Above Ground WRD and investigation area.

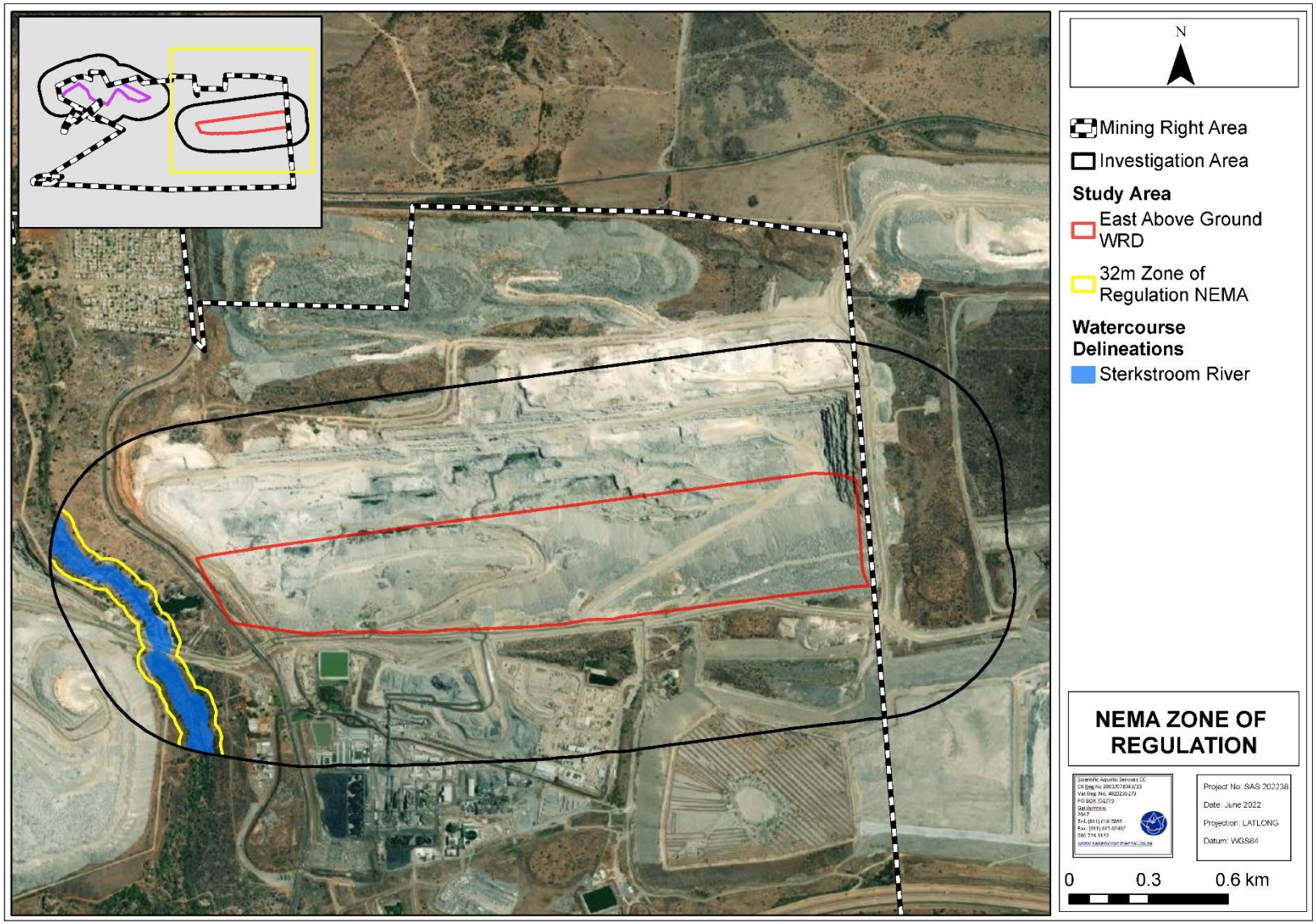


Figure 20: Conceptual representation of the zone of regulation (32 m) in terms of the NEMA in relation to the East Above Ground WRD and investigation area

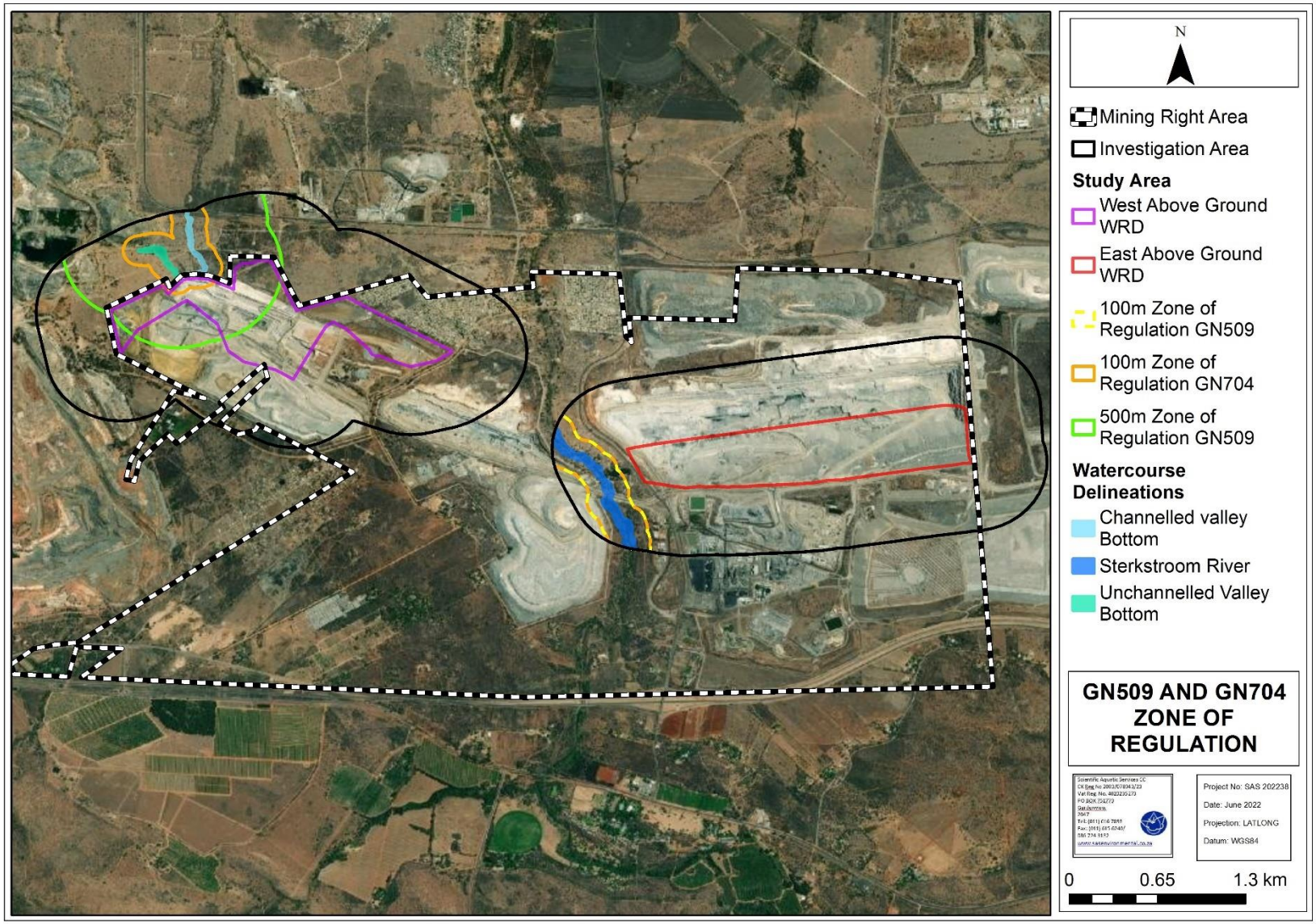


Figure 21: Conceptual representation of the zones of regulation in terms of GN 704 and GN 509 as they relate to the National Water Act, 1998 (Act No. 36 of 1998) in relation to the study and investigation area.

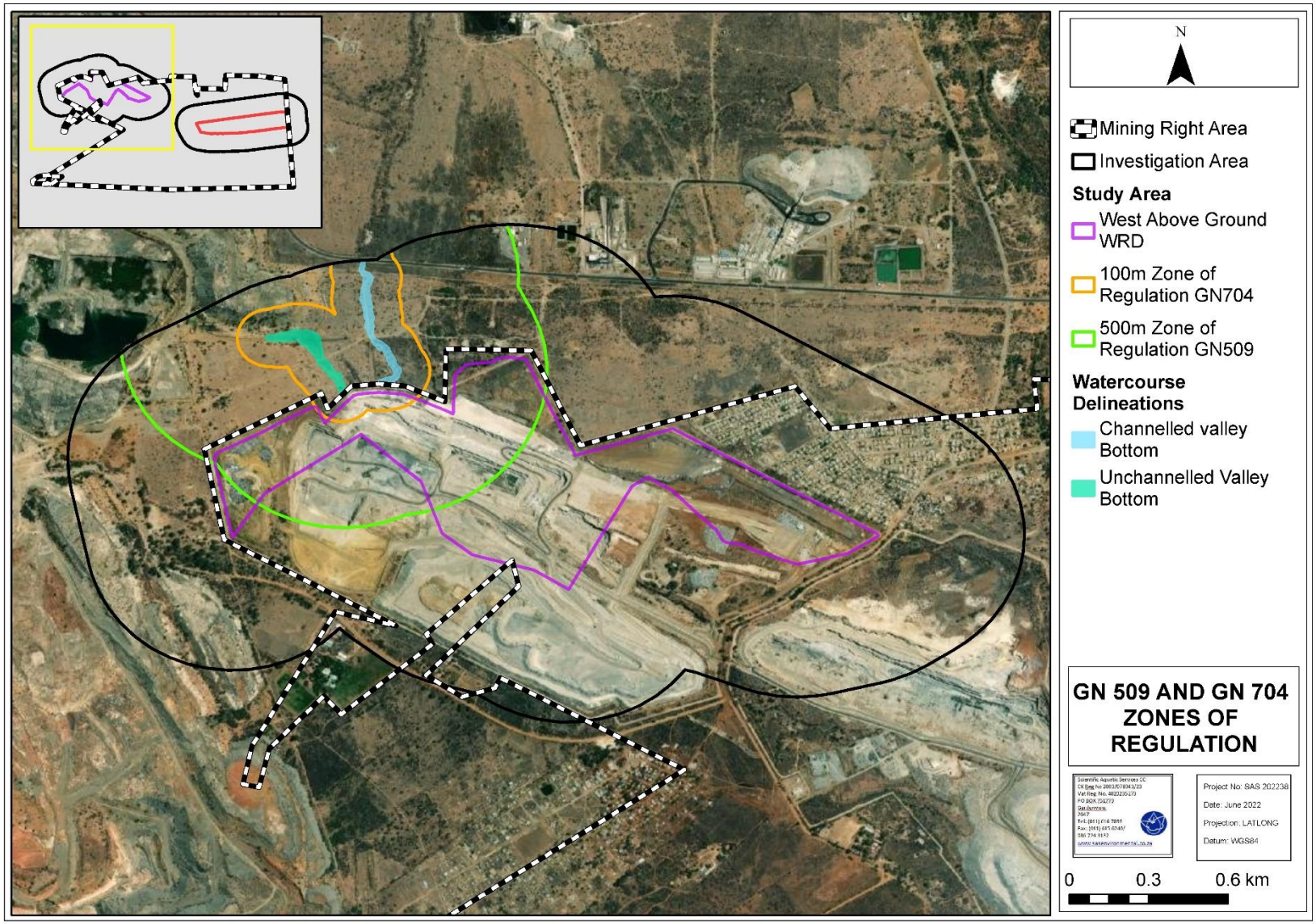


Figure 22: Conceptual representation of the zones of regulation in terms of GN 704 and GN 509 as they relate to the National Water Act, 1998 (Act No. 36 of 1998) NEMA in relation to the West Above Ground WRD and investigation area.

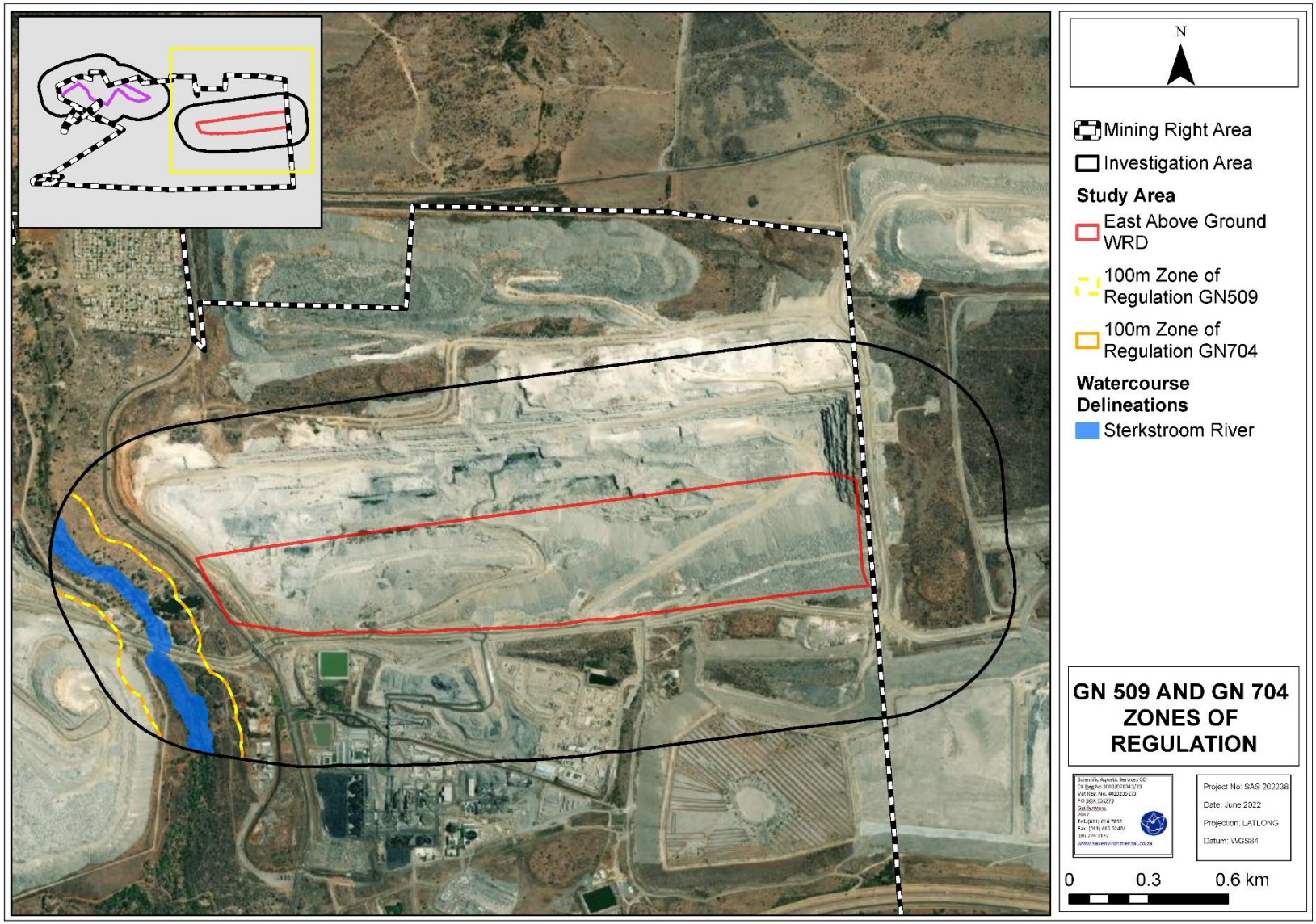


Figure 23: Conceptual representation of the zones of regulation in terms of GN 704 and GN 509 as they relate to the National Water Act, 1998 (Act No. 36 of 1998) NEMA in relation to the East Above Ground WRD and investigation area.

6. IMPACT AND RISK ASSESSMENTS

This section presents the significance of potential impacts on the ecology of the two valley bottom wetlands and the reach of the Sterkstroom River associated with the proposed West and East Above Ground WRDs. In addition, it indicates the required mitigatory measures needed to minimise the perceived impacts of the proposed activities and presents an assessment of the significance of the impacts taking into consideration the available mitigatory measures and assuming that they are fully implemented. The impact significances were determined using the method provided by the Environmental Assessment Practitioner (EAP) (SLR Consulting (South Africa) (Pty) Ltd) and the DWS Risk Assessment Matrix (2016).

The results of the SLR Consulting (South Africa) (Pty) Ltd Impact Assessment as presented here will be utilised in the Environmental Authorisation process, whilst the results of the DWS Risk Assessment Matrix will be utilised in the Water Use Licence Application (WULA) which will be undertaken separately to the EA process, in consultation with the relevant competent authority. Thus, although the two methods may present different scores for the same activity, this is due to differences in their methodologies (refer to Appendix D) and not due to inconsistencies in their application, and each will be judged individually for their specified purpose as discussed above.

When evaluating the perceived impacts of the proposed activities on the freshwater and aquatic resources, the impact significance was ascertained assuming that the recommended mitigation measures will be implemented in order to reduce the impact significance. Thus, the DWS risk assessment provided in this report presents the perceived impact significance *post* mitigation only, whilst the SLR impact assessment method considered the significance both prior to and following the implementation of mitigation measures. It must also be noted that none of the proposed activities encroach directly on the identified freshwater ecosystems therefore no direct impact is anticipated. Potential indirect impacts may occur due to the proximity of freshwater ecosystems (specifically, the two valley bottom wetlands) therefore appropriate mitigation measures must be implemented. The following aspects were taken into consideration when evaluating the potential impacts of the proposed development activities:

- No direct impacts are anticipated as the activities do not encroach on the freshwater ecosystems. However, the proposed activities are located within 50 m and 200 m of the wetlands and Sterkstroom River respectively and as a result may potentially lead to indirect impacts; and

- The majority of the footprint of both WRDs will be contained within existing opencast mining areas, with minimal encroachment into non-opencast areas. Nevertheless, the non-opencast areas where the WRDs may expand into have undergone disturbances and vegetation clearing, thus posing negligible additional risk to the freshwater ecosystems.

There are four key ecological impacts to the freshwater ecosystems that may be anticipated to occur, specifically:

- Loss of wetland habitat and ecological structure;
- Changes to the socio-cultural and ecological service provision;
- Impacts on the hydrology and sediment balance of the wetland; 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.

6.1 Results of the DWS Risk Assessment Matrix (2016)

The results of the risk assessment are presented in the table below, whilst the outcome of the SLR impact assessment are presented in Section 6.2 thereafter. It should be noted that the applicable mitigation measures are only presented once, in Table 7 (the DWS Risk Assessment).

Table 10: Outcome of the DWS Risk Assessment Matrix applied to the proposed development activities.

No.	Phases	Activity	Aspect	Impact	Freshwater Ecosystem	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
Perceived impacts: West and East Above Ground WRDs, within 50 m and 200 m of the wetlands and Sterkstroom River respectively										
1	Construction	Construction of clean and dirty water separation systems / stormwater management systems around the downgradient boundaries of the WRD that direct clean stormwater run-off around and away from the WRD.	•Clearing of vegetation / levelling of soil; •Earthworks, creating potential sources of sediment, which may be transported to the watercourse by stormwater runoff; •Disposal of construction-related waste; •Transportation of construction materials, resulting in disturbances to soil, and increased risk of sedimentation/erosion.	•Temporarily exposed soils, leading to increased risk of transportation of sediment to the watercourse. •Increased sedimentation of the watercourse may lead to altered water quality, smothering of vegetation and/or altered vegetation composition; •Exposed soils may result in increased stormwater runoff, leading to sheet erosion, as well as increased water inputs to the watercourse, in turn potentially leading to an altered vegetation composition.	CVB & UCVB Wetlands	13	55,25	L	80	Encroachment into the wetlands is highly unlikely since these are located outside of the existing boundary fence (albeit partially within the MRA). No encroachment within the riparian zone of the Sterkstroom River is deemed likely, due to the distance of the river from the proposed WRD. Therefore, no contractor laydown areas, material storage facilities or vehicle refuelling is likely to be placed within or occur within the boundaries or 32 m NEMA zone of regulation around these watercourses, however it must be ensured that no activities occur within the wetlands, riparian zone or the associated NEMA regulated zone. •Additional stormwater management and clean and dirty water systems are to be developed first prior to any other major earthworks to reduce risk of erosion and sedimentation; •The majority of the WRD footprints are planned within existing opencast mining and disturbed areas. Where there is marginal encroachment into areas not already cleared (1 ha of the West Above Ground WRD), then clearing must be limited to the approved footprint, and as much indigenous vegetation as possible retained; •It should be feasible to utilise existing roads to gain access to the sites and crossing the river in areas where no existing crossing is apparent should be unnecessary. Should new crossings be required for any reason, the necessary authorisations must be obtained in advance; •Further to the above, the proposed 4 m waste rock road around the perimeter of each WRD must take into consideration the delineations of the watercourses and be planned to avoid these, as much as feasible;
					Sterkstroom River	9	36	L	80	
2		Removal of topsoil (from the proposed project footprint not located within opencast areas) and stockpiling thereof for rehabilitation	•Topsoil removal •Creation of temporary stockpiles	Increased risk of transportation of sediment from exposed soil in stormwater runoff, leading to increased turbidity of surface water, sedimentation of watercourse, smothering of vegetation and/or altered vegetation composition.	CVB & UCVB Wetlands	12	48		80	
					Sterkstroom River	8	32	L	80	

No.	Phases	Activity	Aspect	Impact	Freshwater Ecosystem	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
										•The watercourse areas beyond the proposed footprint of development and the NEMA zone of regulation (32m) should be clearly demarcated with danger tape except where located outside the existing boundary fence of the mine, and areas in which no activities are proposed should be marked as a no-go areas: •Topsoil stockpiling must be undertaken in accordance with the mine's existing topsoil conservation guide. Any soil stockpiles may not exceed the height recommended by the topsoil conservation guide.
OPERATIONAL PHASE IMPACTS										
Perceived impacts: West and East Above Ground WRDs, within 50 m and 200 m of the wetlands and Sterkstroom River respectively										
3	**Operational**	Potential risk of failure if structure is not stable.	•Possible loss of wetland or riparian habitat.	•Further loss of wetland habitat or loss of riparian habitat, leading to loss of biodiversity; •Formation of preferential surface flow paths leading to potential for erosion of terrestrial habitat and sedimentation of downgradient watercourses.	CVB & UCVB Wetlands	**8**	**24**	**L**	**80**	•The structures must be stabilised to prevent failure, and must be regularly inspected to proactively manage any perceived risk of failure; •Should failure occur, and the CVB wetland in particular become blocked as a result, the waste rock must be removed immediately and stockpiled in another appropriate WRD to ensure continued hydraulic connectivity of the channel; and •Due to the distance between the East Above Ground WRD and the Sterkstroom River, the risk posed to the river is considered negligible.
					Sterkstroom River	**4**	**12**	**L**	**8/0**	
4		Seepage and runoff from WRD.	•Increased risk of pollution of surface water which may potentially reach the UCVB and CVB wetlands, and potentially the Sterkstroom River leading to salinisation and pollution by specific contaminants of concern; •Increased risk of sediment transport in surface runoff from the WRD to the watercourses leading to altered water quality and sedimentation of river.	•Possible contamination of surface water, leading to impaired water quality and salination of soil within the watercourses; and •Alteration to the sediment balance of the river could lead to altered water quality, altered channel competency and altered vegetation community composition.	CVB & UCVB Wetlands	**8**	**24**	**L**	**80**	•Additional water inputs to watercourse via groundwater are anticipated to be unlikely due to distance of the WRDs from the respective watercourses; •Notwithstanding the above, monitoring of seepage water contained in the perimeter toe paddocks and of boreholes around the perimeter of each WRD must be undertaken to allow for proactive management; •Although the geochemical work undertaken for waste rock samples at Tharisa indicate that the waste rock is non-acid generating, based on leachate tests chemicals of concern that are
					Sterkstroom River	**6**	**18**	**L**	80	

No.	Phases	Activity	Aspect	Impact	Freshwater Ecosystem	Likelihood	Significance	Risk Rating	Confidence level	Control Measures
										likely to leach from the WRDs when compared to water quality standards include: Elevated concentrations of Al, Chromium (Cr), Iron (Fe), Manganese (Mn), Lead (Pb). Thus the WRDs must be appropriately lined with a Class D liner to prevent pollution of groundwater; and •Regular monitoring of groundwater quality must be undertaken in accordance with existing recommendations by the groundwater specialist or if such recommendations have not been provided, a monitoring plan must be developed by a suitably qualified specialist.
5		Presence of clean and dirty separation infrastructure around downgradient areas of WRD, preventing stormwater runoff from reaching watercourses	Loss of catchment yield due to stormwater containment.	•Altered flood peaks 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 river; •Further reduction in volume of water entering the river, leading to further loss of recharge (and thus increased desiccation) of downstream system; •Altered vegetation communities due to increased moisture stress.	CVB & UCVB Wetlands	**10**	**30**	**L**		The risk of further significant loss of catchment yield is perceived to be almost negligible since losses have already occurred as a result of opencast mining. Notwithstanding this, the following measures must be implemented: •Clean and dirty water systems must be kept separate in line with Regulation GN704; •The clean water diversion structures must be designed to accommodate the peak flow expected for a minimum 1:50 year flood event; •Clean water may be discharged into the watercourses, however the discharge outlet must be equipped with energy dissipating structures (such as Armorflex or reno mattresses) to attenuate the velocity of water inflow into the watercourses and to control erosion and incision.
					Sterkstroom River	**6**	**18**	**L**	80	

6.2 Results of the SLR Impact Assessment

The results of the SLR impact assessment are presented below. As neither WRD is expected to encroach on the wetlands or the Sterkstroom River, and as shown in the DWS Risk Assessment the perceived impact significance is considered low to negligible, the SLR impact assessment was applied once as it is not likely that applying the impact assessment separately to the wetlands and the Sterkstroom River would result in a significantly different outcome.

Table 11: Outcome of the SLR Impact Assessment.

Activity: Establishment, operation and subsequent rehabilitation of the West and East Above Ground WRDs located on backfilled areas of the West Pit and East Pit respectively.		
Issues: ➢ Loss of freshwater habitat and ecological structure and impacts on hydrology ➢ Changes to socio-cultural and ecological service provision ➢ Impacts on the hydrology and sediment balance ➢ Impacts on water quality		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low	Very Low
Duration	Short term	Short term
Extent	Local	Local
Consequence	Very low	Very low
Probability	Possible	Improbable
Significance	**Very Low**	**Insignificant**
Nature of cumulative impacts	➢ Potential further loss of catchment yield of the valley bottom wetlands due to the presence of additional stormwater / clean and dirty water management systems; ➢ Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands.	
Degree to which impact can be mitigated	High	
Degree to which impact may cause irreplaceable loss of resources	Unlikely. The WRDs are not likely to encroach on the freshwater ecosystems and will be placed within existing disturbed areas, with the exception of 1 ha of the West Above Ground WRD which although not within a disturbed area is not located within freshwater habitat.	
Residual impacts	Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands which are located within 50 m of the West Above Ground WRD.	
Phase: Operational		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low	Very Low
Duration	Permanent	Long term
Extent	Local	Local
Consequence	Low	Low
Probability	Possible	Improbable
Significance	**Very low**	**Very low**

Activity: Establishment, operation and subsequent rehabilitation of the West and East Above Ground WRDs located on backfilled areas of the West Pit and East Pit respectively.		
Issues: ➢ Loss of freshwater habitat and ecological structure and impacts on hydrology ➢ Changes to socio-cultural and ecological service provision ➢ Impacts on the hydrology and sediment balance ➢ Impacts on water quality		
Nature of cumulative impacts	➢ Potential increased sedimentation of the freshwater ecosystems, particularly the wetlands which are located within 50 m of the West Above Ground WRD; ➢ Potential alteration of water quality.	
Degree to which impact can be mitigated	High	
Degree to which impact may cause irreplaceable loss of resources	Unlikely, provided that waste rock is only disposed of within the approved WRD footprint.	
Residual impacts	➢ Increased availability of sediment which may enter the freshwater ecosystems; ➢ Potential alteration of water quality should seepage from the WRD enter the freshwater ecosystems, specifically the wetlands.	
Phase: Closure / Rehabilitation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Low	Very Low
Duration	Permanent	Long term
Extent	Local	Local
Consequence	Low	Low
Probability	Possible	Improbable
Significance	**Very low**	**Very low**
Nature of cumulative impacts	As per operational phase.	
Degree to which impact can be mitigated	High	
Degree to which impact may cause irreplaceable loss of resources	Unlikely.	
Residual impacts	As per operational phase.	

6.3 Cumulative and Latent Risks Statement

On a broad scale, freshwater ecosystems in South Africa are threatened by various anthropogenic activities, including agriculture and mining activities, with over 50% of the country's original wetland areas already lost (NBA, 2011; 2018) and approximately 65% of the remaining extent under threat (NBA, 2011). Additionally, extensive mining and agricultural activities surround the freshwater ecosystems within the investigation area further threatening the ecological integrity thereof, particularly as both systems reach outside of the investigation area.

Although the proposed development activity is located within an existing disturbed area and will not impact directly on the freshwater ecosystems, the potential cumulative impacts of additional disturbances to these freshwater ecosystems must be considered and where

possible, prevented or minimised. Possible latent and cumulative impacts include, but are not limited to:

- Potential further loss of catchment yield of the valley bottom wetlands. As the headwaters of these systems have already been lost as a result of opencast mining, further losses may potentially affect the remaining extents of the wetlands. However, this risk is considered negligible, especially for the unchanneled valley bottom wetland due to the relatively low mean annual precipitation and high evaporation rates of the area;
- Potential increased availability of sediment which may enter the freshwater ecosystems. However, it is possible that sediment availability associated with the operation and subsequent rehabilitation of the WRDs will not exceed that generated by the current opencast mining activities. Once the WRDs have been capped and revegetated, sediment availability in the landscape may potentially decrease, providing that the rehabilitation leads to long term stability of the WRDs;
- Potential long-term seepage from the WRDs may lead to altered water quality. This is unlikely to affect the Sterkstroom River due to the distance of the East Above Ground WRD, however care must be taken to ensure that such seepage does not affect the valley bottom wetlands, in particularly the channelled valley bottom wetland, over the long term. Monitoring data obtained during the operational phase must inform monitoring requirements during closure and post-closure; and
- Ongoing proliferation of alien invasive plants and bush encroachment, associated with historical, ongoing and potential future disturbances surrounding the freshwater ecosystems, leading to further changes in ecological functioning and habitat provision.

7. CONCLUSION

No freshwater systems were identified directly within the study area. Two valley bottom wetlands were identified immediately north of and within 50 m of the West Above Ground WRD, whilst the Sterkstroom River, which drains in a northerly direction through the centre of the Tharisa Mine MRA, is located approximately 200 m west of the East Above Ground WRD.

The wetlands were previously assessed by SAS (2013) and found to be moderately modified at the time; however the ecological integrity of the wetlands has subsequently decreased and at the time of this assessment in May 2022, were found to be seriously modified (channelled valley bottom wetland) and critically modified (unchanneled valley bottom wetland).

The Sterkstroom River was previously assessed by SAS (2013) and The Biodiversity Company (TBC). During all assessments undertaken, including this assessment, the river is deemed to be moderately modified. The outcome of the assessments discussed in Section 4 of this report are summarised in the table below:

Table 12: Summary of results of the ecological assessment of the freshwater ecosystems.

Freshwater Ecosystem	PES	EIS	Ecoservices
Sterkstroom River	B/C (IHI) / C (VEGRAI)	Moderate	Low to moderate
Unchannelled Valley Bottom Wetland	F	Low/marginal	Low to moderate
Channelled Valley Bottom Wetland	D	Low/marginal	Low to moderate

Neither of the proposed WRDs will encroach directly on any of the freshwater ecosystems and are therefore deemed to pose no direct risk to the freshwater ecosystems. The quantum of significance of potential indirect impacts is deemed to be low to very low/negligible. Notwithstanding this, edge effects, some of which could potentially contribute to cumulative or residual impacts to the freshwater ecosystems, may potentially occur and therefore the strict implementation of mitigation measures (provided in Section 6.1 of this report) must take place.

Considering that the majority of the WRD footprints will be located within existing disturbed areas, specifically within backfilled areas of existing opencast pits, it is the opinion of the specialist that the proposed activities may be considered for authorisation provided that appropriate mitigation measures are implemented to minimise the potential indirect, cumulative and latent risks potentially associated with the proposed development activities.

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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 and its staff reserve the right to, at their sole discretion, 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, 1998 (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.
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).
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).

Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates to the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004)	NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. This act in terms of alien and invasive species aims to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. Alien species are defined, in terms of the NEMBA as: (a) A species that is not an indigenous species; or (b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention. Categories according to NEMBA (Alien and Invasive Species Regulations, 2017): ➢ **Category 1a:** Invasive species that require compulsory control; ➢ **Category 1b:** Invasive species that require control by means of an invasive species management programme; ➢ **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and ➢ **Category 3:** Ornamentally used plants that may no longer be planted.
Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 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.

APPENDIX C – METHOD OF ASSESSMENT

WATERCOURSE ASSESSMENT APPROACH

1. Literature Review

A desktop study was compiled with all relevant information as presented by the South African National Biodiversity Institutes (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org). Wetland specific information resources taken into consideration during the desktop assessment of the subject property included:

- National Freshwater Ecosystem Priority Areas (NFEPAs, 2011)
  - NFEPA water management area (WMA)
  - FEPA (sub)WMA % area
  - Sub water catchment area FEPAs
  - Water management area FEPAs
  - Fish sanctuaries
  - Wetland ecosystem types
- Limpopo Conservation Plan V2, 2013
- Mining and Biodiversity Guidelines, 2013.

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), Department of Water Affairs (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 resources present within the subject property.

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

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

Table C1: Classification System for Inland Systems, up to Level 3.

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

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

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

Level 1: Inland systems
From the classification system, Inland Systems are defined as **aquatic ecosystems that have no existing connection to the ocean[2]** (i.e. characterised by the complete absence of marine exchange and/or tidal influence) but **which are inundated or saturated with water, either permanently or periodically.** It is important to bear in mind, however, that certain Inland Systems may have had a historical connection to the ocean, which in some cases may have been relatively recent.

Level 2: Ecoregions & NFEPA Wetland Vegetation Groups
For Inland Systems, the regional spatial framework that has been included in Level 2 of the classification system is that of the DWA's Level 1 Ecoregions for aquatic ecosystems (Kleynhans *et. al.,* 2005). There is a total of 31 Ecoregions across South Africa, including Lesotho and Swaziland. DWA Ecoregions have most commonly been used to categorise the regional setting for national and regional water resource management applications, especially in relation to rivers.
The Vegetation Map of South Africa, Swaziland and Lesotho (Mucina & Rutherford, 2006) groups' vegetation types across the country, according to Biomes, which are then divided into Bioregions. To categorise the regional setting for the wetland component of the NFEPA project, wetland vegetation groups (referred to as WetVeg Groups) were derived by further splitting Bioregions into smaller groups through expert input (Nel *et al*., 2011). There are currently 133 NFEPA WetVeg Groups. It is envisaged that these groups could be used as a special framework for the classification of wetlands in national- and regional-scale conservation planning and wetland management initiatives.

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

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

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

- **River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water;
- **Channelled valley-bottom wetland:** a valley-bottom wetland with a river channel running through it;
- **Unchannelled valley-bottom wetland:** a valley-bottom wetland without a river channel running through it;
- **Floodplain wetland:** the mostly flat or gently sloping land adjacent to and formed by an alluvial river channel, under its present climate and sediment load, which is subject to periodic inundation by over-topping of the channel bank;
- **Depression:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and

[2] 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.

- **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. 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".[3] The assessment of the ecosystem services supplied by the identified freshwater features was conducted according to the guidelines as described by Kotze *et al.* (2020). An assessment was undertaken that examines and rates 16 different ecosystem services, selected for their specific relevance to the South African situation, as follows:

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

For each ecosystem service, indicator scores are combined automatically in an algorithm given in the spreadsheet that has been designed to reflect the relative importance and interactions of the attributes represented by the indicators to arrive at an overall supply score. In addition, the demand for the ecosystem service is assessed based on the wetland's catchment context (e.g. toxicant sources upstream), the number of beneficiaries and their level of dependency, which are also all rated on a five-point scale. Again, an algorithm automatically combines the indicator scores relevant to demand to generate a demand score.
*It is important to note that when assessing riparian zones associated with riverine habitats, the contribution of the riparian zone to streamflow regulation is omitted, owing to a lack of relevant studies (Kotze *et al*, 2020).

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

Table C3: Integrating scores for supply and demand to obtain and overall importance score

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

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

Table C4: Classes for determining the likely extent to which a benefit is being supplied.

Importance Category		Description
Very Low	0-0.79	The importance of services supplied is very low relative to that supplied by other wetlands.
Low	0.8 – 1.29	The importance of services supplied is low relative to that supplied by other wetlands.
Moderately-Low	1.3 – 1.69	The importance of services supplied is moderately-low relative to that supplied by other wetlands.
Moderate	1.7 – 2.29	The importance of services supplied is moderate relative to that supplied by other wetlands.
Moderately-High	2.3 – 2.69	The importance of services supplied is moderately-high relative to that supplied by other wetlands.
High	2.7 – 3.19	The importance of services supplied is high relative to that supplied by other wetlands.
Very High	3.2 - 4.0	The importance of services supplied is very high relative to that supplied by other wetlands.

4. Index of Habitat Integrity

The general habitat integrity of each site was discussed based on the application of the Index of Habitat Integrity (Kleynhans et al. 2008). It is important to assess the habitat at each site in order to aid in the interpretation of the results of the community integrity assessments, by taking habitat conditions and impacts into consideration. This method describes the Present Ecological State (PES) of both the in-stream and riparian habitat at each site. The method classifies habitat integrity into one of six classes, ranging from unmodified/natural (Class A) to critically modified (Class F), as indicated in Table C3 below.

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

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

F	Critically / Extremely modified. Modifications have reached a critical level and the system has been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	0 - 19

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

The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term (Rountree & Kotze, 2013).
In order to align the outputs of the Ecoservices assessment (i.e. ecological and socio-cultural service provision) with methods used by the DWA (now the DWS) used to assess the EIS of other watercourse types, a tool was developed using criteria from both WET-Ecoservices (Kotze, *et, al,* 2009) and earlier DWA EIA assessment tools. Thus, three proposed suites of important criteria for assessing the Importance and Sensitivity for wetlands were proposed, namely:

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity.

Table C6: Ecological Importance and Sensitivity Categories and the interpretation of median scores for biota and habitat determinants (adapted from Kleynhans, 1999).

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

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

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

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

Table C7: Recommended management objectives (RMO) for water resources based on PES & EIS scores.

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

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

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

Table C8: 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 – RESULTS OF FIELD INVESTIGATION

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

Table E1: Presentation of the results of the PES (WET-Health) assessment applied to the valley bottom wetlands

Freshwater Ecosystem	Hydrology		Geomorphology		Vegetation		Overall PES Score
	Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score	
UCVB Wetland	F (9.0)	-1 ↓	E (7.5)	-1 ↓	F (9.1)	-1 ↓	F (8.58)
CVB Wetland	E (6.5)	-1 ↓	C (2.8)	-1 ↓	E (7.4)	-1 ↓	D (5.72)

Table E2: Presentation of the results of the PES (Index of Habitat Integrity) assessment applied to the riparian zone of the Sterkstroom River.

RIPARIAN IHI	
Base Flows	0,0
Zero Flows	0,0
Moderate Floods	0,0
Large Floods	0,0
HYDROLOGY RATING	**0,0**
Substrate Exposure (marginal)	1,0
Substrate Exposure (non-marginal)	1,0
Invasive Alien Vegetation (marginal)	2,0
Invasive Alien Vegetation (non-marginal)	2,0
Erosion (marginal)	1,0
Erosion (non-marginal)	1,0
Physico-Chemical (marginal)	1,0
Physico-Chemical (non-marginal)	1,0
Marginal	2,0
Non-marginal	2,0
BANK STRUCTURE RATING	**2,0**
Longitudinal Connectivity	1,0
Lateral Connectivity	1,0
CONNECTIVITY RATING	**1,0**
RIPARIAN IHI %	**77,8**
RIPARIAN IHI EC	**B/C**
RIPARIAN CONFIDENCE	**2,0**

Table E3: Presentation of the results of the PES (VEGRAI) assessment applied to the riparian zone of the Sterkstroom River.

LEVEL 3 ASSESSMENT					
METRIC GROUP	CALCULATED RATING	WEIGHTED RATING	CONFIDENCE	RANK	% WEIGHT
MARGINAL	65,9	41,2	2,0	1,0	100,0
NON MARGINAL	69,6	26,1	0,0	2,0	60,0
2,0					160,0
LEVEL 3 VEGRAI (%)				67,3	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				1,0	

Table E4: Presentation of the results of the Ecoservices assessments applied to the UCVB wetland.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0,0	0,0	0,0	Very Low
	Stream flow regulation	0,0	0,0	0,0	Very Low
	Sediment trapping	0,8	0,0	0,0	Very Low
	Erosion control	1,4	0,7	0,2	Very Low
	Phosphate assimilation	0,6	0,0	0,0	Very Low
	Nitrate assimilation	0,5	0,0	0,0	Very Low
	Toxicant assimilation	0,5	0,0	0,0	Very Low
	Carbon storage	0,6	0,7	0,0	Very Low
	Biodiversity maintenance	0,0	1,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	1,0	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	2,0	0,7	0,8	Low
	Cultivated foods	2,1	0,0	0,6	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0	Very Low
	Education and Research	0,4	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

Table E5: Presentation of the results of the Ecoservices assessments applied to the CVB wetland.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,1	0,0	0,0	Very Low
	Stream flow regulation	0,3	0,0	0,0	Very Low
	Sediment trapping	1,5	0,0	0,0	Very Low
	Erosion control	1,1	0,7	0,0	Very Low
	Phosphate assimilation	1,2	0,0	0,0	Very Low
	Nitrate assimilation	0,9	0,0	0,0	Very Low
	Toxicant assimilation	1,1	0,0	0,0	Very Low
	Carbon storage	0,6	0,7	0,0	Very Low
	Biodiversity maintenance	0,0	1,0	0,0	Very Low
PROVISIONING SERVICES	Water for human use	1,0	0,0	0,0	Very Low
	Harvestable resources	0,5	0,0	0,0	Very Low
	Food for livestock	2,0	0,7	0,8	Low
	Cultivated foods	2,1	0,0	0,6	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,0	0,0	0,0	Very Low
	Education and Research	0,4	0,0	0,0	Very Low
	Cultural and Spiritual	0,0	0,0	0,0	Very Low

Table E6: Presentation of the results of the Ecoservices assessments applied to the Sterkstroom River.

		Present State			
ECOSYSTEM SERVICE		Supply	Demand	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	1,9	0,0	0,4	Very Low
	Stream flow regulation	-	-	#VALUE!	#VALUE!
	Sediment trapping	1,3	4,0	1,8	Moderate
	Erosion control	1,8	1,8	1,2	Low
	Phosphate assimilation	1,3	3,0	1,3	Moderately Low
	Nitrate assimilation	1,4	4,0	1,9	Moderate
	Toxicant assimilation	1,4	4,0	1,9	Moderate
	Carbon storage	1,7	0,7	0,5	Very Low
	Biodiversity maintenance	2,3	2,0	1,8	Moderate
PROVISIONING SERVICES	Water for human use	1,6	0,3	0,3	Very Low
	Harvestable resources	2,0	0,0	0,5	Very Low
	Food for livestock	1,0	0,7	0,0	Very Low
	Cultivated foods	1,3	0,0	0,0	Very Low
CULTURAL SERVICES	Tourism and Recreation	0,5	0,0	0,0	Very Low
	Education and Research	1,0	0,3	0,0	Very Low
	Cultural and Spiritual	2,0	0,0	0,5	Very Low

Table E7: Presentation of the results of the EIS assessment applied to the freshwater ecosystems

			UCVB Wetland	CVB Wetland	Sterkstroom River
Ecological Importance and Sensitivity			Score (0-4)		
Biodiversity support			A (average)	A (average)	A (average)
			0,00	0,00	0,67
Presence of Red Data species			0	0	0
Populations of unique species			0	0	0
Migration/breeding/feeding sites			0	0	2
Landscape scale			B (average)	B (average)	B (average)
			0,80	0,20	1,60
Protection status of the wetland			0	0	1
Protection status of the vegetation type			4	1	1
Regional context of the ecological integrity			0	0	2
Size and rarity of the wetland type/s present			0	0	2
Diversity of habitat types			0	0	2
Sensitivity of the wetland			C (average)	C (average)	C (average)
			0,33	0,33	1,33
Sensitivity to changes in floods			1	1	2
Sensitivity to changes in low flows/dry season			0	0	1
Sensitivity to changes in water quality			0	0	1
ECOLOGICAL IMPORTANCE & SENSITIVITY			**(max of A,B or C)**	**(max of A,B or C)**	**(max of A,B or C)**
Fill in highest score:			**B**	**B**	**B**
Valley bottom wetlands: Low/marginal: Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.					
Sterkstroom River: 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.					
Hydro-Functional Importance			Score (0-4)	Score (0-4)	Score (0-4)
Regulating & supporting benefits	**Flood attenuation**		0	1	1
	Streamflow regulation		0	0	0
	Water Quality Enhancement	***Sediment trapping***	2	2	2
		Phosphate assimilation	1	2	2
		Nitrate assimilation	1	2	2
		Toxicant assimilation	1	2	2
		Erosion control	2	1	2
	Carbon storage		0	0	1
HYDRO-FUNCTIONAL IMPORTANCE			1	1	2
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)
Direct Human Benefits			Score (0-4)	Score (0-4)	Score (0-4)
Subsistence benefits	***Water for human use***		0	0	1
	Harvestable resources		0	0	2
	Cultivated foods		0	0	1
Cultural benefits	***Cultural heritage***		0	0	2
	Tourism and recreation		0	0	0
	Education and research		0	0	1
DIRECT HUMAN BENEFITS			0,50	0,00	1,17

APPENDIX E – GENERAL BEST PRACTICE MITIGATION MEASURES

General management and good housekeeping practices

The following essential mitigation measures are considered to be standard best practice measures applicable to development of this nature and must be implemented during all phases of the proposed development activities, in conjunction with those stipulated in Section 5 of this report which define the mitigatory measures specific to the minimisation of impacts on freshwater resources.

Development and operational footprint

- Sensitivity maps have been developed for the study area, indicating the location of the cryptic wetland and the relevant regulatory zones in accordance with Government Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the National Water Act, 1998 (Act No. 36 of 1998), as shown in Section 4.4. It is recommended that these sensitivity maps be considered during all phases of the development;
- All development footprint areas should remain as small as possible and should not encroach onto surrounding more sensitive areas. It must be ensured that the cryptic wetland and the associated regulatory zones are off-limits to construction vehicles and personnel;
- The boundaries of footprint areas are to be clearly defined and it should be ensured that all activities remain within defined footprint areas;
- Planning of temporary roads and access routes should take the site sensitivity plan into consideration, and wherever possible, existing roads should be utilised. If additional roads are required, then wherever feasible such roads should be constructed a distance from the more sensitive cryptic wetland and not directly adjacent thereto. This should only be necessary if existing access roads are not utilised;
- All areas of increased ecological sensitivity should be marked as such and be off limits to all unauthorised construction and maintenance vehicles and personnel;
- Appropriate sanitary facilities must be provided for the life of the proposed project and all waste removed to an appropriate waste facility;
- All hazardous chemicals should be stored on bunded surfaces and no storage of such chemicals should be permitted within the wetland zones of regulation;
- No informal fires should be permitted in or near the construction areas;
- Ensuring that an adequate number of rubbish and “spill” bins are provided will also prevent litter and ensure the proper disposal of waste and spills; and
- Edge effects of activities, particularly erosion and alien/weed control need to be strictly managed.

Vehicle access

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

Alien plant species

- Proliferation of alien and invasive species is expected within any disturbed areas. These species should be eradicated and controlled to prevent their spread beyond the project footprint, particularly as the study area is located within a sensitive area. Alien plant seed dispersal within the top layers of the soil within footprint areas, that will have an impact on future rehabilitation, has to be controlled;
- Removal of the alien and weed species encountered on the property must take place in order to comply with existing legislation (amendments to the regulations under the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) and Section 28 of the National Environmental Management Act, 1998 (Act No.107 of 1998) (NEMA)). Removal of species

should take place throughout the construction, operational, closure/decommissioning and rehabilitation/ maintenance phases; and

- Species specific and area specific eradication recommendations:
  - Care should be taken with the choice of herbicide to ensure that no additional impact and loss of indigenous plant species occurs due to the herbicide used;
  - Footprint areas should be kept as small as possible when removing alien plant species*;*
  - No vehicles should be allowed to drive through designated sensitive drainage line and riparian areas during the eradication of alien and weed species.

Cryptic wetland habitat

- No encroachment of the cryptic wetland habitat should be necessary or permitted.

Soils

- To prevent the erosion of soils, management measures may include berms, soil traps, hessian curtains and stormwater diversion away from areas particularly susceptible to erosion;
- Install erosion berms during construction to prevent gully formation. Berms every 50m should be installed where any disturbed soils have a slope of less than 2%, every 25m where the track slopes between 2% and 10%, every 20m where the track slopes between 10% and 15% and every 10m where the track slope is greater than 15%;
- Sheet runoff from access roads should be slowed down by the strategic placement of berms and sandbags;
- Maintain topsoil stockpiles below 5 meters in height;
- As far as possible, all construction activities should occur in the low flow season, during the drier winter months;
- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas; and
- Monitor all areas for erosion and incision, particularly any riparian crossings. Any areas where erosion is occurring excessively quickly should be rehabilitated as quickly as possible and in conjunction with other role players in the catchment.

Rehabilitation

- All soils compacted as a result of construction activities falling outside of project footprint areas should be ripped and profiled. Special attention should be paid to alien and invasive control within these areas. Alien and invasive vegetation control should take place throughout all construction and rehabilitation phases to prevent loss of floral habitat;
- Rehabilitate any cryptic wetland habitat areas affected by construction (although no encroachment should take place) to ensure that the ecology of these areas is re-instated during all phases. In this regard, special mention is made of the need to stockpile soils separately during the construction and/or operation phase where relevant in order for these soils to be utilised during the rehabilitation phase;
- Edge effects of activities including erosion and alien/ weed control need to be strictly managed in these areas;
- As far as possible, all rehabilitation activities should occur in the low flow season, during the drier winter months.
- As much vegetation growth (of indigenous/endemic floral species) as possible should be promoted within the proposed development area in order to protect soils;
- All alien vegetation should be removed from rehabilitated areas and reseeded with indigenous grasses as specified by a suitably qualified specialist (ecologist);
- All areas affected by construction and operation should be rehabilitated upon completion of the specific construction and operation activity throughout the life of the development;
- Cryptic wetland vegetation cover should be monitored to ensure that sufficient vegetation is present to bind the soils and prevent erosion and incision; and
- It is recommended that a detailed rehabilitation plan be developed by a suitably qualified ecologist prior to commencement of the operations phase in order to address specific rehabilitation requirements.

APPENDIX F – INTERESTED & AFFECTED PARTIES RESPONSES

The response below was received by the EAP via email and provided to the specialist for inclusion in this report.

Kelebogile Mekgoe Rustenburg Local Municipality	Via email on the 17th of June 2022	With regard to the aforementioned, the Unit: Integrated Environmental Management acknowledges receipt of Scoping Report for the proposed additional waste rock storage project. Tharisa Minerals (Pty) Ltd is an opencast mining operation that produces chrome and platinum group metal (PGMs) concentrates. Mining is undertaken in two mining sections, namely the East Mine and West Mining, using the conventional open pit truck and shovel methods. The mine has been operational since 2008. The opencast mine is located on farms 342 JQ. This nature of the pits at Tharisa is such that there is continually more waste rock generated than capacity available in the worked-out areas of the pits and the balance must be dumped on surface WRDs. Additional waste rock handling and storage capacity is therefore required to accommodate the waste rock from the open pit operations. As part of its on-going mine planning, Tharisa has identified the need for additional WRD storage on site. The following activities are proposed: • The expansion of the existing and approved Far West WRD 1 by footprint of 109 ha. The expanded area will be referred to as the West Above Ground (OG) WRD. Portions of the West OG WRD will be located on backfilled areas of the West Pit; and • The establishment of a waste rock dump (referred to as the East OG WRD) on backfilled portions of the East Pit. The proposed East OG WRD will cover an area of approximately 71 ha. The proposed activities will occurs within the approved mining rights area of Tharisa Minerals. The Mining right area has been extensively disturbed as a result of existing mining, community and private farming activities. Th proposed project is listed in terms of National Environmental Management Act, NEMA, Act 107 of 1998), 07 April 2017, as amended. The prospecting right triggers listed activity, Listing Notice 1 (GNR 983 of 2014), Activity 12, 30, 34 and 48, Listing Notice 2 (GNR 984), Activity 6 and 15 and Listing Notice 3 (GNR 985 of 2014), Activity 12 as amended.	The soil, land use and land capability specialist confirmed that this project is regarded as being of low impact significance due to the inherent soil constraints of the area and the severe disturbance of the majority of the soils on site. However, mitigation measures and recommendations outlined in specialist study must be implemented in efforts to conserve soil resources in the post mining landscape. The recommendations provided in your letter with specialist inputs will be included in the EMPr of the draft EIR.

		The proposed activity is a waste management activity of which the Waste Management License (WML) is required in terms of the National Environmental Management: Waste Act, 59 of 2008 (NEM: WA) for waste activities in Category B (GNR 985 of 2014), Activity 12 as amended. **The proposed activity is a waste management activity of which the Waste Management License (WML) is required in terms of the National Environmental Management: Waste Act, 59 of 2008 (NEM: WA) for waste activities in Category B (GNR 921 of 2013), Activity 7, 10, 11, as amended.** **According to the Bojanala Platinum District Municipality's Environmental Management Framework (BPDM EMF, June 2020), the site is situated in Zone A: Development Zone I, Zone C: Development Zone III, Zone D: Agriculture Zone, Zone E: Agriculture Zone II, Zone F: Biodiversity Zone and Zone G: Sensitive Topography.** i. **Zone A: Development Zone I: 'Developemnt Zone I' is a refinement of areas identified for future urban development in local municipal SDFs. These development uses include, amongst others, residential land uses, commercial land uses and land uses related to government functions, but specifically excludes industrial land uses and mining related land uses** ii. **Zone C: Development Zone III: 'Development Zone II (Industrial)' is a refinement of areas identified for future industrial development in local municipal SDFs.** **iii.** **Zone D: Agriculture Zone I. The 'Agriculture Zone' represents existing high potential agricultural land in the area (i.e. cultivated fields) that should be preserved for crop production and other agricultural purposes.** iv. **Zone E: Agricultural Zone II. The "Agriculture Zone" represents areas deemed suitable for further agricultural development for both grazing and cultivation purposes. The land may also be utilised for other types of development.** v. **Zone F: The "Bioiversity Zone" represents areas of high and significant biodiversity in the Bojanala District Municipality. Areas of**	

		high biodiversity was identified from the North West Province Biodiversity Sector Plan and includes, among others, critical biodiversity areas (CBAs) and Ecological Support Areas (ESAs). vi. Zone G: "Sensitive Topography Zone" represents the sensitive topographical features, such as hills and ridges, which are deemed sensitive to development. According to Zone A: Development Zone I, Zone C: Development Zone III, Zone D: Agriculture Zone I, Zone E: Agriculture Zone II, Zone F: Biodiversity Zone and Zone G: Sensitive Topography Zone, the land use listed above is compatible partially compatible and incompatible, as per the above-mentioned Zone, however, the proposed project will occur within the mining rights area of Tharisa Mine. The Unit: IEM will support the proposed development, however, the following recommendations must be taken into consideration. 1. The mitigation measures and the recommendations contained in the Scoping Report compiled by SLR Consulting (Pty) Ltd for this activity must be implemented. 2. There is possibility of seepage from the waste rock dump (WRD) into surface and groundwater, which may contain elevated levels of chromium and other elements; therefore continuous water monitoring should be done on the existing and proposed waste rock dump (WRD) 3. Waste rock dump is susceptible to wind entrainment and can lead to some environmental impacts especially if there are sensitive receptors down wind (i.e. The school, Lapologang and Mmaditlhokwa community and the neighbouring farm owners). It is therefore recommended that proper rehabilitation measures be put in place (i.e. slopes well managed and the dust be minimised). 4. The stripped and stockpiled topsoil may be chemically altered due to storage, this can potentially alter nutrient levels in the soil and result in a loss of fertility, therefore	

		proper management of topsoil must be ensured. 5. For the proposed Waste rock dump expansion, mitigation measures must be implemented to minimise health hazard and risk to Lapologang and Maditlhowa Village, and nearby landowners (i.e. noise, dust and ground vibration). 6. All plant species of conservation importance (i.e. *Scletocarya birrea subsp.Africana)* must be removed from demarcation area prior to construction commencing and must either be relocated outside of the construction area. 7. Any complaint from the public during the construction and operation of this project must be attended to by the person involved as soon as possible to the satisfaction of the parties concerned. A complaint register must be kept up to date and shall be produced upon request. 8. As far as possible, employment opportunities should be given to the local skilled, semi-skilled and unskilled labour force during the construction and operation phases to stimulate the local and regional economy as per Social and Labour Plan. The applicant must be responsible for compliance with the provisions for duty of care and remediation of environmental damage in accordance with Section 28 of National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended.	

APPENDIX G - DECLARATION OF INDEPENDENCE

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 Advanced Diploma: Nature Conservation (UNISA)

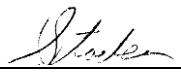
1. (a). (ii) The expertise of that specialist to compile a specialist report including a curriculum vitae

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

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.



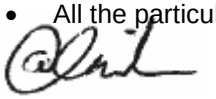
Signature of the Specialist

Company of Specialist:	Scientific Aquatic Services		
Name / Contact person:	Amanda Mileson		
Postal address:	29 Arterial Road West, Oriel, Bedfordview		
Postal code:	2007	Cell:	082 569 9052
Telephone:	011 616 7893	Fax:	011 615 6240/ 086 724 3132
E-mail:	Amanda@sasenvgroup.co.za		
Qualifications	Advanced Diploma: Nature Conservation (UNISA)		
Registration / Associations	Member of the South African Wetland Society (SAWS) Member of the Gauteng Wetland Forum (GWF)		

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

I, Amanda Mileson, declare that -

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



Signature of the Specialist

APPENDIX I- CVs OF SPECIALISTS

SAS ENVIRONMENTAL GROUP OF COMPANIES –
SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

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

EDUCATION

Qualifications

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

Short Courses

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

AREAS OF WORK EXPERIENCE

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

DEVELOPMENT SECTORS OF EXPERIENCE

1. Mining: Coal, chrome, Platinum Group Metals (PGMs), mineral sands, gold, phosphate, river sand, clay, fluorspar
2. Linear developments (energy transmission, telecommunication, pipelines, roads)

3. Minerals beneficiation
4. Renewable energy (Hydro, wind and solar)
5. Commercial development
6. Residential development
7. Agriculture
8. Industrial/chemical

KEY SPECIALIST DISCIPLINES

Legislative Requirements, Processes and Assessments

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

Freshwater Assessments

- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning
- Maintenance and Management Plans
- Plant Species and Landscape Plans
- Freshwater Offset Plans
- Hydropedological Assessment
- Pit Closure Analysis

Aquatic Ecological Assessment and Water Quality Studies

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

Biodiversity Assessments

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

Soil and Land Capability Assessment

- Soil and Land Capability Assessment
- Hydropedological Assessment

Visual Impact Assessment

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

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF AMANDA MILESON

PERSONAL DETAILS

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

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Wetland Society (SAWS)
Member of the Gauteng Wetland Forum (GWF)

EDUCATION

Qualifications

N. Dip Nature Conservation (UNISA)	2017
Advanced Diploma: Nature Conservation (UNISA)	2020
Post Graduate Diploma: Nature Conservation (UNISA)	In progress

Short Courses

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

AREAS OF WORK EXPERIENCE

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

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

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

Biodiversity Assessments

- Ecological Scan
- Biodiversity Offset Plan