FRESHWATER RESOURCE BASELINE ASSESSMENT AS PART OF THE ENVIRONMENTAL IMPACT ASSESSMENT AND AUTHORISATION PROCESS FOR THE KANAKIES GYPSUM MINE, NEAR LOERIESFONTEIN, NORTHERN CAPE

Prepared for

Cabanga Environmental

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Prepared by:	**Scientific Aquatic Services**
Report author	**B. Mzila**
Report reviewer	**S. van Staden (Pr. Sci. Nat)**
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Scientific Aquatic Services CC
CC Reg No 2003/078943/23
Vat Reg. No. 4020235273
PO Box 751779
Gardenview
2047
Tel: 011 616 7893
Fax: 086 724 3132
E-mail: admin@sasenvgroup.co.za

EXECUTIVE SUMMARY

The freshwater resources located within the MRA are deemed to be of moderate ecological integrity. Taking this into consideration, these resources play an important role in maintaining the overall ecological functioning of the surrounding ecosystem. The freshwater resources are not readily susceptible to impacts from the proposed mining and related activities since the footprint area is not situated in close proximity to the freshwater resources. However, it is deemed essential that, as far as possible, the ephemeral drainage line connectivity be preserved to prevent further cumulative impacts on the system downgradient of the focus area. The impact must be considered in conjunction with other environmental aspects and sensitivities present in the area. Once the impact has been considered in this context, the relevant stakeholders including the EAP, the proponent and the regulating as well as commenting authorities must make an informed decision in line with the principals of sustainable development and the requirements for protection of the environment. It is the opinion of the wetland ecologist that this report provides sufficient and appropriate information to allow informed decision making in this regard.

MANAGEMENT SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource ecological assessment as part of the environmental impact assessment and authorisation process for the proposed mining of natural gypsum (Gy) on the remaining extent of the farm Kanakies 332, near Loeriesfontein, Northern Cape. Of the overall mining right area (MRA), approximately 700 Ha will be affected by mining and related activities, henceforth referred to as the "focus area"

In order to identify all potential freshwater resources that may potentially be impacted by the proposed development in the focus area, a 500m “zone of investigation” was placed around the MRA, in accordance with Regulation 509 of 2016 as it relates to the National Water Act (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment.

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

The assessment took the following approach:

- A desktop study was conducted, and the results thereof are contained in Section 3 of this report;
- A field assessment took place in January 2018, to delineate the freshwater resources, and ground-truth pre-defined points of interest. Factors influencing the habitat integrity of the freshwater resource identified during the field survey were noted, and the functioning and the environmental and socio-cultural services provided by the freshwater resources were determined; and
- The results of the field assessment are contained in Section 4 of this report and are summarised in the table below.

Table A: Summary of the results of the field assessment

Freshwater Resource	PES	Ecoservices	EIS	REC
Unchannelled Valley Bottom	C (Moderately modified)	Intermediate	B (High)	C (Moderately modified)
Floodplain	B (Largely Natural)	Intermediate	B (High)	B (Largely Natural)
Drainage Lines	D (largely modified)	Moderately low	B (High))	D (largely modified)
Anabranching areas	C (Moderately modified)	Moderately low	B (High)	C (Moderately modified)

Following the results of the site assessment, it is apparent that the freshwater resources located within the MRA are deemed to be of a moderate ecological integrity. Taking this into consideration, these resources play an important role in maintaining the overall ecological functioning of the surrounding ecosystem. The freshwater resources are not readily susceptible to impacts from the proposed mining and related activities. However, it is deemed essential that as far as possible the ephemeral drainage line connectivity be preserved to prevent further cumulative impacts on the system downgradient of the focus area.

The perceived impact significance of activities within the focus area on the downgradient receiving environment are considered to be of medium-low to low levels since the footprint area is situated ± 1.1km away from the wetlands. Nevertheless, since the ephemeral drainage lines are located immediately to the south of the mining area, indirect impact may occur, thus strict mitigation measures are still required, and if effectively implemented, perceived impacts can be reduced to low significance

Provided that responsible implementation of the mitigation hierarchy, as well as strict adherence to cogent, well-developed mitigation measures throughout all phases of the proposed development, the significance of potential impacts arising from the proposed activities can be reduced.

In conclusion, the proposed mining of gypsum would have a moderately low impact on the freshwater ecology of the MRA. The impact must be considered in conjunction with other environmental aspects and sensitivities present in the area. Once the impact has been considered in this context, the relevant stakeholders including the EAP, the proponent and the regulating as well as commenting authorities must make an informed decision in line of the principals of sustainable development and the requirements for protection of the environment. It is the opinion of the wetland ecologist that this report provides sufficient and appropriate information to allow informed decision making in this regard.

DOCUMENT GUIDE

The table below provides the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) Regulations 2017 (as amended in 2014) for Specialist Reports and also the relevant sections in the reports where these requirements are addressed.

NEMA Regulations (2017) - Appendix 6	Relevant section in report
(1) A specialist report prepared in terms of these Regulations must contain -	
(a) details of -	
(i) the specialist who prepared the report; and	Appendix E
(ii) the expertise of that specialist to compile a specialist report, including a curriculum vitae;	Appendix E
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix E
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 2.1 and 3.1
(cB) a description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4.1 and 5
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 2.1
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Appendix C
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying alternatives;	Section 4
(g) an identification of any areas to be avoided, including buffers;	Section 4.3
(h) a map superimposing the activity, including the associated structures and infrastructure on the environmental sensitivities of the site, including areas to be avoided, including buffers;	Section 4.3
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.2
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment or activities;	Section 4, 5, and 6
(k) any mitigation measures for inclusion in the EMPr;	Section 5.2 and Appendix F
(l) any conditions for inclusion in the environmental authorisation;	Section 5
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 5
(n) a reasoned opinion -	
(i) as to whether the proposed activity, activities or portions thereof should be authorised;	Section 6
(iA) regarding the acceptability of the proposed activity or activities; and	Section 6
(ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 6
(o) a description of any consultation process that was undertaken during the course of preparing the specialist report	Section 5.6
(p) a summary and copies, if any, comments received during any consultation process and, where applicable all responses thereto; and	Section 5.6.1
(q) any other information requested by the competent authority.	No other information requested

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ACRONYMS

°C	Degrees Celsius.
BAR	Basic Assessment Report
BGIS	Biodiversity Geographic Information Systems
CBA	Critical Biodiversity Area
CSIR	Council of Scientific and Industrial Research
DWA	Department of Water Affairs
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class or Electrical Conductivity (use to be defined in relevant sections)
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMC	Ecological Management Class
EMP	Environmental Management Program
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information System
GN	General Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IHI	Index of Habitat Integrity
m	Meter
MAP	Mean Annual Precipitation
MC	Management Classes
NAEHMP	National Aquatic Ecosystem Health Monitoring Programme
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NFEPA	National Freshwater Ecosystem Priority Areas
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
NWCS	National Wetland Classification System
PEMC	Present Ecological Management Class
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
WRC	Water Research Commission
WULA	Water Use License Application

1. INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource baseline assessment as part of the environmental impact assessment and authorisation process for the proposed mining of natural gypsum (Gy) on the remaining extent of the farm Kanakies 332, near Loeriesfontein, Northern Cape, henceforth referred to as the Mining Right Area (MRA) (Figure 1 & 2). The MRA is situated within the Hantam Local Municipality and within the Calvinia magisterial district.

In order to identify all potential freshwater resources that may potentially be impacted by the proposed development in the focus area, a 500m "zone of investigation" was defined around the MRA, in accordance with Regulation 509 of 2016 as it relates to the National Water Act (NWA), was used as a guide in which to assess possible sensitivities of the receiving environment. This area – i.e. the 500m zone of investigation around the MRA, will henceforth be referred to as the "Investigation Area".

The MRA is situated approximately 41 km west of the town of Loeriesfontein, and 40 km north north-west of Niewhoudtville, and 53 km north north-east of Nuwerus. The Doring River traverses the southwest corner of the MRA. The extent of the MRA is approximately 7457 ha, while the concentrated gypsum deposit is approximately 689 ha. The area where the gypsum deposit is concentrated will henceforth be referred to as the "focus area". Furthermore, the approximate area required for infrastructure is 9 ha, and will comprise the following infrastructure (Cabanga Concepts, 2017):

- Mobile crushing and high frequency screening plant;
- Shipping container type office block and ablution facility;
- Vehicle parking area and fuel storage area;
- Product stockpile area;
- Run of Mine (ROM) stockpile area; and
- Access Road

The gypsum deposit consists of 2 layers i.e. a powder layer of an approximate thickness of 0.4 meters, approximately 0.2 to 0.7 meters below the surface, followed by a nodular crystalline layer with an approximate thickness of 0.9 to 1.3 meter. The gypsum deposit will be harvested by trench mining with the depth of trenching varying between 1.4 and 2.5m. The overburden layer will first be removed (0.2 to 0.7m), followed by the selective removal of the powder layer (0.4m) and subsequently the removal of the crystal containing clay layer (between 0.9 and 1.3m). The powder will be screened to remove foreign materials and is expected to be recovered by a margin of at least 90%. The clay layer will be roll-crushed and

screened by means of high frequency technology alongside the trench to increase the average gypsum composition from between 40 and 50 percent to between 80 and 90%. For more information regarding the mining activities refer to the Witkop Fluorspar Mine (Pty) Ltd Mining Work Programme.

This report, after consideration and a description of the ecological integrity of the MRA and the proposed mining activities, must guide the relevant authorities, by means of a reasoned opinion and recommendations, as to the viability of the proposed development activities in relation to the freshwater resources.

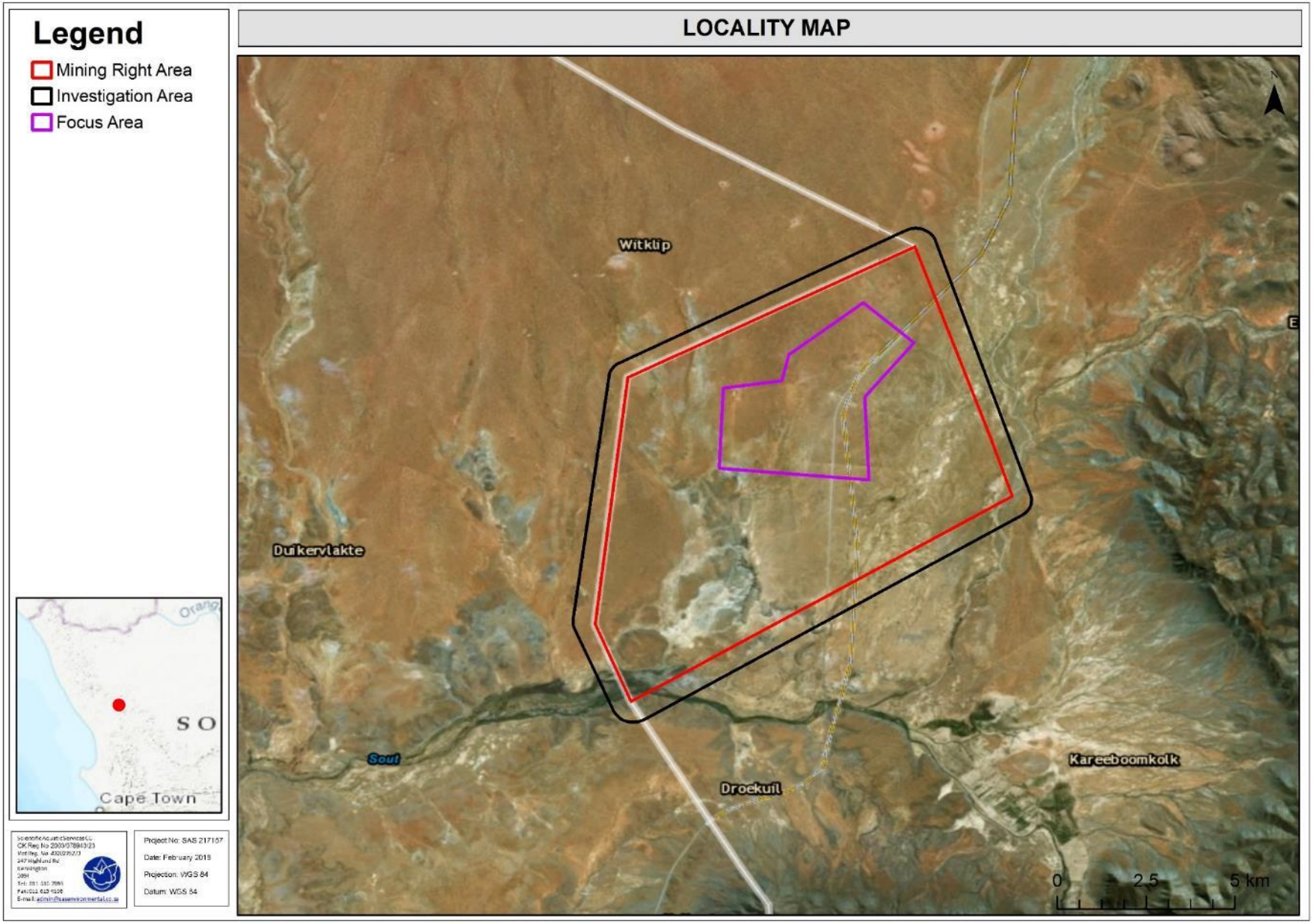


Figure 1: Digital satellite image depicting the focus area in relation to surrounding areas.

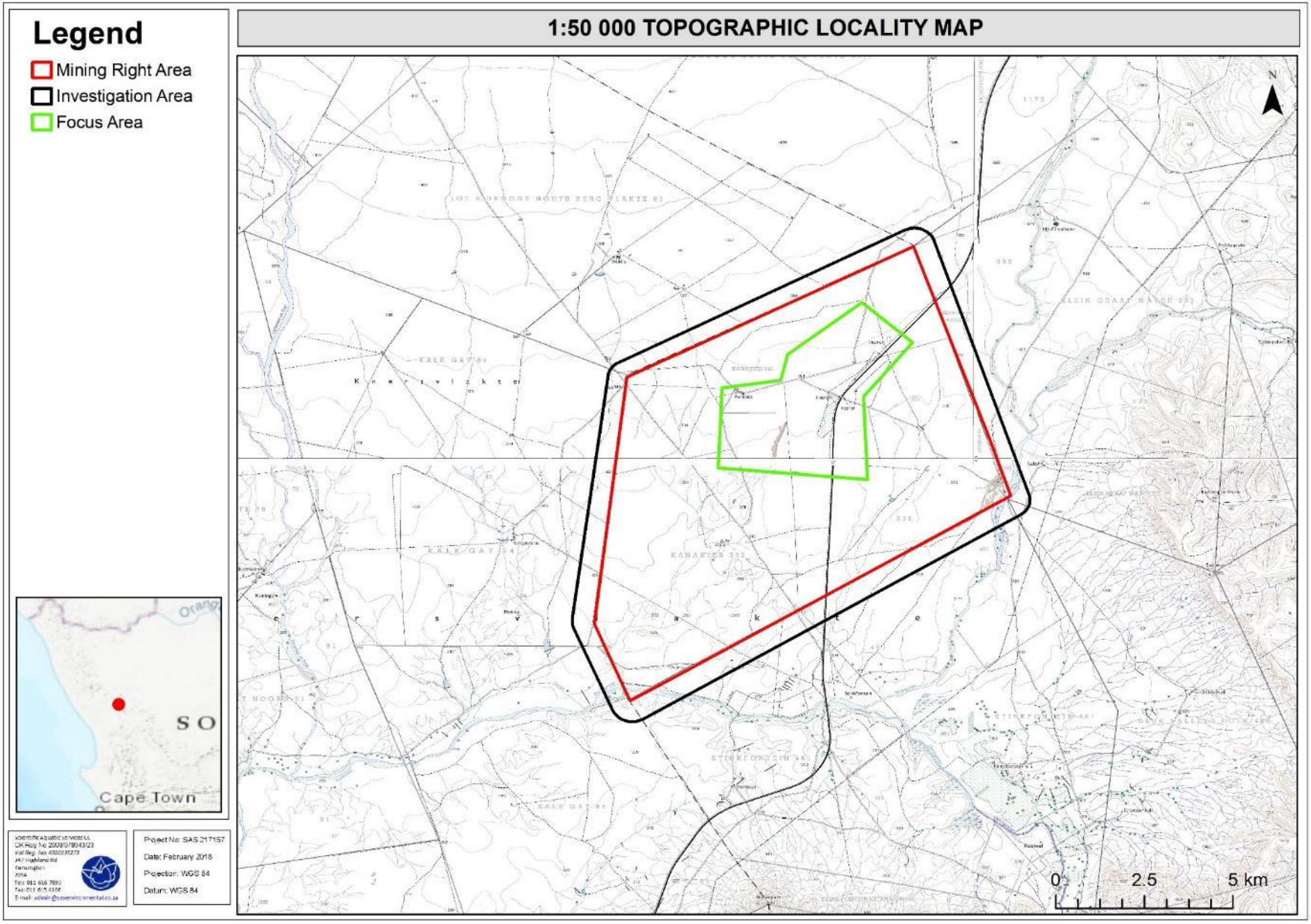


Figure 2: Location of the focus area depicted on a 1:50 000 topographical map in relation to surrounding area.

1.1 Scope of work

Specific outcomes in terms of the report are as follows:

- A desktop background study with all relevant national and provincial datasets as presented by the South African National Biodiversity Institute (SANBI) Biodiversity Geographic Information System (GIS) website (http://bgis.sanbi.org) as well as location of National Freshwater Ecosystem Priority Areas (NFEPAs) was compiled to aid in defining the PES and EIS of the freshwater resources;
- Freshwater resources were delineated according to "DWAF, 2008: A practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones". Aspects such as soil morphological characteristics, vegetation types and wetness were used to delineate the freshwater resources;
- All freshwater resources within the investigation area were delineated using desktop methods such as heads up digitising in accordance with Regulation 509 of 2016 as it pertains to the NWA, 2016;
- The wetland classification assessment was undertaken according to the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems (Ollis et al., 2013);
- The EIS of the freshwater resources were determined according to the method described by Rountree & Kotze, (2013);
- The services provided by the freshwater resources associated with the MRA were assessed according to the method of Kotze *et al.* (2009) in which services to the ecology of the site as well as services to the people of the area were defined;
- The PES of the freshwater resources was determined according to the resource-directed measures guideline of Macfarlane *et al.,* (2008);
- Freshwater resources were mapped according to the ecological sensitivity of each hydrogeomorphic unit in relation to the MRA. In addition to the freshwater resource boundaries, the appropriate legislated zones of regulation were depicted where applicable;
- A suitable REC to the freshwater resources was defined based on the results obtained from the PES, Ecoservices and EIS assessments;
- Determine the environmental impacts of the proposed development activities on the freshwater resource areas within the focus area;
- Development of recommendations for mitigating impacts on the receiving environment.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The determination of the freshwater resource boundaries and the assessment, is confined to the MRA. All freshwater resources identified within 500m of the MRA were delineated in fulfilment of Regulation GN509 of the NWA using desktop methods, however these resources were not assessed individually. The general surroundings were, however, considered in the desktop assessment of the MRA;
- The freshwater resource delineation as presented in this report is regarded as a best estimate of the temporary zone boundary, based on the site conditions present at the time of assessment. Global Positioning System (GPS) technology is inherently inaccurate and some inaccuracies due to the use of handheld GPS instrumentation may occur. If more accurate assessments are required the wetland will need to be surveyed and pegged according to surveying principles and with surveying equipment;
- Wetland, riparian and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to obligate/facultative species. Within this transition zone, some variation of opinion on the freshwater resource boundary may occur. However, if the DWAF (2008) method is followed, all assessors should obtain largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. However, it is expected that the proposed development activities have been accurately assessed and considered, based on the field observations and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

1.3 Legislative Requirements

The following legislative requirements were considered during the assessment:

- National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA);
- National Water Act, 1998 (Act 36 of 1998) (NWA);
- General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998); and
- Requirements of the Government Notice 704 in Government Gazette 20119.

The details of each of the above, as they pertain to this study, are provided in **Appendix B** of this report.

2. ASSESSMENT APPROACH

2.1 Field Verification

For the purposes of this investigation, the definition of wetland and riparian systems was taken as per that in the National Water Act (1998). The definitions are as follows:

Wetland habitat is “land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.”

Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure **distinct** from those of adjacent areas.

The following was taken into consideration during delineation of the freshwater resources:

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

The freshwater resource delineation was verified in the field, and this delineation took place according to the method presented in the “Updated manual for the identification and delineation of wetland and riparian resources” (DWAF, 2008). The foundation of the method is based on the fact that freshwater resources 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.

A field assessment was undertaken from the 31st January to the 02nd February 2018, during which the presence of any areas displaying riparian or wetland characteristics as defined by DWAF (2008) and by the NWA, were noted (please refer to Section 4 of this report). In addition to the delineation process, detailed assessments of the delineated freshwater resources were undertaken, at which time factors affecting the integrity of these features were taken into consideration and aided in the determination of the functioning and the ecological and socio-cultural services provided by the freshwater resource. A detailed explanation of the methods of assessment and characterization of the features undertaken is provided in Appendix C of this report.

2.2 Sensitivity Mapping

All freshwater resources associated with the MRA were delineated with the use of a Global Positioning System (GPS). Geographic Information System (GIS) was used to project these features onto digital satellite imagery and topographic maps. The sensitivity map presented in Section 4.4 should guide the design and layout of the development.

3. RESULTS OF THE DESKTOP ANALYSIS

The following section contains data accessed as part of the desktop assessment and are presented as a “dashboard” report below (Table 1). The dashboard report aims to present concise summaries of the data on as few pages as possible in order to allow for integration of results by the reader to take place. Where required, further discussion and interpretation is provided.

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 MRA’s actual site characteristics at the scale required to inform the environmental authorisation and/or water use licencing processes. However, this information is considered useful as background information to the study. Thus, this data was used as a guideline to inform the assessment and to focus on areas and aspects of increased conservation importance.

Table 1: Desktop data relating to the character of freshwater resources within the MRA and surrounding region.

Aquatic ecoregion and sub-regions in which the MRA is located		
Ecoregion	Western Coastal Belt	
Catchment	Olifants (South)	
Quaternary Catchment	E31H and E33A	
WMA	Olifants/Doorn	
subWMA	Knersvlakte	
Dominant characteristics of the Western Coastal belt (25.01) Aquatic Ecoregion Level 2 (Kleynhans *et al.*, 2007)		
Dominant primary terrain morphology	Plains: low relief. Closed Hills and Mountains: moderate and high relief.	
Dominant primary vegetation types	Upland Succulent Karoo, Mountain Fynbos, Strandveld Succulent Karoo	
Altitude (m a.m.s.l)	100 to 1300	
MAP (mm)	100 to 200	
Coefficient of Variation (% of MAP)	35 to 40	
Rainfall concentration index	50 to 60	
Rainfall seasonality	Winter	
Mean annual temp. (°C)	16 to 20	
Winter temperature (July)	10 to 20 °C	
Summer temperature (Feb)	14 to > 32 °C	
Median annual simulated runoff	<5	
Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)		
Sub-quaternary reach	E31H-05723 (Krom River)	E33A-05743 (Doring River)
Proximity to the MRA	Traversing southeastern corner	Traversing southwestern corner
Assessed by expert?	Yes	Yes
PES Category Median	B	B
Mean Ecological Importance (EI) Class	Moderate	Moderate
Mean Ecological Importance (EI) Class	High	High
Stream Order	4	4
Default Ecological Class (based on median PES and highest EI or ES mean)	B (High)	B (High)

Detail of the MRA in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database	
FEPACODE	The MRA is located within a subWMA not considered important in terms of River or Fish conservation (FEPACODE = 0).
NFEPA Wetlands (Figure 3 and 4)	Three natural wetlands are situated within the MRA. A natural channelled valley bottom wetland with artificial areas is situated within the eastern portion, while a flat wetland is situated within the central region ±300m north of the southern boundary, and a floodplain wetland is situated within the southwestern portion of the MRA. Two channelled valley bottom wetlands fall within the southwestern (natural) and northwestern (artificial) corners of the focus area. The flat, floodplain and channelled valley bottom wetland associated with the western portion of the i focus area are considered to be in a natural/ good (AB) ecological condition, while the artificial wetland and the channelled valley bottom situated within the MRA, is in a heavily to critically modified ecological condition (Z2 and Z3)
Wetland Vegetation Type	The MRA falls within the Knersvlakte wetland vegetation type. This vegetation type is considered least threatened for channelled valley bottom and flat wetlands, however floodplain wetlands are considered Endangered within this vegetation type.
NFEPA Rivers (Figure 3)	The Doring River traverses the southwestern corner of the MRA, while the Krom River is situated on the southeastern boundary. The Doring River is considered to be in a natural or good (AB) ecological condition, while the Krom River is considered to be moderately modified (C) ecological condition.
Detail of the focus area in terms of the Northern Cape Critical Biodiversity Areas (2016) (Figure 5)	
Critical Biodiversity Area (CBA) 2	The south western corner of the MRA falls within a CBA 2. According to the Technical Guidelines for CBA Maps document CBAs are areas that must remain in good ecological condition for meeting biodiversity targets for ecosystem types, species of special concern or ecological processes. CBA2 are areas that have been selected as the best option for meeting biodiversity targets, based on complementary, efficiency, connectivity and / or avoidance of conflict with other land or resource users.
Ecological Support Area (ESA)	The majority of the eastern half of the MRA falls within an ESA. According to the Technical Guidelines for CBA Maps document ESAs are areas which must retain their ecological processes in order to meet biodiversity targets for ecological processes that have not been met in CBAs or protected areas; meet biodiversity targets for representation of ecosystem types or Species of special concern when it's not possible to meet them in CBAs; support ecological functioning of protected areas or CBAs or a combination of these (SANBI, 2017)
Other Natural Area (ONA)	The remaining extent of the MRA falls within the ONA category. According to the Technical Guidelines for CBA Maps document ONA consist of all those areas in good or fair ecological condition that fall outside the protected area network and have not been identified as CBAs or ESAs (SANBI, 2017).
Detail of the focus area in terms of Mining and Biodiversity Guidelines (2013) (Figure 6)	
Highest Biodiversity Importance	The southwestern corner of the MRA falls within an area considered to be of **Highest Biodiversity Importance.** Highest Biodiversity Importance areas include areas where mining is not legally prohibited, but where there is a very high risk that due to their potential biodiversity significance and importance to ecosystem services (e.g. water flow regulation and water provisioning) that mining projects will be significantly constrained or may not receive necessary authorisations**.**
Moderate Biodiversity Importance	The majority of the MRA is considered to be of **Moderate Biodiversity Importance.** Moderate Biodiversity Importance areas include Ecological Support Areas (ESAs), vulnerable ecosystems and focus areas for protected area expansion. Areas of Moderate Biodiversity Importance are considered of moderate risk for mining. EIAs and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, identifying features (e.g. threatened species) not included in the existing datasets and on providing site-specific information to guide the application of the mitigation hierarchy. Authorisations may set limits and specify biodiversity offsets that would be written into licence agreements and/or authorisations

CBA = Critical Biodiversity Area; DWS = Department of Water and Sanitation; EI = Ecological Importance; ES = Ecological Sensitivity; ESA = Ecological Support Area; m.a.m.s.l = Metres Above Mean Sea Level; MAP = Mean Annual Precipitation; NFEPA = National Freshwater Ecosystem Priority Areas; ONA = Other Natural Areas; PES = Present Ecological State WMA = Water Management Area

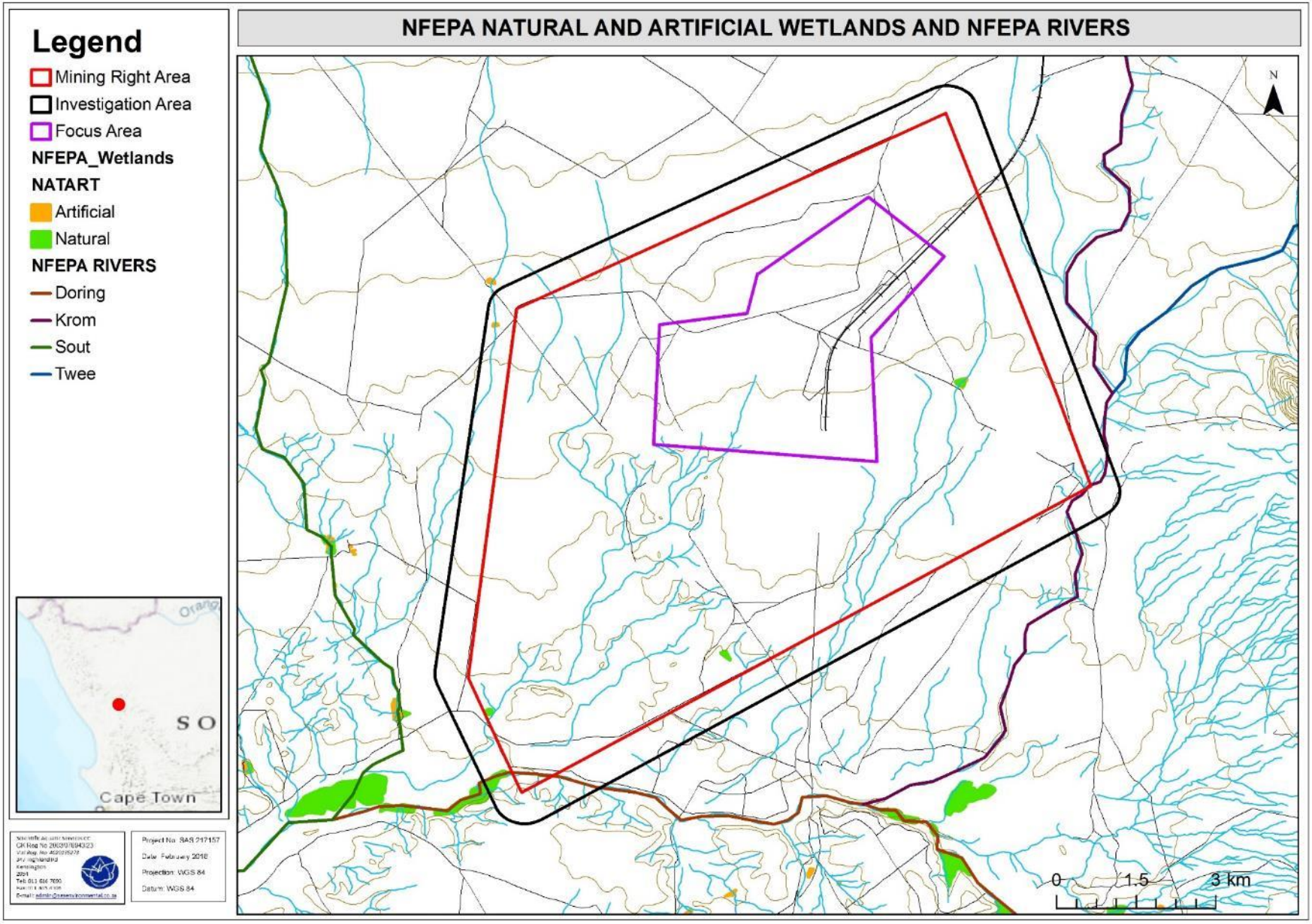


Figure 3: Natural and artificial wetlands as well as Rivers associated with the MRA and Investigation Area according to NFEPA (2011).

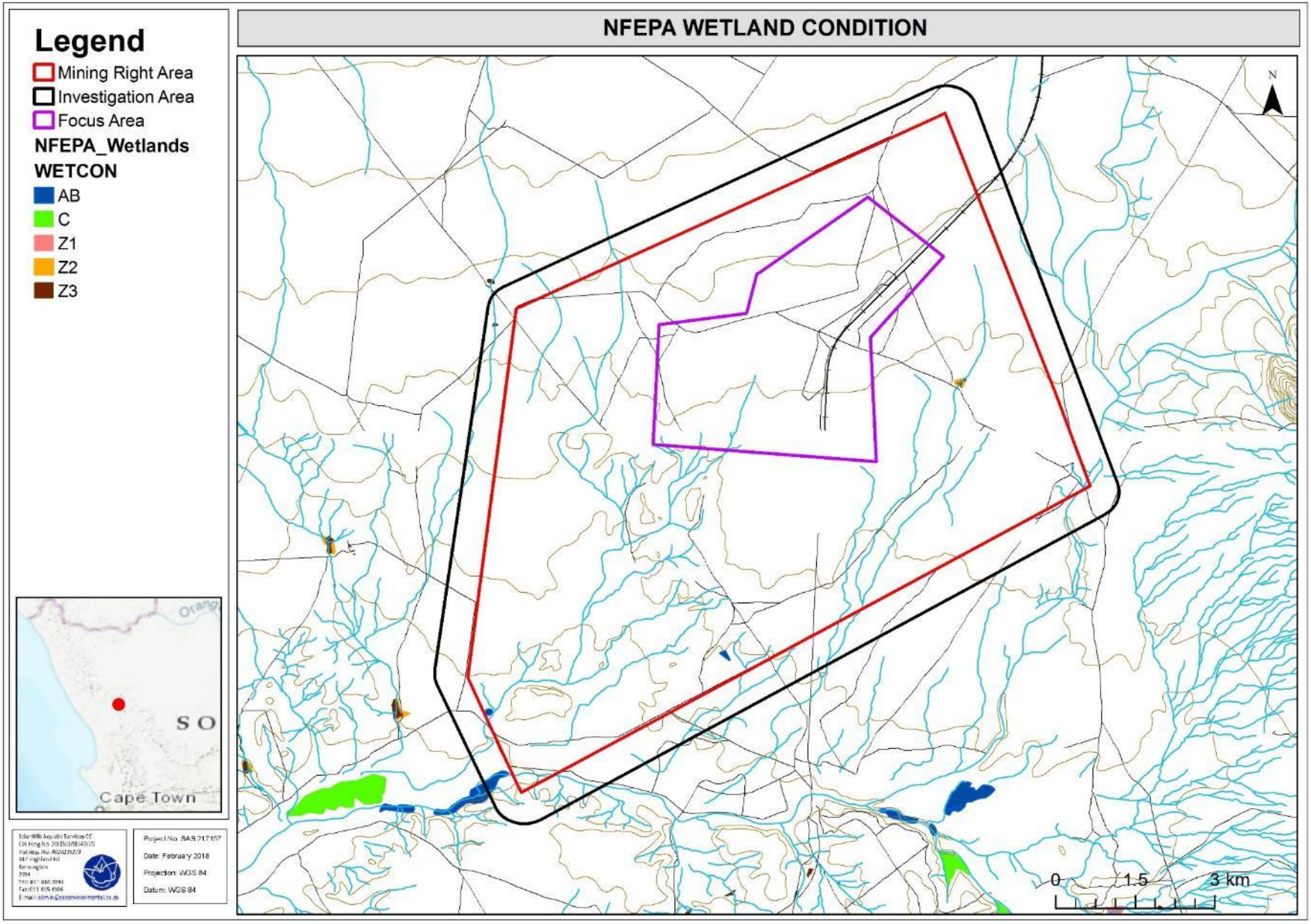


Figure 4: Condition of the Wetlands associated with the MRA (NFEPA, 2011)

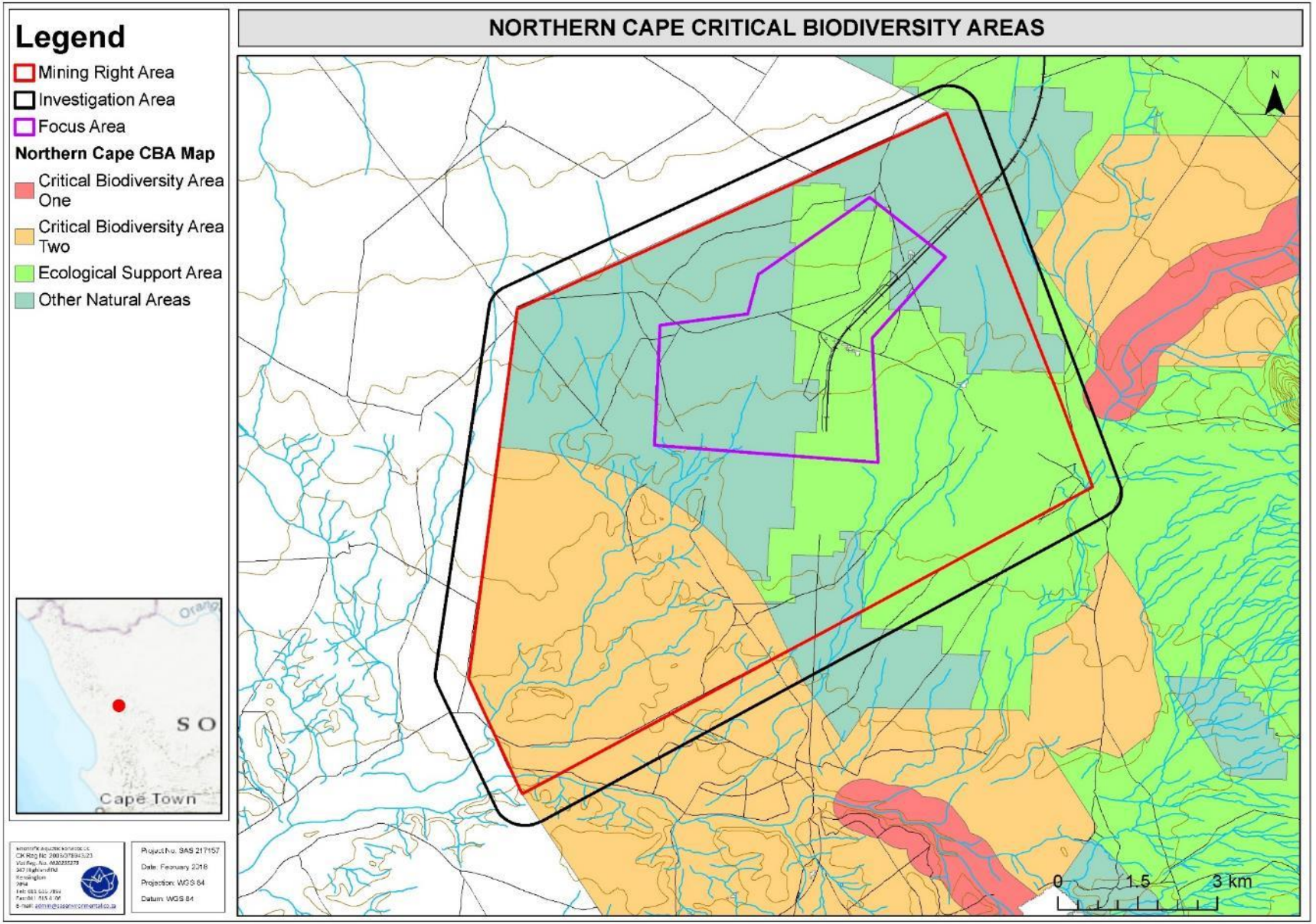


Figure 5: The Critical Biodiversity Areas and Ecological Support Areas associated with the MRA according to the Northern Cape Critical Biodiversity Area Database (2016).

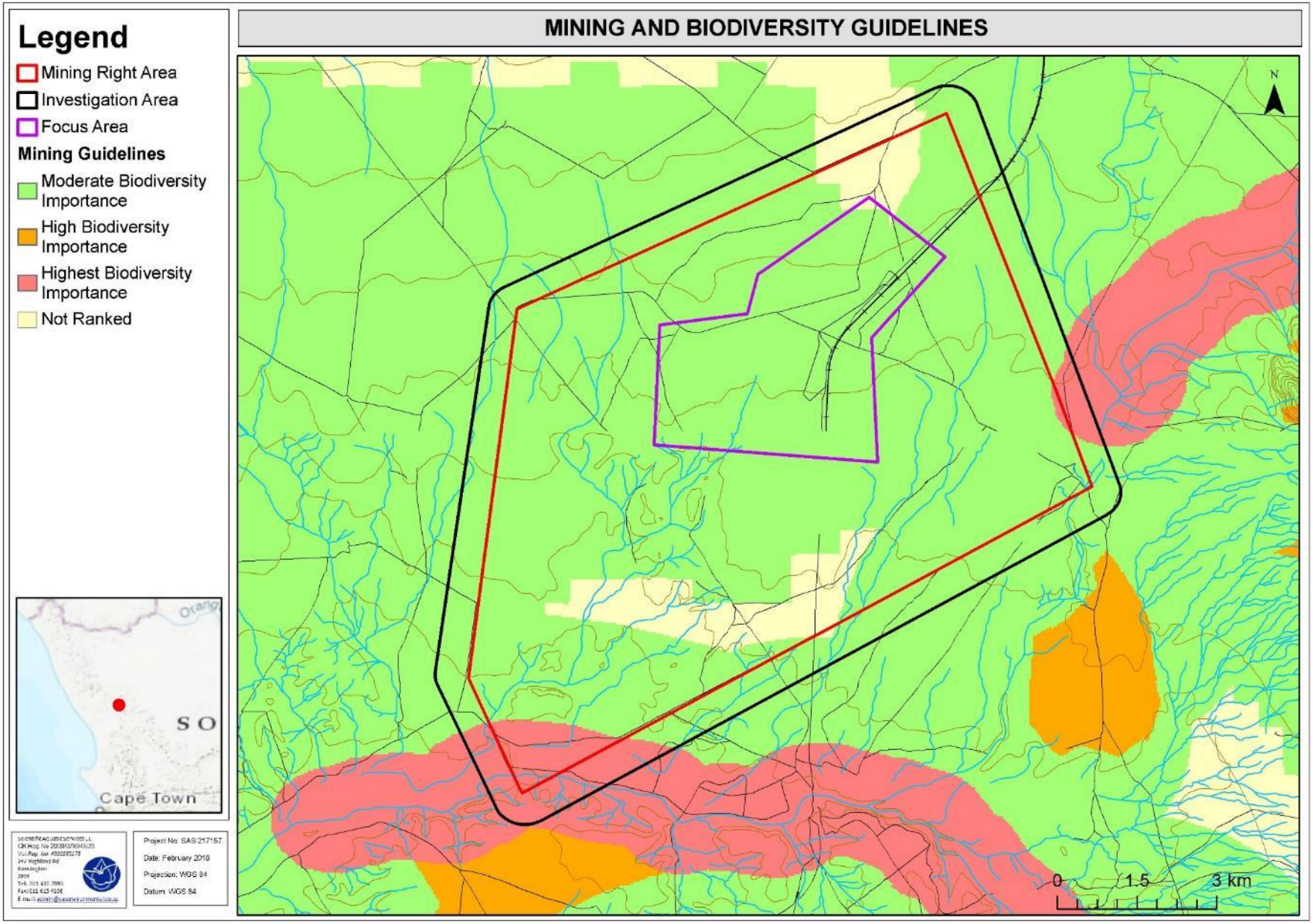


Figure 6: Importance of the MRA according to the Mining and Biodiversity Guidelines (2013)

3.1 Department of Water and Sanitation (DWS) Resource Quality Information Services (RQIS) PES/EIS database

The PES/EIS database, as developed by the DWS RQIS department, was utilised to obtain additional background information on the project area. The PES/EIS database has been made available to consultants since mid-August 2014. The information from this database is based on information at a sub-quaternary catchment reach (SQR) level. Descriptions of the aquatic ecology is based on information collated by the DWS RQIS department from available sources of reliable information, such as SA RHP sites, Ecological Water Requirements (EWR) sites and Hydro Water Management system (WMS) sites.

In this regard, information for the SQRs of Rivers traversing the MRA were obtained. The Rivers traversing the MRA and their applicable SQR Points are as follows (Figure 7 below):

- Krom River (E31H-05723); and
- Doring River (E33A-05743)

Key information on fish species, invertebrates and background conditions, associated with the above listed SQR Points, as contained in this database and pertaining to the Present Ecological State (PES), ecological importance and ecological sensitivity for the Rivers, are tabulated in Tables 2 to 4 below.

Table 2: Invertebrates previously collected from or expected at the Krom River (E31H-05723); and Doring River (E33A-05743) SQR monitoring points associated with the MRA.

Aeshnidae	Culicidae	Libellulidae
Caenidae	Dytiscidae	Notonectidae
Ceratopogonidae	Hydracarina	Oligochaeta
Chironomidae	Hydraenidae	Physidae
Corduliidae	Lestidae	Simuliidae

***** There are no fish species recorded for either of the SQR Monitoring Points within the database.

Table 3: Summary of the ecological status of the sub-quaternary catchment (SQ) reaches associated with the MRA based on the DWS RQS PES/EIS database

	E31H-05723 (Krom River)	E33A-05743 (Doring River)
Synopsis		
PES Category Median	Largely Natural	Largely Natural
Mean EI class	Moderate	Moderate
Mean ES class	High	High
Length	10.01	9.57
Stream order	4	4
Default EC[4]	B (High)	B (High)
PES Details		
Instream habitat continuity MOD	None	None
RIP/wetland zone continuity MOD	Small	Small
Potential instream habitat MOD activities	Small	Small
Riparian/wetland zone MOD	Small	Small
Potential flow MOD activities	Small	Small
Potential physico-chemical MOD activities	Small	Small
EI Details		
Fish spp/SQ	N/A	N/A
Fish average confidence	N/A	N/A
Fish representivity per secondary class	N/A	N/A
Fish rarity per secondary class	N/A	N/A
Invertebrate taxa/SQ	15	15
Invertebrate average confidence	2.73	2.73
Invertebrate representivity per secondary class	Low	Low
Invertebrate rarity per secondary class	Low	Low
EI importance: riparian-wetland-instream vertebrates (excluding fish) rating	Very Low	Very Low
Habitat diversity class	Low	Low
Habitat size (length) class	Very Low	Very Low
Instream migration link class	Very High	Very High
Riparian-wetland zone migration link	Very High	Very High
Riparian-wetland zone habitat integrity class	Very High	Very High
Instream habitat integrity class	Very High	Very High
Riparian-wetland natural vegetation rating based on percentage natural vegetation in 500m	Very High	Very High
Riparian-wetland natural vegetation rating based on expert rating	High	High
ES Details		
Fish physical-chemical sensitivity description	N/A	N/A
Fish no-flow sensitivity	N/A	N/A
Invertebrates physical-chemical sensitivity description	Moderate	Moderate
Invertebrates velocity sensitivity	High	High
Riparian-wetland-instream vertebrates (excluding fish) intolerance water level/flow changes description	High	High
Stream size sensitivity to modified flow/water level changes description	Very High	Very High
Riparian-wetland vegetation intolerance to water level changes description	High	High

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

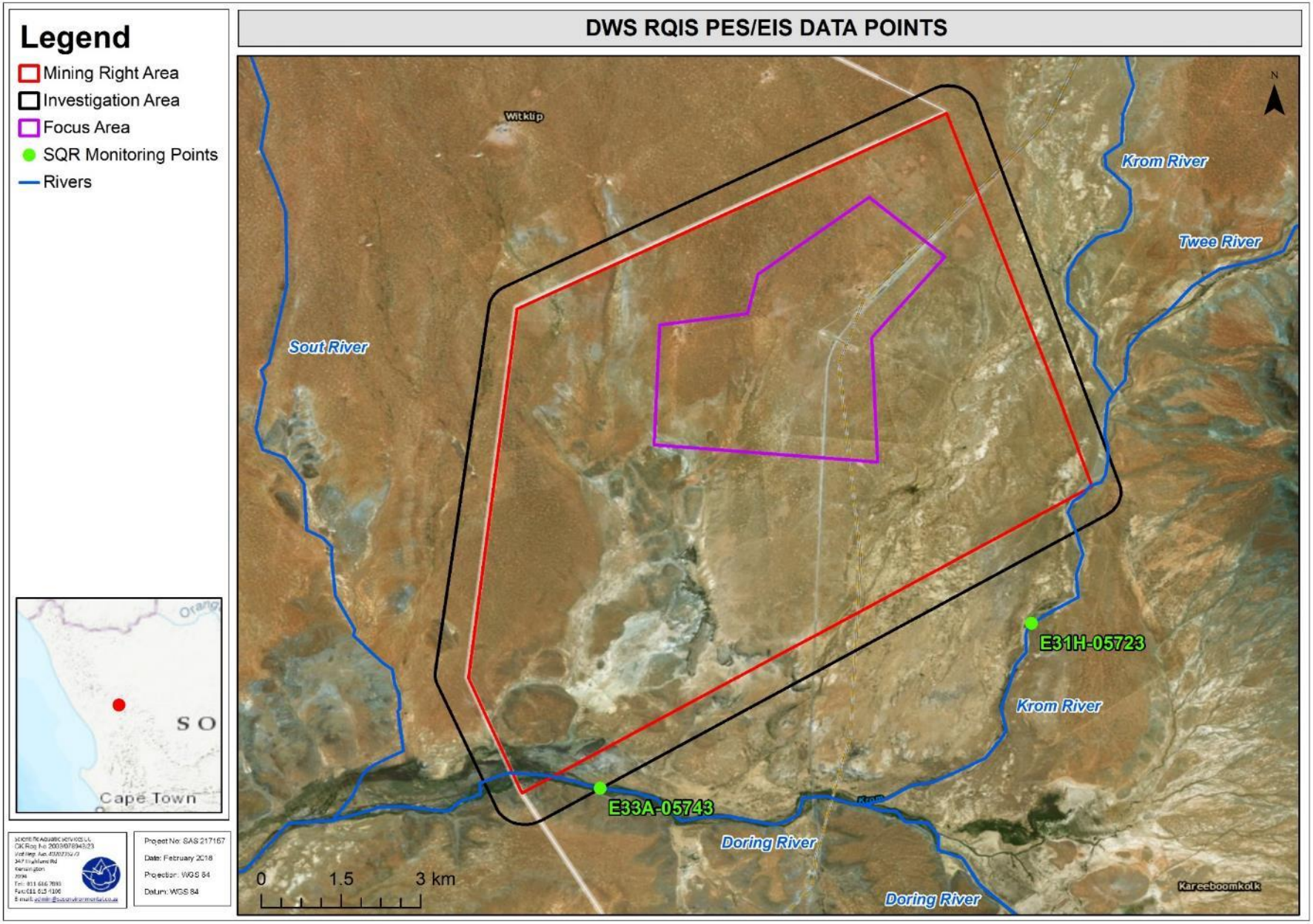


Figure 7: Relevant Sub-Quaternary Catchment Reaches (SQRs) of Rivers traverses various assessment areas

4. RESULTS

4.1 Freshwater System Characterisation

During the site assessment several freshwater resources were identified, namely:

- Doring River and its associated floodplain traversing the south western corner of the MRA;
- Krom River traversing the eastern corner of the MRA;
- An Unchannelled Valley Bottom (UVB), located south of the MRA area.
- Anabranching areas of the unnamed tributary of the Doring River;
- Ephemeral drainage lines with no true watercourse characteristics located south of the focus area as well as drainage lines located within the southern portion of the MRA, some of which link the UVB and the anabranching areas, which ultimately flow into the Doring River when there is sufficient rainfall. The locality of these freshwater resources in relation to the focus area is depicted in Figure 8 below.

Numerous ephemeral[1] drainage lines were identified which are located within the southwestern portion of the focus area, but are considered to not receive and retain sufficient water to support wetland or riparian characteristics (such as facultative or obligate wetland vegetation; soils with prolonged and frequent saturation; and no indication of a saturated soil zone within 50 cm of the soil surface and no significant change in structure and composition of bankside vegetation). These drainage lines are connected to a tributary which forms an anabranching or braided tributary of the Doring River located south west of the broader MRA. Since these features cannot be classified as a riparian resource in the traditional sense due to the lack of saturated soils and wetland/riparian vegetation, it does still function as a waterway, through episodic conveying of water, and therefore potentially enjoys protection in terms of the National Water Act, 1998 (Act 36 of 1998), if a 1:100 floodline is applicable to these features.

[1] "Ephemeral rivers flow for less time than they are dry. Flow or flood for short periods of most years in a five-year period, in response to unpredictable high rainfall events." (Rossouw *et. al*, 2006)

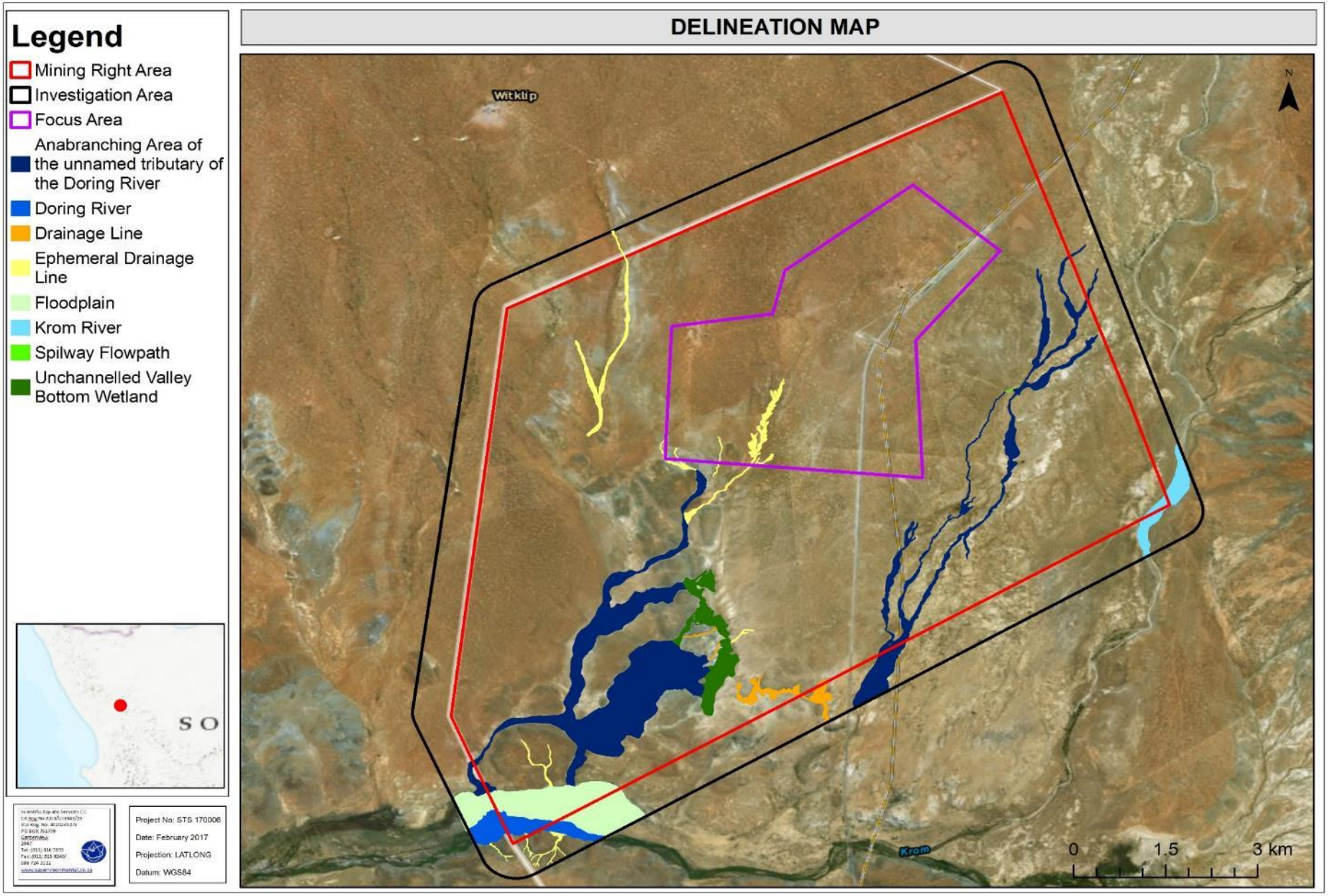


Figure 8: The location of freshwater resources identified within the MRA during the field assessment.

Also, several areas of floodplain were identified within the MRA, within the temporary zone of the UVB and within the terrestrial areas. It is assumed that these areas have been created due to subsidence from the underlying limestone being dissolved by the shallow water table of this area, corresponding with the cavity clusters identified within the GPR survey.

Groundwater is deemed the main hydrological driver of the UVB and floodplain wetlands, whilst surface water is present within the drainage line only during periods of rainfall. These freshwater resources could be dry for relatively long periods of time between temporary flooding. This is mainly due to a high evaporation rate and low precipitation received in this part of the country.

Table 4: Characterisation of the riparian features identified within the focus area.

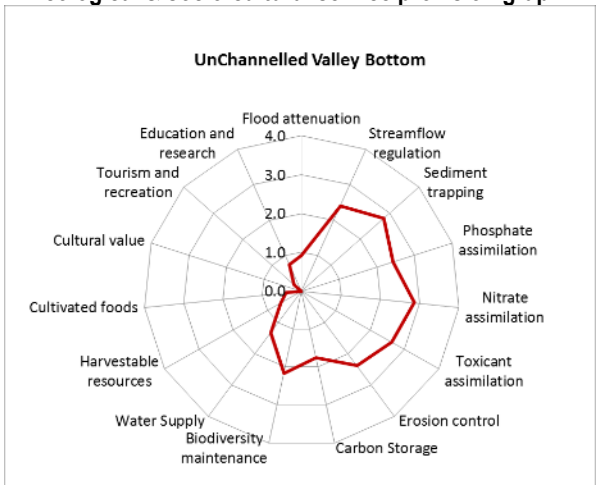
Feature	Level 3: Landscape unit	Level 4: HGM Type
UVB & Floodplain	**Valley floor:** the base of a valley, situated between two distinct valley side-slopes, where alluvial or fluvial processes typically dominate.	**Floodplain:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates.
Ephemeral drainage line	**Plain**: an extensive area of low relief. These areas are generally characterised by relatively level, gently undulating or uniformly sloping land with a very gentle gradient that is not located within a valley. Gradient is typically less than 0.01 or 1:100.	**River:** a linear landform with clearly discernible bed and banks, which permanently or periodically carries a concentrated flow of water (It should be noted that the above-mentioned description applies only to true riparian systems/true watercourses. Since the episodic preferential flow paths identified within the focus area are not true watercourses, this description does not strictly apply)

4.2 Field Verification Results

The tables below summarise the findings of the field assessment in terms of relevant aspects (hydrology, geomorphology and vegetation components) of freshwater ecology. The details pertaining to the method of assessment used to assess the freshwater resources is contained in Appendix C of this report and Appendix E presents the calculations for each of the methods.

Table 5: Summary of the assessment of the Unchannelled Valley Bottom located within the southern portion of the MRA

Ecological & socio-cultural service provision graph:



View of the Unchannelled Valley Bottom wetland located downgradient of the focus Area

PES discussion	**PES Category: C (Moderate)** Impacts on this UVB are mainly due to the transformation of the surrounding area of the UVB, particularly due to historical agricultural activities within the buffer zone of the UVB, and recently, from the trampling and grazing of livestock within the UVB. Various trenches draining water into and from the UVB has been created.	**Watercourse drivers:** **a) Hydrology** This UVB is hydrologically driven by groundwater. Surface water is not always present within the UVB, as the water table fluctuates. Lowering of the water table is potentially due to abstraction of water by local farmers from boreholes, and the rising thereof due to overland inflow (especially during rainfall events). Due to the high evaporation rate of this area, surface water is only present within the UVB for short periods of time. Since trenches have also been created to drain water to and from the UVB, it is most likely that the UVB would not exceed its banks during rainfall events as water would be conveyed to downgradient areas but would also receive water from the surrounding old agricultural fields.
Ecoservice provision	**Moderately: Intermediate** This UVB plays an important role in the assimilation of nutrients due to the nature of this wetland within the landscape. The intact vegetation component within and	**b) Water quality** Water quality was not tested, however no obvious influencing factors, such as direct discharge of contaminated water, which may impact on the water quality of this UVB. Some enrichment of the water due to livestock grazing and trampling is possible. Drying out of the UVB drives the precipitation of minerals, including calcium and phosphate minerals due to the concentrating effects of evaporation.

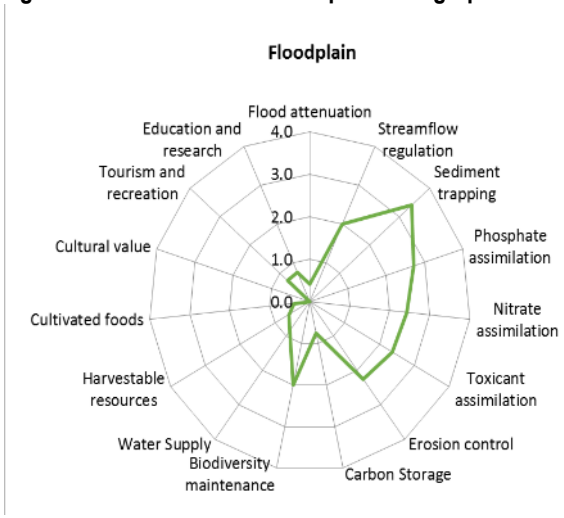
<table>
<tr><td></td><td>surrounding this wetland provides habitat to a variety of species. This wetland is not considered important for any direct human benefits (water supply, tourism and recreation or cultivated foods), mainly because this wetland is in an isolated area which is not regularly traversed.</td><td colspan="2">c) Topography: Geomorphology and sediment balance

Some impacts to the geomorphology were noted, relating to historical anthropogenic activities, and it is anticipated that under current conditions, natural deterioration of the geomorphology is considered unlikely. The most notable impact on the geomorphology is the irregular soil mounts which may have been created to drain water to and from the UVB, which transport additional sediment into the UVB. Also, due to the extent of the grazing activities of livestock/sheep within and surrounding the UVB, some areas are left bare, from which sediment enters the UVB.</td></tr>
<tr><td rowspan="2">EIS discussion</td><td rowspan="2">EIS Category B (High)
As with the drainage line this floodplain is connected to, this wetland is also considered of high ecological importance due to its hydro-functional importance (with specific mention of its nutrient assembly), and because it forms part of a CBA (Northern Cape Critical Biodiversity Database, 2016).</td><td colspan="2">d) Habitat and biota

Common reed as well as small sedge species within the UVB provide habitat for a variety of faunal species, and since it is connected to the drainage lines, acts as a migration corridor. Overall, the vegetation associated with this UVB is considered intact and representative of the natural vegetation type. For more detail pertaining to the surrounding vegetation habitat, please refer to the Terrestrial Sensitivity Report for a more detailed discussion (STS, 2018).</td></tr>
<tr><td>REC Category</td><td>Category C
Due to the above-mentioned activities which have historically and currently impact on this UVB, this REC category indicates that management measures should be implemented to maintain the present level of ecological services and functioning of this UVB, so as to ensure that no further deterioration of the UVB is permitted as a result of the proposed mining activities.</td></tr>
</table>

Table 6: Summary of the assessment of the Floodplain associated with the Doring River, traversing the southwest corner of the MRA

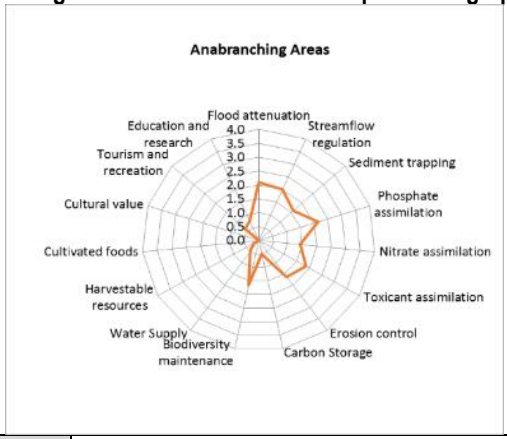
Ecological & socio-cultural service provision graph:



PES discussion	**PES Category: B (Largely natural with few modifications)** This floodplain wetland is considered to be largely natural, mainly because there are anthropogenic influences occurring in the vicinity of this feature. The vegetation component of this feature is considered somewhat intact. The hydrology of this wetland has been impacted on to some degree, however it is still in a more natural condition.	**Watercourse drivers:** **a) Hydrology** As this floodplain forms part of the Doring River, the Doring River allows for water to drain into the floodplain during times of high rainfall and exit the floodplain to drain to the downstream section of the Doring River. The floodplain is also fed by runoff water from the upgradient areas, which flow into the flood plain before it reaches the Doring River. **b) Water quality** This floodplain was dry at the time of the assessment. However, due to the relatively remote locality of thereof, it can be concluded that the water quality is unlikely to be impacted by pollutants, however may be potentially enriched with nutrients by the presence of livestock within the upgradient areas.	
Ecoservice provision	**Category: Intermediate** This floodplain plays an important role in the flood attenuation due to its location in the landscape and its association with the Doring River. This Floodplain is not considered important for any direct human benefits (water supply, tourism and recreation or cultivated foods).	**c) Topography: Geomorphology and sediment balance** Sedimentation largely occurs within this feature, and it enters via the Doring River and from upgradient areas during high rainfall events, but no significant deposition was evident. Also, due to the surface roughness of the wetland and the surrounding terrestrial habitat, limited excessive sediment is likely available to enter this wetland. **d) Habitat and biota** Vegetation was observed within the floodplain and since it is connected to the Doring River, it acts as a migration corridor. Overall, the vegetation associated with this floodplain is considered fairly intact. For more detail pertaining to the surrounding vegetation habitat, please refer to the Terrestrial Report for a more detailed discussion (STS, 2018).	
EIS discussion	**EIS Category B (High)** This floodplain is connected to the Doring River, and thus considered important due to its hydro-functional importance (with specific mention of its nutrient assembly), and because it forms part of a CBA (Northern Cape Critical Biodiversity Database, 2016).	**REC Category**	**Category B (Largely natural with few modifications)** As this floodplain has not experienced a variety of impacts originating from anthropogenic related activities, it is considered to be largely natural. Therefore, future developments within the surrounding area to this floodplain should not be allowed to impact on this resource as it is considered to be ecologically important.

Table 7: Summary of the assessment of the Anabranching areas and Drainage lines located within the MRA.

Ecological & socio-cultural service provision graph:



View of the anabranching areas within the MRA

PES and general habitat integrity discussion	**PES Category: C (Moderate)** The riparian vegetation cover within the marginal zone remains fairly intact and indicative of the natural species composition expected in the vegetation type, however some invasive species were present in areas which are extensively trampled. Farm roads, trenches, fences and powerlines which traverse some portions of this drainage line, have resulted in localised incidences of increased sediment inputs and altered flow patterns during rainfall events, which has altered the overall ecological integrity of this feature.	**Watercourse drivers:** **a) Hydrology** As this drainage line is ephemeral in nature, it only conveys water during times of rainfall, when water from the larger catchment drains into this resource. Some localised alterations to flow patterns within the drainage line have occurred as a result roads and where trenches crosses through this drainage line. Small geomorphological modifications such as accumulation of sediment as a result of trampling have occurred, however, it is not deemed to have had significant detrimental impacts on the overall hydrological functionality of the drainage line.	
		b) Water quality The water quality is unlikely to be impacted by pollutants relating to the surrounding areas but may be enriched with nutrients by the presence of sheep in the in the surrounding areas.	
Ecoservice provision	**Category: Moderately Low** These features are considered important for flood attenuation, streamflow regulation as well as some sediment trapping. These features are however not considered important for water supply, harvestable resources or cultivated foods, mainly due to it being located in a naturally water scarce region.	**c) Topography: Geomorphology and sediment balance** Erosion was apparent in some areas but was not considered severe at the time of the assessment, although losses of vegetation in is largely sparse, leading to erosion increased sedimentation.	
		e) Habitat and biota These features have sparse vegetative cover and did not have enough wetland vegetation. For more detail pertaining to the surrounding vegetation habitat, please refer to the Terrestrial Report for a more detailed discussion (STS, 2018).	
EIS discussion	**EIS Category B (High)** These features are considered of high ecological importance due to its hydro-functional importance (with specific mention of the streamflow and flood attenuation it provides), and because it forms part of an CBA (Northern Cape Critical Biodiversity Database, 2016).	**REC Category**	**Category C** This ephemeral drainage lines remain in relatively good condition despite some modification to this resource, and is considered to be ecologically important; therefore, efforts should be made to retain current levels of ecological functioning and prevent degradation of this resource.

Table 8: VEGRAI results for the Doring River traversing the MRA

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	73.3	45.8	3.0	1.0	100.0
NON MARGINAL	46.7	17.5	3.0	2.0	60.0
2.0					160.0
LEVEL 3 VEGRAI (%)				63.3	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3.0	

Table 9: VEGRAI results for the Krom River traversing the MRA

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	68.3	42.7	3.0	1.0	100.0
NON MARGINAL	55.6	20.8	3.0	2.0	60.0
2.0					160.0
LEVEL 3 VEGRAI (%)				63.5	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3.0	

4.2.1 Delineation

All freshwater features within the focus area were delineated in the field according to the method of DWAF (2008), however use was made of topographic maps and historical and current digital satellite imagery to aid in the delineation. The freshwater feature delineations as presented in this report are regarded as a best estimate of the temporary zone boundaries based on the site conditions present at the time. Freshwater resources located outside of, but within 500m of the focus area, were delineated using digital satellite imagery, but were not ground-truthed.

During the assessment, the following indicators were used to ascertain the boundaries of the temporary zones of the freshwater resources:

- Terrain units were used to determine in which parts of the landscape freshwater features would most likely occur in;
- Soils were also used to determine the boundary of the wetland features; and
- The vegetation indicator was used, where possible, in the identification of the freshwater feature boundaries through the identification of the distribution of facultative and obligate wetland vegetation. However, the use of this parameter was limited. Nonetheless, in areas where the vegetation was considered intact, this was considered a useful indicator (Figure 7).

Figure 9: Vegetation species associated with wetlands and soils depicting redoximorphic character within the UVB wetlands.

4.2.2 Legislative requirements and national guidelines pertaining to the application of buffer zones

According to Macfarlane *et al.* (2015) the definition of a buffer zone is variable, depending on the purpose of the buffer zone, however in summary, it is considered to be "a strip of land with a use, function or zoning specifically designed to protect one area of land against impacts from another". Buffer zones are considered to be significant in providing protection of basic ecosystem processes (in this case, the protection of aquatic as well as 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 that buffer zones are not considered to be effective mitigation against impacts such as water quality and quantity degradation (due to the cone of floodplain and decant of water into the groundwater supply), hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

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

- In accordance with GN509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as:
  - the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
  - in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
  - a 500 m radius from the delineated boundary (extent) of any wetland or UVB; and
- In terms of Regulation GN 704 of the NWA, 1998 (Act no. 36 of 1998), a 100m zone of regulation or 1:100 year or 1:50 year floodline (dependent on activity) around the freshwater resource is required, whichever is greater.

However, as mentioned above, it should be noted that application of a buffer zone or zone of regulation does not necessarily provide protection of groundwater resources, and it is therefore recommended that the mitigation measures contained within a specialist hydrogeology report be adhered to in order to minimise the impacts on groundwater which in turn could manifest as surface water impacts.

Therefore, the abovementioned legislative requirements were used to determine the extent of buffer zone/zone of regulation required for the identified freshwater resources. If any activities are to take place within 100m or the 1:100 year flood lines (which ever distance is the greatest) exemption terms of Regulation GN 704 of the NWA, 1998 (act no. 36 of 1998) needs to be obtained. Section 21 of the NWA (Act 36 of 1998) as well as General Notice no. 509 of 2016 as it relates to the NWA will also apply and therefore authorisation will be required.

Numerous ephemeral drainage features were also identified. These drainage features, with specific mention to the ones within the focus area did not have any true riparian characteristics (i.e. vegetation of terrestrial zone does not differ from the vegetation found within the drainage features). It must however be noted that should these ephemeral drainage features have a floodline applicable to them, they would be defined as a watercourse and enjoy protection as such in terms of the National Water Act (Act 36 of 1998). Should the ephemeral drainage features be defined as a watercourse according to the NWA (1998), then the GN 704 100m

zone of regulation will apply. If no floodline is associated with the ephemeral drainage features, it cannot be defined as a watercourse as defined in the National Water Act. The floodline determination has been verified by a suitably qualified hydrologist. The figures below conceptually depict the applicable legislative zones of regulation for the identified freshwater resources. It is acknowledged that the ephemeral drainage lines within the focus area have been afforded a 100m buffer by the hydrologists, however from an ecological point of view these features do not enjoy protection under the NWA. Thus, this 100m buffer should rather be treated as a precautionary measure to avoid any flooding of infrastructure however no authorisation is deemed necessary. Thus, for this reason they are not indicated on the figures below.

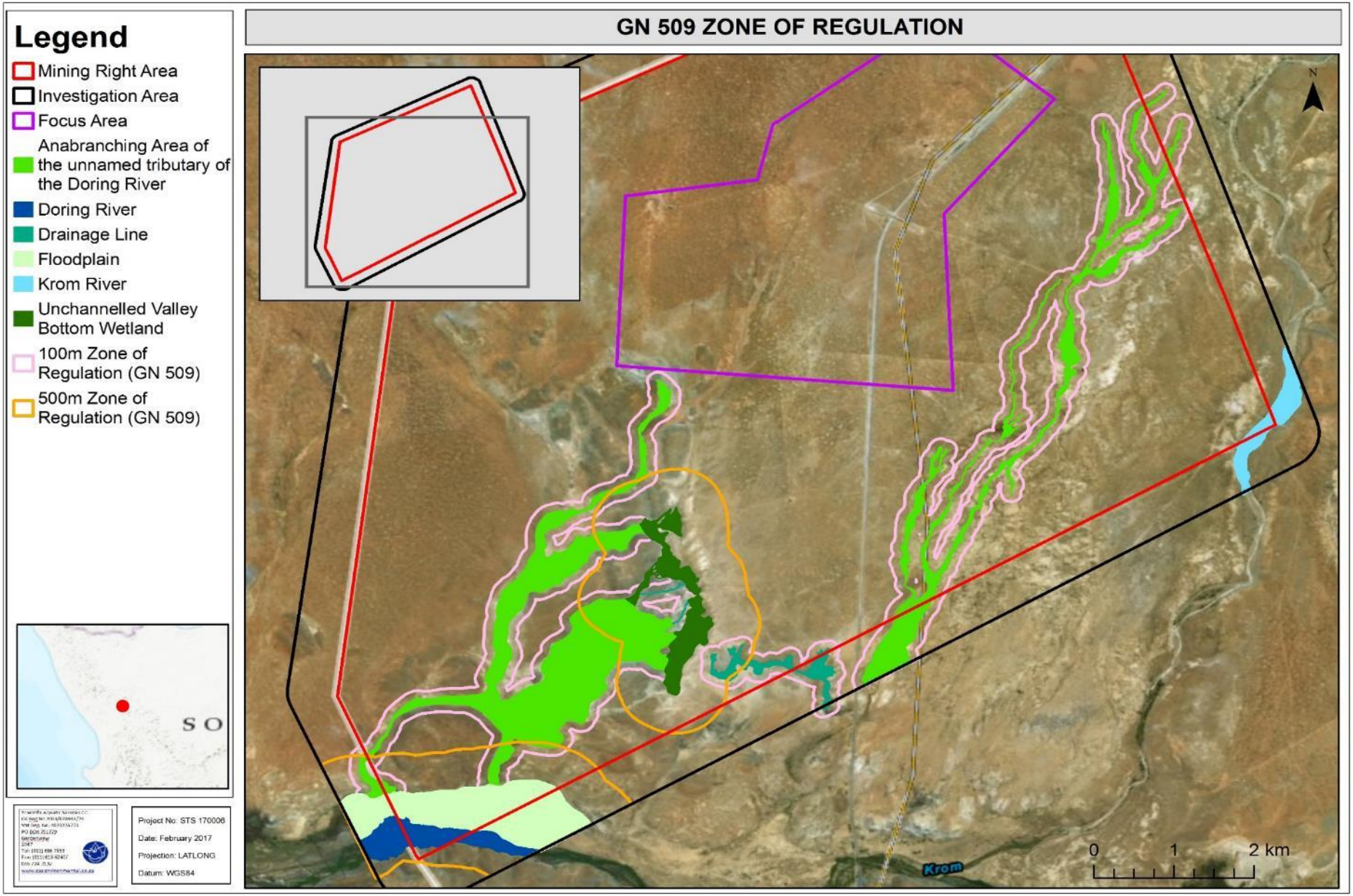


Figure 10: Map indicating the GN509 zones of regulation pertaining to the freshwater resources associated with the focus area and MRA

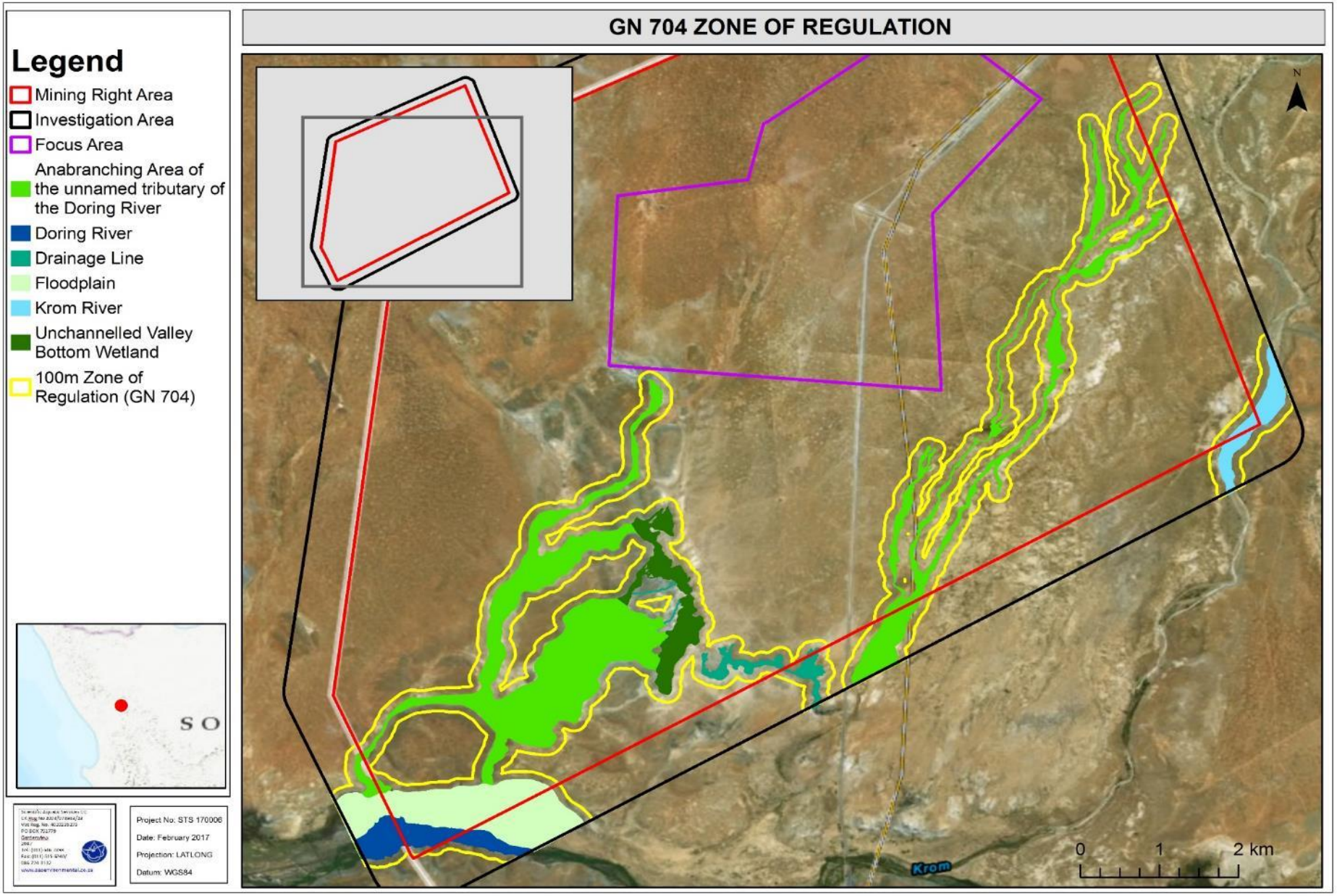


Figure 11: Map indicating the GN 704 zones of regulation applicable to the freshwater resources associated with the focus area and MRA

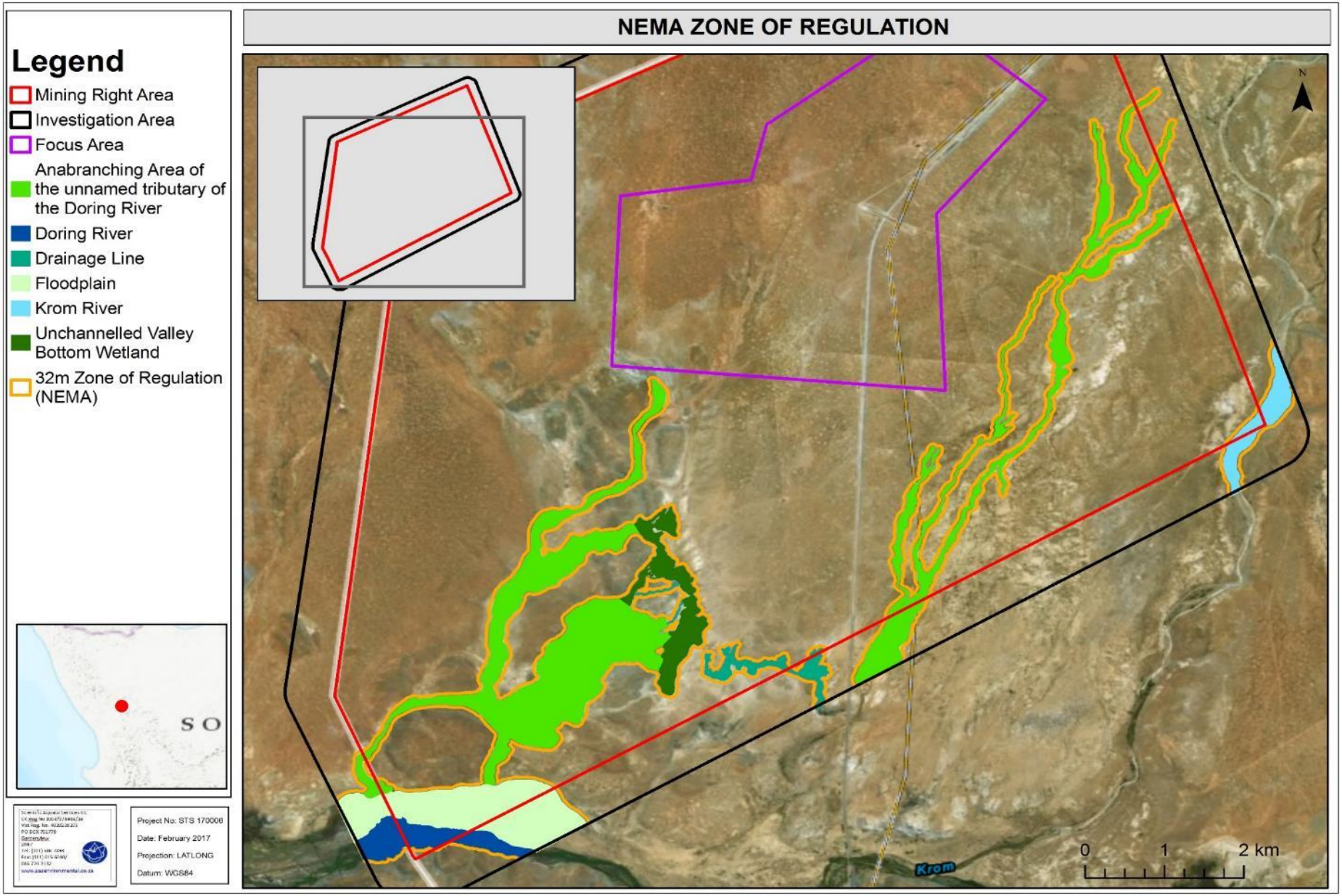


Figure 12: Map indicating the NEMA zones of regulation pertaining to the freshwater resources associated with the focus area and MRA

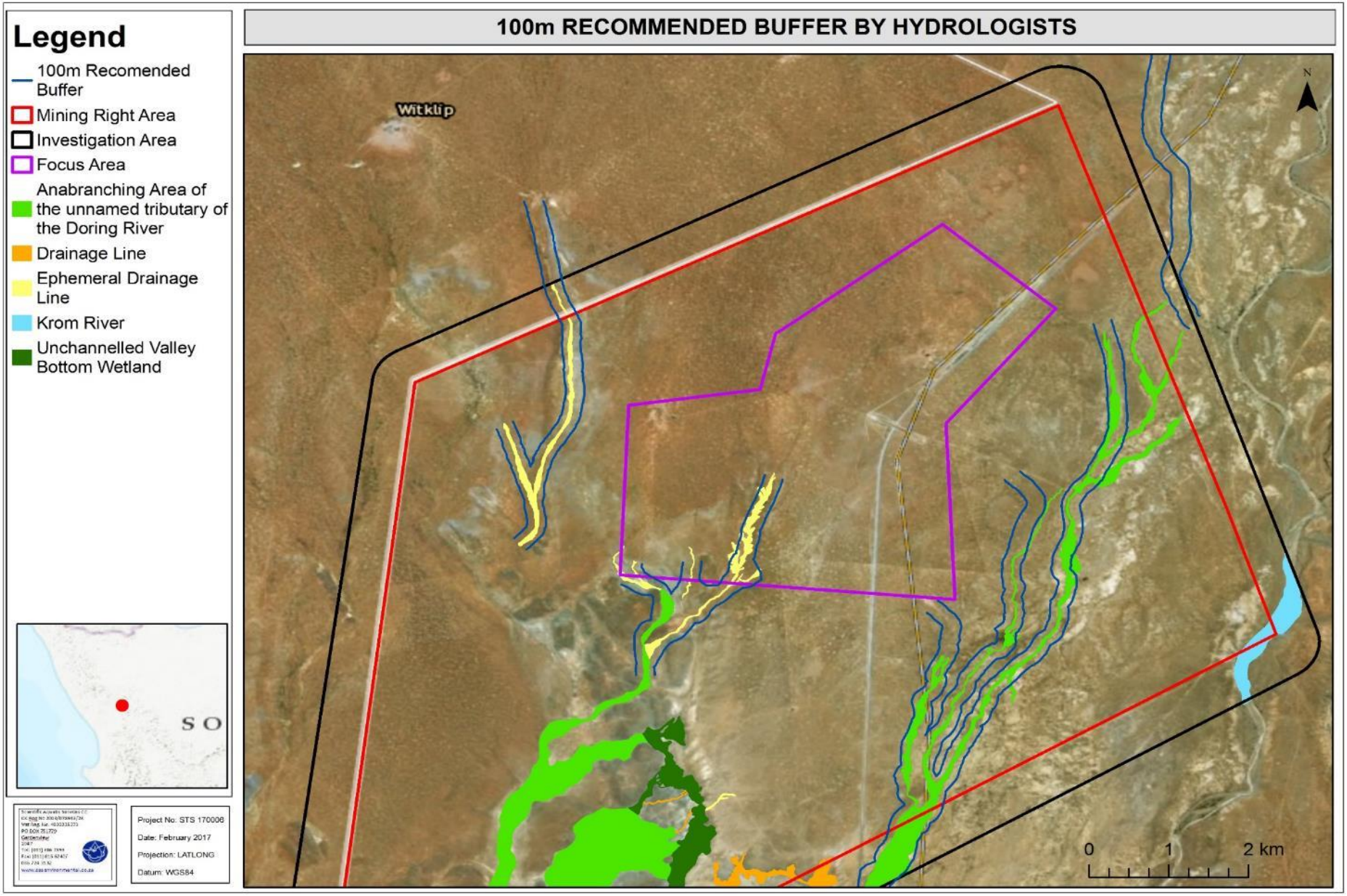


Figure 13: Map indicating the 100m recommended buffer by hydrologist associated with the focus area and MRA

5. IMPACT/RISK ASSESSMENT

The wetland impact assessment was undertaken on all aspects of wetland ecology likely to be affected by the proposed mining activities. The sections below present the results of the findings per identified risk/impact for the wetland ecology associated with the MRA.

Construction and mining related activities that will be undertaken include those such as the removal of the topsoil, clearing of vegetation in preparation for mining, and infrastructure to support mining including storage infrastructure and offices. The construction activities do not directly interact with the wetlands since they are located approximately 1 km south of the proposed activities. Thus, direct impact is highly unlikely, however due to the occurrence of ephemeral drainages lines (not considered wetlands) adjacent to the proposed activities and their connectivity to the downgradient wetland systems, indirect impacts may occur if mitigation measures are not implemented. Clearing of vegetation in preparation for construction, and ongoing disturbances to vegetation during operational activities will result in exposed soils, in turn increasing the risk of erosion and potentially sedimentation of freshwater resources. Impacts on the freshwater will potentially lead to a loss/alteration of ecological structures.

Operational activities will likely result in the hydrocarbon contamination of soils as well as sedimentation within the ephemeral drainage lines, potentially leading to the alteration or loss of habitat for floral and faunal species associated with freshwater resources downgradient.

Three aspects of freshwater ecology are considered when assessing the impacts of the proposed project and related activities:

- Loss of wetland habitat and ecological structure;
- Changes to wetland ecological and sociocultural service provision; and
- Wetland hydrological function and sediment balance.

The following tables provide an indication of the anticipated impact significance pre- and post-mitigation, of the various activities to take place during the construction, operational, closure/rehabilitation and post-closure phases on the wetland habitats and ecological service provision, and hydrology and sediment budgets of these features within the Leandra B Section footprint. Essential and recommended mitigation measures pertinent to all aspects of the wetland ecology, and applicable throughout all phases of the proposed project, are then presented in Section 9.

5.1 Impact 1: Loss of Wetland Habitat and Ecological Structure

Aspects and activities register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to occurrence of mining activities in close proximity to ephemeral drainage lines, which will potentially transport materials to the downgradient freshwater features.	Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased runoff and erosion and consequent sedimentation of freshwater resources downgradient	Ongoing disturbances to soils, resulting in increased sedimentation and risk of erosion, arising from mining activities	Disturbance of soils as part of demolition activities and backfilling
	Earthworks in close proximity to drainage line areas, leading to increased runoff and erosion and altered runoff patterns	Migration of contaminants in soil (i.e. hydrocarbon) as a result of spillages by mining vehicles in close proximity to the ephemeral drainage lines which are linked to the downgradient wetland systems	Ongoing seepage and runoff from mining infrastructure (e.g. diesel storage tanks) to the groundwater regime beyond closure
	Potential movement of mining vehicles within the ephemeral drainage lines during mining, leading to destabilisation of soil particles which will subsequently be transported to the downgradient freshwater resources during rainfall events	Ongoing disturbance as a result of maintenance activities, leading to further destabilisation of soil particles which will subsequently be transported to the downgradient freshwater resources during rainfall events	Potential contamination from the decommissioning of mining infrastructure
	Potential dumping of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil and ephemeral drainage lines		Ineffective rehabilitation may lead to further habitat transformation and increased alien vegetation encroachment

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction Phase	2	4	2	2	3	6	7	42 (low)
Operational Phase	3	4	2	2	3	7	7	49 (Low)
Closure Phase	2	2	1	2	3	7	6	42 (Low)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction Phase	1	2	2	2	1	3	5	15 (Very low)
Operational Phase	1	2	2	2	1	3	5	15 (Very low)
Closure Phase	1	1	1	2	1	2	4	8 (Very low)

5.2 Impact 2: Changes to Wetland Ecological and Sociocultural Service Provision

Aspects and Activities Register

Pre-Construction	Construction	Operational	Decommissioning and Closure
Potential poor planning leading to occurrence of mining activities in close proximity to ephemeral drainage lines, which will potentially transport materials to the downgradient freshwater features.	Site clearing, the removal of vegetation, and associated disturbances to soils, leading to increased runoff and erosion and consequent sedimentation of freshwater resources downgradient	Ongoing disturbances to soils, resulting in increased sedimentation and risk of erosion, arising from mining activities	Disturbance of soils as part of demolition activities and backfilling
	Earthworks in close proximity to drainage line areas, leading to increased runoff and erosion and altered runoff patterns	Migration of contaminants in soil (i.e. hydrocarbon) as a result of spillages by mining vehicles in close proximity to the ephemeral drainage lines which are linked to the downgradient wetland systems	Ongoing seepage and runoff from mining infrastructure (e.g. diesel storage tanks) to the groundwater regime beyond closure
	Potential movement of mining vehicles within the ephemeral drainage lines during mining, leading to destabilisation of soil particles which will subsequently be transported to the downgradient freshwater resources during rainfall events	Ongoing disturbance as a result of maintenance activities, leading to further destabilisation of soil particles which will subsequently be transported to the downgradient freshwater resources during rainfall events	Potential contamination from the decommissioning of mining infrastructure
	Potential dumping of hazardous and non-hazardous waste, including waste material spills and refuse deposits into the soil and ephemeral drainage lines		Ineffective rehabilitation may lead to further habitat transformation and increased alien vegetation encroachment

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction Phase	3	2	2	2	3	5	7	35 (Low)
Operational Phase	3	2	2	2	3	5	7	35 (Low)
Closure Phase	2	2	2	2	3	4	7	28 (Low)
Managed	**Probability of Impact**	**Sensitivity of receiving environment**	**Severity**	**Spatial scale**	**Duration of impact**	**Likelihood**	**Consequence**	**Significance**
Construction Phase	1	2	2	2	1	3	5	15 (Very Low)
Operational Phase	1	2	2	1	1	3	5	15 (Very Low)
Closure Phase	1	1	1	1	1	2	3	6 (Very Low)

5.3 Impact 3: Impacts on Wetland Hydrological Function

Aspects and Activities Register

Pre-Construction	Construction	Operational	Closure
Potential poor planning leading to occurrence of mining activities in close proximity to ephemeral drainage lines, which will potentially transport materials to the downgradient freshwater features.	Site clearing, including the removal of vegetation and disturbances to soils, leading to increased runoff and erosion	Ongoing disturbance of soils as a result of general operational activities, leading to increased risk of erosion and increased sedimentation of ephemeral drainage lines which will consequently transport sedimentation to the freshwater features downgradient of the focus area	Disturbance of soils as part of demolition activities, leading to increased risk of erosion and increased sedimentation of freshwater features downgradient
Potential inadequate design of infrastructure leading to changes in hydrological function and sediment control capacity	Earthworks in close proximity to drainage line areas, leading to increased runoff and erosion and altered runoff patterns	Runoff from material stockpiles areas leading to increased	Movement of demolition vehicles the ephemeral drainage lines resulting in disturbances to the soil material resulting in increased sedimentation of freshwater feature downgradient
	Potential movement of mining vehicles within the ephemeral drainage lines during mining, leading to destabilisation of soil particles which will subsequently be transported to the downgradient freshwater resources during rainfall events	Increased runoff volumes due to paved and other impervious surfaces	
	Increased runoff volumes due to paved and other impervious surfaces		

Unmanaged	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction Phase	3	2	2	2	4	5	8	40 (Medium Low)
Operational Phase	3	2	2	2	4	5	8	40 (Medium Low)
Closure Phase	2	1	1	2	3	3	6	18 (Very Low)
Managed	Probability of Impact	Sensitivity of receiving environment	Severity	Spatial scale	Duration of impact	Likelihood	Consequence	Significance
Construction Phase	1	2	2	1	1	3	4	12 (Very Low)
Operational Phase	1	2	2	1	1	3	4	12 (Very Low)
Closure Phase	1	1	1	1	1	2	3	6 (Very Low)

5.4 Assessment Summary

From the results of the wetland impact assessment it can be noted that prior to mitigation, impacts on the receiving wetland environment downgradient of the focus area are of Medium-low to low levels since the footprint area is not situated close to the freshwater resources, and with good mitigation can be reduced low levels.

Table 10: Summary of impact significance on the freshwater resources associated with the MRA.

Construction Phase		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland habitat and ecological structure	Low	Very low
2: Changes to wetland ecological and socio-cultural service provision	Low	Very low
3: Impacts on wetland hydrological function	Medium-low	Very low
Operational Phase		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland habitat and ecological structure	Low	Very low
2: Changes to wetland ecological and socio-cultural service provision	Low	Very low
3: Impacts on wetland hydrological function	Medium-low	Very low
Decommissioning and Closure Phase		
Impact	**Unmanaged**	**Managed**
1: Loss of wetland habitat and ecological structure	Low	Very low
2: Changes to wetland ecological and socio-cultural service provision	Low	Very low
3: Impacts on wetland hydrological function	Very-low	Very-low

5.5 Integrated Impact Mitigation

Based on the findings of the wetland ecological assessment, several recommendations are made to minimise the impact on the aquatic and wetland ecology of the area, should the proposed Kanakies Project proceed:

5.5.1 Planning and layout

- During any construction phase no vehicles should be allowed to drive through the ephemeral drainage lines located immediately adjacent to the footprint area. Although these drainage lines are not considered to be watercourses and do not enjoy protection under the National Water Act, their connectivity to the downgradient wetlands will increase the susceptibility of the wetlands if mitigation measure are not implemented; and
- All mining infrastructure should remain far from the ephemeral drainage lines located in close proximity to the footprint area since impacts on these ephemeral drainage lines will likely be conveyed to the freshwater features located downgradient during high rainfall events

5.5.2 Hydrological drivers and consumption management

- Limit the footprint area of the construction activities to what is absolutely essential in order to minimise the loss of clean water runoff areas which recharge the receiving aquatic environment; and
- The landscape should be resurfaced and resloped in a manner that allows water to freely drain to the downgradient receiving environment post closure to avoid water ponding.

5.5.3 Contamination management

- Ensure that all spills are immediately cleaned up;
- All hazardous chemicals must be stored on specified surfaces;
- No dirty water runoff must be permitted to reach the wetland and riverine resources downgradient through the ephemeral drainage lines during the entire life of mine, and clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from entering the receiving aquatic environment. Clean and dirty water runoff systems should be constructed before construction of any other infrastructure takes place;
- Temporary clean and dirty water management systems must be put in place to prevent the contaminated runoff (suspended solids and salts and water with low pH) from reaching the downstream receiving environment. Clean and dirty water runoff systems should be constructed before construction of any other infrastructure takes place;
- Ensure that the mine process water system is managed in such a way as to prevent discharge to the receiving environment and to prevent discharge of dirty water;
- Implement measures to contain seepage as far as possible to prevent contamination of the groundwater regime;

- Upon closure all mining infrastructure should be removed in order to minimise the impacts on the aquatic resources of the area beyond the life of mine.

5.5.4 Geomorphological drivers and habitat management

- Ensure that all stockpiles are well managed and have measures such as berms are implemented to prevent erosion and sedimentation;
- During the construction and operational phases of the proposed mining and related activities erosion berms should be installed on roadways to prevent gully formation and siltation of the wetland resources, particularly since the soils in the focus area are naturally prone to erosion. The following points should serve to guide the placement of erosion berms:
  - Where the track has slope of less than 2%, berms every 50m should be installed;
  - Where the track slopes between 2% and 10%, berms every 25m should be installed;
  - Where the track slopes between 10%-15%, berms every 20m should be installed; and
  - Where the track has slope greater than 15%, berms every 10m should be installed.
- Monitor all drainage systems for erosion and incision;
- Adequate stormwater management must be incorporated into the design of the proposed development in order to prevent erosion and the associated sedimentation of the riparian and instream areas. In this regard special mention is made of:
  - Sheet runoff from cleared areas, paved surfaces and access roads needs to be curtailed;
  - Runoff from paved surfaces should be slowed down by the strategic placement of berms; and
  - All overburden stockpiles and waste stockpiles must have berms and/catchment paddocks at their toe to contain runoff from the facilities.

5.5.5 Essential mitigation measures in the closure phase:

- Demolition footprint must be clearly demarcated and no related activities, including the movement of vehicles, must be permitted to occur outside of the footprint area;
- All related waste and rubble must be removed from site and disposed of according to relevant SABS standards. No waste must be permitted to enter wetland resources;
- Edge effects such as erosion must be monitored and managed;
- All areas affected by stockpiling during the operational phase of the mine should be rehabilitated and stabilised using suitable grass mix to prevent sedimentation of the freshwater resources in the area;

- All areas should be resloped and topsoiled where necessary and reseeded with indigenous grasses; and
- It is deemed important that monitoring of alien vegetation is undertaken post-closure, as proliferation of alien vegetation in the demolition areas is expected.

5.5.6 Probable Latent Impacts

Even with extensive mitigation latent impacts on the receiving aquatic environment are deemed highly likely. The following points highlight the key latent impacts that have been identified:

- Sedimentation of the systems may occur for long after mining is completed;
- Eroded and incised drainage lines are unlikely to be rehabilitated; and
- Loss of soil volume and depth is likely since some soil material will be sold as a product.

5.6 Public Consultation

The Scoping Phase Public Meeting was held on the 9th of February 2018, and the Scoping Report was made available for public review between the 27th of March – 29th of April 2018, whereby Interested and Affected Parties (I&APs) were allowed to comment on the proposed project. A second Public Meeting is scheduled for the 29th of August 2018 to summarise the findings from the specialist studies for I&APs, which will be held concurrently with the public review of the EIA EMP report. Any comments received during the second round of public review will be addressed accordingly.

5.6.1 Brief Summary of Concerns and Issues Raised By I&APs

The following table summarises the issues raised by I&AP's during the Scoping phase public consultation on the relevant specialist report.

Comment received by I&AP's during Scoping Phase	Response
Proximity of the Kalk Gat Reserve to the proposed operations. This is a protected area. Appropriate buffer zones must be recommended and established	With reference to the comments concerning the Kalk Gat Private Reserve, although the western portion of the MRA does border the reserve, the actual focus area is located approximately 6km north-east of this reserve, and as such mining activities, provided mitigation measure are suitable implemented, are unlikely to impact upon the reserve. According to the NEMA Regulations 2017, "buffer" means an area extending 5km from the proclaimed boundary of nature reserve or that defined as such for a biosphere.
Certain areas have been mapped as areas of biodiversity importance appropriate ecological buffers should be recommended by the specialists and implemented	Refer to Section 4.2.2 for requirements on the buffer zones.
Waste generation and management	Refer to Section 5.5.3. for mitigation on contamination management.

6. CONCLUSION

Scientific Aquatic Services (SAS) was appointed to conduct a freshwater resource baseline assessment as part of the environmental impact assessment and authorisation process for the proposed mining of natural gypsum (Gy) on the remaining extent of the farm Kanakies 332, near Loeriesfontein, Northern Cape.

Following the results of the site assessment, it is apparent that the freshwater resources located within the MRA are deemed to be of a moderate ecological integrity. Taking this into consideration, these resources play an important role in maintaining the overall ecological functioning of the surrounding ecosystem. The freshwater resources are not readily susceptible to impacts from the proposed mining and related activities since they are located ± 1.1km away from proposed activities. However, it is deemed essential that as far as possible the ephemeral drainage line connectivity be preserved to prevent further cumulative impacts on the system downgradient of the focus area.

The perceived impact significance of activities within the focus area on the downgradient receiving environment are considered to be of medium-low to low levels since the footprint area is situated ± 1.1km away from the wetlands. Nevertheless, since the ephemeral drainage lines are located immediately to the south of the mining area, indirect impact may occur, thus strict mitigation measures are still required, and if effectively implemented, perceived impacts can be reduced to low significance.

Provided that responsible implementation of the mitigation hierarchy, as well as strict adherence to cogent, well-developed mitigation measures throughout all phases of the proposed development, the significance of potential impacts arising from the proposed activities can be reduced.

In conclusion, the proposed mining of gypsum would have a moderately-low to low impact on the freshwater ecology of the MRA. This impact must be considered in conjunction with other environmental aspects and sensitivities present in the area. Once the impact has been considered in this context, the relevant stakeholders including the EAP, the proponent and the regulating as well as commenting authorities must make an informed decision in line of the principals of sustainable development and the requirements for protection of the environment. It is the opinion of the wetland ecologist that this report provides sufficient and appropriate information to allow informed decision making in this regard.

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APPENDIX A: Indemnity and Terms of use of this Report

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken and SAS CC and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX B: Legislative Requirements

National Environmental Management Act (NEMA) (Act No. 107 of 1998)	The National Environmental Management Act (NEMA) (Act 107 of 1998) and the associated Regulations as amended in 2017, states that prior to any development taking place within a wetland or riparian area, an environmental authorisation process needs to be followed. This could follow either the Basic Assessment Report (BAR) process or the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
National Water Act (NWA) (Act No. 36 of 1998)	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).
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA (Act 36 of 1998)	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as: ➢ The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; ➢ In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or ➢ A 500 m radius from the delineated boundary (extent) of any wetland or UVB. 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.
Mineral and Petroleum Resources Development Act (MPRDA) (Act 28 of 2002)	The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the MPRDA Regulations and specifically requires the preparation of a Scoping Report, an Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP), and a Public Participation Process (PPP).
National Water Act (NWA) (Act No. 36 of 1998) GN 704 – Regulations on use of water for mining and related activities aimed at the protection of water resources, 1999	These Regulations, forming part of the NWA, 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, 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.

APPENDIX C: Method of Assessment

Wetland and Riparian Delineation

For the purposes of this investigation, a wetland and a riparian habitat are defined in the National Water Act (NWA) (1998) as stated below:

- A wetland is a land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.
- Riparian habitat is defined as including 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.

The wetland and riparian zone delineations took place according to the method presented in the "The practical field procedure for identification and delineation of wetlands and riparian areas" published by DWAF in 2005. The foundation of the method is based on the fact that wetlands have several distinguishing factors including the following:

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

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant period of wetness (at least three months of saturation per annum) and the temporary zone surrounds the seasonal zone and is only saturated for a short period of saturation (typically less than three months of saturation per annum), but is saturated for a sufficient period, under normal circumstances, to allow for the formation of hydromorphic soils and the growth of wetland vegetation. The objective of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland or riparian area.

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

The river encountered during site assessment was assessed using the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual: Inland systems, hereafter referred to as the "Classification System" (Ollis *et. al*., 2013). A summary on Levels 1 to 4 of the classification system are presented in the tables below.

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

<table>
<tr><td colspan="3">WETLAND / AQUATIC ECOSYSTEM CONTEXT</td></tr>
<tr><td>LEVEL 1:
SYSTEM</td><td>LEVEL 2:
REGIONAL SETTING</td><td>LEVEL 3:
LANDSCAPE UNIT</td></tr>
<tr><td rowspan="4">Inland Systems</td><td rowspan="4">DWA Level 1 Ecoregions
OR
NFEPA WetVeg Groups
OR
Other special framework</td><td>Valley Floor</td></tr>
<tr><td>Slope</td></tr>
<tr><td>Plain</td></tr>
<tr><td>Bench
(Hilltop / Saddle / Shelf)</td></tr>
</table>

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	(not applicable)
	Floodplain flat	(not applicable)
Floodplain	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

[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.

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;
- **Floodplain:** a landform with closed elevation contours that increases in depth from the perimeter to a central area of greatest depth, and within which water typically accumulates;
- **Wetland Flat:** a level or near-level wetland area that is not fed by water from a river channel, and which is typically situated on a plain or a bench. Closed elevation contours are not evident around the edge of a wetland flat; and
- **Seep:** a wetland area located on (gently to steeply) sloping land, which is dominated by the colluvial (i.e. gravity-driven), unidirectional movement of material down-slope. Seeps are often located on the side-slopes of a valley but they do not, typically, extend into a valley floor.

The above terms have been used for the primary HGM Units in the classification system to try and ensure consistency with the wetland classification terms currently in common usage in South Africa. Similar terminology (but excluding categories for "channel", "flat" and "valleyhead seep") is used, for

example, in the recently developed tools produced as part of the Wetland Management Series including WET-Health (Macfarlane *et. al*., 2008) and WET-EcoServices (Kotze *et. al*., 2009).

WETLAND PES CALCULATIONS

WET-Health

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

Level of Evaluation

Two levels of assessment are provided by WET-Health:

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

Framework for the Assessment

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

Units of Assessment

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

Quantification of Present State of a wetland

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

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

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

Assessing the Anticipated Trajectory of Change

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

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

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

Overall health of the wetland

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

Wet-Ecoservices (2009)

"The importance of a water resource, in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class" (DWA, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described by Kotze *et al.* (2009). An assessment was undertaken that examines and rates the following services according to their degree of importance and the degree to which the service is provided:

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

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

Table C5: Classes for determining the likely extent to which a benefit is being supplied.

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

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

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

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

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

The highest of these three suites of scores is then used to determine the overall Importance and Sensitivity category (Table C7) of the wetland system being assessed.

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

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

Recommended Ecological Category (REC)

“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 REC (table below) was determined based on the results obtained from the PES, reference conditions and EIS of the resource (sections above), and is followed by realistic recommendations, mitigation, and rehabilitation measures to achieve the desired REC.

A wetland may receive the same class for the PES as the REC if the wetland 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 wetland feature.

Table C7: Description of REC classes.

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

Ecological Impact Assessment Method

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[3]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as wetlands, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria. Refer to the Table C8. The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity and the frequency of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value of 10. The values for likelihood and consequence of the impact are then read off a significance-rating matrix and are used to determine whether mitigation is necessary[4].

The assessment of significance is undertaken twice. Initial, significance is based on only natural and existing mitigation measures (including built-in engineering designs). The subsequent assessment takes into account the recommended management measures required to mitigate the impacts. Measures such as demolishing infrastructure, and reinstatement and rehabilitation of land, are considered post-mitigation.

The model outcome of the impacts was then assessed in terms of impact certainty and consideration of available information. The Precautionary Principle is applied in line with South Africa's National Environmental Management Act (No. 108 of 1997) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or

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

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

outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

Table C8: Criteria for assessing significance of impacts
LIKELIHOOD DESCRIPTORS

Probability of impact	**RATING**
Highly unlikely	1
Possible	2
Likely	3
Highly likely	4
Definite	5
Sensitivity of receiving environment	**RATING**
Ecology not sensitive/important	1
Ecology with limited sensitivity/importance	2
Ecology moderately sensitive/ /important	3
Ecology highly sensitive /important	4
Ecology critically sensitive /important	5

CONSEQUENCE DESCRIPTORS

Severity of impact	**RATING**
Insignificant / ecosystem structure and function unchanged	1
Small / ecosystem structure and function largely unchanged	2
Significant / ecosystem structure and function moderately altered	3
Great / harmful/ ecosystem structure and function largely altered	4
Disastrous / ecosystem structure and function seriously to critically altered	5
Spatial scope of impact	**RATING**
Activity specific/ < 5 ha impacted / Linear developments affected < 100m	1
Development specific/ within the site boundary / < 100ha impacted / Linear developments affected <	2
Local area/ within 1 km of the site boundary / < 5000ha impacted / Linear developments affected <	3
Regional within 5 km of the site boundary / < 2000ha impacted / Linear developments affected < 3000m	4
Entire habitat unit / Entire system/ > 2000ha impacted / Linear developments affected > 3000m	5
Duration of impact	**RATING**
One day to one month	1
One month to one year	2
One year to five years	3
Life of operation or less than 20 years	4
Permanent	5

Table C9: Significance Rating Matrix.

LIKELIHOOD (Frequency of activity + Frequency of impact)	CONSEQUENCE (Severity + Spatial Scope + Duration)														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30
	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45
	4	8	12	16	20	24	28	32	36	40	44	48	52	56	60
	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75
	6	12	18	24	30	36	42	48	54	60	66	72	78	84	90
	7	14	21	28	35	42	49	56	63	70	77	84	91	98	105
	8	16	24	32	40	48	56	64	72	80	88	96	104	112	120
	9	18	27	36	45	54	63	72	81	90	99	108	117	126	135
	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150

Table C10: Positive/Negative Mitigation Ratings.

Significance Rating	Value	Negative Impact Management Recommendation	Positive Impact Management Recommendation
Very high	126-150	Critically consider the viability of proposed projects Improve current management of existing projects significantly and immediately	Maintain current management
High	101-125	Comprehensively consider the viability of proposed projects Improve current management of existing projects significantly	Maintain current management
Medium-high	76-100	Consider the viability of proposed projects Improve current management of existing projects	Maintain current management
Medium-low	51-75	Actively seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Low	26-50	Where deemed necessary seek mechanisms to minimise impacts in line with the mitigation hierarchy	Maintain current management and/or proposed project criteria and strive for continuous improvement
Very low	1-25	Maintain current management and/or proposed project criteria and strive for continuous improvement	Maintain current management and/or proposed project criteria and strive for continuous improvement

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for all stages of the project cycle including:
  - Pre-construction;
  - Construction; and
  - Operation.
- If applicable, transboundary or global effects were assessed.
- Individuals or groups who may be differentially or disproportionately affected by the project because of their *disadvantaged* or *vulnerable* status were assessed.
- Particular attention was paid to describing any residual impacts that will occur after rehabilitation.

Mitigation measure development

According to the DEA *et al.,* (2013) "Rich biodiversity underpins the diverse ecosystems that deliver ecosystem services that are of benefit to people, including the provision of basic services and goods such as clean air, water, food, medicine and fibre; as well as more complex services that regulate and mitigate our climate, protect people and other life forms from natural disaster and provide people with a rich heritage of nature-based cultural traditions. Intact ecological infrastructure contributes significant savings through, for example, the regulation of natural hazards such as storm surges and flooding by which is attenuated by wetlands".

According to the DEA *et al.,* (2013) Ecosystem services can be divided into 4 main categories:

- Provisioning services are the harvestable goods or products obtained from ecosystems such as food, timber, fibre, medicine, and fresh water;
- Cultural services are the non-material benefits such as heritage landscapes and seascapes, recreation, ecotourism, spiritual values and aesthetic enjoyment;
- Regulating services are the benefits obtained from an ecosystem's control of natural processes, such as climate, disease, erosion, water flows, and pollination, as well as protection from natural hazards; and
- Supporting services are the natural processes such as nutrient cycling, soil formation and primary production that maintain the other services.
-

Loss of biodiversity puts aspects of the economy, wellbeing and quality of life at risk, and reduces socio-economic options for future generations. This is of particular concern for the poor in rural areas who have limited assets and are more dependent on common property resources for their livelihoods. The importance of maintaining biodiversity and intact ecosystems for ensuring on-going provision of ecosystem services, and the consequences of ecosystem change for human well-being, were detailed in a global assessment entitled the Millennium Ecosystem Assessment (MEA, 2005), which established a scientific basis for the need for action to enhance management and conservation of biodiversity.

Sustainable development is enshrined in South Africa's Constitution and laws. The need to sustain biodiversity is directly or indirectly referred to in a number of Acts, not least the National Environmental Management: Biodiversity Act (No. 10 of 2004) (hereafter referred to as the Biodiversity Act), and is fundamental to the notion of sustainable development. In addition, International guidelines and commitments as well as national policies and strategies are important in creating a shared vision for sustainable development in South Africa (DEA *et al.,* 2013).

The primary environmental objective of the Mineral and Petroleum Resources Development Act (MPRDA) is to give effect to the environmental right contained in the South African Constitution. Furthermore, Section 37(2) of the MPRDA states that "any prospecting or mining operation must be conducted in accordance with generally accepted principles of sustainable development by integrating social, economic and environmental factors into the planning and implementation of prospecting and mining projects in order to ensure that exploitation of mineral resources serves present and future generations".

Pressures on biodiversity are numerous and increasing. According to the DEA *et al.,* (2013) Loss of natural habitat is the single biggest cause of biodiversity loss in South Africa and much of the world. The most severe transformation of habitat arises from the direct conversion of natural habitat for human requirements, including[5]:

- Cultivation and grazing activities;
- Rural and urban development;
- Industrial and mining activities, and
- Infrastructure development.

Impacts on biodiversity can largely take place in four ways (DEA *et al.,* 2013):

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from riverine resources;

[5] Limpopo Province Environment Outlook. A Report on the State of the Environment, 2002. Chapter 4.

- **Indirect impacts:** are impacts associated with a project that may occur within the zone of influence in a project such as surrounding terrestrial areas and downstream areas on water courses;
- **Induced impacts:** are impacts directly attributable to the project but are expected to occur due to the activities of the project. Factors included here are urban sprawl and the development of associated industries; and
- **Cumulative impacts:** can be defined as the sum of the impact of a project as well as the impacts from past, existing and reasonably foreseeable future projects that would affect the same biodiversity resources. Examples include numerous mining operations within the same drainage catchment or numerous residential developments within the same habitat for faunal or floral species.

Given the limited resources available for biodiversity management and conservation, as well as the need for development, efforts to conserve biodiversity need to be strategic, focused and supportive of sustainable development. This is a fundamental principle underpinning South Africa's approach to the management and conservation of its biodiversity and has resulted the definition of a clear mitigation strategy for biodiversity impacts.
'Mitigation' is a broad term that covers all components of the 'mitigation hierarchy' defined hereunder. It involves selecting and implementing measures – amongst others – to conserve biodiversity and to protect, the users of biodiversity and other affected stakeholders from potentially adverse impacts as a result of mining or any other land use. The aim is to prevent adverse impacts from occurring or, where this is unavoidable, to limit their significance to an acceptable level. Offsetting of impacts is considered to be the last option in the mitigation hierarchy for any project.
The mitigation hierarchy in general consists of the following in order of which impacts should be mitigated (DEA *et al.,* 2013):

- **Avoid/prevent impact:** can be done through utilising alternative sites, technology and scale of projects to prevent impacts. In some cases, if impacts are expected to be too high the "no project" option should also be considered, especially where it is expected that the lower levels of mitigation will not be adequate to limit environmental damage and eco-service provision to suitable levels;
- **Minimise impact:** can be done through utilisation of alternatives that will ensure that impacts on biodiversity and ecoservices provision are reduced. Impact minimisation is considered an essential part of any development project;
- **Rehabilitate impact:** is applicable to areas where impact avoidance and minimisation are unavoidable where an attempt to re-instate impacted areas and return them to conditions which are ecologically similar to the pre-project condition or an agreed post project land use, for example arable land. Rehabilitation can however not be considered as the primary mitigation tool as even with significant resources and effort rehabilitation that usually does not lead to adequate replication of the diversity and complexity of the natural system. Rehabilitation often only restores ecological function to some degree to avoid ongoing negative impacts and to minimise aesthetic damage to the setting of a project. Practical rehabilitation should consist of the following phases in best practice:
  - **Structural rehabilitation** which includes physical rehabilitation of areas by means of earthworks, potential stabilisation of areas as well as any other activities required to develop a long terms sustainable ecological structure;
  - **Functional rehabilitation** which focuses on ensuring that the ecological functionality of the ecological resources on the focus area supports the intended post closure land use. In this regard special mention is made of the need to ensure the continued functioning and integrity of wetland and riverine areas throughout and after the rehabilitation phase;
  - **Biodiversity reinstatement** which focuses on ensuring that a reasonable level of biodiversity is re-instated to a level that supports the local post closure land uses. In this regard special mention is made of re-instating vegetation to levels which will allow the natural climax vegetation community of community suitable for supporting the intended post closure land use; and
  - **Species reinstatement** which focuses on the re-introduction of any ecologically important species which may be important for socio-cultural reasons, ecosystem functioning reasons and for conservation reasons. Species re-instatement need only occur if deemed necessary.

- **Offset impact:** refers to compensating for latent or unavoidable negative impacts on biodiversity. Offsetting should take place to address any impacts deemed to be unacceptable which cannot be mitigated through the other mechanisms in the mitigation hierarchy. The objective of biodiversity offsets should be to ensure no net loss of biodiversity. Biodiversity offsets can be considered to be a last resort to compensate for residual negative impacts on biodiversity.

The significance of residual impacts should be identified on a regional as well as national scale when considering biodiversity conservation initiatives. If the residual impacts lead to irreversible loss or irreplaceable biodiversity the residual impacts should be considered to be of *very high significance* and when residual impacts are considered to be of *very high significance*, offset initiatives are not considered an appropriate way to deal with the magnitude and/or significance of the biodiversity loss. In the case of residual impacts determined to have *medium to high significance*, an offset initiative may be investigated. If the residual biodiversity impacts are considered of low significance no biodiversity offset is required.[6]

In light of the above discussion the following points present the key concepts considered in the development of mitigation measures for the proposed development.

- Mitigation and performance improvement measures and actions that address the risks and impacts[7] are identified and described in as much detail as possible.
- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation.
- Desired outcomes are defined, and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, with estimates of the resources (including human resource and training requirements) and responsibilities for implementation wherever possible.

Recommendations

Recommendations were developed to address and mitigate impacts associated with the proposed development. These recommendations also include general management measures which apply to the proposed development as a whole. Mitigation measures have been developed to address issues in all phases throughout the life of the operation from planning, through to construction and operation.

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

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

APPENDIX D: Results of the Field Investigation

Table D1: Summary of the results from the WET-Health assessment of the UVB wetland

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	53	100	2.0	1	2.3	0	2.4	0
2	0		0.0	0	0.0	0	0.0	0
3	0		0.0	0	0.0	0	0.0	0
4	0		0.0	0	0.0	0	0.0	0
5	0		0.0	0	0.0	0	0.0	0
Area weighted impact scores*			**2.0**	**1.0**	**2.3**	**0.0**	**2.4**	**0.0**
PES Category (See Table 5.29)			**C**	**↑**	**C**	**→**	**C**	**→**

Table D2: Summary of the results from the WET-Health assessment of the Floodplain wetland

HGM Unit	Ha	Extent (%)	Hydrology		Geomorphology		Vegetation	
			Impact Score	Change Score	Impact Score	Change Score	Impact Score	Change Score
1	156	100	1.0	1	2.0	0	1.2	0
2	0		0.0	0	0.0	0	0.0	0
3	0		0.0	0	0.0	0	0.0	0
4	0		0.0	0	0.0	0	0.0	0
5	0		0.0	0	0.0	0	0.0	0
Area weighted impact scores*			**1.0**	**1.0**	**2.0**	**0.0**	**1.2**	**0.0**
PES Category (See Table 5.29)			**B**	**↑**	**B**	**→**	**B**	**→**

Table D3: Summary of the results from the VEGRAI assessment, for the PES of the Drainage Lines.

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	68.3	42.7	3.0	1.0	100.0
NON MARGINAL	55.6	20.8	3.0	2.0	60.0
		2.0			160.0
LEVEL 3 VEGRAI (%)				63.5	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3.0	

Table D4: Presentation of the results of the VEGRAI assessment of the Doring River

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	73.3	45.8	3.0	1.0	100.0
NON MARGINAL	46.7	17.5	3.0	2.0	60.0
2.0					160.0
LEVEL 3 VEGRAI (%)				63.3	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3.0	

Table D5: Presentation of the results of the VEGRAI assessment of the Krom River

LEVEL 3 ASSESSMENT					
METRIC GROUP	**CALCULATED RATING**	**WEIGHTED RATING**	**CONFIDENCE**	**RANK**	**% WEIGHT**
MARGINAL	68.3	42.7	3.0	1.0	100.0
NON MARGINAL	55.6	20.8	3.0	2.0	60.0
2.0					160.0
LEVEL 3 VEGRAI (%)				63.5	
VEGRAI EC				**C**	
AVERAGE CONFIDENCE				3.0	

Table D6: Presentation of the results of the ecosystem services provided by the assessed freshwater resources associated with the MRA

Ecosystem service	Unchannelled Valley bottom	Drainage Lines	Anabranching areas	Floodplain
Flood attenuation	0.9	2.0	2.1	0.4
Streamflow regulation	2.4	2.0	2.0	2.0
Sediment trapping	2.8	1.6	1.6	3.4
Phosphate assimilation	2.4	1.9	2.1	2.7
Nitrate assimilation	2.9	1.1	1.4	2.4
Toxicant assimilation	2.6	1.6	1.9	2.4
Erosion control	2.4	1.6	1.6	2.3
Carbon Storage	1.8	0.5	0.5	0.8
Biodiversity maintenance	2.2	1.7	1.7	2.0
Water Supply	1.3	0.5	0.5	0.8
Harvestable resources	0.6	0.2	0.2	0.6
Cultivated foods	0.4	0.0	0.0	0.4
Cultural value	0.0	0.0	0.0	0.0
Tourism and recreation	0.3	0.6	0.6	0.8
Education and research	0.8	0.8	0.8	0.8
SUM	**23.7**	**16.1**	**17.0**	**21.7**
Average score	**1.6**	**1.1**	**1.1**	**1.4**

Table D7: Presentation of the results of the EIS assessment of the assessed freshwater features associated with the MRA

FRESHWATER FEATU+A1:G30RE:			UnChannelled Valley Bottom	Floodplain	Drainage Lines	Anabranching Areas
Ecological Importance and Sensitivity			Score (0-4)			
Biodiversity support			**A (average)**			
			0.67	0.67	0.00	0.00
Presence of Red Data species			0	0	0	0
Populations of unique species			1	1	0	0
Migration/breeding/feeding sites			1	1	0	0
Landscape scale			**B (average)**			
			2.00	2.00	1.20	1.20
Protection status of the wetland			3	3	3	3
Protection status of the vegetation type			1	1	1	1
Regional context of the ecological integrity			2	2	1	1
Size and rarity of the wetland type/s present			3	3	1	1
Diversity of habitat types			1	1	0	0
Sensitivity of the wetland			**C (average)**			
			2.67	2.00	1.00	1.00
Sensitivity to changes in floods			2	4	1	1
Sensitivity to changes in low flows/dry season			4	1	1	1
Sensitivity to changes in water quality			2	1	1	1
ECOLOGICAL IMPORTANCE & SENSITIVITY (max of A,B or C)			**B**	**B**	**B**	**B**
Hydro-Functional Importance			**Score (0-4)**			
Regulating & supporting benefits	**Flood attenuation**		3	4	1	3
	Streamflow regulation		1	3	2	2
	Water Quality Enhancement	***Sediment trapping***	2	3	1.5	1.5
		Phosphate assimilation	2	1	2	2
		Nitrate assimilation	2	1	2	2
		Toxicant assimilation	2	2	2	2
		Erosion control	1.5	1.5	2	2
	Carbon storage		1	1	1	1
HYDRO-FUNCTIONAL IMPORTANCE (average score)			2	2	2	2
Direct Human Benefits			**Score (0-4)**			
Subsistence benefits	***Water for human use***		0	0	0	0
	Harvestable resources		1	0	0	0
	Cultivated foods		0	0	0	0
Cultural benefits	***Cultural heritage***		0	0	1	1
	Tourism and recreation		1	1	1	1
	Education and research		1	1	1	1
DIRECT HUMAN BENEFITS (average score)			0.50	0.33	0.50	0.50

APPENDIX E: Details, Expertise and Curriculum Vitae of Specialists

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

Braveman Mzila BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)

Stephen van Staden MSc (Environmental Management) (University of Johannesburg)

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

Company of Specialist:	Scientific Aquatic Services		
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		

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

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF STEPHEN VAN STADEN

PERSONAL DETAILS

Position in Company	Managing member, Ecologist, Aquatic Ecologist
Date of Birth	13 July 1979
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2003 (year of establishment)
Other Business	Trustee of the Serenity Property Trust

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 IAIA South Africa

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2003
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2001
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	2000
Tools for wetland Assessment short course Rhodes University	2016

COUNTRIES OF WORK EXPERIENCE

South Africa – All Provinces

Southern Africa – Lesotho, Botswana, Mozambique, Zimbabwe Zambia

Eastern Africa – Tanzania Mauritius

West Africa – Ghana, Liberia, Angola, Guinea Bissau, Nigeria, Sierra Leona

Central Africa – Democratic Republic of the Congo

SELECTED PROJECT EXAMPLES

Client	Project	Project Description	Area
RESIDENTIAL			
GIBB (PTY) LTD	Bloemwater Knelpoort Project	Full ECO Assessment	Free State
DLC Town Plan (Pty) Ltd	Bongwini and Toekomsrus Project Gold 1	Environmental Sensitivity Analyses as part of the development of site Development Plans and Precinct Planning on the outskirts of Takoradi Ghana (2000 ha)	Randfontein
SRK Consulting (PTY) Ltd	Skoenmaker River	Wetland, Aquatic & ECO Assessment	Somerset East
Century Property Development	The Hills Eco Estate	Wetland delineation and ecological assessment, and rehabilitation plan	Midrand, Gauteng
ROADS, PIPELINES, POWERLINES AND OTHER LINEAR DEVELOPMENTS			
Delta Built Environment Consultants	Lesotho Border Road Project	Soil & Land Capability Assessment, full wetland ecological assessment and aquatic assessment as part of the EIA process	Lesotho
Spoor Environmental	Thabazimbi Waste Water Treatment Works; Upgrade of Sewer Pipeline	Freshwater resource ecological assessment and rehabilitation and management plan	Limpopo
Royal Haskoning DHV (Pty) Ltd	N11 Ring Road	Freshwater Ecological Assessment	Limpopo
Chameleon Environmental	N7 Road Upgrade Cederberg & Kransvleikloof	Floral RDL scan and delineation of the wetland areas along the proposed N7 road upgrade between Clanwilliam and Citrusdal	Western Cape
Iliso Consulting (Pty Ltd)	N3TC De Beers Pass Route	Variation order for additional work on N3TC De Beers pass route and existing N3 route	Kwa-Zulu Natal
MINING			
Anglo Platinum	Der Brochen Mine	Ongoing bi-annual seasonal aquatic biomonitoring from 2011 to present	Steelport Limpopo
Anglo Platinum	Der Brochen Mine	Wetland Ecological Assessment (2014) Full terrestrial, wetland and aquatic ecological assessment, soil and land capability assessment (2018)	Steelpoort, Limpopo
Bokoni Platinum Mine	Bokoni Platinum Mine	Annual Soil Monitoring & Soil Contamination	Free State
GIBB (PTY) LTD	Rustenburg Bridges	Aquatic Biomonitoring Assessment	Rustenburg, North West
Assmang Chrome Machadodorp	Assmang Chrome Machadodorp Works	Biomonitoring & Toxicological Monitoring for the 2015 period	Machadodorp, Mpumalanga
Globesight Advisory, Consulting & Training	Sabie TGME Project	Freshwater Ecological Assessment as part of the environmental assessment and authorization process for the proposed development (gold mining project – pre-mined residue and hard rock mining near Sabie)	Mpumalanga
Ikwezi Mining (Pty) Ltd	Ikwezi Doornkop Colliery	Develop freshwater resource rehabilitation and management plans, and conduct ecological biomonitoring in fulfillment of the water use licensing process for the Ikwezi Doornkop Colliery near Newcastle	Newcastle
Sappi Southern Africa (Pty) Ltd	Blesbokspruit Enstra Mill	Biomonitoring studies, whole effluent toxicity (WET) studies, bioaccumulation assessment and sediment heavy metal contaminant analyses	Johannesburg
Stibium Mining	Malati Opencast	Freshwater ecological assessment, risk assessment and freshwater rehabilitation and management plan and plant species plan as part of the water use authorization process for a proposed Malati opencast near Tzaneen	Limpopo
EXM Advisory Services	Heuningkranz Mine	Freshwater assessment, soil and land capability assessment done for Sishen Iron Ore Company (Pty) Ltd part of Kumba Iron Ore limited as part of the environmental management services for the Heuningkranz project	Northern Cape
Shangoni Management Services (Pty) Ltd	Leslie Colliery	Project manager, freshwater ecological assessment as part of the environmental impact assessment process for the underground coal mine to determine the status of the freshwater resources within the proposed mining area	Mpumalanga

SLR Consulting (Africa) (Pty) Ltd	Commissiekraal Colliery	Full Ecological investigation, including a terrestrial fauna and flora assessment as well as an assessment of the wetland and aquatic PES and wetland ecoservices on the site.	Kwa-Zulu Natal
Jacana Environmental CC	Leandra Colliery	Full Ecological Assessment, including a terrestrial fauna and flora assessment as well as an assessment of the wetland and aquatic PES and wetland ecoservices on the site.	Mpumalanga
SRK Consulting (PTY) Ltd	Marula Platinum Mine	Freshwater resource ecological assessment. Development of a plant species plan in line with the project's rehabilitation objectives	Burgersfort
Jacana Environmental CC	Donkerhoek Dam development	Full ecological assessment (Fauna, floral, wetland and aquatic assessment) as part of the EIA process	Mpumalanga
EXM Advisory Services	Evander Gold Mining (Pty) Ltd	Determination of the Wetland Offset Requirements for the proposed expansion of the Elikhulu Tailings Storage Facility	Mpumalanga
EXM Advisory Services	Canyon Coal - Witfontein mining project	Delineate and characterize the wetland and aquatic resources for the Witfontein mining project located by the farms Holfontein and Witrand near Bethal	Mpumalanga
SRK Consulting (South Africa) (PTY) Ltd	The Sierra Rutile Mine	Specialist terrestrial ecology, aquatic ecology and wetland ecology studies	Moyamba District - Sierra Leona
INFRASTRUCTURE			
GIBB (Pty) Ltd	Bronkhorstspruit Feeder Line	Monthly Aquatic Biomonitoring as part of the environmental assessment and authorization process for the proposed conversion of the Bronkhorstspruit plots feeder from 6.6kv to 22kv	Bronkhorstspruit
SRK Consulting (PTY) Ltd	South Dunes Precinct Project	Full Ecological Assessment	Richards Bay
SRK Consulting (PTY) Ltd	Braamfonteinspruit Rehabilitation	Terrestrial, Freshwater and Aquatic Ecological Assessment as part of the rehabilitation and management plan for the Braamfonsteinspruit, Johannesburg	Johannesburg
Iliso Consulting (Pty Ltd)	City of Johannesburg	Aquatic Ecological Assessment, monitoring and managing the ecological state of rivers in the City Of Johannesburg Metropolitan area	Johannesburg
Maanakana Projects and Consulting (Pty) Ltd	Lethabo Pump Station	Aquatic present ecological state assessment of the Vaal river	Vereeniging
SRK Consulting	CTIA runway re-alignment project – Wetland Offset	Determination of the Wetland offset requirements for Cape Town international Airport runway realignment, identification of a suitable offset location and compilation of relevant baseline assessments (Wetland and faunal), Khayelitsha. (2017)	Cape Town
GIBB (Pty) Ltd	Musami Dam	Determination of the draft environmental water quality requirements for the project	Zimbabwe
Nemai Consulting (PTY) Ltd	uMkhomazi Water Project	Determination of the Wetland and Terrestrial Biodiversity Offset Requirements for the proposed uMkhomazi Water Project	Richmond - KZN
POWER GENERATION			
Iliso Consulting	Mzimvubu Dam	Full Terrestrial (Flora and Faunal), Wetland and Aquatic Baseline Ecological Assessment	Eastern Cape
WKN-Wind current SA C/O Alan Wolfromm	HGA HAGA WEF	Hydrological Assessment	Eastern Cape
SRK Consulting (PTY) Ltd	RPM Crossing	Wetland Delineation	Free State
SRK Consulting (Pty) Ltd	Eskom Denova Powerline and sub-station	Freshwater assessment as part of the EIA process for the proposed Eskom powerline (1, 75 km in length) and sub-station (132kV) near Denova, Western Cape. (2014)	Western Cape
CSIR Consulting & Analytical Services	Sutherland WEF	Freshwater Ecological Assessments	Northern Cape
CSIR Consulting & Analytical Services	Victoria West WEF	Freshwater Ecological Assessments	Northern Cape

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF BRAVEMAN MZILA

PERSONAL DETAILS

Position in Company	Junior Wetland Ecologist
Date of Birth	03 January 1991
Nationality	South African
Languages	IsiZulu, English
Joined SAS	2017

EDUCATION

Qualifications

BSc (Hons) Environmental Hydrology (University of KwaZulu-Natal)	2013
BSc Hydrology and Soil Science (University of KwaZulu-Natal))	2012

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, KwaZulu-Natal, Eastern Cape

SELECTED PROJECT EXAMPLES

Freshwater Ecological Assessments

- Freshwater ecological assessment as part of the water use authorisation relating to stormwater damage of a tributary of the Sandspruit, Norwood, Gauteng province.
- Wetland verification as part of the environmental assessment and authorization process for the proposed development in Crowthorne extension 67, Gauteng province.
- Freshwater assessment as part of the section 24g rectification process for unauthorised construction related activities that took place on erf 411, Ruimsig extension 9, Gauteng province
- Baseline aquatic and freshwater assessment as part of the environmental assessment And authorisation process for the N11 Ring Road, Mokopane, Limpopo Province
- Wetland Resource Scoping Assessment As Part Of The Environmental Assessment And Authorisation Process For The Kitwe TSF Reclamation Project, Kitwe, Zambia
- Wetland delineation as part of the environmental assessment and authorization process for the proposed development in Boden Road, Benoni, Ekurhuleni Metropolitan Municipality, Gauteng Province.

Soil, Land Use and Land Capability Assessments

- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Witfontein Focus area Project Near Bethal, Mpumalanga Province
- Soil, Land Use and Land Capability Assessment as part of the environmental assessment and authorisation process for the proposed Heuningkranz Mine, Postmasburg, Northern Cape Province

Hydropedological Wetland Impact Assessments

- Hydropedological Assessment as Part of the Environmental Assessment and Authorisation Process for the proposed Vandyksdrift Central Dewatering Project
- Hydropedological Assessment for the Proposed Evander Gold Elikhulu Tailings Storage Facility (TSF) Expansion, Mpumalanga Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Palmietkuilen Mine, Springs, Gauteng Province
- Hydropedological Assessment as part of the environmental assessment and authorisation process for the proposed Uitkomst Colliery Mine expansion, Newcastle, KwaZulu-Natal Province