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FAUNAL, FLORAL AND FRESHWATER ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETKOL MINING OPERATIONS NEAR DELMAS WITHIN THE MPUMALANGA PROVINCE.

Prepared for

Jacana Environmentals CC

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Section A – Summary and Background Info

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EXECUTIVE SUMMARY

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral and freshwater ecological investigation as part of the environmental authorisation process for the proposed Rietkol Mining Operation (Rietkol Project), where mining of silica through opencast methods will occur. The proposed Rietkol Project is situated within Wards 8 and 9 of the Victor Khanye Local Municipality and the Nkangala District Municipality. The Mining Right Application (MRA) area is situated approximately 6km west of the town of Delmas/ Botleng. The MRA area is further situated approximately 900m southeast of the N12, 2.1 km southwest of the R50, and 2.7 km north of the R555 (Figure 1 & 2).

The MRA area covers an area of 221 ha, and consists of

- 16 Modder East Agricultural Holdings on the farm Olifantsfontein 196IR;
- Portion 71 of the farm Rietkol 237 IR; and
- A portion of the remaining extent of Portion 31 of the farm Rietkol 237 IR.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The proposed Rietkol Project estimated life of mine (LOM) is 20 years, although further exploration drilling to be conducted during the operational phase, may increase the LOM and the depth of mining if resources proof viable (Jacana, 2021).

The following infrastructure is associated with the proposed project (Figure 3):

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening etc.);
- Product Stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc);
- Access Roads; and
- Clean and dirty water management infrastructure.

The ecological assessment will fulfil the requirements of the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated regulations, as well as other legal requirements applicable on both a national and provincial level, including the requirements of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and associated guidelines and regulations.

The purpose of this report is to define the ecology of the area including both terrestrial and wetland aspects as well as mapping of the resources and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the MRA area. It is the objective of this study to provide detailed information to guide the activities associated with the proposed mining activities in the vicinity of the resources to ensure that the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

Flora:

The findings of the field assessment indicate that the habitat associated with the study area is mostly of low to intermediate sensitivity, with only the wetland habitat unit being of a higher sensitivity rating. Much of the study area has been disturbed through agricultural activities as a result of crop farming and to a lesser extent grazing of cattle. The overall diversity and abundance of medicinal species was low, with most of the species being considered common and widespread. Furthermore, several floral Species of Conservational Concern (SCC), namely *Hypoxis hemerocallidea, Gladiolus vinosomaculatus, Gladiolus permeabilis, Gladiolus crassifolius, Habenaria galpinii* and *Crinum graminicola,* which are protected under Schedule 11 of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA) were encountered within the study area. Two other floral SCC listed by the South African National Biodiversity Institute (SANBI) PRECIS Red Data List for the study area (*Crinum bulbispermum* and *Kniphofia typhoides*) were not encountered, however it is possible that they may occur within the Wetland Habitat Unit. It is recommended that a walkthrough of the MRA be conducted prior to the commencement of any construction and/or mining activities and that all

encountered floral SCC are marked. If individuals or communities of these species will be disturbed by mining activities, they must be relocated by suitably trained personnel to a suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Mpumalanga Tourism and Parks Agency (MTPA). MTPA also raised concern regarding the critically endangered orchid species *Brachycorythis conica subsp. transvaalensis,* which has previously been recorded in nearby areas. However, this orchid species was not observed within the MRA area. Should any individuals of this species be located within the MRA area, the MTPA is to be notified immediately and the appropriate steps taken as guided by MTPA to ensure that the individuals are not impacted upon by the mining activities.

Fauna:

The findings of the field assessment indicate that the habitat associated with the study area is mostly of intermediate sensitivity, with the exception being that of the Wetland Habitat, which is considered to be moderately high. The MRA area has been disturbed as a result of anthropogenic activities, notably relating to agriculture (crops), grazing activities and unsuitable veld management. The MRA area provides habitat to a number of common faunal species, whilst the wetland area was noted to provide habitat to an increased number of species with a higher level of diversity. Furthermore, the wetland habitat and adjacent grasslands are considered important in terms of SCC, namely *Pyxicephalus adspersus* (Giant Bullfrog), *Metisella meninx* (Marsh Sylph), *Geronticus calvus* (Bald Ibis), *Sagittarius serpentarius* (Secretarybird), *Tyto capensis* (African Grass Owl) and *Phoenicopterus ruber* (Greater Flamingo). *Pyxicephalus adspersus* (Giant Bullfrog) is known to utilise the wetlands within the MRA area, and as such is at increased risk should mining activities occur. It is important that the wetland habitat and potential movement corridors between the wetlands are not impacted upon.

Wetlands:

Three hydrogeomorphic (HGM) units were identified within the proposed MRA, these were classified as a depression (pan) and two hillslope seep wetlands. In addition, a wetland flat and another depression wetland was identified within the investigation area of the proposed MRA. A summary of the assessment of these wetlands are summarised in the table below.

Table A: Summary of the results of the assessments applied to the wetlands located within the MRA.

Freshwater Ecosystem	Present Ecological State	Ecological function and service provision	Ecological Importance and Sensitivity (EIS)	Recommended Ecological Class (REC)
Hillslope Seep 1 and 2	D (Largely modified)	Intermediate	D (Largely modified)	D (Largely modified)
Pan 1	C (Moderately modified)	Moderately low/ Intermediate	C (Moderately modified)	C (Moderately modified)

Conclusion:

From analysis of the results of the ecological assessment, it became clear that a significant portion of the study area is of low to intermediate sensitivity, however the wetland areas from a faunal, floral and freshwater ecosystem management point of view are considered to be of a higher sensitivity. Thus, suitable planning and mitigation will be necessary, so as to avoid negative impacts on the sensitive wetland habitat. Several potential risks to the receiving terrestrial and wetland ecological environment by the proposed mining operation have been identified. These impacts have been assessed in detail and presented in the impact assessment section (please refer to individual reports namely Section B, C, D and Section E).

In the impact assessment, mitigatory recommendations and measures are presented in line with the mitigation hierarchy as advocated by the Department of Mineral Resources (DMR, 2013) in order to ensure informed decision making and improved sustainable development in the area.

DOCUMENT GUIDE

The table below provides a guide to the reporting of biodiversity impacts as they relate to 1) Government Notice No. 320 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on **Terrestrial Biodiversity** as published in Government Gazette 43110 dated 20 April 2020, and 2) Government Notice No. 1150 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on **Terrestrial Plant and Animal Species** as published in Government Gazette 43855 dated 30 October 2020.

Theme-Specific Requirements as per Government Notice No. 320 Terrestrial Biodiversity Theme – Very High Sensitivity Rating as per Screening Tool Output		
No.	**SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS**	**Section in report/Notes**
2	**Terrestrial Biodiversity Specialist Assessment**	
2.1	The assessment must be prepared by a specialist registered with the South African Council for Natural Scientific Professionals (SACNASP) with expertise in the field of terrestrial biodiversity.	**Part A – C:** Cover Page **Part A:** Appendix E
2.2	The assessment must be undertaken on the preferred site and within the proposed development footprint.	**Part A**: Section 1
2.3	**The assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:**	
2.3.1	A description of the ecological drivers or processes of the system and how the proposed development will impact these;	**Part B & Part C**
2.3.2	Ecological functioning and ecological processes (e.g., fire, migration, pollination, etc.) that operate within the preferred site;	**Part B & Part C**
2.3.3	The ecological corridors that the proposed development would impede including migration and movement of flora and fauna;	**Part A, Part B & Part C**
2.3.4	The description of any significant terrestrial landscape features (including rare or important flora-faunal associations, presence of Strategic Water Source Areas (SWSAs) or Freshwater Ecosystem Priority Area (FEPA) sub catchments;	**Part A, Part B, Part C & Part D**
2.3.5	A description of terrestrial biodiversity and ecosystems on the preferred site, including: a) main vegetation types; b) threatened ecosystems, including listed ecosystems as well as locally important habitat types identified; c) ecological connectivity, habitat fragmentation, ecological processes and fine scale habitats; and d) species, distribution, important habitats (e.g. feeding grounds, nesting sites, etc.) and movement patterns identified;	**Part A, Part B & Part C**
2.3.6	The assessment must identify any alternative development footprints within the preferred site which would be of a "low" sensitivity as identified by the screening tool and verified through the site sensitivity verification; and	Not Applicable.
2.3.7	**The assessment must be based on the results of a site inspection undertaken on the preferred site and must identify:**	
2.3.7.1	Terrestrial Critical Biodiversity Areas (CBAs), including: *a) the reasons why an area has been identified as a CBA;* *b) an indication of whether or not the proposed development is consistent with maintaining the CBA in a natural or near natural state or in achieving the goal of rehabilitation;* *c) the impact on species composition and structure of vegetation with an indication of the extent of clearing activities in proportion to the remaining extent of the ecosystem type(s);* *d) the impact on ecosystem threat status;* *e) the impact on explicit subtypes in the vegetation;* *f) the impact on overall species and ecosystem diversity of the site; and* g) *the impact on any changes to threat status of populations of species of conservation concern in the CBA;*	**Part A, Part B & Part C**
2.3.7.2	Terrestrial Ecological Support Areas (ESAs), including: *a) the impact on the ecological processes that operate within or across the site;* *b) the extent the proposed development will impact on the functionality of the ESA; and* c) *loss of ecological connectivity (on site, and in relation to the broader landscape) due to the degradation and severing of ecological corridors*	

	or introducing barriers that impede migration and movement of flora and fauna;	
2.3.7.3	Protected areas as defined by the National Environmental Management: Protected Areas Act, 2004 including- *a) an opinion on whether the proposed development aligns with the objectives or purpose of the protected area and the zoning as per the protected area management plan;*	**Part A**
2.3.7.4	Priority areas for protected area expansion, including- *a) the way in which in which the proposed development will compromise or contribute to the expansion of the protected area network;*	**Part A**
2.3.7.5	SWSAs including: *a) the impact(s) on the terrestrial habitat of a SWSA; and* b) *the impacts of the proposed development on the SWSA water quality and quantity (e.g. describing potential increased runoff leading to increased sediment load in water courses);*	**Part A & Part D**
2.3.7.6	FEPA sub catchments, including- *a) the impacts of the proposed development on habitat condition and species in the FEPA sub catchment;*	Part D
2.3.7.7	Indigenous forests, including: *a) impact on the ecological integrity of the forest; and* b) *percentage of natural or near natural indigenous forest area lost and a statement on the implications in relation to the remaining areas.*	Not Applicable
2.4	**The findings of the assessment must be written up in a Terrestrial Biodiversity Specialist Assessment Report.**	
	Part B: Results of the **Floral Assessment** as well as conclusions on Terrestrial Biodiversity as it relates to vegetation communities. **Part C:** Results of the **Faunal Assessment** as well as conclusions on Terrestrial Biodiversity as it relates to faunal communities.	
3	**Terrestrial Biodiversity Specialist Assessment Report**	
3.1	**The Terrestrial Biodiversity Specialist Assessment Report must contain, as a minimum, the following information:**	
3.1.1	Contact details of the specialist, their SACNASP registration number, their field of expertise and a curriculum vitae;	**Part A:** Appendix E
3.1.2	A signed statement of independence by the specialist;	**Part A:** Appendix E
3.1.3	A statement on the duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	**Part B & Part C**
3.1.4	A description of the methodology used to undertake the site verification and impact assessment and site inspection, including equipment and modelling used, where relevant;	**Part A**: Appendix C **Part B:** Section 2 (flora) **Part B:** Appendix A (flora) **Part C:** Section 2 (fauna) **Part C**: Appendix A (fauna)
3.1.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	**Part B:** Section 1.3 (flora) **Part C:** Section 1.3 (fauna)
3.1.6	A location of the areas not suitable for development, which are to be avoided during construction and operation (where relevant);	**Part B:** Section 4 (flora) **Part C:** Section 4 (fauna)
	Impact Assessment Requirements 3.1.7 Additional environmental impacts expected from the proposed development; 3.1.8 Any direct, indirect and cumulative impacts of the proposed development; 3.1.9 The degree to which impacts and risks can be mitigated; 3.1.10 The degree to which the impacts and risks can be reversed; 3.1.11 The degree to which the impacts and risks can cause loss of irreplaceable resources; 3.1.12 Proposed impact management actions and impact management outcomes proposed by the specialist for inclusion in the Environmental Management Programme (EMPr);	**Part E**
3.1.14	A substantiated statement, based on the findings of the specialist assessment, regarding the acceptability, or not, of the proposed development, if it should receive approval or not; and	**Part A:** Executive summary **Part B & Part C**
3.1.15	Any conditions to which this statement is subjected.	**Part B & Part C**
3.2	The findings of the Terrestrial Biodiversity Specialist Assessment must be incorporated into the Basic Assessment Report or the Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which must be incorporated into the EMPr where relevant.	**Not Applicable to this report**
3.3	A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.	**Not Applicable to this report**

Theme-Specific Requirements as per Government Notice No. 1150		
- **Plant Species Theme - Medium Sensitivity Rating as per Screening Tool Output** - **Animal Species Theme – Medium Sensitivity Rating as per Screening Tool Output** - **Terrestrial Biodiversity Theme – Very High Sensitivity Rating as per Screening Tool Output**		
NO.	**REQUIREMENTS**	**SECTION IN REPORT/NOTES**
4	**Medium Sensitivity Species of Conservation Concern Confirmation**	
4.1	Medium sensitivity data represents suspected habitat for SCC based on occurrence records for these species collected prior to 2002 and/or is based on habitat suitability modelling.	**Part A:** Section 3
4.2	The presence or likely presence of the SCC identified by the screening tool, must be confirmed through a site inspection by a specialist registered with the SACNASP in a field of practice relevant to the taxonomic group ("taxa") for which the assessment is being undertaken.	**Part B:** Section 3 (flora) & Appendix B **Part C:** Section 3 (fauna) & Appendix B
4.3	The assessment must be undertaken within the study area.	**Part A**: Section 1 **Part B**: Section 1 (flora) **Part C**: Section 1 (fauna)
4.4	The site inspection to determine the presence or likely presence of SCC must be undertaken in accordance with the Species Environmental Assessment Guideline (Available at https://bgis.sanbi.org/).	**Part B:** Section 2 (flora) **Part B:** Appendix A (flora) **Part C:** Section 2 (fauna) **Part C**: Appendix A (fauna)
4.5	The site inspection is to confirm the presence, likely presence or confirmed absence of a SCC within the site identified as "medium" sensitivity by the screening tool.	**Part B:** Section 3 (flora) & Appendix B **Part C:** Section 3 (fauna) & Appendix B
4.6	Where SCC are found on site or have been confirmed to be likely present, a Terrestrial Plant Species Specialist Assessment must be submitted in accordance with the requirements specified for "very high" and "high" sensitivity in this protocol.	Refer to Parts B & C
4.7	Similarly, where no SCC are found on site during the investigation or if the presence is confirmed to be unlikely, a Terrestrial Plant Species Compliance Statement must be submitted.	Not applicable

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

No.	Requirements	Section in report
2.1	Assessment must be undertaken by a suitably qualified SACNASP registered specialist	Part A: Appendix A and G
2.2	Description of the preferred development site, including the following aspects-	Part D - Section 1
2.2.1	a. Aquatic ecosystem type b. Presence of aquatic species and composition of aquatic species communities, their habitat, distribution and movement patterns	Part D - Section 4.3
2.2.2	Threat status, according to the national web based environmental screening tool of the species and ecosystems, including listed ecosystems as well as locally important habitat types identified	Part D - Section 3.1
2.2.3	National and Provincial priority status of the aquatic ecosystem (i.e. is this a wetland or river Freshwater Ecosystem Priority Area (FEPA), a FEPA sub- catchment, a Strategic Water Source Area (SWSA), a priority estuary, whether or not they are free-flowing rivers, wetland clusters, etc., a CBA or an ESA; including for all a description of the criteria for their given status	Part D - Section 3.1
2.2.4	A description of the Ecological Importance and Sensitivity of the aquatic ecosystem including: a. The description (spatially, if possible) of the ecosystem processes that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface and subsurface water, recharge, discharge, sediment transport, etc.); b. The historic ecological condition (reference) as well as Present Ecological State (PES) of rivers (in-stream, riparian and floodplain habitat), wetlands and/or estuaries in terms of possible changes to the channel, flow regime (surface and groundwater)	Part D - Section 4.3
2.3	Identify any alternative development footprints within the preferred development site which would be of a "low" sensitivity as identified by the national web based environmental screening tool and verified through the Initial Site Sensitivity Verification	Part D - Section 7
2.4	Assessment of impacts - a detailed assessment of the potential impact(s) of the proposed development on the following very high sensitivity areas/ features:	Part D - Section 6
2.4.1	Is the development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal?	Part D - Section 4.3 and Section 6
2.4.2	Is the development consistent with maintaining the Resource Quality Objectives for the aquatic ecosystems present?	Part D - Section 4.3
2.4.3	How will the development impact on fixed and dynamic ecological processes that operate within or across the site, including: a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); b. Change in the sediment regime (e.g. sand movement, meandering river mouth/estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub-catchment; c. The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary / seasonal / permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). d. Assessment of the risks associated with water use/s and related activities.	Part D - Section 4.3
2.4.4	How will the development impact on the functionality of the aquatic feature including: a. Base flows (e.g. too little/too much water in terms of characteristics and requirements of system); b. Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river);	Part D - Section 4.3

	c. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland); d. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); and e. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal).	
2.4.5	How will the development impact on the functionality of the aquatic feature including: a. water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over-abstraction or instream or off-stream impoundment of a wetland or river) b. Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley-bottom wetland to a channelled valley-bottom wetland). c. Quality of water (e.g. due to increased sediment load, contamination by chemical and/or organic effluent, and/or eutrophication); d. Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal); e. The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soil, etc.) associated with or within the aquatic ecosystem.	Part D - Section 4.3
2.4.6	How will the development impact on key ecosystem regulating and supporting services especially Flood attenuation; Streamflow regulation; Sediment trapping; Phosphate assimilation; Nitrate assimilation; Toxicant assimilation; Erosion control; and Carbon storage.	Part D - Section 4.3
2.4.7	How will the development impact community composition (numbers and density of species) and integrity (condition, viability, predator-prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Part D - Section 4.3
2.4.9	A motivation must be provided if there were development footprints identified as per paragraph 2.3 above that were identified as having a “low” biodiversity sensitivity and were not considered appropriate.	Part D - Section 7
3.	The report must contain as a minimum the following information:	
3.1	Contact details and curriculum vitae of the specialist including SACNASP registration number and field of expertise and their curriculum vitae;	Part A - Appendix A and G
3.2	A signed statement of independence by the specialist;	Part A - Appendix A
3.3	The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment;	Part D - Section 1 and 4.3
3.4	The methodology used to undertake the impact assessment and site inspection, including equipment and modelling used, where relevant;	Part A and Part D - Appendix C
3.5	A description of the assumptions made and any uncertainties or gaps in knowledge or data as well as a statement of the timing and intensity of site inspection observations;	Part D - Section 1.3
3.6	Areas not suitable for development, to be avoided during construction and operation (where relevant);	Part D - Section 6
3.7	Additional environmental impacts expected from the proposed development based on those already evident on the site and a discussion on the cumulative impacts;	Part D - Section 6
3.8	A suitable construction and operational buffer for the aquatic ecosystem, using the accepted protocol;	Part D - Section 5
3.9	Impact management actions and impact management outcomes proposed by the specialist for inclusion in the EMPr;	Part D - Section 6
3.10	A motivation where the development footprint identified as per 2.3 were not considered stating reasons why these were not being considered; and	Part D - Section 7
3.11	A reasoned opinion, based on the finding of the specialist assessment, regarding the acceptability or not, of the development and if the development should receive approval, and any conditions to which the statement is subjected.	Part D - Section 7

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GLOSSARY

Alien vegetation	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Alluvial soil	A deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers.
Base flow	Long-term flow in a river that continues after storm flow has passed.
Biodiversity	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the Ecosystems, ecological processes and landscape of which they are integral parts.
Buffer	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment	The area contributing to runoff at a particular point in a river feature.
Chroma	The relative purity of the spectral colour which decreases with increasing greyness.
Delineation (of a wetland)	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion	An ecoregion is a "recurring pattern of Ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Ephemeral stream	A stream that has transitory or short-lived flow.
Facultative species	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas.
Fluvial	Resulting from water movement.
Gleying	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater	Subsurface water in the saturated zone below the water table.
Hydromorphic soil	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soils).
Hydrology	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydromorphy	A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile.
Hydrophyte	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Intermittent flow	Flows only for short periods.
Indigenous vegetation	Vegetation occurring naturally within a defined area.
Mottles	Soils with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species	Species almost always found in wetlands (>99% of occurences).
Perched water table	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater.
Perennial	Flows all year round.
RAMSAR	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of

	wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Species of Conservation Concern	The term SCC in the context of this report refers to all RDL (Red Data) and IUCN (International Union for the Conservation of Nature) listed species as well as protected species of relevance to the project.
Seasonal zone of wetness	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50cm of the surface.
Temporary zone of wetness	the outer zone of a wetland characterised by saturation within 50cm of the surface for less than three months of the year.

ACRONYMS

BAR	Basic Assessment Report
BGIS	Biodiversity GIS
DMR	Department of Mineral Resources
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
EC	Ecological Class
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Programme
EN	Endangered
ES	Ecological Sensitivity
FEPA	Freshwater Ecosystem Priority Areas
GIS	Geographic Information Feature
GPS	Global Positioning System
GN	General Notification
HGM	Hydro-geomorphic
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
LOM	Life of Mine
MAP	Mean Annual Precipitation
MAPE	Mean annual potential evaporation
MASMS	Mean annual soil moisture stress
MAT	Mean Annual Temperature
mbs	Meters below surface
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998)
MPRDA	Minerals and petroleum Resource Development Act
MRA	Mining Right Area
MTPA	Mpumalanga Tourism and Park Agency
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
PPP	Public Participation Process
PRECIS	Pretoria Computer Information Systems
QDS	Quarter Degree Square
REC	Recommended Ecological Category
SANBI	Southern African National Biodiversity Institute
SAS	Scientific Aquatic Services
SCC	Species of Conservational Concern
SQ	Sub-quaternary
SQR	Sub-quaternary Reach
subWMA	Sub-Water Management Area
TSP	Threatened species programme
VU	Vulnerable
WMA	Water Management Area

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, freshwater and surface water quality ecological investigation as part of the environmental authorisation process for the proposed Rietkol Project, where mining of silica through opencast methods will occur. The proposed Rietkol Project is situated within Wards 8 and 9 of the Victor Khanye Local Municipality and the Nkangala District Municipality. The Mining Right Application (MRA) area is situated approximately 6km west of the town of Delmas/ Botleng. The MRA area is further situated approximately 900m southeast of the N12, 2.1 km southwest of the R50, and 2.7 km north of the R555 (Figures1 & 2).

The MRA area covers an area of 221 ha, and consists of the following farm portions:

- 16 Modder East Agricultural Holdings on the farm Olifantsfontein 196IR;
- Portion 71 of the farm Rietkol 237 IR; and
- A portion of the remaining extent of Portion 31 of the farm Rietkol 237 IR.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The proposed Rietkol Project estimated life of mine (LOM) is 20 years, although further exploration drilling to be conducted during the operational phase, may increase the LOM and the depth of mining if resources proof viable (Jacana, 2021).

The infrastructure layout as proposed during the initial EIA phase for the proposed Rietkol mining operations near Delmas can be seen in Figure 3 below. The initial proposed infrastructure layout, hereafter referred to as the “Initial Infrastructure Layout” encroached into the buffer of a nearby Wetland. The initial Rietkol application for Environmental Authorisation lapsed in 2020 due to administration issues within the Department of Mineral Resources (DMR). As such a new mining right and environmental authorisation application has been proposed. However, in the current application, the proposed infrastructure layout has been moved north, creating a 100m buffer between the proposed infrastructure and the wetland area to the south, hereafter referred to as the “Preferred Infrastructure Layout”. This report has been updated to illustrate the impacts associated with the preferred infrastructure layout.

The following infrastructure is currently associated with the proposed project (Figure 4):

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening etc.);

- Product Stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc);
- Access Roads; and
- Clean and dirty water management infrastructure.

The ecological assessment will fulfil the requirements of the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA), the National Environmental Management Act (Act No. 107 of 1998) (NEMA) and associated regulations, as well as other legal requirements applicable on both a national and provincial level, including the requirements of the National Water Act (Act No. 36 of 1998) (NWA) and associated guidelines and regulations.

The purpose of this report is to define the ecology of the area including both terrestrial and wetland aspects as well as mapping of the resources and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the MRA area. It is the objective of this study to provide detailed information to guide the activities associated with the proposed mining activities in the vicinity of the resources to ensure that the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

1.2 Site Sensitivity Verification Statement

Nhlabathi applied for a Mining Right to mine silica in February 2018 and commenced with the Environmental Impact Assessment (EIA) process as contemplated in the National Environmental Management Act 107 of 1998 (NEMA) and Government Notice (GN) No. R. 982-986 of 4 December 2014: NEMA: Environmental Impact Assessment Regulations, as amended (2014 EIA Regulations), for the Rietkol Project.

Several specialist studies were conducted within the Mining Right Application (MRA) area in support of the EIA process, and a comprehensive Public Participation process was initiated. The Final Scoping Report was submitted on 3 April 2018 and accepted by the Department of Mineral Resources and Energy (DMRE) on 26 April 2018. However, the MRA was rejected by the DMRE Mpumalanga Mine Economics Directorate on the basis that the MRA formed part of another right granted in terms of the MPRDA. This decision resulted in a delay in the EIA process, ultimately causing the application for Environmental Authorisation to lapse.

Nhlabathi has recently re-initiated the MRA process and applied for a Mining Right over the same farm portions in early 2020. The MRA was accepted by the DMRE on 21 January 2021

and Nhlabathi has since re-initiated the EIA process with Jacana Environmentals cc (Jacana) appointed as the independent Environmental Assessment Practitioner (EAP).

Several additional requirements when applying for Environmental Authorisation (EA) have emerged since the 2018 EIA process, including but not limited to:

1. Notice was given in Government Notice No. 960 (GN 960) dated 5 July 2019 of the requirement to submit a report generated by the National Web Based Environmental Screening Tool in terms of section 24(5)(h) of the NEMA and regulation 16(1)(b)(v) of the 2014 EIA Regulations. Such a Screening Rreport became compulsory when applying for an EA 90 days from publication of GN 960 (5 October 2019). The purpose of the Screening Report is to identify the list of specialist assessments that needs to be conducted in support of the EA application, based on the selected classification, and the environmental sensitivities of the proposed development footprint.
2. Government Notice No. 320 (GN 320) dated 20 March 2020 prescribes general requirements for undertaking site sensitivity verification and for protocols for the assessment and minimum report content requirements of environmental impacts for environmental themes for activities requiring EA in terms of sections 24(5)(a), (h) and 44 of NEMA. These procedures and requirements came into effect 50 days after publication of GN 320 (15 May 2020). The purpose of the site sensitivity verification is to verify (confirm or dispute) the current use of the land and the environmental sensitivity of the site under consideration as identified in the Screening Report. This will determine the level of assessment required for each environmental theme, i.e. Specialist Assessment or Compliance Statement.

As indicated above, several specialist studies were commissioned for the Rietkol Project during 2016-2018 in support of the previous application, including:

- Soils, land use and capability, Hydropedology;
- Terrestrial / Aquatic Biodiversity;
- Groundwater;
- Air Quality;
- Ambient Noise;
- Blasting & Vibration;
- Traffic;
- Heritage and Cultural Resources;
- Palaeontology;
- Visual and Aesthetics;
- Social;

- Hazard Identification and Risk Assessment (HIRA); and
- Land Trade-off & Macro-Economic Analysis.

Comprehensive specialist assessments were conducted for all the environmental and social themes listed above, irrespective of the sensitivity identified by the specialist assessment (2018) or the Screening Report. Therefore, no site sensitivity verification has been done for this EA application as all themes have been considered to have a **high to very high sensitivity**, requiring a full Specialist Assessment.

The list of specialist assessments listed in the Screening Report and the extent to which it has been addressed in the re-application for EA for the Rietkol Project is indicated below. Where applicable, motivation is provided for the exclusion of certain specialist assessments.

GN 960 requirement	**Extent to which it is included in the Plan of Study**
Agricultural Impact Assessment	Soil and Land Capability Assessment by Scientific Aquatic Services.
Landscape/Visual Impact Assessment	Visual Impact Assessment by Scientific Aquatic Services.
Archaeological and Cultural Heritage Impact Assessment	Phase 1 Heritage Impact Assessment by R&R Cultural Resource Consultants.
Palaeontology Impact Assessment	Palaeontology Impact Assessment by ASG Geo Consultants (Pty) Ltd {Dr Gideon Groenewald}.
Terrestrial Biodiversity Impact Assessment	Faunal, Floral and Freshwater Assessment by Scientific Terrestrial Services.
Aquatic Biodiversity Impact Assessment	Faunal, Floral and Freshwater Assessment by Scientific Terrestrial Services.
Hydrology Assessment	Baseline Water Quality Assessment by Scientific Aquatic Services. Water Management Plan – Preliminary Design Report by Onno Fortuin Consulting.
Noise Impact Assessment	Environmental Noise Impact Assessment by Enviro Acoustic Research.
Radioactivity Impact Assessment	Waste Classification by Groundwater Complete. Analysis will include Uranium and Thorium to determine potential for radioactivity within the resource.

GN 960 requirement	**Extent to which it is included in the Plan of Study**
Traffic Impact Assessment	Traffic Impact Assessment by Avzcons Civil Engineering Consultant.
Geotechnical Assessment	A geotechnical assessment will be undertaken as part of the engineering package for the project, if required. This is not included in the application for EA.
Climate Impact Assessment	A greenhouse gas emissions statement is included in the Air Quality Impact Assessment by EBS Advisory.
Health Impact Assessment	Hazard Identification and Risk Assessment by AirCheck Occupational Health, Environmental & Training Services.
Socio-Economic Assessment	Socio-Economic Impact Assessment by Diphororo Development.
Ambient Air Quality Impact Assessment	Air Quality Impact Assessment by EBS Advisory.
Seismicity Assessment	A Blasting Impact Assessment is included and has been conducted by Blast Management Consulting. It deals extensively with the potential impact in respect of air blast and vibration from blasting operations.
Plant Species Assessment	Part of Terrestrial Biodiversity Impact Assessment.
Animal Species Assessment	Part of Terrestrial Biodiversity Impact Assessment.

Further studies that are not included in the GN 960 requirements, but were commissioned for the Rietkol Project, are:

- Hydropedological Assessment by Scientific Aquatic Services.
- Geohydrological Investigation by Groundwater Complete.
- Blasting Impact Assessment by Blast Management Consulting.
- Land Trade-off Study and Macro-Economic Impact Analysis by Mosaka Economic Consultants.
- Rehabilitation, Decommissioning and Closure Plan by Jacana Environmentals.

Where a specific environmental theme protocol has been prescribed by GN 320, the specialist assessment will adhere to such protocol. Where no protocol has been prescribed, the report will comply with Appendix 6 of the EIA Regulations.

Figure 1: Digital Satellite image depicting the location of the MRA area in relation to surrounding areas.

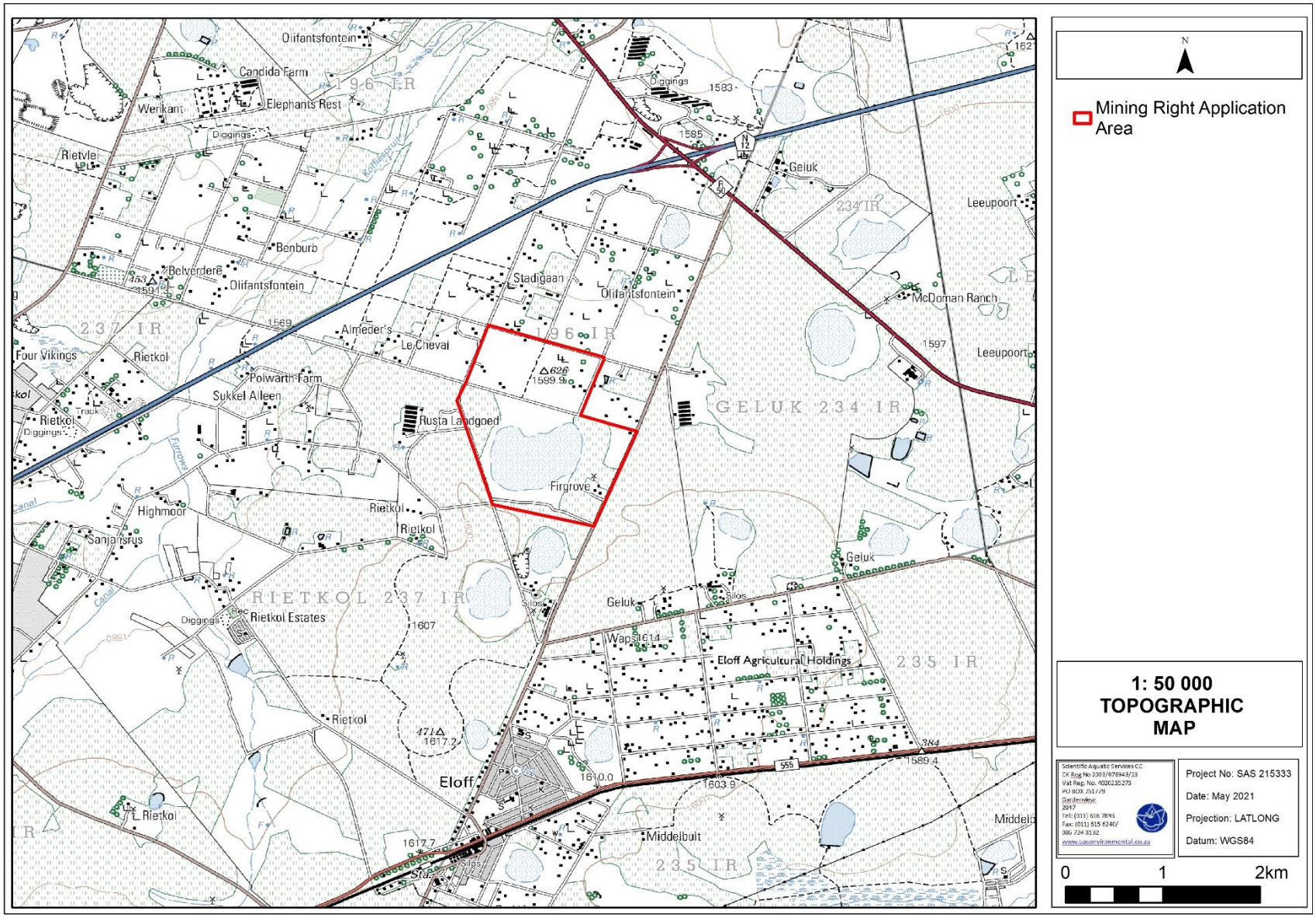

Figure 2: MRA area depicted on a 150 000 topographical map in relation to its surrounding area.

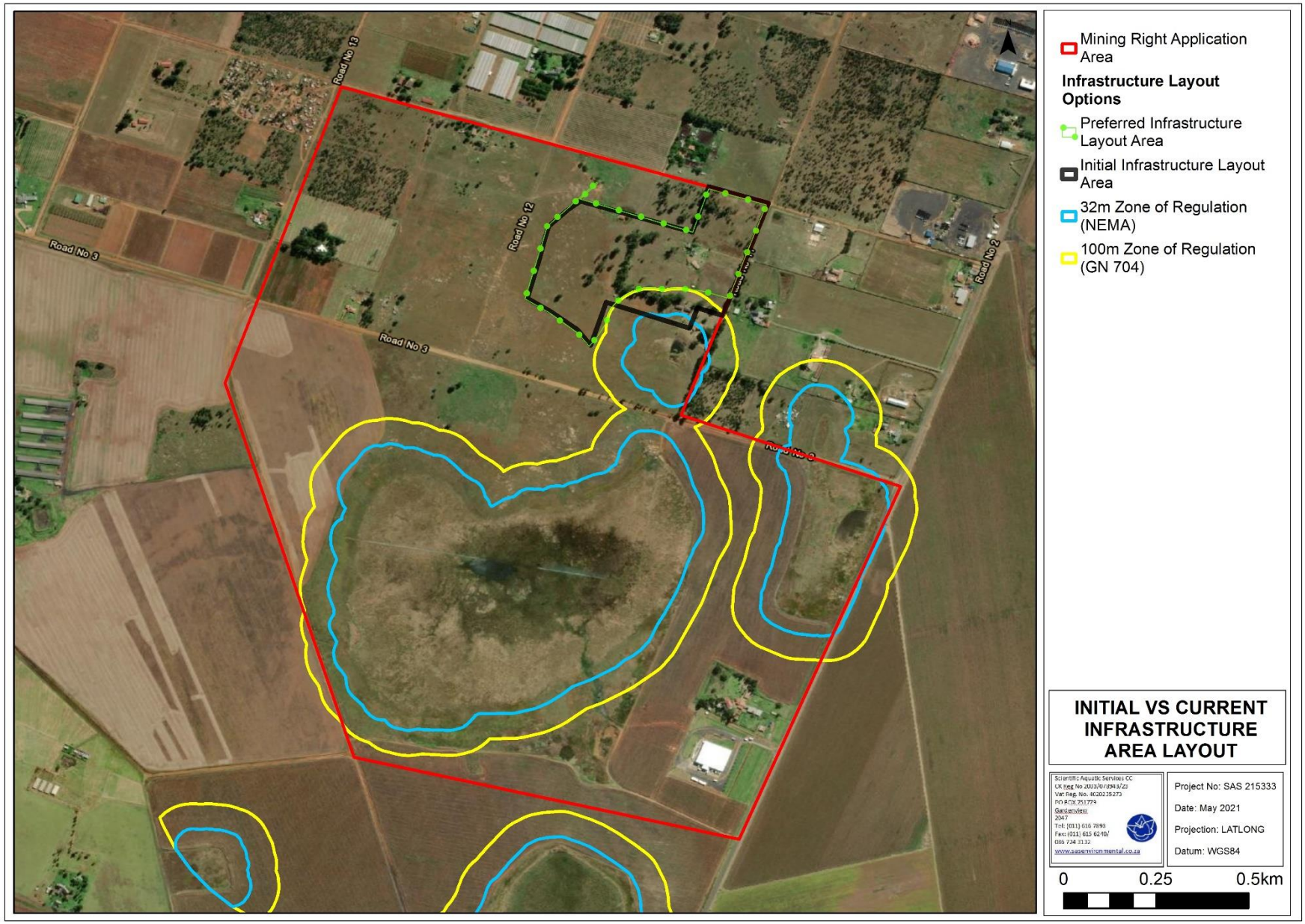

Figure 3: Initial Vs Current Infrastructure Layout Areas associated with the MRA.

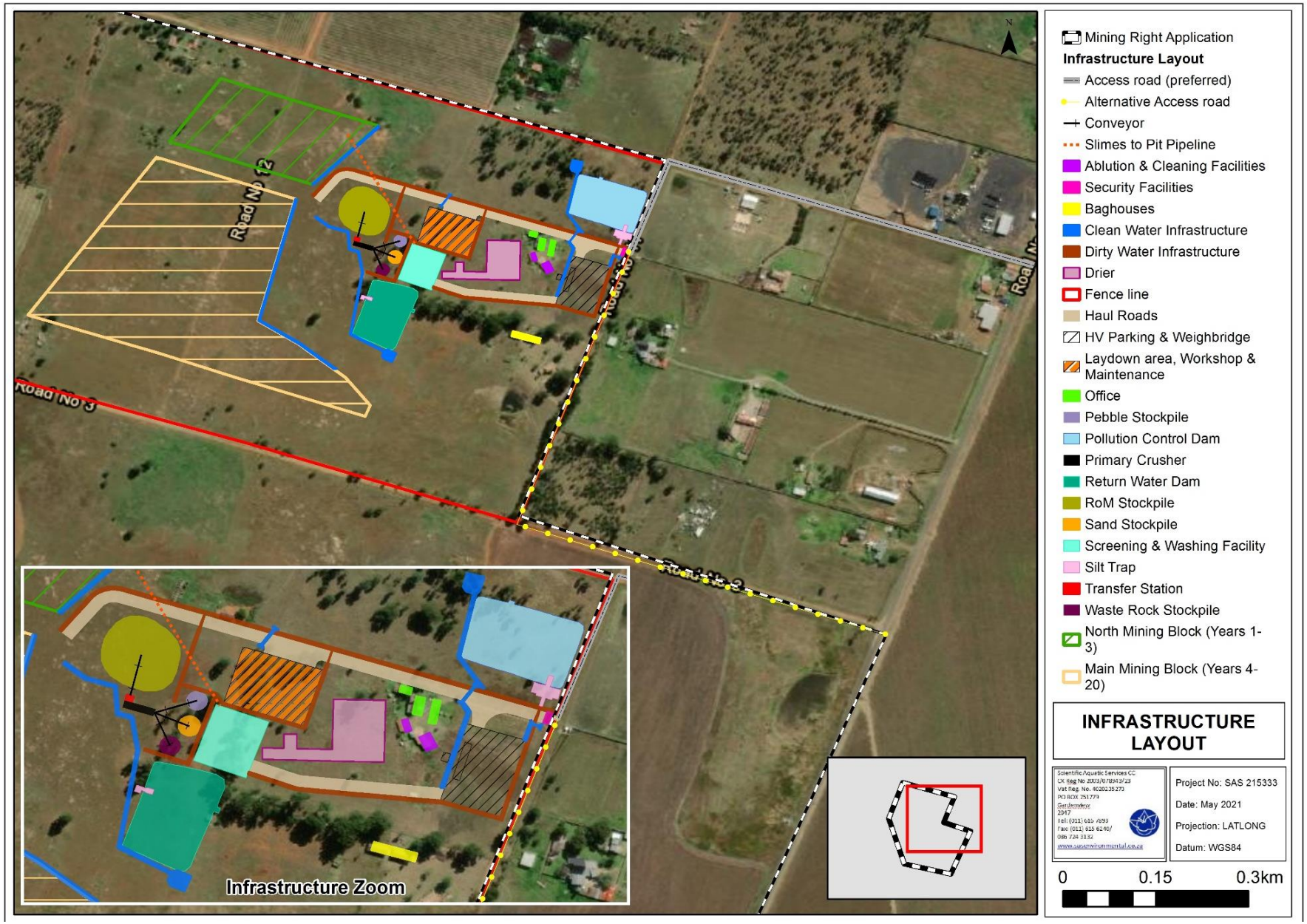

Figure 4: Proposed Infrastructure Layout associated with the MRA area.

1.3 Project Scope

Specific outcomes in terms of this report are outlined below.

Terrestrial Ecological Assessment

- To conduct a habitat evaluation in terms of ecological integrity and present ecological state;
- To conduct a Species of Conservational Concern (SCC) assessment, including potential for species to occur within the MRA area;
- To provide faunal and floral inventories of species as encountered on site;
- To determine and describe habitats, communities and ecological state of the study area;
- To describe the spatial significance of the MRA area with regards to surrounding natural areas;
- To identify and consider all sensitive landscapes including rocky ridges, wetlands and/or any other special features;
- To determine the environmental risks of the proposed mining activity on the terrestrial ecology within the MRA area; and
- To present management and mitigation measures which should be included in the Environmental Management Programme (EMPr) of the development to assist in minimising the impact on the receiving environment.

Freshwater Ecological Assessment

- Classification of wetland features following the guidelines in the Classification System for Wetlands and other Aquatic Ecosystems in South Africa. User Manual Inland Systems (Ollis *et al*., 2013);
- Delineate all freshwater features within the MRA area according to “DWAF (Department of Water Affairs and Forestry), 2005 and 2008 A Practical Guideline Procedure for the Identification and Delineation of Wetlands and Riparian Zones;
- To define the drivers of the wetland with specific mention of hydrology, sediment balance and geomorphology;
- Define the ecological function service provision of the features within the study area according to the method of Kotze *et. al*., (2009);
- Assess the health of the features according and thereby define the Present Ecological State (PES) of the features;
- To define the Ecological Importance and Sensitivity (EIS) and Recommended Ecological Category (REC) for the features (DWA, 1999) and consider the biota that the wetland resources support;

- To determine the environmental risks the proposed mining development will have on the wetland ecology within the MRA area; and
- To present management and mitigation measures which should be implemented during the various development phases to assist in minimizing the impact on the receiving wetland habitat.

1.4 Assumptions and Limitations

The following assumptions and limitations are applicable to this report

- The detail ecological assessment and field work is confined to the MRA area and does not include the neighbouring and adjacent properties; these were however considered as part of the desktop assessment;
- The Department of Environmental Affairs screening tool provides names of sensitive species likely to be present within the study area and its surrounds. Within the screening tool outcome, the names of some species are not provided, and these species are rather assigned a number keeping them unidentifiable (e.g., Sensitive species 1). This procedure is attributed to the vulnerability of the species to threats such as illegal harvesting and overexploitation. According to the best practise guidelines provided by South African National Biodiversity Institute (SANBI), the name of sensitive species **may not appear** in the final EIA report **nor any of the specialist reports** released into the public domain. However, the conservation threat status of the species has been provided;
- Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal and floral communities have been accurately assessed and considered;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the study area may have been missed during the assessment;
- The freshwater assessment is confined to the MRA area and resources within 500m of the MRA area. The general surroundings including freshwater resources within 500 m of the MRA area that may potentially be affected by the proposed mining activity were however considered in the desktop assessment of the study area;

- The freshwater delineation as presented in this report is regarded as a best estimate of the freshwater boundary based on the site conditions present at the time of the assessment; and
- Wetland and terrestrial areas form transitional areas where an ecotone is formed as vegetation species change from terrestrial species to facultative and obligate wetland species. Within the transition zone some variation of opinion on the wetland boundary may occur, however if the Department of Water Affairs (DWAF), 2005 and 2008 method is followed, all assessors should get largely similar results.

1.5 Legislative Requirements

The following legislative requirements were considered during the assessment:

- The Constitution of the Republic of South Africa, 1996[1];
- The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA);
- Government Notice R598 Alien and Invasive Species Regulations as published in the Government Gazette 37885 dated 1 September 2014 as it relates to the National Environmental Management Biodiversity Act, 1998 (Act No. 107 of 1998)[2] (NEMA);
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA).
- Government Notice No. 320 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Biodiversity as published in Government Gazette 43110 dated 20 April 2020;
- Government Notice No. 1150 Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Plant and Terrestrial Animal Species as published in Government Gazette 43855 dated 30 October 2020;
- The Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA); and
- The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA).

[1] Since 1996, the Constitution has been amended by seventeen amendments acts. The Constitution is formally entitled the 'Constitution of the Republic of South Africa, 1996". It was previously also numbered as if it were an Act of Parliament – Act No. 108 of 1996 – but since the passage of the Citation of Constitutional Laws Act, neither it not the acts amending it are allocated act numbers.

[2] Legislation to come into force on the 1st of May 2021: Government Notice number R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated 25 September 2020 as it relates to the NEMBA

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 General approach

Maps and digital satellite images were generated prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. The biodiversity desktop assessment is confined to the study area and does not include the neighbouring and adjacent properties, although the sensitivity of surrounding areas is included on the respective maps.

Field assessments were undertaken on the 4th and 16th of February 2016, in January 2017, and the 24th of March 2021 to determine the ecological status of the study area and to "ground-truth" the results of the desktop assessment. Results of the field assessment is presented in Parts B and C.

In order to accurately determine the PES of the MRA area and capture comprehensive data with respect to freshwater, faunal and floral taxa, the following methodology was used

- Maps, aerial photographs and digital satellite images were consulted prior to the field assessment in order to determine broad habitats, vegetation types and potentially sensitive sites. An initial visual on-site assessment of the MRA area was made in order to confirm the assumptions made during consultation of the maps;
- Literature review with respect to habitats, vegetation types and species distribution was conducted;
- Relevant databases and documentation that were considered during the assessment of the study area include[3]:
    - The National Protected Areas Expansion Strategy (NPAES) focus areas for Protected Area Expansion, 2010 (including Formally and Informally Protected Areas);
    - The South African Conservation Areas Database, Quarter 3 (SACAD, 2020);

[3] Datasets obtained from:

- SANBI BGIS (2020). The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org; and
- Environmental Geographical Information Systems (E-GIS) website. URL: https://egis.environment.gov.za/

- The South African Protected Areas Database, Quarter 3 (SAPAD, 2020);
- The Mining and Biodiversity Guidelines (2012);
- The Mpumalanga Biodiversity Sector Plan (MBSP) – 2014 data set;
- Mucina and Rutherford, 2018:
- Biomes, Bioregions and Vegetation Type(s)
- The National Threatened Ecosystems (2011);
- The National Web-Based Environmental Screening Tool (accessed 2021);
- The National Biodiversity Assessment (NBA, 2018);
- Important Bird and Biodiversity Areas (IBAs) (2015), in conjunction with the South African Bird Atlas Project 2 (SABAP2); and
- The International Union for Conservation of Nature (IUCN).

- Site visits were undertaken on 4th and 16th of February 2016, January 2017, and the 24th March 2021 to determine the ecological status within the MRA area. A reconnaissance 'drive around' followed by thorough 'walk through' on foot was undertaken;
- Specific methodologies for the assessment, in terms of field work and data analysis of faunal, floral, and freshwater ecological assemblages will be presented in the Appendices of the relevant sections along with the methodologies for assessing the integrity and function of wetland systems; and
- An impact assessment was undertaken including the development of mitigation measures according to the method outlined in Appendix C of this section of the report (Section A).

3 RESULTS OF THE DESKTOP ANALYSIS

3.1 Conservation characteristics of the study area

The following table contains data accessed as part of the desktop assessment. It is important to note, that although all data sources used provide useful and often verifiable high-quality data, the various databases do not always provide an entirely accurate indication of the study area's actual biodiversity characteristics. As such, the data provided below is used to inform and guide the field assessments, however this data should not be seen as superseding the results obtained from the on-site assessments. The below information must always be verified during the site assessment, as it is often noted that data capturing errors occur when the relevant authorities compile the information below.

Table 1 Summary of the conservation characteristics for the study area

<table>
<tr><th colspan="6">National datasets</th></tr>
<tr><th colspan="2">Aquatic ecoregion and sub-regions in which the MRA area is located</th><th colspan="4">Detail of the MRA area in terms of the National Freshwater Ecosystem Priority Area (NFEPA) (2011) database</th></tr>
<tr><td>Ecoregion</td><td>Highveld</td><td>FEPACODE</td><td colspan="3">The MRA area is located within a subWMA currently not considered important in terms of fish species or freshwater resource conservation.</td></tr>
<tr><td>Catchment</td><td>Olifants North</td><td rowspan="3">NFEPA Wetlands (Figure 5)</td><td colspan="3" rowspan="3">According to the NFEPA database a natural depression wetland is situated within the southern portion of the MRA area, with a second natural depression situated ± 30m to the south. Both of these features are considered to be in a moderately modified (Class C) ecological condition. There are no other wetland features situated within 500 m of the MRA area according to this dataset.</td></tr>
<tr><td>Quaternary Catchment</td><td>B20B</td></tr>
<tr><td>WMA</td><td>Olifants</td></tr>
<tr><td>subWMA</td><td>Upper Olifants</td><td>Wetland vegetation Type</td><td colspan="3">The MRA area is located within the Mesic Highveld Grassland Group 4, a least threatened wetland vegetation type (formerly critically endangered).</td></tr>
<tr><th colspan="2" rowspan="2">Dominant characteristics of the Highveld Ecoregion Level 2 (11.03) (Kleynhans et al., 2007)</th><td rowspan="2">NFEPA Rivers (Figure 5)</td><td colspan="3" rowspan="2">According to the NFEPA database there are no Rivers located within the MRA area or the immediate vicinity (within 500m). The Koffiespruit River is situated ± 2.5 km northwest of the MRA area.</td></tr>
<tr><th colspan="2">Ecological Status of the most proximal sub-quaternary reach (DWS, 2014)</th></tr>
<tr><td>Dominant primary terrain morphology</td><td>Plains; Low and Moderate Relief; Slightly irregular undulating plains, few hills.</td><td>Sub-quaternary reach</td><td colspan="3">B20B-01285 (Koffiespruit)</td></tr>
<tr><td>Dominant primary vegetation types</td><td>Moist Cool Highveld Grassland</td><td>Assessed by expert?</td><td colspan="3">Yes</td></tr>
<tr><td>Altitude (m a.m.s.l)</td><td>1300-2100</td><td>Mean Ecological Importance (EI) Class</td><td colspan="3">Moderate</td></tr>
<tr><td>MAP (mm)</td><td>400 to 800</td><td>Mean Ecological Sensitivity (ES) Class</td><td colspan="3">Moderate</td></tr>
<tr><td>Coefficient of Variation (% of MAP)</td><td>20 to 34</td><td>Stream Order</td><td colspan="3">1</td></tr>
<tr><td>Rainfall concentration index</td><td>45 to 64</td><td rowspan="2">Default Ecological Class (based on median PES and highest EI or ES mean)</td><td colspan="3" rowspan="2">C (Moderate)</td></tr>
<tr><td>Rainfall seasonality</td><td>Early to late-summer</td></tr>
<tr><td>Mean annual temp. (°C)</td><td>12 to 18</td><td colspan="4" rowspan="4"></td></tr>
<tr><td>Winter temperature (July)</td><td>-2 – 18 ºC</td></tr>
<tr><td>Summer temperature (Feb)</td><td>10 – 28 ºC</td></tr>
<tr><td>Median annual simulated runoff (mm)</td><td>5 to 10 (limited); 10 to 150</td></tr>
<tr><th colspan="6">National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (Figure 6)</th></tr>
<tr><td colspan="6">According to the NBA 2018: SAIIAE there are two natural seep wetlands and one natural depression located within the MRA. The seep wetlands and the depression wetlands are considered heavily to critically modified (Class D/E/F) ecological condition. The Ecosystem Protection level (EPL) of the seep wetlands and depression wetlands are poorly protected whilst the Ecosystem threat status (ETS) of the seep wetlands are critically endangered and the ETS of the depression is least concern.</td></tr>
<tr><th colspan="6">Mining and Biodiversity Guidelines (2013)</th></tr>
<tr><td>Highest Biodiversity Importance</td><td colspan="5">A small section within the southwestern corner of the MRA area is 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 (Figure 7).</td></tr>
<tr><td>Moderate Biodiversity Importance</td><td colspan="5">The majority of the central portion and various other smaller portion of the MRA area 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 (Figure 7).</td></tr>
<tr><th colspan="2">Details of the MRA area in terms of Mucina & Rutherford (SANBI, 2018)</th><th colspan="4">Description of the vegetation type(s) relevant to the study area (Mucina & Rutherford 2006)</th></tr>
<tr><td rowspan="2">Biome (Figure 8)</td><td rowspan="2">The majority of the MRA area is situated within the Grassland Biome, while the depression wetland situated</td><td>Vegetation Type</td><td>Eastern Highveld Grassland</td><td colspan="2">Eastern Temperate Freshwater Wetlands</td></tr>
<tr><td>Climate</td><td>Strongly seasonal summer rainfall, with very dry winters</td><td colspan="2">Exclusively summer-rainfall region</td></tr>
</table>

	within the study area, and identified by NFEPA, falls within the **Azonal Vegetation Biome.**	Altitude (m)	1 520–1 780 m, but also as low as 1 300 m.	750–2 000 m
Bioregion (Figure 8)	The depression wetland falls within **Freshwater Wetlands Bioregion**, with the remaining portion of the study area situated within the **Mesic Highveld Grassland Bioregion**	MAP* (mm)	726	704
		MAT* (°C)	14.7	19.9
		MFD* (Days)	32	38
Vegetation Type (Figure 8)	The study area is situated within the **Eastern Highveld Grassland** vegetation type (VU), with the exception of the depression wetland which falls within the **Eastern Temperate Freshwater Wetlands** vegetation type.	MAPE* (mm)	926	1953
		MASMS* (%)	73	N/A
		Distribution	Mpumalanga and Gauteng Provinces	Northern Cape, Eastern Cape, Free State, North-West, Gauteng, Mpumalanga and KwaZulu-Natal
Conservation details pertaining to the MRA area (Various databases)		Conservation	Endangered. Target 24%. Only very small fraction conserved in statutory reserves	Target 24%. About 5% statutorily conserved
NBA (2018) (Figure 9)	The MRA is located within the remaining extent of the the **Eastern Highveld Grassland** (**Vulnerable**) (SANBI. 2018a), which is currently **poorly protected (**SANBI. 2018b). The depression wetland is located within an area that is poorly protected.	Geology and Soils	Red to yellow sandy soils of the Ba and Bb land types found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup)	Found on younger Pleistocene to recent sediments overlying fine-grained sedimentary rocks of the Karoo Supergroup as well as of the much older dolomites of the Malmani Subgroup of the Transvaal Supergroup in the northwest. The vleis form where flow of water is impeded by impermeable soils and/or by erosion resistant features, such as dolerite intrusions.
National Threatened Ecosystems (2011) (Figure 10)	Various sections of the MRA area form part of the remaining extent of the **vulnerable Eastern Highveld Grassland**, with the area associated with the depression wetland considered to form part of the remaining extent of the **vulnerable Eastern Temperate Freshwater Wetlands** Ecosystem According to the description in GN 102, the **Eastern Highveld Grassland** falls under **Criterion A1**, which identifies ecosystems that have undergone loss of natural habitat, impacting on their structure, function, and composition. Loss of natural habitat includes outright loss, for example the removal of natural habitat for cultivation, building of infrastructure, mining etc., as well as severe degradation. For this purpose, habitat is considered severely degraded if it would be unable to recover to a natural or near-natural state following the removal of the cause of the degradation (e.g., invasive aliens, over-grazing), even after very long time periods.			

SAPAD[4] (Q3, 2020), SACAD[5] (Q3, 2020) & NPAES (2010)	Neither the SAPAD (2017), SACAD (2017) or the NPAES (2009) database indicate any protected, or conservation areas to be situated within 10 km of the MRA area	Vegetation & landscape features	Slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition with small, scattered rocky outcrops with wiry, sour grasses and some woody species	Flat landscape or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands.
IBA (2015)	The MRA area is not located within 10 km of an IBA. The Devon Grassland IBA is situated ± 11 km southwest of the MRA area.			
Provincial datasets				
Detail of the MRA area in terms of the Mpumalanga Biodiversity Sector Plan (2019)				
Terrestrial Dataset (Figure 11)		**Aquatic Dataset (Figure 12)**		
Heavily modified	Various portions of the MRA area is considered to be Heavily modified. These are areas that are modified to such an extent that any valuable biological and ecological functions have been lost	ESA Wetlands	According to the MBSP (2019) dataset, two ESA Wetlands are present in the study area. These includes the depression wetland identified previously by NFEPA (2011) dataset. Included are all non-FEPA wetlands and whilst these are not FEPA wetlands they still maintain the hydrological functioning of rivers, water tables and fresh water biodiversity, as well as offer various ecosystem services through the ecological infrastructure that they provide	
Moderately modified – Old Lands	The MBSP dataset indicate various sections of the MRA area to be moderately modified – old lands. Old, cultivated lands that have been allowed to recover (within the last 80 years) and support some natural vegetation. Although biodiversity pattern and ecological functioning may have been compromised, the areas may still play a role in supporting biodiversity and providing ecosystem services	Heavily modified	The areas identified by the terrestrial dataset as heavily modified is again considered to be heavily modified from an aquatic perspective. These are all areas that are currently modified to such an extent that any valuable biodiversity and ecological function has been lost	
Other Natural Areas	The majority of the MRA area, particularly the northern and central portion is considered to be other natural area. These are areas that have not been identified as priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions	Other Natural Areas	The remaining areas is considered to be other natural areas. These area areas that are not currently identified as priority areas, however most of the natural character is retained and various biodiversity and ecological infrastructural functions are performed	
Mpumalanga Highveld Wetlands (MHW) Database (2014)				
HGM Units (Figure 13)	Various natural depression and seep wetlands are situated within the MRA area and the immediate surrounding region (within 500m). The majority of the MRA comprise of a seep wetland which are associated with a depression according to the MHW Dataset, with a second seep wetland associated with the central section of the eastern boundary, and a third depression wetland situated ± 115m to the south. None of the other wetlands indicated on the map falls within 500m of the MRA area.			
Wetland Condition (Figure 14)	The wetlands situated within the MRA area are considered to be in a moderately modified (WETCONC) ecological condition, while the depression wetland situated to the south is considered to be heavily to critically modified (WETCON Z)			
National Web-based Environmental Screening Tool (2020)				
The Screening Tool is intended to allow for pre-screening of sensitivities in the landscape to be assessed within the Environmental Authorisation process. This assists with implementing the mitigation hierarchy by allowing developers to adjust their proposed development footprint to avoid sensitive areas.				
Animal Species	For the Animal Species theme, much of the study area is considered to have a **Medium Sensitivity.** Species triggering this sensitivity include**:** *Clonia uvarovi* (Bush cricket, VU), *Chrysospalax villosus* (Rough-haired golden mole, VU) and *Hydrictis maculicollis* (Spotted-necked otter, NT)			

[4] **SAPAD (2020):** The definition of protected areas follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas - 1. Special nature reserves; 2. National parks; 3. Nature reserves; 4. Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003); 5. World heritage sites declared in terms of the World Heritage Convention Act; 6. Marine protected areas declared in terms of the Marine Living Resources Act; 7. Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and 8. Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

[5] **SACAD (2020):** The types of conservation areas that are currently included in the database are the following: 1. Biosphere reserves, 2. Ramsar sites, 3. Stewardship agreements (other than nature reserves and protected environments), 4. Botanical gardens, 5. Transfrontier conservation areas, 6. Transfrontier parks, 7. Military conservation areas and 8. Conservancies.

Plant Species	For the Plant Species theme, much of the study area is considered to have a **Medium Sensitivity. Species triggering this sensitivity include:** Sensitive species 691[6] (VU), *Pachycarpus suaveolens* (VU) and *Brachycorythis conica* subsp. *transvaalensis* (CR).
Terrestrial Sensitivity	The Terrestrial Sensitivity for the entire study area is considered to have a **Very High sensitivity**. The triggered sensitivity features include a **Vulnerable ecosystem** (i.e., Eastern Highveld Grassland).
Aquatic Sensitivity	The Aquatic Sensitivity for the entire study area is considered to have a **Very High sensitivity**. The triggered sensitivity features include a **Strategic water source area (SWSAs) and Wetlands and Estuaries.**
Strategic Water Source Areas for Surface Water (2017)	
Surface water Strategic Water Source Areas (SWSAs) are defined as areas of land that supply a disproportionate (i.e., relatively large) quantity of mean annual surface water runoff in relation to their size. They include transboundary areas that extend into Lesotho and Swaziland. The sub-national Water Source Areas (WSAs) are not nationally strategic as defined in the report but were included to provide a complete coverage.	
Name & Criteria	The MRA is not within 10 km of a Strategic Water Source Area.

NBA = National Biodiversity Assessment; SAPAD = South African Protected Areas Database; SACAD = South African Conservation Areas Database; NPAES = National Protected Areas Expansion Strategy; IBA = Important Bird Area; MAP = Mean annual precipitation; MAT = Mean annual temperature; MAPE = Mean annual potential evaporation; MFD = Mean Frost Days; MASMS = Mean annual soil moisture stress (% of days when evaporative demand was more than double the soil moisture supply); CBA = Critical Biodiversity Areas; ESA = Ecological Support.

[6] According to the best practise guidelines provided by SANBI, the name of sensitive species provided by the Online EIA screening tool may not appear in the final EIA report nor any of the specialist reports released into the public domain. This is to protect species that are under threat to factors such as illegal harvesting and overexploitation.

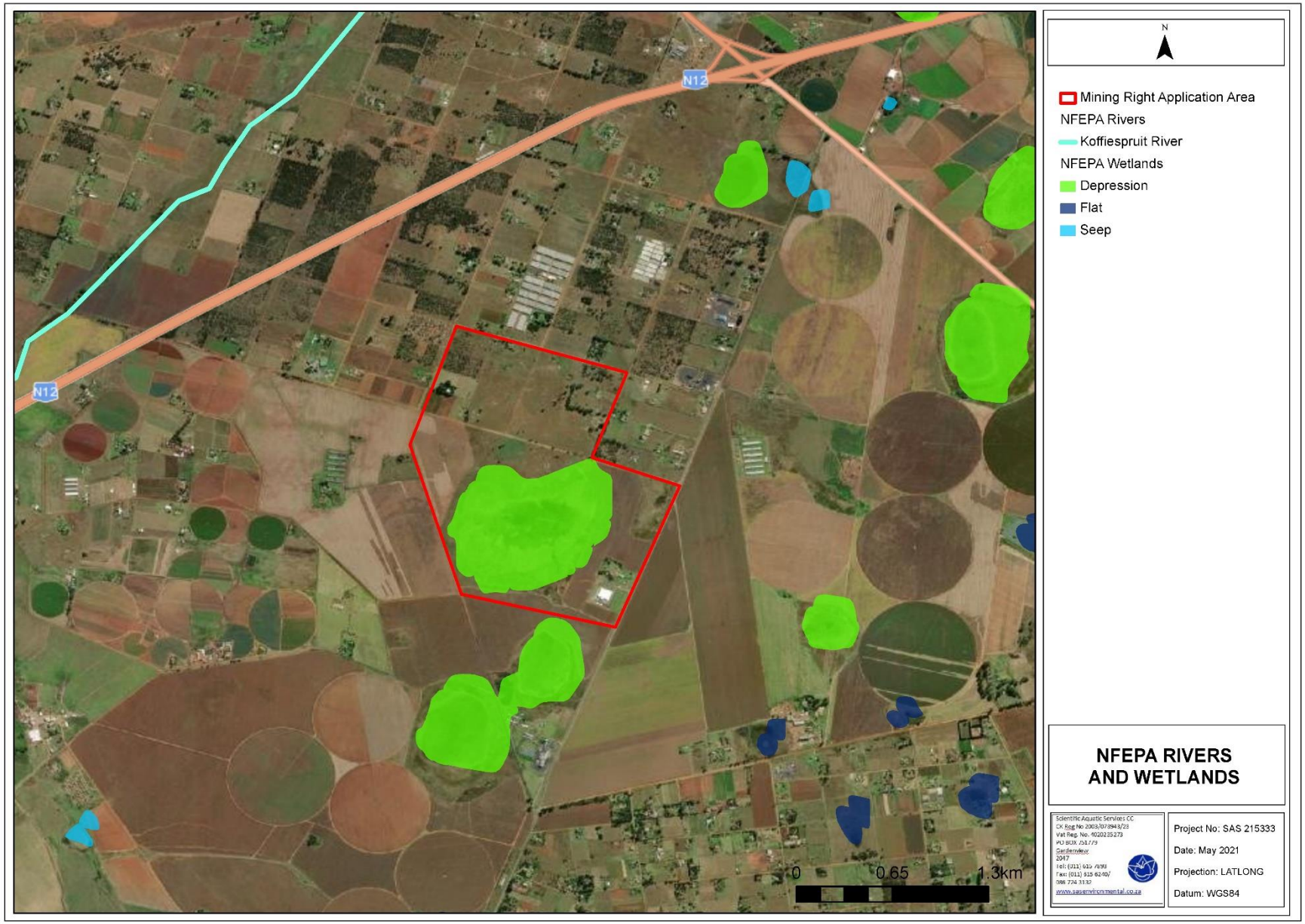

Figure 5: Wetlands and Rivers associated with the MRA area and surrounding areas according to NFEPA (2011) database.

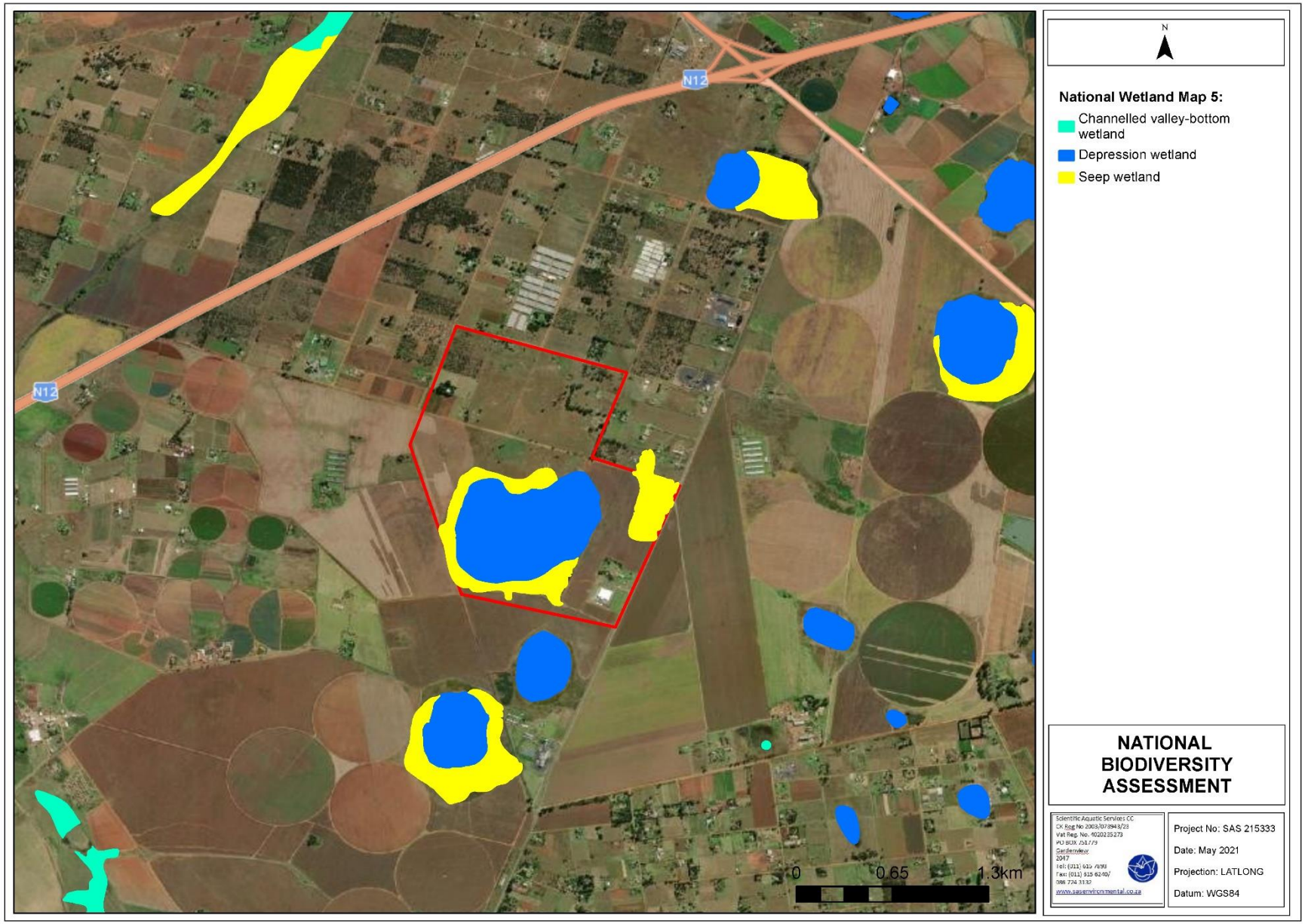

Figure 6: National Biodiversity Assessment (2018): South African Inventory of Inland Aquatic Ecosystems (SAIIAE).

Figure 7: Importance of the MRA area according to the Mining and Biodiversity Guidelines (2013)

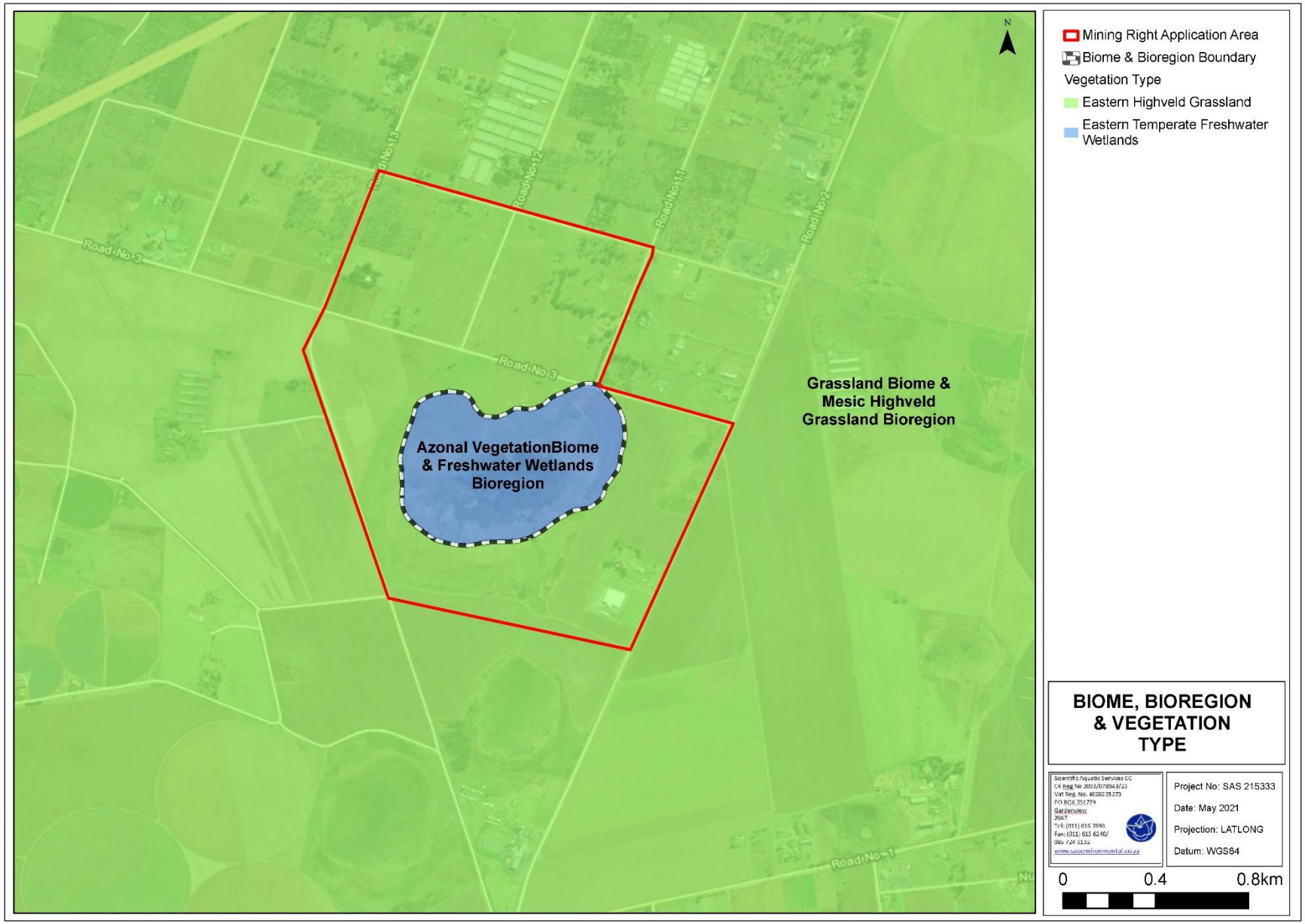

Figure 8: Biomes, Bioregions and Vegetation Types associated with the MRA area according to Mucina & Rutherford (SANBI, 2018).

Figure 9: Eastern Highveld Grassland Vegetation type as per the National Biodiversity assessment (2018).

Figure 10: Vulnerable ecosystems associated with the MRA area according to the National Threatened Ecosystem Database (2011).

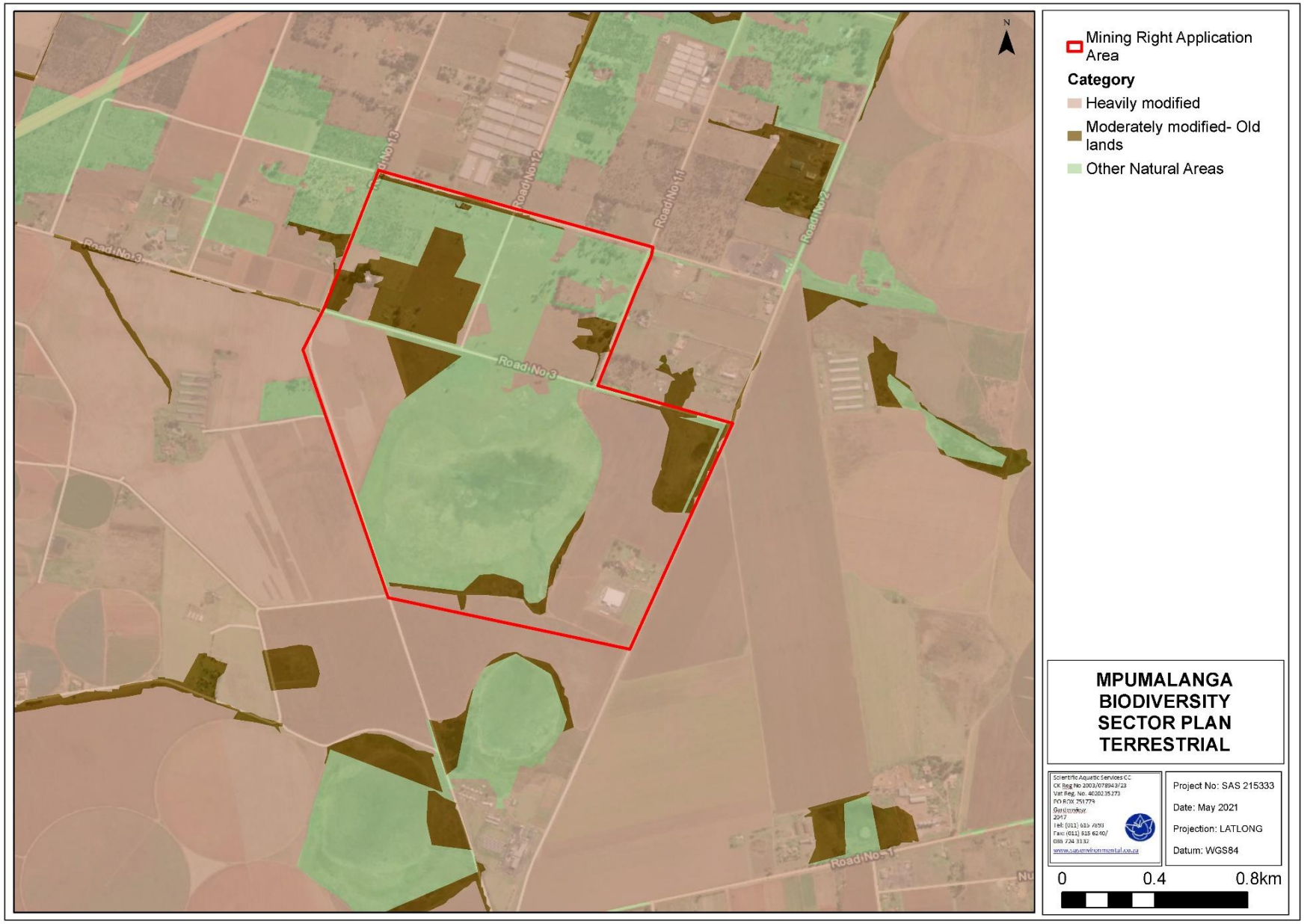

Figure 11: Mpumalanga Biodiversity Sector Plan Terrestrial Biodiversity Assessment applicable to the MRA area (MBSP, 2018).

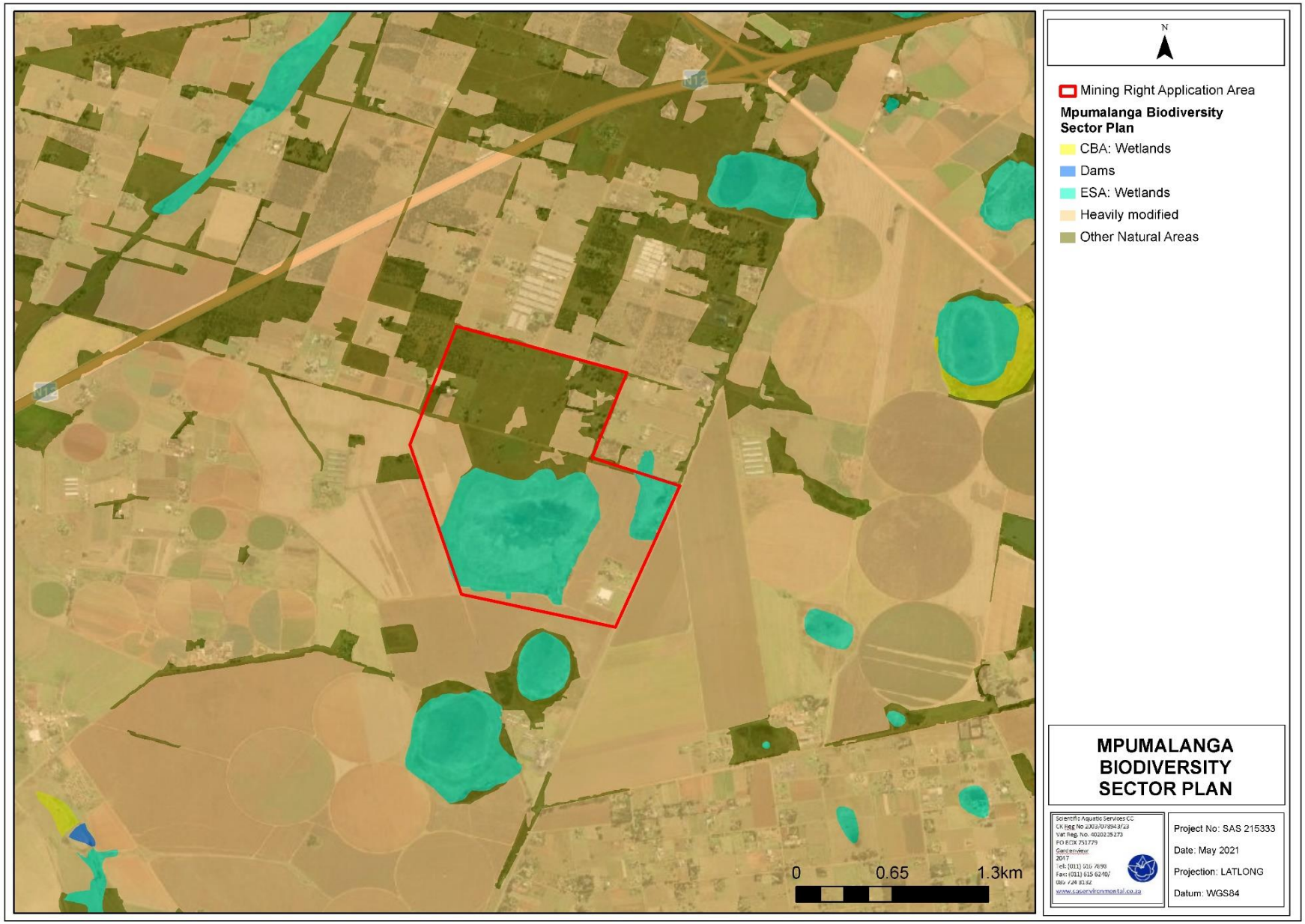

Figure 12: Mpumalanga Biodiversity Sector Plan Aquatic Biodiversity Assessment associated with the MRA area (MBSP, 2014).

Figure 13: Hydrogeomorphic units of wetlands associated with the MRA area and the surrounding region according to the Mpumalanga Highveld Wetlands (2014).

Figure 14: Ecological condition of the wetlands associated with the MRA area and the surrounding region according to the Mpumalanga Highveld Wetlands (2014).

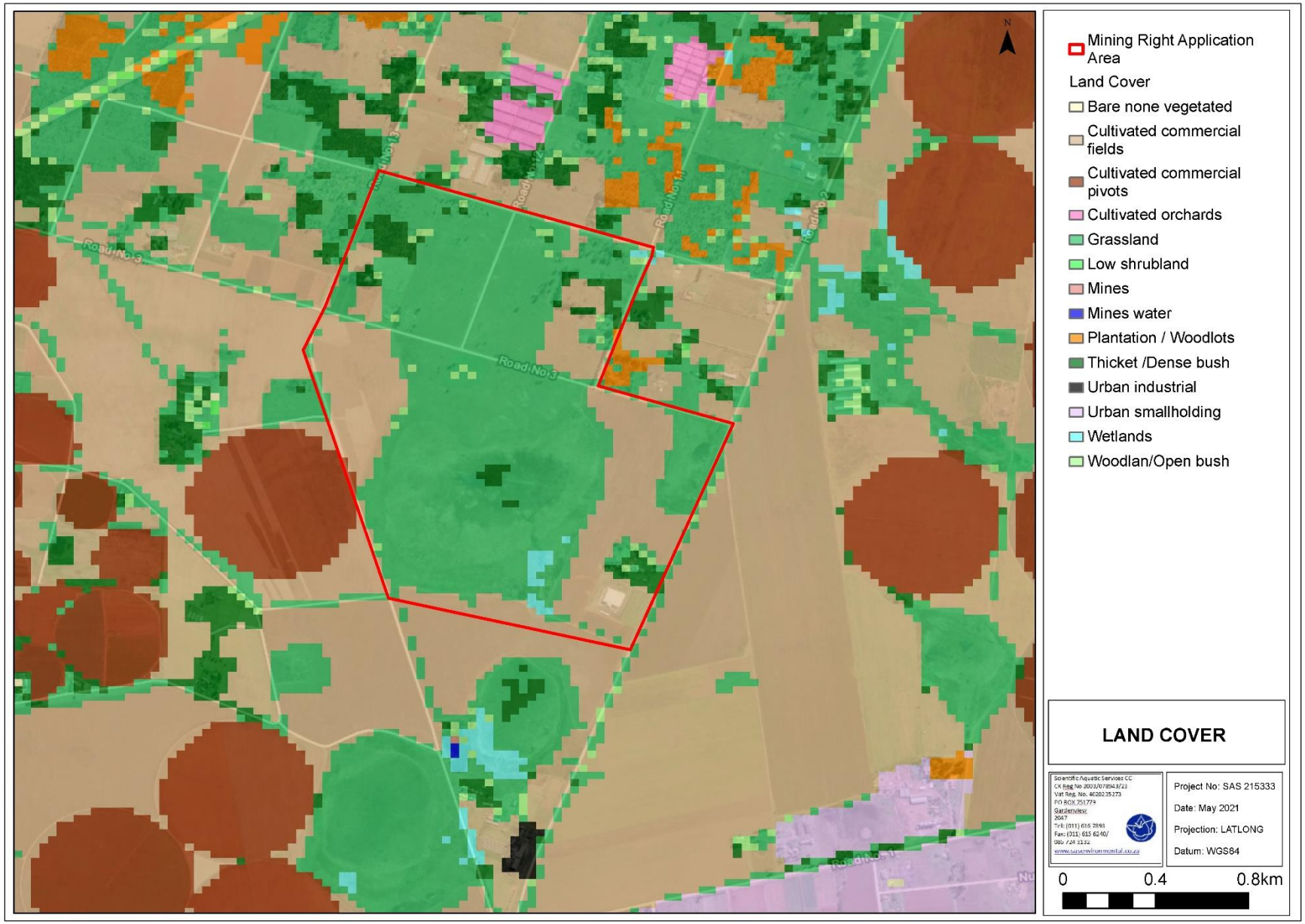

Figure 15: Land cover associated with the MRA area (National Land Cover, 2013).

4 STRUCTURE OF THE REPORT

Section A of this report served to introduce the MRA area as well as the general approach to the study. Section A also presents the results of general desktop information reviewed as part of the study including the information generated by the relevant authorities as well as the context of the site in relation to the surrounding anthropogenic activities and ecological characteristics;

Section B addresses all the issues pertaining to the assessment of the floral ecology of the MRA;

Section C addresses all the issues pertaining to the assessment of the faunal ecology of the MRA;

Section D addresses all the issues pertaining to the assessment of the freshwater ecology of the MRA; and

Section E presents the results of the risk assessment and the mitigation measure development as well as the impact statement for the project.

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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.

Although SAS CC exercises due care and diligence in rendering services and preparing documents, SAS CC accepts no liability and the client, by receiving this document, indemnifies SAS CC and its directors, managers, agents and employees against all actions, claims, demands, losses, liabilities, costs, damages and expensed arising from or in connection with services rendered, directly or indirectly by SAS CC and by the use of the information contained in this document.

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

APPENDIX B - Legislative Requirements

National Environmental Management Act (Act No. 107 of 1998) (NEMA).	The National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) 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 should follow the Environmental Impact Assessment (EIA) process depending on the scale of the impact. Provincial regulations must also be considered.
The National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA).	The objectives of this act are (within the framework of NEMA) to provide for: ➢ The management and conservation of biological diversity within the Republic of South Africa and of the components of such diversity; ➢ The use of indigenous biological resources in a sustainable manner; ➢ The fair and equitable sharing among stakeholders of the benefits arising from bio prospecting involving indigenous biological resources; ➢ To give effect to ratify international agreements relating to biodiversity which are binding to the Republic; ➢ To provide for cooperative governance in biodiversity management and conservation; and ➢ To provide for a South African National Biodiversity Institute to assist in achieving the objectives of this Act. This act alludes to the fact that management of biodiversity must take place to ensure that the biodiversity of the surrounding areas are not negatively impacted upon, by any activity being undertaken, in order to ensure the fair and equitable sharing among stakeholders of the benefits arising from indigenous biological resources. Furthermore, a person may not carry out a restricted activity involving either: a) A specimen of a listed threatened or protected species; b) Specimens of an alien species; or c) A specimen of a listed invasive species without a permit.
Government Notice 598 Alien and Invasive Species Regulations (2014), including the Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates to the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004)[7]	NEMBA is administered by the Department of Environmental Affairs and aims to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA. In terms of alien and invasive species. This act in terms of alien and invasive species aims to: ➢ Prevent the unauthorized introduction and spread of alien and invasive species to ecosystems and habitats where they do not naturally occur, ➢ Manage and control alien and invasive species, to prevent or minimize harm to the environment and biodiversity; and ➢ Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats. Alien species are defined, in terms of the National Environmental Management: Biodiversity Act, 2004 (Act No 10 of 2004) as: (a) A species that is not an indigenous species; or (b) An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.

[7] **Legislation to come into force on 1st May 2021**:

- Government Notice number R.1020: Alien and Invasive Species Regulations, 2020, in Government Gazette 43735 dated 25 September 2020.
- Government Notice number 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020.

	Categories according to NEMBA (Alien and Invasive Species Regulations, 2017): ➢ **Category 1a:** Invasive species that require compulsory control; ➢ **Category 1b:** Invasive species that require control by means of an invasive species management programme; ➢ **Category 2:** Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread; and ➢ **Category 3:** Ornamentally used plants that may no longer be planted.
The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA)	The Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA) provides for the protection of indigenous plants. Subject to the provisions of this Act, no person shall: ➢ Pick, be in possession of, sell, purchase, donate, receive as a gift, import into, export, or remove from the Province, or convey: o A specially protected plant; or o A protected plant. ➢ Pick any indigenous plant: o On a public road; o On land next to a public road within 100 m measured from the centre of the road; o Within an area bordering any natural watercourse, whether wet or dry, up to and within 50 m from the high watermark on either side of the natural watercourse; or o In a Provincial Park, a site of Ecological Importance or a Protected Natural Environment. The below schedules were applicable for the floral and faunal assessments (Part B and C): ➢ Schedule 1: Specifically Protected Game (Section 4 (1) (a)); ➢ Schedule 2: Protected Game (Section 4 (1) (b)); ➢ Schedule 4: Protected Wild Animals (Section 4 (1) (d)); ➢ Schedule 7: Invertebrates (Section 35 (1)); ➢ Schedule 11: Protected Plants (Section 69 (1) (a)); and ➢ Schedule 12: Specifically Protected Plants (Section 69 (1) (b)).
The Constitution of the Republic of South Africa, 1996	The environment and the health and well-being of people are safeguarded under the Constitution of the Republic of South Africa, 1996 by way of Section 24. Section 24(a) guarantees a right to an environment that is not harmful to human health or well-being and to environmental protection for the benefit of present and future generations. Section 24(b) directs the state to take reasonable legislative and other measures to prevent pollution, promote conservation, and secure the ecologically sustainable development and use of natural resources (including water and mineral resources) while promoting justifiable economic and social development. Section 27 guarantees every person the right of access to sufficient water, and the state is obliged to take reasonable legislative and other measures within its available resources to achieve the progressive realisation of this right. Section 27 is defined as a socio-economic right and not an environmental right. However, read with Section 24 it requires of the state to ensure that water is conserved and protected and that sufficient access to the resource is provided. Water regulation in South Africa places a great emphasis on protecting the resource and on providing access to water for everyone.
National Water Act, 1998 (Act No. 36 of 1998) (NWA)	The National Water Act (NWA) (Act No. 36 of 1998) recognises that the entire ecosystem and not just the water itself in any given water resource constitutes the resource and as such needs to be conserved. No activity may therefore take place within a watercourse unless it is authorised by the Department of Water and Sanitation (DWS). Any area within a wetland or riparian zone is therefore excluded from development unless authorisation is obtained from the DWS in terms of Section 21 (c) & (i).
General Notice 509 as published in the Government Gazette 40229 of 2016 as it relates to the NWA	In accordance with Regulation GN509 of 2016, a regulated area of a watercourse for section 21c and 21i of the NWA, 1998 is defined as a) The outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam; b) In the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

	This notice **replaces GN1199** and may be exercised as follows i) Exercise the water use activities in terms of Section 21(c) and (i) of the Act as set out in the table below, subject to the conditions of this authorisation; ii) Use water in terms of section 21(c) or (i) of the Act if it has a low risk class as determines through the Risk Matrix; iii) Do maintenance with their existing lawful water use in terms of section 21(c) or (i) of the Act that has a LOW risk class as determined through the Risk Matrix; iv) Conduct river and stormwater management activities as contained in a river management plan; v) Conduct rehabilitation of wetlands or rivers where such rehabilitation activities has a LOW risk class as determined through the Risk Matrix; and vi) Conduct emergency work arising from an emergency situation or incident associated with the persons' existing lawful water use, provided that all work is executed and reported in the manner prescribed in the Emergency protocol. A General Authorisation (GA) issued as per this notice will require the proponent to adhere with specific conditions, rehabilitation criteria and monitoring and reporting programme. Furthermore, the water user must ensure that there is a sufficient budget to complete, rehabilitate and maintain the water use as set out in this GA. Upon completion of the registration, the responsible authority will provide a certificate of registration to the water user within 30 working days of the submission. On written receipt of a registration certificate from the Department, the person will be regarded as a registered water user and can commence within the water use as contemplated in the GA.
Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA)	The obtaining of a New Order Mining Right (NOMR) is governed by the MPRDA. The MPRDA requires the applicant to apply to the DMR for a NOMR which triggers a process of compliance with the various applicable sections of the MPRDA. The NOMR process requires environmental authorisation in terms of the NEMA and the 2014 EIA regulations as amended in 2017 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).
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 1100 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 1100 year floodline of the aquatic resource or 100m from the edge of the resource, whichever distance is the greatest.
Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA)	Removal of the alien and weed species encountered in the application area must take place in order to comply with existing legislation (amendments to the regulations under the CARA, 1983 and Section 28 of the NEMA, 1998). Removal of species should take place throughout the construction and operation, phases.

APPENDIX C - Vegetation Types

Eastern Highveld Grassland

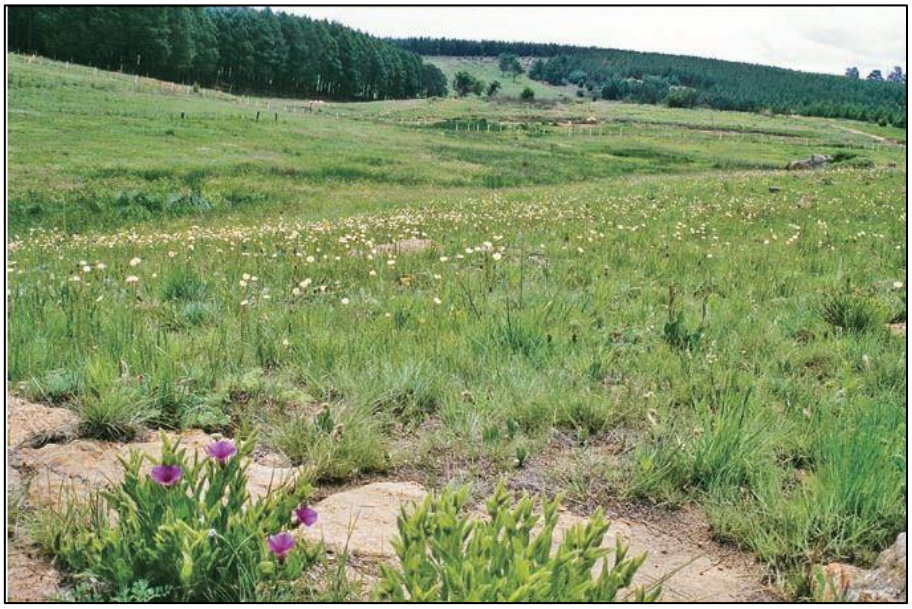


Figure D1: Gm 12 Eastern Highveld Grassland: Grasslands of the Warburton area (Mpumalanga) with species of *Berkheya* and *Ipomoea* prominent in the foreground. Image by T. Steyn.

Table D1: Floristic species of *The Eastern Highveld Grassland* (Mucina & Rutherford, 2012).

Plant Community	Species
Dominant (*d) and typical floristic species	
Woody Layer	
Low Shrubs	*Anthospermum rigidum* subsp. *pumilum*, *Seriphium plumosum*.
Forb layer	
Herbs	*Berkheya setifera* (d), *Haplocarpha scaposa* (d), *Justicia anagalloides* (d), *Pelargonium luridum* (d), *Acalypha angustata*, *Chamaecrista mimosoides*, *Dicoma anomala*, *Euryops gilfillanii, E. transvaalensis* subsp. *setilobus, Helichrysum aureonitens*, *H. caespititium*, *H. callicomum*, *H. oreophilum*, *H. rugulosum*, *Ipomoea crassipes*, *Pentanisia prunelloides* subsp. *latifolia*, *Selago densiflora*, *Senecio coronatus*, *Hilliardiella elaeagnoides*, *Wahlenbergia undulata*.
Geophytic herbs	*Gladiolus crassifolius*, *Haemanthus humilis* subsp. *hirsutus*, *Hypoxis rigidula* var. *pilosissima*, *Ledebouria ovatifolia*.
Succulent herbs	*Aloe ecklonis*.
Graminoid layer	
Graminoids	*Aristida aequiglumis* (d), *A. congesta* (d), *A. junciformis* subsp. *galpinii* (d), *Brachiaria serrata* (d), *Cynodon dactylon* (d), *Digitaria monodactyla* (d), *D. tricholaenoides* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *E. racemosa* (d), *E. sclerantha* (d), *Heteropogon contortus* (d), *Loudetia simplex* (d), *Microchloa caffra* (d), *Monocymbium ceresiiforme* (d), *Setaria sphacelata* (d), *Sporobolus africanus* (d), *S. pectinatus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *T. rehmannii* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *A. schirensis*, *Bewsia biflora*, *Ctenium concinnum*, *Diheteropogon amplectens*, *Eragrostis capensis*, *E. gummiflua*, *E. patentissima*, *Harpochloa falx*, *Panicum natalense*, *Rendlia altera*, *Schizachyrium sanguineum*, *Setaria nigrirostris*, *Urelytrum agropyroides*.

Eastern Temperate Freshwater Wetlands

Dominant Floral Taxa

Table C2 Dominant & typical floristic species of Eastern Temperate Freshwater Wetlands (Mucina & Rutherford, 2012)

Floral Community	Species
Marches	
Megagraminoids	*Cyperus congestus* (d)
Graminoids	*Agrostis lachnantha* (d), *Carex acutiformis* (d), *Eleocharis palustris* (d), *Eragrostis plana* (d), *E. planiculmis* (d), *Fuirena pubescens* (d), *Helictotrichon turgidulum* (d), *Hemarthria altissima* (d), *Imperata cylindrica* (d), *Leersia hexandra* (d), *Paspalum dilatatum* (d), *P. urvillei* (d), *Pennisetum thunbergii* (d), *Schoenoplectus decipiens* (d), *Scleria dieterlenii* (d), *Setaria sphacelata* (d), *Andropogon appendiculatus*, *A. eucomus*, *Aristida aequiglumis*, *Ascolepis capensis, Carex austro-africana*, *C. schlechteri*, *Cyperus cyperoides*, *C. distans*, *C. longus*, *C. marginatus*, *Echinochloa holubii*, *Eragrostis micrantha*, *Ficinia acuminata*, *Fimbristylis complanata*, *F. ferruginea*, *Hyparrhenia dregeana*, *H. quarrei, Ischaemum fasciculatum*, *Kyllinga erecta*, *Panicum schinzii*, *Pennisetum sphacelatum*, *Pycreus macranthus*, *P. nitidus*, *Setaria pallide-fusca*, *Xyris gerrardii*.
Herbs	*Centella asiatica* (d), *Ranunculus multifidus* (d), *Berkheya radula*, *B. speciosa*, *Berula erecta* subsp. *thunbergii*, *Centella coriacea*, *Chironia palustris*, *Equisetum ramosissimum*, *Falckia oblonga, Haplocarpha lyrata, Helichrysum difficile*, *H. dregeanum*, *H. mundtii*, *Hydrocotyle sibthorpioides, H. verticillata*, *Lindernia conferta*, *Lobelia angolensis, L. flaccida*, *Mentha aquatica*, *Monopsis decipiens*, *Pulicaria scabra*, *Pycnostachys reticulata*, *Rorippa fluviatilis* var. *fluviatilis*, *Rumex lanceolatus*, *Senecio inornatus*, *S. microglossus*, *Sium repandum*, *Thelypteris confluens*, *Wahlenbergia banksiana, Rorippa fluviatilis* var. *caledonica*[h]
Geophytic Herbs	*Cordylogyne globosa*, *Crinum bulbispermum*, *Gladiolus papilio*, *Kniphofia ensifolia*, *K. fluviatilis*, *K. linearifolia*, *Neobolusia tysonii, Nerine gibsonii* (only in Eastern Cape), *Satyrium hallackii* subsp. *hallackii*. *Nerine platypetala* (e)
Succulent Herb	*Crassula tuberella* (e)
Reeds and Sedge Beds	
Megagraminoids	*Phragmites australis* (d), *Schoenoplectus corymbosus* (d), *Typha capensis* (d), *Cyperus immensus*.
Graminoid	*Carex cernua*
Waterbodies	
Aquatic Herbs	*Aponogeton junceus*, *Ceratophyllum demersum*, *Lagarosiphon major*, *L. muscoides*, *Marsilea capensis*, *Myriophyllum spicatum, Nymphaea lotus*, *N. nouchali* var. *caerulea*, *Nymphoides thunbergiana*, *Potamogeton thunbergii*
Carnivorous Herb	*Utricularia inflexa*
Herb	*Marsilea farinosa* subsp. *farinosa*

APPENDIX D – Comments and Response Report

DIRECTLY AFFECTED PARTIES

Comments from the Municipalities

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
What will happen if the protected species need to be moved?	Tenith Masombuka Town Planner Victor Khanye Local Municipality Meeting 9-3-2018	The mine will have to obtain approval from the Mpumalanga Tourism and Parks Agency (MTPA) to relocate the species to a similar habitat. All relocation activities will have to be overseen by a suitably qualified specialist.

Comments from Organs of State

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
The MTPA has no objection to the proposed mining project, but has the following concerns: 1. The MBSP (2014) Terrestrial assessment fig 1. and fig 3. attached indicate that there is a section of portion 9 of the farm Rietkol 237 IR that consists of a Critical Biodiversity Area Optimal. Although that the mining right area and mine plan lies in another portion of the farm, the MTPA is concerned that mining activities might impact on this natural area. The EMP should ensure that the natural state is maintained. 2. The Freshwater assessment fig 2. Attached indicate Ecological Support Area Wetlands (ESA). These areas should also be maintained in a natural state with no loss of ecosystem services. In the event that the mine plan is going to affect these wetlands, the company should invest in an offset strategy. 3. MTPA is further concerned that the critically endangered terrestrial orchid, *Albertan Sisal orchid, Brachycorythis conice subs.transvaalensis* (Johnson, Bytebier & Starker, 2015) which is restricted to SA might occur on this farm. It has been listed for this farm. (Flowers from January to February).	Mr JJ Eksteen Manager Scientific Services MTPA	We take note of your comments, which will be addressed in the relevant specialist reports and EIAR/EMPr. **Environmental Studies Complete** Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C In addition, a freshwater ecosystem assessment was undertaken and is presented in Section D. Furthermore, the perceived impacts pertaining to the proposed mining activities were assessed and presented in Section E. The ESA wetlands referred to were identified to be pan 1 and seep wetland 2 (refer to freshwater ecosystem assessment in Section D). The recommendations made in the freshwater ecosystem assessment are to demarcate the pan and seep wetland 2 and 100 m Mpumalanga Biodiversity setback buffers as a “no-go” areas in which no encroachment of mining activities and infrastructure is to occur which will prevent the degradation of the wetlands. Records indicate that the species *Brachycorythis conice subs.transvaalensis* has been previously recorded to the south of the MRA area, with no records of occurrence for the MRA area itself. Floral assessments were undertaken during the correct flowering season; however, no individuals were observed. This species has been highlighted in the floral report (Section B), and specific reference made to actions needed should individuals be found.
Recommendations 1. The MTPA recommends that a thorough flora study is done during the growing season over the whole of both farms.	Mr JJ Eksteen Manager Scientific Services MTPA	We take note of your comments, which will be addressed in the relevant specialist reports and EIAR/EMPr.

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
2. Wetland delineation is done in order to include the buffer zone of 100 metres as well as a determination of the size in hectares of these sensitive areas. 3. If the plant in question is found that the MTPA Scientific Services is notified. 4. That the flora study must include all exotic plants that need to be removed and a long-term maintenance plan is included in the EMP. 5. Active water purification forms part of the EMP as well for the next 100 years after mining.		**Environmental Studies Complete** Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C. Furthermore, the perceived impacts pertaining to the proposed mining activities were assessed within each of these reports. The scope of the floral studies was restricted to assessing that of the MRA area only. A buffer of 100m has been advocated around the wetlands, and infrastructure has been moved so as to not impact on this buffer. The floral study has highlighted all alien and invasive plant species observed within the MRA area during the field assessments. Records indicate that the species *Brachycorythis conice subs.transvaalensis* has been previously recorded to the south of the MRA area, with no records of occurrence for the MRA area itself. Floral assessments were undertaken during the correct flowering season; however, no individuals were observed. This species has been highlighted in the floral report (Section B), and specific reference made to actions needed should individuals be found.
Detailed soil studies must be included in the EMPR. Weeds and invader plants management plan must be included in the EMPR. Current land use must be included in the EMPR. Sensitive areas like wetlands must not be disturbed.	Mary Mogale Department of Agriculture, Land Reform and Rural Development Email 19 Feb 2021	These aspects will be addressed in the Soils, Land Use and Land Capability specialist assessment and in the EIAR. **Environmental Studies Complete**. Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C. The floral study has highlighted all alien and invasive plant species observed within the MRA area during the field assessments. The wetlands and 32 m NEMA are recommended to be allocated as "no-go" areas in which no mining activities are to occur.

OTHER AFFECTED PARTIES

Comments from Neighbouring Landowners

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
Based on the Environmental Impact Evaluation and Mitigation measures and specifically the Impact Risk Matrix (Table 63 Initial High- Level Risk Impact Matrix Summary) our client's immovable properties, as above, will be impacted negatively as is clearly set out in the report. The properties are adjacent to the proposed location of the mine. Our client therefore objects to the proposed location of the mine based on the direct negative impact it will have on the properties as per Table 63 and Table 4. These are, inter alia, as follows 1. Infrastructure area Loss of soil, impact of fauna and flora, killing of animals, loss of biodiversity and pollution. 2. Hazardous chemicals and waste. Pollution due to accidental spillage. 3. Mining Lowering of groundwater levels. 4. Communities Increased dust, noise impact, traffic etc. 5. Residual impact Post closure land use, impact on ecosystem. 6. Negative visual impact. 7. Lighting Constant lighting due to night-time lighting. 8. The purpose for which our client's properties are used will be affected negatively by the proposed mine and will therefore greatly reduce in value as our client will no longer be in a position to use the properties for the purposes it is currently used for. All our client's rights remain strictly reserved but our client will consider as acceptable, reasonable and fair offer for the three properties, in its totality.	Arthur Channon on behalf of Roy Robertson Family Trust Plot 278,279,281 Neighbouring landowner to the MRA area Email 19-03-2018	Noted. Impacts associated with the proposed Rietkol Project will be identified during the EIA Phase, including impacts on groundwater levels and quality, air quality and property value. The potential impact on the economic activities situated on these properties will be assessed as part of the macro-economic impact assessment. **Environmental Studies Complete** Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C. Furthermore, the perceived impacts pertaining to the proposed mining activities were assessed and presented in Section E.

Comments from Neighbouring Land Occupants

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
Grazing for animals can be affected.	Mavie, Fernando Occupant of Plot 152 Neighbouring Land Occupant Survey 15-03-2016	Noted, your comments will be considered during the social impact assessment that addresses both impacts and benefits to the community. The impact on the existing livelihood of communities and grazing land will be investigated. **Environmental Studies Complete** Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C. Furthermore, the perceived impacts pertaining to the proposed mining activities were and are presented in Section E. Studies noted that mining activities will result in the loss of grazing within the proposed open cast areas.

Comments from Landowners within a 1km radius (not direct neighbours)

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
10. Biodiversity (as per 8.5) a. Only considered the proposed mining area – surrounding areas were excluded b. No account for movement of species like the Giant Bullfrog across roads and to neighboring wetland areas.	Sarel Kritzinger Goudhoek SA Boerperd Stoet / Ovomart (Pty) Ltd / SJN Kritzinger cc Plot 158, 160, 161, 162. Landowners within the 1km MRA buffer Email 19-03-2018	Thank you for your comment. The DSR indicated that it is highly likely that *Pyxicephalus adspersus* (Giant Bullfrog) will occur within and around the non-cultivated areas of the large wetland in the southern portion of the study area. The wetland further south of this (outside of the MRA) is further likely to also provide suitable habitat to *Pyxicephalus adspersus*. Proposed mining activities will result in increased traffic frequency, which will inevitably result in a higher risk of *Pyxicephalus adspersus* mortality rates associated with vehicles. The occurrence of *Pyxicephalus adspersus* (Bullfrogs) has been addressed within the faunal report, Section C in sections 3.4 and 3.8. It has been highlighted that the movement of vehicles and loss of habitat pose a threat to this species. The use of the north road alternative has been highlighted in order to minimise the risk of vehicle collisions with bullfrogs moving between the wetland areas. The freshwater ecosystem assessment further highlights that the pan and seep wetlands as well as their associated buffer zones be demarcated as “no-go areas” in which no mining activities are to take place.

Comments from Landowners outside the 1km radius

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
What will the impact be on our: 1. Water supply 2. Health 3. Roads 4. Land & property value 5. Safety 6. Damage to property 7. Wildlife and endangered animals and plants like the Bull frogs, vet plants	Rentia Rohlandt AJM Boerdery Plot 241 Landowner outside the 1km MRA buffer Online 15-2-2018	Noted. Impacts associated with the proposed Rietkol Project will be identified during the EIA Phase, including impacts on groundwater levels and quality, air quality and property value. A Health Impact Risk Assessment (HIRA) will be conducted to determine the potential health risks to the community, with a focus on the impacts concerning silicosis. Other studies include a traffic impact assessment and a social impact assessment, to address issues such as safety and security. **Environmental Studies Complete** Current species habitat, diversity and abundance levels were assessed and presented in Sections B and C. Furthermore, the perceived impacts pertaining to the proposed mining activities were assessed and presented in Section E. Protected plant species were identified and noted as per the specialist floral report, Section B. In the report it mandates that should any protected floral species be identified within the mining area, they are to be rescued and relocated as per a rescue and relocation plan. These activities are to be overseen by a qualified specialist, following the granting of the relevant removal permits from MTPA.

Comments/Suggestion/Question/Concern	Stakeholder, date & method	Response
		The occurrence of *Pyxicephalus adspersus* (Bullfrogs) has been addressed within the faunal report, Section C in sections 3.4 and 3.8. It has been highlighted that the movement of vehicles and loss of habitat pose a threat to this species. The use of the north road alternative has been highlighted in order to minimise the risk of vehicle collisions with bullfrogs moving between the wetland areas.
I do not agree with this venture. The dust is not good for farming activities. The mine cannot guarantee our air quality for cattle farming and the growth of grass for grazing for the cattle. After 4 years they want to do blasting and that will have severe negative affects on our water levels that is under pressure already. This is a definite NO from my side with my main residence in the affected area. Not to mention the endangered species of bull frog that will be affected and we have indigenous cranes and secretary birds which will all be affected by this mine. The noise levels are another concern.	Corne Henning Land Owner Holding 76, 86, 93 Email 18 Mar 2021	Your concerns around environmental degradation are noted and will be considered during the EIA process and within the relevant specialist impact studies. Mitigation measures will be determined to deal with any of the concerns raised and impacts identified by the specialists for inclusion in the EMPr. The DSR indicated that it is highly likely that *Pyxicephalus adspersus* (Giant Bullfrog) will occur within and around the non-cultivated areas of the large wetland in the southern portion of the study area. The wetland further south of this (outside of the MRA) is further likely to also provide suitable habitat to *Pyxicephalus adspersus*. Proposed mining activities will result in increased traffic frequency, which will inevitably result in a higher risk of *Pyxicephalus adspersus* mortality rates associated with vehicles. The occurrence of *Pyxicephalus adspersus* (Bullfrogs) has been addressed within the faunal report, Section C in sections 3.4 and 3.8. It has been highlighted that the movement of vehicles and loss of habitat pose a threat to this species. The use of the north road alternative has been highlighted in order to minimise the risk of vehicle collisions with bullfrogs moving between the wetland areas. The occurrence of *Sagittarius serpentarius* (Secretarybird) has been addressed within the faunal report, Section C in sections 3.3 and 3.8. With regard to Crane species, there are no records from the South African Bird Atlas Project 2 nor from Mpumalanga Tourism and Parks Agency, from whom data records were requested. Any Crane species, should they occur on site, will likely utilise the large pans to the south, and as such be outside of the mining footprint. Several other threatened avifaunal species may however be associated with the MRA and are discussed in Sections 3.3 and 3.8 of the faunal report.

APPENDIX E – Specialists CV's and Declaration

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

Stephen van Staden	MSc Environmental Management (University of Johannesburg)
Chris Hooton	BTech Nature Conservation (Tshwane University of Technology)
Sinethemba Mchunu	MSc Soil Science (University of Stellenbosch)
Christel du Preez	MSc Environmental Sciences (North West University)
Samantha-Leigh Daniels	PhD Candidate Plant Science (University of Pretoria)
Emile van der Westhuizen	BSc (Hons) Plant Science (University of Pretoria)
Sashin Pillay	BSc (Hons) Biological Science (University of KwaZulu-Natal)

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		

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)

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

EDUCATION

Qualifications

MSc (Environmental Management) (University of Johannesburg)	2002
BSc (Hons) Zoology (Aquatic Ecology) (University of Johannesburg)	2000
BSc (Zoology, Geography and Environmental Management) (University of Johannesburg)	1999

COUNTRIES OF WORK EXPERIENCE

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

SELECTED PROJECT EXAMPLES

Development compliance studies

- Project co-leader for the development of the EMP for the use of the Wanderers stadium for the Ubuntu village for the World Summit on Sustainable Development (WSSD).
- Environmental Control Officer for Eskom for the construction of an 86Km 400KV power line in the Rustenburg Region.
- Numerous Environmental Impact Assessment (EIA) and EIA exemption applications for township developments and as part of the Development Facilitation Act requirements.
- EIA for the extension of mining rights for a Platinum mine in the Rustenburg area by Lonmin Platinum.
- EIA Exemption application for a proposed biodiesel refinery in Chamdor.
- Compilation of an EIA as part of the Bankable Feasibility Study process for proposed mining of a gold deposit in the Lofa province, Liberia.

- EIA for the development of a Chrome Recovery Plant at the Two Rivers Platinum Mine in the Limpopo province, South Africa.
- Compilation of an EIA as part of the Bankable Feasibility Study process for the Mooihoek Chrome Mine in the Limpopo province, South Africa.
- Mine Closure Plan for the Vlakfontein Nickel Mine in the North West Province.

Specialist studies and project management

- Development of a zero discharge strategy and associated risk, gap and cost benefit analyses for the Lonmin Platinum group.
- Development of a computerised water balance monitoring and management tool for the management of Lonmin Platinum process and purchased water.
- The compilation of the annual water monitoring and management program for the Lonmin Platinum group of mines.
- Analyses of ground water for potable use on a small diamond mine in the North West Province.
- Project management and overview of various soil and land capability studies for residential, industrial and mining developments.
- The design of a stream diversion of a tributary of the Olifants River for a proposed opencast coal mine.
- Waste rock dump design for a gold mine in the North West province.
- Numerous wetland delineation and function studies in the North West, Gauteng and Mpumalanga Kwa-Zulu Natal provinces, South Africa.
- Hartebeespoort Dam Littoral and Shoreline PES and rehabilitation plan.
- Development of rehabilitation principles and guidelines for the Crocodile West Marico Catchment, DWAF North West.

Aquatic and water quality monitoring and compliance reporting

- Development of the Resource Quality Objectives for the Local Authorities in the Upper Crocodile West Marico Water Management Area.
- Development of the 2010 State of the Rivers Report for the City of Johannesburg.
- Development of an annual report detailing the results of the Lonmin Platinum groups water monitoring program.
- Development of an annual report detailing the results of the Everest Platinum Mine water monitoring program.
- Initiation and management of a physical, chemical and biological monitoring program, President Steyn Gold Mine Welkom.
- Aquatic biomonitoring programs for several Xstrata Alloys Mines and Smelters.
- Aquatic biomonitoring programs for several Anglo Platinum Mines.
- Aquatic biomonitoring programs for African Rainbow Minerals Mines.
- Aquatic biomonitoring programs for several Assmang Chrome Operations.
- Aquatic biomonitoring programs for Petra Diamonds.
- Aquatic biomonitoring programs for several coal mining operations.
- Aquatic biomonitoring programs for several Gold mining operations.
- Aquatic biomonitoring programs for several mining operations for various minerals including iron ore, and small platinum and chrome mining operations.
- Aquatic biomonitoring program for the Valpre bottled water plant (Coca Cola South Africa).
- Aquatic biomonitoring program for industrial clients in the paper production and energy generation industries.
- Aquatic biomonitoring programs for the City of Tshwane for all their Waste Water Treatment Works.
- Baseline aquatic ecological assessments for numerous mining developments.
- Baseline aquatic ecological assessments for numerous residential commercial and industrial developments.
- Baseline aquatic ecological assessments in southern, central and west Africa.
- Lalini Dam assessment with focus on aquatic fish community analysis.
- Musami Dam assessment with focus on the FRAI and MIRAI aquatic community assessment indices.

Wetland delineation and wetland function assessment

- Wetland biodiversity studies for three copper mines on the copper belt in the Democratic Republic of the Congo.

- Wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Terrestrial and wetland biodiversity studies for developments in the mining industry.
- Terrestrial and wetland biodiversity studies for developments in the residential commercial and industrial sectors.
- Development of wetland riparian resource protection measures for the Hartbeespoort Dam as part of the Harties Metsi A Me integrated biological remediation program.
- Priority wetland mammal species studies for numerous residential, commercial, industrial and mining developments throughout South Africa.

Terrestrial ecological studies and biodiversity studies

- Biodiversity Action plans for numerous mining operations of Assmang Chrome throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plans for numerous mining operations of Xstrata Alloys and Mining throughout South Africa in line with the NEMBA requirements.
- Biodiversity Action plan for the Nkomati Nickel and Chrome Mine Joint Venture.
- Terrestrial and wetland biodiversity studies for three copper mines on the copperbelt in the Democratic Republic of the Congo.
- Terrestrial and wetland biodiversity studies for proposed mining projects in Guinea Bissau, Liberia and Angola in West Africa.
- Numerous terrestrial ecological assessments for proposed platinum and coal mining projects.
- Numerous terrestrial ecological assessments for proposed residential and commercial property developments throughout most of South Africa.
- Specialist Giant bullfrog (*Pyxicephalus adspersus*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist Marsh sylph (*Metisella meninx*) studies for several proposed residential and commercial development projects in Gauteng, South Africa.
- Project management of several Red Data Listed (RDL) bird studies with special mention of African grass owl (*Tyto capensis*).
- Project management of several studies for RDL Scorpions, spiders and beetles for proposed residential and commercial development projects in Gauteng, South Africa.
- Specialist assessments of terrestrial ecosystems for the potential occurrence of RDL spiders and owls.
- Project management and site specific assessment on numerous terrestrial ecological surveys including numerous studies in the Johannesburg-Pretoria area, Witbank area, and the Vredefort dome complex.
- Biodiversity assessments of estuarine areas in the Kwa-Zulu Natal and Eastern Cape provinces.
- Impact assessment of a spill event on a commercial maize farm including soil impact assessments.

Fisheries management studies

- Tamryn Manor (Pty.) Ltd. still water fishery initiation, enhancement and management.
- Verlorenkloof Estate fishery management strategising, fishery enhancement, financial planning and stocking strategy.
- Mooifontein fishery management strategising, fishery enhancement and stocking programs.
- Wickams retreat management strategising.
- Gregg Brackenridge management strategising and stream recalibration design and stocking strategy.
- Eljira Farm baseline fishery study compared against DWAF 1996 aquaculture and aquatic ecosystem guidelines.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTOPHER HOOTON

PERSONAL DETAILS

Position in Company	Ecologist
Date of Birth	24 June 1986
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2013

EDUCATION

Qualifications

BTech Nature Conservation (Tshwane University of Technology)	2013
National Diploma Nature Conservation (Tshwane University of Technology)	2008

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Eastern Cape, Western Cape, Northern Cape, Freestate
Zimbabwe, Sierra Leon, Zambia

SELECTED PROJECT EXAMPLES

Faunal Assessments

- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Mzimvubu Water Project, Eastern Cape.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Setlagole Mall Development, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Expansion and Upgrade of the Springlake Railway Siding, Hattingspruit, Kwa-Zulu Natal.
- Faunal assessment as part of the environmental assessment and authorisation process for the proposed Styldrift tailings storage facility, return water dams, topsoil stockpile and other associated infrastructure, North West.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Brand se Baai, Western Cape.
- Faunal assessment as part of the environmental assessment and authorisation process for the development of a proposed abalone farm, Doringbaai, Western Cape.
- Vegetation composition and subsequent loss of carrying capacity for the Rand Water B19 and VG Residue Pipeline Project, Freestate.
- Faunal assessment as part of the environmental assessment and authorisation process for the Evander Shaft 6 Plant Upgrade, New Tailings Dam Area and Associated Tailings Delivery and Return Water Pipeline, Evander, Mpumalanga.

Previous Work Experience

- Spotted Hyaena Research Project, Phinda Private Game Reserve, KwaZulu Natal.
- Camera Trap Survey as part of the Munyawana Leopard Project, Mkuze Game Reserve, KwaZulu Natal.
- Lowveld Wild Dog Project, Savé Valley Conservancy, Zimbabwe.
- Lion collaring and Tracking as part lion management program, Savé Valley Conservancy, Zimbabwe.
- Junior Nature Conservator, Gauteng Department of Rural Development and Land Reform.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SINETHEMBA MCHUNU

PERSONAL DETAILS

Position in Company	Soil Scientist
Date of Birth	24 April 1988
Nationality	South African
Languages	English, isiZulu
Joined SAS	2015

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Professional member of the South African Council for Natural Scientific Professions (SACNASP)
Member of the South African Soil Surveyors Organisation (SASSO)
Member of the Land Rehabilitation Society of Southern Africa (LaRSSA)
Member of the Soil Science Society of South Africa (SSSSA)

EDUCATION

Qualifications

M.Sc Soil Science – University of Stellenbosch (2012) 2009
B.Sc (Hons) Soil Science – University of Stellenbosch (2010)
B.Sc. Agric. Soil Science and Viticulture – University of Stellenbosch (2009)

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, Free State, KwaZulu-Natal, Northern Cape, and Western Cape

RELEVANT WORKING EXPERIENCE

Sept 2012 – Nov 2013 Soil Scientist at Strategic Environmental Focus (Pty) Ltd; specialising in Soil Contamination, Land Capability and Agricultural Potential assessments, Groundwater Monitoring, and providing specialist input for various EIA, BA, and Risk and Liability Assessment reports.

Dec 2013 – Apr 2015 Contaminated Site Consultant at Environmental Resources Management (ERM) South Africa; managing hydrocarbon contamination projects for contaminated soil and groundwater investigations, and soil waste classification for landfill disposal.

May 2015 – May 2017 Soil Scientist at Scientific Aquatic Services (SAS) cc; specialising in Soil Contamination, Land Capability and Agricultural Potential assessments.

SELECTED PROJECT EXAMPLES

Impact Assessment Investigations

- Soil and Land Capability Impact Assessment for the proposed Xstrata Coal Mine in Paardekop, Mpumalanga Province, South Africa;
- Soil and Land Capability Impact Assessment for the proposed Xstrata Coal Mine in Amersfoort, Mpumalanga Province, South Africa;
- Agricultural Impact Assessment for a proposed 30 megaWatts (MW) Photo Voltaic (PV) Solar Facility in Mareetsane, North West Province, South Africa;
- Soil and Land Capability Impact Assessment for the proposed BioGas Plant facility in Malmesbury, Western Cape Province, South Africa; and
- Soil and Agricultural Potential Assessment for the proposed Hulett Milling Plant at the Owen Sithole College of Agriculture (OSCA) in Empangeni, KwaZulu Natal Province, South Africa.

Contaminated Site Investigations

- Soil and Groundwater contamination assessments prior to installation and decommissioning of underground fuel storage tanks at multiple petroleum filling stations within the Gauteng, Limpopo, Free State, Northern Cape, and North West Provinces;
- Soil contamination assessment at ELCA Engineering Turbo Manufacturing and Fabrication to inform the due diligence process;
- Bi-annual soil contamination assessment at BHP Billiton Klipspruit Coal Mine for Water Use Licence compliance;
- Soil and Groundwater contamination assessments at multiple Mining and Distribution operations with private fuel storage facilities; and
- Sediment and water quality assessment for the Bokoni Platinum Mine.

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF CHRISTEL DU PREEZ

PERSONAL DETAILS

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

EDUCATION

Qualifications

MSc Environmental Sciences (North West University)	2016
BSc (Hons) Environmental Sciences (North West University)	2012
BSc Environmental and Biological Sciences (North West University)	2011

COUNTRIES OF WORK EXPERIENCE

South Africa – KwaZulu Natal, Northern Cape, Gauteng, Mpumalanga, Free State

SELECTED PROJECT EXAMPLES

Wetland Assessments

- Baseline freshwater assessment as part of the environmental assessment and authorisation process for the proposed National Route 3 (N3) Van Reenen Village Caltex Interchange, KwaZulu Natal
- Basic assessment for the proposed construction of supporting electrical infrastructure for the Victoria West Wind Farm, Victoria West, Northern Cape Province
- Freshwater Ecological Assessment in Support of the WULA Associated with the Rehabilitation of the Wetland Resources in Ecopark, Centurion, Gauteng
- Wetland Ecological Assessment for the Proposed Mixed Land Use Development (Kosmosdal Extension 92) on the remainder of Portion 2 of the farm Olievenhoutbosch 389 Jr, City of Tshwane Metropolitan Municipality, Gauteng Province
- Freshwater Ecological Assessment for the Mokate Pig Production and Chicken Broiler Facility on the farm Rietvalei Portion 1 and 6 near Delmas, Mpumalanga
- Wetland Ecological Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Relocation of a Dragline from the Kromdraai Section to Navigation Section of the Anglo American Landau Colliery in Mpumalanga
- Freshwater Assessment as part of the Environmental Assessment and Authorisation Process for a proposed 132kv powerline and associated infrastructure for the proposed Kalkaar Solar Thermal Power Plant near Kimberley, Free State and Northern Cape Provinces
- Freshwater Ecological Assessment of the Freshwater Prospect Stream in the AEL Operational Area, Modderfontein, Gauteng
- Specialist Freshwater Scoping and Environmental Impact Assessment for the Proposed Development of the Platberg and Teekloof Wind Energy Facility and Supporting Electrical Infrastructure near Victoria West, Northern Cape Province

- Wetland Ecological Assessment as part of the Environmental Assessment and Authorisation Process for the Proposed Development of Wilgedraai, Vaaldam Settlement 1777, Free State Province
- Freshwater Resource Delineation and Assessment as part of the consolidation of four Environmental Management Plans at the Graspan Colliery, in Middelburg, Mpumalanga Province
- Freshwater Assessment as part of the Water Use Authorisation for the proposed Copperton Wind Energy Facility, Northern Cape.
- Freshwater Resource and Water Quality Ecological Assessment for the Lakefield Manor Residential project, Boksburg, Gauteng Province
- Wetland Assessment as part of the Environmental Assessment and Authorisation Process for the proposed Vredenburg Wind Energy Facility Development near Saldanha, Western Cape Province
- Freshwater Ecological Assessment as part of the Environmental Assessment and Authorisation process for the proposed upgrade of a portion of Allandale Road Midrand, Gauteng Province
- Baseline Freshwater Resource Delineation and Assessment for the Gedex Project, in Brakpan, Gauteng
- Aquatic and Wetland Assessment as part of the Environmental Assessment and Authorisation Process for the Leslie 2 Underground Coal Mining Operation, Gauteng Province
- Biodiversity Assessment with focus on Freshwater Ecology as part of the S24G Application for 136 Plane Road in Kempton Park, Gauteng Province

Rehabilitation and Management Plans

- Wetland Rehabilitation and Management Plan for the proposed Residential Development on Portion 19 of Farm 653 (Vergenoegd) within the Western Cape Province
- Freshwater Resource Rehabilitation and Management Plan for the proposed Copperton Wind Energy Facility, Northern Cape
- Surface Water Rehabilitation and Management Plan as part of the Water Use Authorisation process for the proposed upgrade of a portion of Allandale Road and associated culverts, Midrand, Gauteng Province

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SAMANTHA-LEIGH DANIELS

PERSONAL DETAILS

Position in Company	Junior Floral Ecologist
Joined SAS Environmental Group of Companies	2020

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Member of the South African Association of Botanists (SAAB)

Member of the Botanical Society of South Africa (BotSoc)

Member of the *Association for Tropical Biology and Conservation (ATBC)*

EDUCATION

Qualifications

PhD (Plant Science) (University of Pretoria)	Present
MSc (Plant Science) (University of Pretoria)	2017
BSc (Hons) Zoology & Entomology (University of Pretoria)	2014
BSc Zoology & Entomology (University of Pretoria)	2013

AREAS OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State

KEY SPECIALIST DISCIPLINES

Biodiversity Assessments

- Terrestrial Ecological and Biodiversity Scoping Assessments
- Terrestrial Ecological and Biodiversity Screening Assessments
- Floral Assessments
- Alien and Invasive Control Plan (AICP)
- Terrestrial Monitoring
- Desktop Studies, Mapping and Background Information Research

Training

- Plant species identification
- Herbarium usage and protocols

SCIENTIFIC AQUATIC SERVICES (SAS) – SPECIALIST CONSULTANT INFORMATION
CURRICULUM VITAE OF EMILE BASSON VAN DER WESTHUIZEN

PERSONAL DETAILS

Position in Company	Ecologist, Botanist
Date of Birth	30 May 1984
Nationality	South African
Languages	English, Afrikaans
Joined SAS	2008

MEMBERSHIP IN PROFESSIONAL SOCIETIES

Candidate Member of the South African Council for Natural Scientific Professions (SACNASP) (Reg. Number 100008/15).

EDUCATION

Qualifications

BSc (Hons) Plant Science (University of Pretoria)	2012
B.Sc. Botany and Environmental Management (University of South Africa)	2010

Short Courses

Grass Identification – Africa Land Use Training	2009
Wild Flower Identification – Africa Land Use Training	2009

COUNTRIES OF WORK EXPERIENCE

South Africa – Gauteng, Mpumalanga, North West, Limpopo, KwaZulu-Natal, Free State, Eastern Cape.
Mozambique (Tete, Sofala and Manica Provinces)
Democratic Republic of the Congo (Katanga and Kivu Provinces)
Ghana (Western and Greater Accra Provinces)

SELECTED PROJECT EXAMPLES

Floral Assessments

- Floral assessment for the proposed Modikwa Platinum Mine South 2 Shaft Project, Burgersfort, Limpopo Province.
- Floral assessment for the proposed New Clydesdale Colliery Stoping Project, Vandyksdrift, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Harriet's Wish PGM Project, Limpopo Province.
- Floral assessment as part of the environmental authorisation process for the proposed Shanduka Coal Argent Colliery in the vicinity of Argent, Mpumalanga.
- Floral assessment for the Auroch Resources Manica Gold Mining Project, Manica, Mozambique.
- Floral assessment for the Namoya Gold Mine project in Namoya, Democratic Republic of Congo.
- High level floral risk assessment and alternatives analysis for the proposed new Tete Airport, Tete, Mozambique.
- Floral assessment for the proposed Richardsbay Harbour Compactor Slab development, Richardsbay, Kwa-Zulu-Natal Province.
- Site walkdown and floral ecological input prior to the construction of the proposed 180km Mfolozi-Mbewu powerline, Richardsbay, Kwa-Zulu-Natal Province.
- Floral assessment as part of the EIA process for the proposed Peerboom Colliery, Lephalale, Limpopo Province.
- Floral assessment as part of the EIA process for the proposed Overvaal Underground Coal Mine Project, Ermelo, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed King's City Takoradi 3000 hectare development, Takoradi, Ghana

- Floral assessment as part of the EIA process for the proposed Aquarius Platinum Fairway Platinum Mine, Steelpoort, Mpumalanga Province.
- Floral assessment as part of the EIA process for the proposed Geniland Lubumbashi City 4000 hectare development, Likasi, Katanga Province, Democratic Republic of Congo.
- Floral, faunal, aquatic and wetland assessment as part of the EIA process for the proposed Appollonia City Accra 3000 hectare development, Accra, Ghana.
- Floral assessment as part of the EIA process for the proposed Leeuw Colliery, Utrecht, Kwa-Zulu Natal Province.
- Floral assessment as part of the EIA process for the proposed Lubembe Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Kinsenda Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Lonshi Coppermine Project, Lubumbashi, Katanga Province, Democratic Republic of Congo.
- Floral assessment as part of the EIA process for the proposed Jozini Shopping Mall, Jozini, Kwa-Zulu Natal Province.
- Floral assessment as part of the Biodiversity Action Plan for the Assmang Chrome Dwarsrivier Mine, Steelpoort, Mpumalanga Province.

SAS ENVIRONMENTAL GROUP OF COMPANIES –

SPECIALIST CONSULTANT INFORMATION

CURRICULUM VITAE OF SASHIN PILLAY

PERSONAL DETAILS

Position in Company	Junior Ecologist
Joined SAS Environmental Group of Companies	2019

MEMBERSHIP IN PROFESSIONAL SOCIETIES

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

EDUCATION

Qualifications

BSc (Hons) Biological Sciences (Aquatic Ecology) (University of KwaZulu-Natal)	2017
BSc (Environmental and Life Sciences) (University of KwaZulu-Natal)	2016

SHORT COURSES

Additional Training

Back-2-Basics wetland workshop presented by Piet-Loius Grundling	(2020)
Environmental management training course by Enaq Environmental Consulting	(2018)
Young-Leaders academy, leadership development programme	(2012)

AREAS OF WORK EXPERIENCE

South Africa – KwaZulu-Natal, Gauteng, Mpumalanga, Free-State, Limpopo

KEY SPECIALIST DISCIPLINES

Freshwater Assessments

- Desktop Freshwater Delineation
- Freshwater Verification Assessment
- Freshwater (wetland / riparian) Delineation and Assessment
- Freshwater Eco Service and Status Determination
- Rehabilitation Assessment / Planning

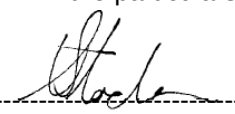
Aquatic Ecological Assessment and Water Quality Studies

- Habitat Assessment Indices (IHAS, IHIA)
- Toxicological Analysis
- Water quality Monitoring

Declaration that the specialist is independent in a form as may be specified by the competent authority

I, Stephen van Staden, declare that -

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



Signature of the Specialist

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FAUNAL, FLORAL, FRESHWATER AND SURFACE WATER QUALITY ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETKOL MINING OPERATION NEAR DELMAS WITHIN THE MPUMALANGA PROVINCE.

Prepared for

Jacana Environmentals CC

April 2018 (Updated May 2021)

Section B: Floral Assessment

Prepared by: Scientific Aquatic Services
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S. van Staden (Pr. Sci. Nat)
Report Reference: SAS 215333

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ACRONYMS

CR	Critically Endangered
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EN	Endangered
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
Ha	Hectares
IUCN	International Union for Conservation of Nature and Natural Resources
Km	Kilometres
LOM	Life of Mine
mbs	Meters below surface
MNCA	Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998)
MPRDA	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
MRA	Mining Right Application
MTPA	Mpumalanga Tourism & Parks Agency
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NT	Near Threatened
NWA	National Water Act (Act No. 36 of 1998)
PES	Present Ecological State
POC	Probability of Occurrence
PRECIS	Pretoria Computerised Information System
RE	Regionally Extinct
SANBI	South Africa National Biodiversity Institute
SAS	Scientific Aquatic Services
SCC	Species of Conservation Concern
VU	Vulnerable

GLOSSARY OF TERMS

Most definitions are based on terms and concepts elaborated by Richardson *et* al. (2011), Hui and Richardson (2017), Wilson *et* al. (2017) and Skowno et al. (2019), with consideration to their applicability in the South African context, especially South African legislation [notably the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), and the associated Alien and Invasive Species Regulations, 2020].

Alien species (syn. exotic species; non-native)	A species that is present in a region outside its natural range due to human actions (intentional or accidental) that have enabled it to overcome biogeographic barriers.
Biodiversity Management Plan	A plan aimed at ensuring the long-term survival in nature of an indigenous species, a migratory species, or an ecosystem, published in terms of the Biodiversity Act. Norms and standards to guide the development of Biodiversity Management Plans for Species have been developed. At the time of writing, norms and standards for Biodiversity Management Plans for Ecosystems were in the process of being developed.
Biodiversity priority areas	Features in the landscape or seascape that are important for conserving a representative sample of ecosystems and species, for maintaining ecological processes, or for the provision of ecosystem services. They include the following categories, most of which are identified based on systematic biodiversity planning principles and methods: protected areas, Critically Endangered and Endangered ecosystems, Critical Biodiversity Areas and Ecological Support Areas, Freshwater Ecosystem Priority Areas, high water yield areas, flagship free-flowing rivers, priority estuaries, focus areas for land-based protected area expansion, and focus areas for offshore protection. Marine ecosystem priority areas and coastal ecosystem priority areas have yet to be identified but will be included in future. The different categories are not mutually exclusive and, in some cases, overlap, often because a particular area or site is important for more than one reason. They should be complementary, with overlaps reinforcing the importance of an area.
Biological diversity or Biodiversity (as per the definition in NEMBA)	The variability among living organisms from all sources including, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.
Biome - as per Mucina and Rutherford (2006); after Low and Rebelo (1998).	A broad ecological spatial unit representing major life zones of large natural areas – defined mainly by vegetation structure, climate, and major large-scale disturbance factors (such as fires).
Bioregion (as per the definition in NEMBA)	A geographic region which has in terms of section 40(1) been determined as a bioregion for the purposes of this Act;
Casual species	Those alien species that do not form self-replacing populations in the invaded region and whose persistence depends on repeated introductions of propagules (Richardson et al. 2000; Pyšek et al. 2004). The term is generally used for plants.
Critical Biodiversity Area (CBA)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation and ridges.
Corridor	A dispersal route or a physical connection of suitable habitats linking previously unconnected regions.
Critically Endangered (CR) (IUCN Red List category)	**Applied to both species/taxa and ecosystems**: A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction. Critically Endangered ecosystem types are at an extremely high risk of collapse. Most of the ecosystem type has been severely or moderately modified from its natural state. The ecosystem type is likely to have lost much of its natural structure and functioning, and species associated with the ecosystem may have been lost. Critically endangered species are those considered to be at extremely high risk of extinction.
Degradation	The many human-caused processes that drive the decline or loss in biodiversity, ecosystem functions or ecosystem services in any terrestrial and associated aquatic ecosystems.

Disturbance	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.
Driver (ecological)	A driver is any natural or human-induced factor that directly or indirectly causes a change in ecosystem. A direct driver clearly influences ecosystem processes, where indirect driver influences ecosystem processes through altering one or more direct drivers.
Endangered (EN) (Red List category)	**Applied to both species/taxa and ecosystems**: A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction. Endangered ecosystem types are at a very high risk of collapse. Endangered species are those considered to be at very high risk of extinction.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g. southern Africa), national (South Africa), provincial, regional, or even within a particular mountain range.
Habitat (as per the definition in NEMBA)	A place where a species or ecological community naturally occurs.
Indigenous vegetation (as per the definition in NEMA)	Vegetation occurring naturally within a defined area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Invasive species	Alien species that sustain self-replacing populations over several life cycles, produce reproductive offspring, often in very large numbers at considerable distances from the parent and/or site of introduction, and have the potential to spread over long distances.
Listed alien species	All alien species that are regulated in South Africa under the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), Alien and Invasive Species (A&IS) Regulations, 2020.
Least Threatened	Least threatened ecosystems are still largely intact.
Native species (syn. indigenous species)	Species that are found within their natural range where they have evolved without human intervention (intentional or accidental). Also includes species that have expanded their range as a result of human modification of the environment that does not directly impact dispersal (e.g., species are still native if they increase their range as a result of watered gardens, but are alien if they increase their range as a result of spread along human-created corridors linking previously separate biogeographic regions).
Red Data Listed (RDL) species	According to the Red List of South African plants (http://redlist.sanbi.org/) and the International Union for Conservation of Nature (IUCN), organisms that fall into the Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Species of Conservation Concern (SCC)	**Specifically related to flora**: A list of floral SCC (from the Species Status Report) recorded within the Quarter Degree Square (QDS) 2628BA was obtained from the Mpumalanga Tourism and Park Agency (MTPA), comprising South African National Biodiversity Institute (SANBI) RDL species. Additional datasets and sources that were also taken into consideration included: - The National Environmental Management: Biodiversity Act, 2004 (Act No.10 of 2004) (NEMBA) Threatened or Protected Species (TOPS) list (Government Gazette [GN] 29657, as amended in GN R1187 in Government Gazette 30568 of 2007 **and again in** GN 627 in Government Gazette 43386 of 2020); - The Botanical Database of Southern Africa (BODATSA) to obtain plant names and floristic details (http://posa.sanbi.org); and - Provincially protected floral species under Schedule 11 and 12 of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA).
Threatened ecosystem	An ecosystem that has been classified as Critically Endangered, Endangered or Vulnerable, based on an analysis of ecosystem threat status. A threatened ecosystem has lost or is losing vital aspects of its structure, function, or composition. The Biodiversity Act allows the Minister of Environmental Affairs or a provincial MEC for Environmental Affairs to publish a list of threatened ecosystems. To date, threatened ecosystems have been listed only in the terrestrial environment. In cases where no

	list has yet been published by the Minister, such as for all aquatic ecosystems, the ecosystem threat status assessment in the NBA can be used as an interim list in planning and decision making. Also see Ecosystem threat status.
Threatened species	A species that has been classified as Critically Endangered, Endangered or Vulnerable, based on a conservation assessment (Red List), using a standard set of criteria developed by the IUCN for determining the likelihood of a species becoming extinct. A threatened species faces a high risk of extinction in the near future.
Vulnerable (VU) (Red List category)	Applied to both species/taxa and ecosystems: A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction. An ecosystem type is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for VU and is then considered to be at a high risk of collapse.
Weeds	A plant is a weed '*if, in any specified geographical area, its populations grow entirely or predominantly in situations markedly disturbed by man (without, of course, being deliberately cultivated plants*)' (Baker 1965); in cultural terms, weeds are plants (**not necessarily alien**) that grow in sites where they are not wanted and that have detectable economic or environmental impacts (Pyšek et al. 2004).

1 INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, freshwater and surface water quality ecological investigation as part of the environmental authorisation process for the proposed Rietkol Mining Operation (Rietkol Project), where mining of silica through opencast methods will occur. The proposed Rietkol Project is situated within Wards 8 and 9 of the Victor Khanye Local Municipality and the Nkangala District Municipality. The Mining Right Application (MRA) area is situated approximately 6km west of the town of Delmas/ Botleng. The MRA area is further situated approximately 900m southeast of the N12, 2.1 km southwest of the R50, and 2.7 km north of the R555. See Part A for detailed maps of the MRA.

The MRA area covers an area of 221 ha, and consists of the following farm portions:

- 16 Modder East Agricultural Holdings on the farm Olifantsfontein 196IR;
- Portion 71 of the farm Rietkol 237 IR; and
- A portion of the remaining extent of Portion 31 of the farm Rietkol 237 IR.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The proposed Rietkol Project estimated life of mine (LOM) is 20 years, although further exploration drilling to be conducted during the operational phase, may increase the LOM and the depth of mining if resources proof viable (Jacana, 2021).

The following infrastructure is associated with the proposed project (Figure 1):

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening etc.);
- Product Stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc);
- Access Roads; and
- Clean and dirty water management infrastructure.

The infrastructure layout as proposed during the initial EIA phase for the proposed Rietkol mining operations near Delmas can be seen in Figure 1 below. The initial proposed infrastructure layout, hereafter referred to as the “Initial Infrastructure Layout” encroached into the buffer of a nearby Wetland. The initial Rietkol application for Environmental Authorisation lapsed in 2020 due to administration issues within the Department of Mineral Resources

(DMR). As such a new mining right and environmental authorisation application has been proposed. However, in the current application, the proposed infrastructure layout has been moved north, creating a 100m buffer between the proposed infrastructure and the wetland area to the south, hereafter referred to as the “Preferred Infrastructure Layout”. This report has been updated to illustrate the impacts associated with the preferred infrastructure layout.

The ecological assessment will fulfil the requirements of the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated regulations, as well as other legal requirements applicable on both a national and provincial level, including the requirements of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and associated guidelines and regulations.

The purpose of this report is to define the ecology of the area including both terrestrial and wetland aspects as well as mapping of the resources and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the MRA area. It is the objective of this study to provide detailed information to guide the activities associated with the proposed mining activities in the vicinity of the resources to ensure that the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

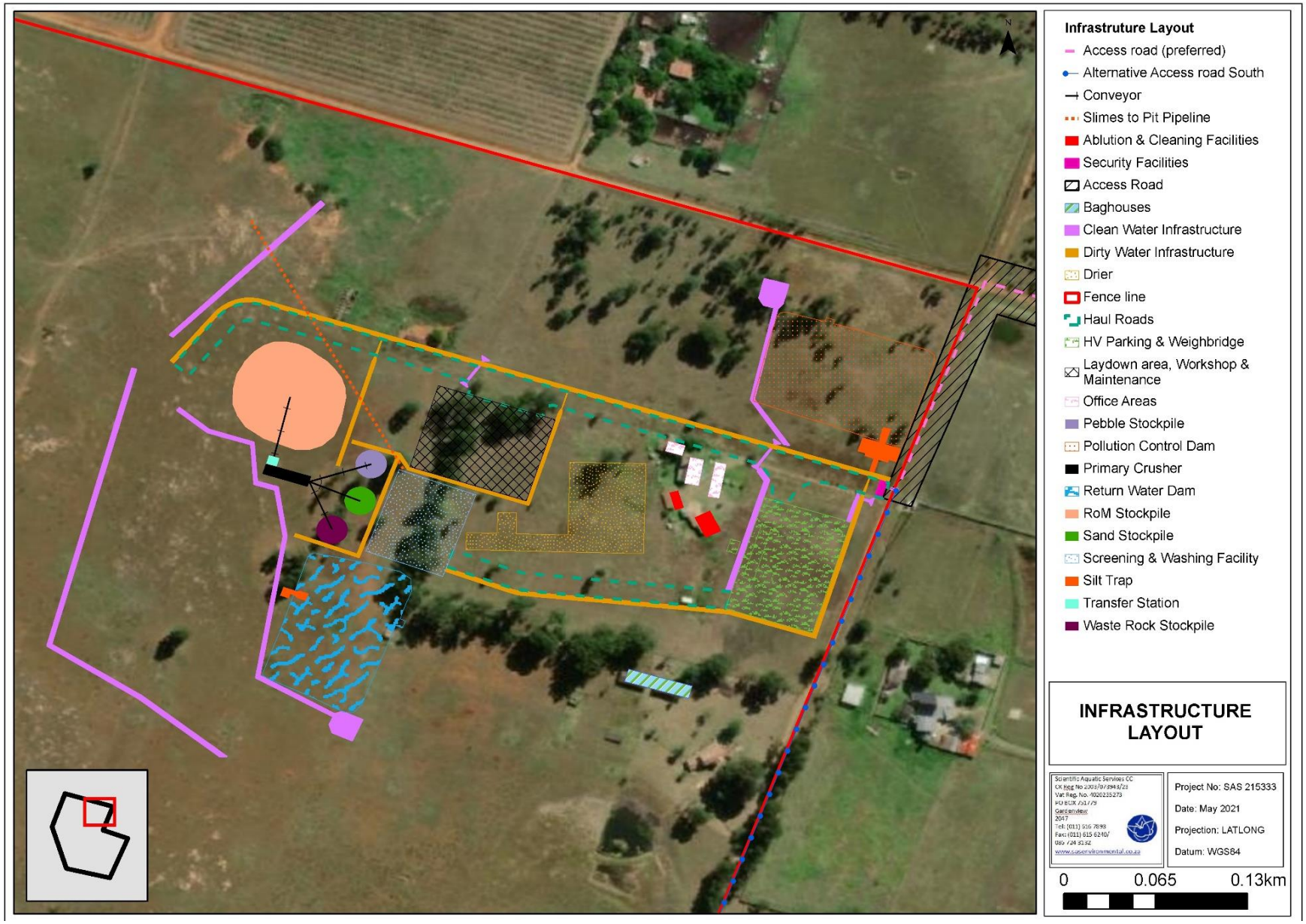


Figure 1: Proposed Infrastructure Layout associated with the MRA area.

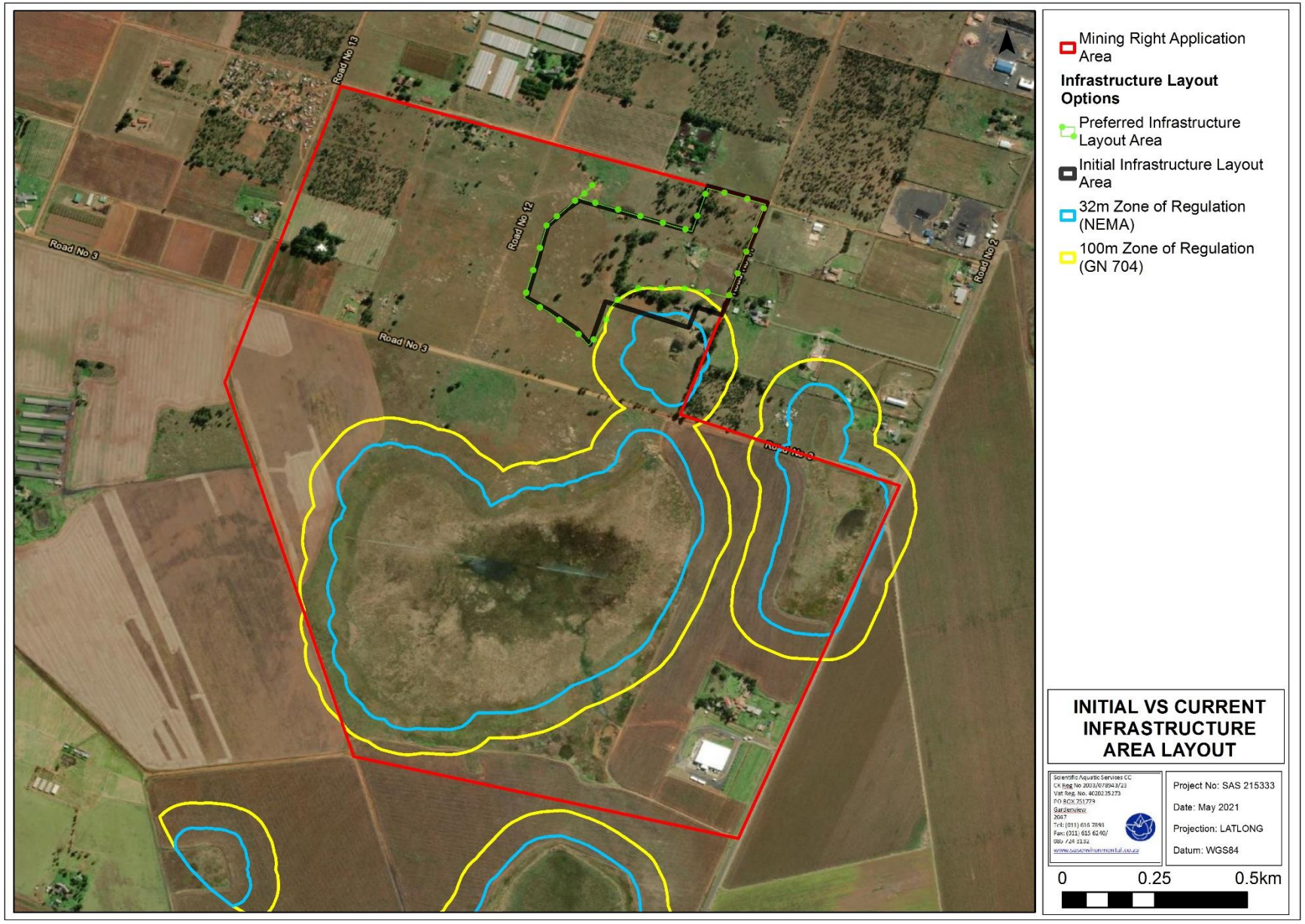


Figure 2: Initial Vs Current Infrastructure Layout Areas associated with the MRA.

1.2 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The floral assessment is **confined to the study area** and does not include the neighbouring and adjacent properties. The entire study area and immediate surroundings were, however, is included in the desktop analysis of which the results are presented in **Part A: Section 3**; and
- The Department of Environmental Affairs screening tool provides names of sensitive species likely to be present within the study area and its surrounds. Within the screening tool outcome, the names of some species are not provided, and these species are rather assigned a number keeping them unidentifiable (e.g., Sensitive species 1). This procedure is followed because of the vulnerability of the species to threats such as illegal harvesting and overexploitation. According to the best practise guidelines provided by the South African National Biodiversity Institute (SANBI), the name of sensitive species **may not appear** in the final EIA report **nor any of the specialist reports** released into the public domain. However, the conservation threat status of such species has been provided;
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most floral and faunal communities have been accurately assessed and considered. Relevant online sources and background information were further assessed to improve on the overall understanding of the study area's ecology;
- Sampling by its nature means that not all individuals are assessed and identified. With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. Four field assessments were undertaken as part of this study, notably the 4th and 16th of February 2016, in January 2017, and 24th March 2021. A more comprehensive assessment would require that assessments take place in all seasons of the year. However, on-site data was augmented with all available desktop data. Together with project experience in the area, the findings of this assessment are considered an accurate reflection of the ecological characteristics of the study area.

An on-site visual investigation of the assessment areas was conducted on the 4th and 16th of February 2016, in January 2017, and the 24th March 2021 to confirm the assumptions made during the consultation of the background maps and to determine whether the sensitivity of the terrestrial biodiversity associated with the assessment areas confirms the results of the online National Web-based Environmental Screening Tool.

1.3 General Approach

The vegetation surveys are based on the subjective sampling method which is a technique where the specialist chooses specific sample sites within the area of interest, based on their professional experience in the area and background research done prior to the site visit. This allows representative recordings of floral communities and optimal detection of species of conservation concern (SCC) (refer to the methodology description in **Appendix A**).

The below list includes the steps followed during the preparation for, and the conduction of, the field assessments:

- To guide the selection of appropriate sample sites, background data and digital satellite images were consulted before going to site, during which broad habitats, vegetation types and potentially sensitive sites were identified. The results of these analyses were then used to focus the fieldwork on specific areas of concern and to identify areas where targeted investigations were required (e.g., for SCC detection and within the direct footprint of the proposed mining project);
- All relevant resources and datasets as presented by the South African National Biodiversity Institute's (SANBI's) Biodiversity Geographic Information Systems (BGIS) website (http://bgis.sanbi.org) and the Environmental Geographical Information Systems (E-GIS) website (https://egis.environment.gov.za/), including the Mpumalanga Biodiversity Sector Plan (2014) and the online National Web-based Environmental Screening Tool, were consulted to gain background information on the physical habitat and potential floral diversity associated with the assessment areas;
- Based on the broad habitat units delineated before going to site and the pre-identified points of interest, which is updated based on on-site observations and access constraints, the selected sample areas were surveyed on foot, following subjective transects, to identify the occurrence of the dominant plant species and habitat diversities, but also to detect SCC which tend to be sparsely distributed; and
- Photographs were taken of each vegetation community that is representative of typical vegetation structure of that community, as well as photos of all detected SCC;

Additional information on the method of assessment is provided in **Appendix A** of this report.

1.1 Definitions, descriptions, and taxon nomenclature

Scientific nomenclature for plant species in this report follows that of the SANBI's Red List of South African Plants Online, as it relates to the Botanical Database of Southern Africa

(BODATSA). For alien species, the definitions of Richardson et al. (2011) are used. Vegetation structure is described as per Edwards (1983) (refer to Figure A1 of this report).

1.2 Sensitivity Mapping

All the ecological features of the MRA area were considered and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed mining operations.

2 RESULTS OF FLORAL ASSESSMENT

2.1 Broad-scale Vegetation Characteristics

The MRA falls within the Eastern Highveld Grassland vegetation type (listed as endangered in Mucina and Rutherford, 2006 – but has been updated to a vulnerable status in the 2018 Final Vegetation Map of South Africa, Lesotho, and Swaziland), i.e., the reference state. Mucina and Rutherford (2006) describe the Eastern Highveld Grassland as having slightly to moderately undulating plains, including some low hills and pan depressions. The vegetation is short dense grassland dominated by the usual highveld grass composition (*Aristida*, *Digitaria*, *Eragrostis* spp, *Themeda* spp, *Tristachya* spp etc.) with small, scattered rocky outcrops with wiry, sour grasses and some woody species (e.g., *Celtis africana*, *Diospyros lycioides* subsp *lycioides*, *Parinari capensis*, *Protea caffra*, *P. welwitschii* and *Searsia magalismontanum*).

2.2 Ground-truthed Vegetation Characteristics

During the field assessments, several habitat units were identified. These habitat units are:

- Three wetland systems located within the MRA area;
- Rocky Grassland located predominantly in the central portion of the MRA area, running from north to south. This habitat unit was also of a higher elevation than the surrounding areas;
- Disturbed areas associated with overgrazed pastures and old lands where ecological succession processes have commenced; and
- Agricultural areas where the vegetation has been completely transformed by current crop cultivation activities.

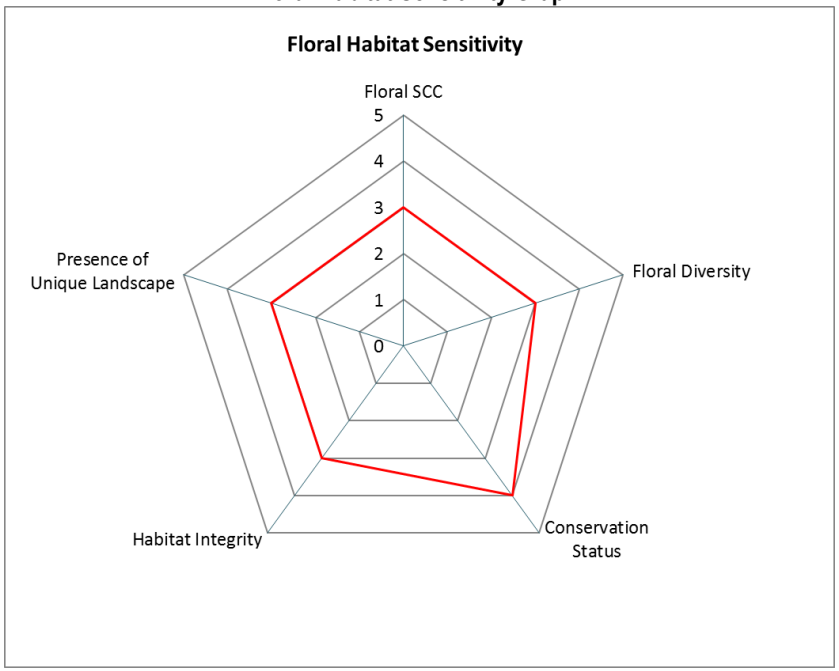
These habitat units are indicated below in Figure 3 and discussed further in Section 2.3 -2.6.

Figure 3: Conceptual illustration of the habitat units within the MRA area.

2.3 Habitat Unit 1: Rocky Grassland

Habitat Unit: Rocky Grassland	**Floral Habitat Sensitivity**	**Intermediate**
	Notes on Photograph: Typical view of the Rocky Grassland habitat unit	

Floral Habitat Sensitivity Graph:



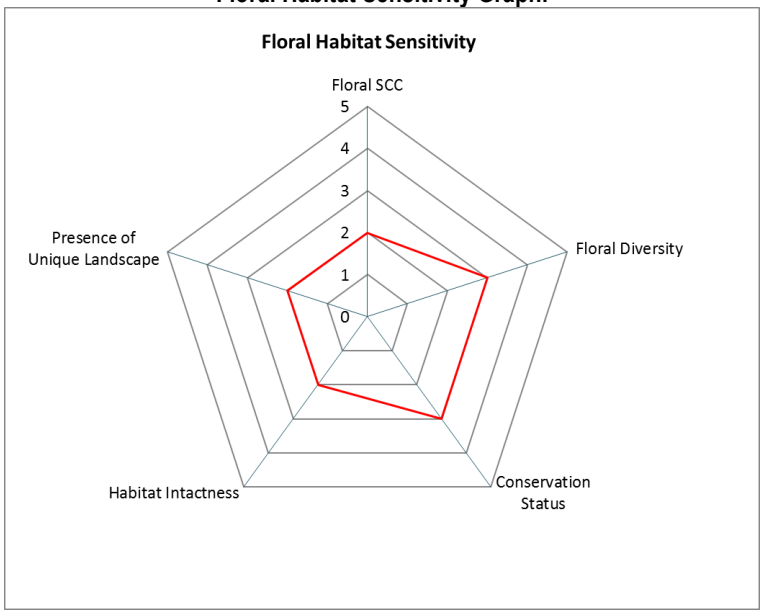
Floral Species of Conservation Concern (SCC)	Several floral SCC which are listed as declining, namely *Hypoxis hemerocallidea, Gladiolus vinosomaculatus, Gladiolus permeabilis, Gladiolus crassifolius, Habenaria galpinii* and *Crinum graminicola,* which are protected under Schedule 11 of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998) (MNCA) were encountered within this habitat unit. Only two other SCC are listed for the QDS, namely *Crinum bulbispermum* and *Kniphofia typhoides*, however neither were found within this habitat unit. Years of

	overgrazing combined with unsuitable habitat is likely to exclude both these species from this habitat unit.		
Floral Diversity	Floral diversity was intermediate with a number of species indicative of the vegetation type in which the habitat unit is situated recorded. However anthropogenic activities have had a marked impact on the overall floral diversity. Typical species found in this habitat unit include *Gladiolus vinosomaculatus, Gladiolus permeabilis, Aristida difusa, Heteropogon contortus* and *Eragrostis chloromelas.*	**General comments:** This habitat unit is associated with rocky outcrops and areas of higher elevation within the MRA area. Cattle grazing is the dominant land use, however grazing pressure is considered to be intermediate. There is a high presence of forbs within the habitat unit as well as common grassland flowers, but importantly a number of floral SCC were observed within this habitat unit.	**Business Case, Conclusion and Mitigation Requirements:** This habitat unit is of intermediate ecological sensitivity, with a loss of floral diversity and species being inevitable should mining within this habitat unit occur. Mining activities within this habitat unit should be minimised where possible, ensuring that the mining footprint is kept to a minimum. It is advised that a rescue and relocation plan for floral SCC be implemented where the mining footprint will encroach on this habitat unit. Where possible and feasible the open pit should be filled with tailings in order minimise pit depth. The sides of the open pits should be sloped in such a way as to create ease of access in and out for faunal species once mining activities in that block have ceased.
Conservation Status of Vegetation Type/Ecosystem	The vegetation type is listed as Endangered (Mucina & Rutherford 2006) however the species composition of the habitat unit is no longer representative of this vegetation type.		
Habitat Integrity/Alien and Invasive species	Overall intactness of the habitat unit is considered to be of an intermediate level. The grass species present within the habitat unit are non-climax species, further indicating levels of disturbance within the habitat unit. Although the habitat unit has undergone varying levels of disturbance, very few alien and invasive species were present within the habitat unit, partly attributable to the very shallow soils present.		
Presence of Unique Landscapes	The rocky nature and elevated position of the habitat unit in comparison to the surrounding areas creates niche habitat for floral species whilst providing an increased level of protection from veld fires. The rocky outcrops shelter many of the plants in the rocky grassland from the more severe heat and damaging effects of veld fires due to the decreased tuft density and grass layer.		

2.4 Habitat Unit 2: Disturbed Grassland

Habitat Unit: Disturbed Grassland	**Floral Habitat Sensitivity**	**Moderately Low**
	Notes on Photograph: View of the disturbed grassland with stands of *Eucalyptus grandis* trees evident.	

Floral Habitat Sensitivity Graph:



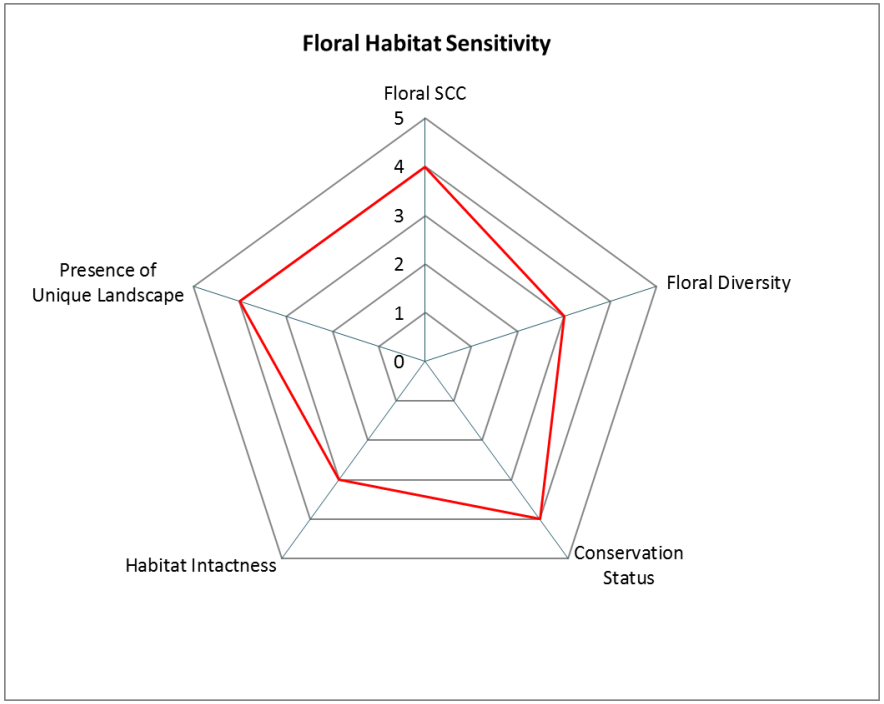
Floral Species of Conservation Concern (SCC)	Two floral SCC which is listed as declining, namely *Crinum graminicola* and *Habenaria galpinii,* listed as declining and protected under Schedule 11 of the MNCA were encountered within this habitat unit. Past agricultural and current grazing activities have led to the habitat being largely disturbed, lowering the probability of any other SCC being present.

Floral Diversity	Very few floral species that are indicative of the Eastern Highveld Grassland vegetation type were recorded. However, the majority of species within this habitat unit are pioneer species or species that are generally associated with disturbed habitat. Dominant species within this habitat unit include *Stoebe plumosum, Hyparrhenia hirta, Diheteropogon amplectens, Eragrostis chloromelas, Eucalyptus grandis, Cosmos bipinnatus* and *Eragrostis gummiflua*.	**General comments:** Overgrazing and trampling by livestock was evident within the unfenced sections of this habitat unit. Pioneer grass species, alien invasive trees as well as grass species commonly associated with disturbed habitats dominated this habitat unit. Fenced off areas are still used for grazing in a more controlled manner, however many of these areas were also previously utilised for crop cultivation.	**Business Case, Conclusion and Mitigation Requirements:** This habitat unit is of moderately low ecological sensitivity. Although mining in this habitat unit is unlikely to have a significant impact on the receiving environment, it is advised that a rescue and relocation plan for floral SCC be implemented where the mining footprint will encroach on this habitat unit. Where possible and feasible the open pit should be filled with tailings in order minimise pit depth. The sides of the open pits should be sloped in such a way as to create ease of access in and out for faunal species once mining activities in that block have ceased.
Conservation Status of Vegetation Type/Ecosystem	The vegetation type is listed as Endangered (Mucina & Rutherford 2006). Although a number of species (grass) known to occur within this vegetation type were observed, the overall floristic diversity of this habitat is not fully comparable to that which is known to occur within the listed vegetation type.		
Habitat Integrity/Alien and Invasive species	Habitat was largely modified due to livestock grazing, agricultural activities and presence of alien trees such as *Eucalyptus* spp. and forb and herb species such as *Campuloclinium macrophalum* and *Cosmos bipinnatus*.		
Presence of Unique Landscapes	The disturbed grassland habitat is located in the lower regions of the MRA area and surrounds the Rocky Grassland Habitat Unit as well as the large wetland in the southern portion of the MRA area. The landscape in which this habitat unit is situated is not considered to be particularly unique.		

2.5 Habitat Unit 3: Wetlands

Habitat Unit:	Floral Habitat Sensitivity	Moderately high
Wetlands	**Notes on Photograph:** Wetland feature with excavated dam within the MRA area	

Floral Habitat Sensitivity Graph:



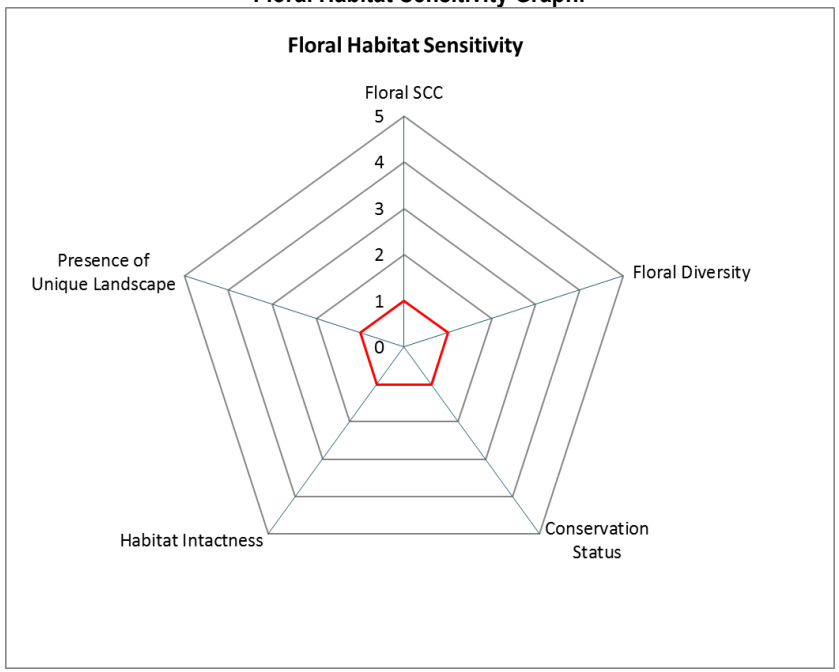
Floral Species of Conservation Concern (SCC)	No floral SCC were encountered within this habitat unit, however there remains the possibility that *Crinum bulbispermum* and *Kniphofia typhoides* may occur within this habitat unit.

Floral Diversity	Floral diversity was moderate with obligate and facultative wetland species being observed within this habitat unit. The diversity of the hillslope seep wetland has been degraded due to the loss of wetland habitat resulting from the creation of the artificial impoundment located adjacent to the proposed mining infrastructure. The floral diversity of the pan wetland in the south of the MRA area was moderately high, with the pan providing suitable habitat to a number of floral species over a large area.	**General comments:** There are two wetlands located within the MRA area that are at risk from mining related activities, namely the seep wetland with the artificial impoundment located adjacent to the proposed mining infrastructure area, as well as the large pan wetland in the south of the MRA area. These wetlands provide habitat for floral species generally associated with saturated soil conditions, and although some of the areas have been disturbed, the overall habitat suitability for floral species is considered to be moderately high.	**Business Case, Conclusion and Mitigation Requirements:** This habitat unit is of moderately high ecological sensitivity and if any activities are to infringe upon this habitat unit t impact on floral habitat, diversity and floral SCC is likely to be significant. All possible steps must be taken to ensure that mining activities within the MRA area do not negatively affect the wetland areas and their associated integrity and function with specific mention of biodiversity support functions. Mitigation measures must include measures to ensure that increased sediment loads are not carried into the wetland systems from the mining areas.
Conservation Status of Vegetation Type/Ecosystem	Wetlands by nature are considered important and are to be protected and conserved at all times. Further, the wetland habitat is located within an endangered vegetation type as listed by Mucina & Rutherford (2006).		
Habitat Integrity/Alien and Invasive species	The habitat and integrity of the hillslope seep has been altered due to the excavation of the artificial impoundment located adjacent to the proposed mining infrastructure area. The increased drainage of the hillslope seep combined with grazing activities has resulted in the degradation of the wetland habitat for floral species. A small number of alien invasive forb species were observed within the wetland habitat. The large pan wetland in the south of the MRA area is still considered to be intact, with minimal disturbance other than that of grazing by local herds of cattle. The surrounding agricultural activities have had an impact on the wetland pan, with increased sediment being carried into the pan wetland from the cultivated fields during periods of high rainfall.		
Presence of Unique Landscapes	The wetland habitat unit contributes to floral diversity of the MRA area through the creation of niche habitat for flora adapted to saturated soil conditions.		

2.6 Habitat Unit 4: Agricultural Fields

Habitat Unit:	Floral Habitat Sensitivity	Low
Agricultural Fields	Notes on Photograph: Typical view of current agricultural fields (Pecan nut plantation) within the MRA area.	

Floral Habitat Sensitivity Graph:



Floral Species of Conservation Concern (SCC)	No floral SCC were encountered in this habitat unit and it is highly unlikely that any such species will occur

Floral Diversity	Floral diversity was considered to be low with much of the areas having been cleared to make way for agricultural crops.	**General comments:** This habitat unit is associated with current and historic crop fields which has completely transformed the ecological structure of the natural vegetation. Overall ecological function is low in the areas of the orchard and very low in the maize fields.	**Business Case, Conclusion and Mitigation Requirements:** This habitat unit is of low ecological sensitivity. Activities within this habitat unit will have an insignificant impact on the floral environment, however care must be taken to limit edge effects on the surrounding natural areas.
Conservation Status of Vegetation Type/Ecosystem	The vegetation type is listed as Endangered (Mucina & Rutherford 2006), however no representative vegetation remains.		
Habitat Integrity/Alien and Invasive species	Habitat is severely transformed and dominated by pioneer grasses such as *Cynodon dactylon* in the newly planted orchards. The remaining agricultural areas are currently homogenously planted with *Zea mays* (Maize).		
Presence of Unique Landscapes	No unique landscapes important to flora were present.		

2.7 Floral Species of Conservation Concern Assessment

An assessment considering the presence of any plant species of concern, as well as suitable habitat to support any such species was undertaken. The complete PRECIS Red Data Listed plants for the grid reference 2628BA was acquired from SANBI.

Threatened species are species that are facing a high risk of extinction. Any species classified in the IUCN categories Critically Endangered (CR), Endangered (EN) or Vulnerable (VU) is a threatened species.

SCC are species that have a high conservation importance in terms of preserving South Africa's high floristic diversity and include not only threatened species, but also those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare and Declining.

The SCC listed for the area together with their calculated POC are tabulated in Appendix B. Table 1 below represent those species that obtained a POC score of 60% or more.

Table 1: Floral SCC (as per Schedule 11) of the MNCA that obtained a POC score of 50% or more. Species indicated with an asterisk (*) were also identified by the PRECIS RDL plant list for the MRA AREA (see Table 1b, Appendix B).

Species	Status	POC	Motivation
Habenaria galpinii	LC	100%	Suitable habitat within the Rocky and Disturbed Grassland Habitat Units
Gladiolus vinosomaculatus	LC	100%	Suitable habitat within the Rocky and Disturbed Grassland Habitat Units
Gladiolus permeabilis	LC	100%	Suitable habitat within the Rocky and Disturbed Grassland Habitat Units
Gladiolus crassifolius	LC	100%	Suitable habitat within the Rocky Grassland Habitat
Crinum graminicola	LC	100%	Suitable habitat within the Rocky and Disturbed Grassland Habitat Units
Hypoxis hemerocallidea	LC	100%	Suitable habitat within the Rocky and Disturbed Grassland Habitat Units
**Crinum bulbispernum*	LC	70%	Within distribution range with suitable habitat in the form of wetlands and damp depressions being present. Not recorded during assessment
**Kniphofia typhoides*	NT	50%	Suitable habitat potentially within Wetland Habitat. Not recorded during assessment

From the above assessment, it is evident that *Crinum bulbispernum* and *Kniphofia typhoides* have the potential to occur within the MRA area, although neither of these species were recorded during the site assessment. The above species, should they occur on site, are likely to be found within the Wetland habitat unit, which adds to the sensitivity of the habitat unit.

It is recommended that a walkthrough of the MRA be conducted prior to the commencement of any construction and/or mining activities and that all encountered floral SCC are marked. If individuals or communities of these species will be disturbed by mining activities, they must be relocated by suitably trained personnel to a suitable, similar habitat in close proximity to

where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Mpumalanga Tourism and Parks Agency (MTPA). MTPA also raised concern regarding the critically endangered orchid species *Brachycorythis conica subsp. transvaalensis* (Figure 3) which has been recorded on portion 9 of the farm Rietkol, located to the south-west of the MRA area. During the floral assessments conducted during February 2016, January 2017, and March 2021, no individuals of *Brachycorythis conica subsp. transvaalensis* were observed, which may be attributed to the increased grazing and agricultural activities in the area, as well as the harvesting/ collection of individuals by local residents and/or collectors. However, should any individuals of this species be located within the MRA area, **MTPA is to be notified immediately** and the appropriate steps taken as guided by MTPA to ensure that the individuals are not impacted upon by the mining activities.

Figure 4: Image of *Brachycorythis conica subsp. transvaalensis* (SANBI Red List, 2018)

Where mining activities will encroach upon the Rocky Grassland, Disturbed Grassland and the Wetland habitat units and above-mentioned floral SCC, a rescue and relocation plan is to be implemented by a suitably qualified ecologist in the correct flowering season after obtaining the relevant permits from the MTPA. Species removed are to either be re-located to similar suitable habitat in the vicinity of the MRA area.

2.8 Alien and Invasive Plant Species

South Africa is home to an estimated 759 naturalised or invasive terrestrial plant species (Richardson et al., 2020), with 327 plant species, most of which are invasive, listed in national legislation[1]. Many introduced species are beneficial, e.g., almost all agriculture and forestry production are based on alien species, with alien species also widely used in industries such as horticulture. However, some of these species manage to "escape" from their original locations, spread and become invasive. Although only a small proportion of introduced species become invasive (~0.1–10%), those that do proceed to impact negatively on biodiversity and the services that South Africa's diverse natural ecosystems provide (from ecotourism to harvesting food, cut flowers, and medicinal products) (van Wilgen and Wilson, 2018).

2.8.1.1 **Legal Context**

South Africa has released several Acts legislating the control of alien species. Currently, invasive species are controlled by the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004) (NEMBA) – Alien and invasive Species Regulations, which were gazetted on 1 August 2014 and became law on 1 October 2014. AIPs defined in terms of NEMBA are assigned a category and listed within the NEMBA List of Alien and Invasive Species (2016) in accordance with Section 70(1)(a) of the NEMBA:

- **Category 1a** species are those targeted for national eradication;
- **Category 1b** species must be controlled as part of a national management programme, and cannot be traded or otherwise allowed to spread;
- **Category 2** species are the same as category 1b species, except that permits can be issued for their usage (e.g. invasive tree species can still be used in commercial forestry providing a permit is issued that specifies where they may be grown and that permit holders "*must ensure that the specimens of the species do not spread outside of the land or the area specified in the permit*"); and
- **Category 3** are listed invasive species that can be kept without permits, although they may not be traded or further propagated, and must be controlled if they occur in protected areas or riparian zones.

Duty of care related to listed invasive species are referred to in NEMBA Section 73[2]. The motivation for this duty of care is both environmentally and economically driven. Management

[1] Government Notice 864 Alien Invasive Species List as published in the Government Gazette 40166 of 2016, as it relates to the National Environmental Management Biodiversity Act, 2004 (Act No 10 of 2004).
From 1 May 2021, the new legislation will come into effect: Government Notice number 1003: Alien and Invasive Species Lists, 2020, in Government Gazette 43726 dated 18 September 2020

[2] Section 73(2): A person who is the owner of land on which a listed invasive species occurs must-
a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;

of alien species in South Africa is estimated to cost at least ZAR 2 billion (US$142 million) each year - this being the amount currently spent by the national government's Department of Forestry, Fishery and the Environment (DFFE) - i.e., the Working for Water programme (van Wilgen, 2020). Managing AIPs early on will reduce clearing costs in the long run.

2.8.1.2 **Site Results**

In total, 19 AIP species were recorded within the study area. Of these 19 species, seven are listed as NEMBA Category 1b, one is listed as NEMBA Category 2, one is listed as NEMBA Category 3 and the remaining 10 species are not listed. Although a large majority of the species are not listed as per NEMBA, these species are considered to be problem plants (i.e., any plant, shrub or tree which has a negative environmental impact in a particular locality and result in the subsequent loss of biodiversity, and (potential) excessive water consumption although not listed under NEMBA). Although not listed, these species still pose a significant threat to the biodiversity and ecosystem functionality of the study area.

Due to the extent of AIPs within the study area, as well as the proximity to wetlands, it is highly recommended that an Alien and Invasive Species Control and Management Plan be set up and implemented to ensure further loss of indigenous floral communities do not occur.

b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
c) take all the required steps to prevent or minimise harm to biodiversity.

Table 2: Dominant alien vegetation species identified during the field assessment.

Species	English name	Country of Origin	NEMBA Category*
	Trees/ shrubs		
Acacia dealbata	Silver wattle	Australia	2
Schinus molle	Peruvian pepper tree	S. America	NL
Eucalyptus grandis	Blue Gum	Australia	1b
Robinia pseudoacacia	Black Locust	N. America	1b
Celtis australis	Nettle tree	Australia	3
Datura stramonium	Large-thorn apple	C. America	1b
	Forbs		
Bidens pilosa	Common blackjack	S America	NL
Cirsium vulgare	Spear thistle	Eurasia & N Africa	1b
Conyza bonariensis	Flax-leaved horseweed	C America	NL
Gomphrena celosioides	Bachelor's button	Cosmopolitan	NL
Xanthium stramonium	Large cocklebur	N America	1b
Persicaria limbata	Knot Weed	Tropical Africa	NL
Campuloclinium macrophalum	Pompom weed	S. America	NL
Cosmos bipinnatus	Cosmos	S. America	NL
Stoebe plumosum	Bankrupt bush	Indigenous	NL
Verbena tenuisecta	Fine-leaved Verbena	S. America	NL
Solanum mauritianum	Bugweed	South America	1b
Tagetes minuta	Tall khakiweed	S. America	NL
Verbena bonariensis	Purple top	S. America	1b

*N/L = Not Listed and not categorised

National Environmental Management: Biodiversity Act (Act 10 of 2004): Alien and Invasive Species Regulations, GN R598 of 2014:

Category 1a – Invasive species that require compulsory control.

Category 1b – Invasive species that require control by means of an invasive species management programme.

Category 2 – Commercially used plants that may be grown in demarcated areas, provided that there is a permit and that steps are taken to prevent their spread.

Category 3 – Ornamentally used plants that may no longer be planted. Existing plants may remain, except within the flood line of watercourses and wetlands, as long as all reasonable steps are taken to prevent their spread (Bromilow, 2001).

2.9 Medicinal Plant Species

Medicinal plant species are not necessarily indigenous species, with many of them regarded as alien invasive weeds. The table below presents a list of dominant plant species with traditional medicinal value, plant parts traditionally used and their main applications, which were identified during the field assessment. These medicinal species are all commonly occurring species and are not confined to the MRA area.

Table 3: Dominant traditional medicinal floral species identified during the field assessment. Medicinal applications and application methods are also presented (van Wyk, Oudtshoorn, Gericke, 2009).

Species	Name	Plant parts used	Medicinal uses
Hypoxis hemerocallidea	Star flower	Bulb	Infusions of the corm are used as emetics to treat dizziness bladder disorders and insanity. Decoctions have been given to weak children as a tonic and the juice is reported to be applied to burns. The stems and leaves are mixed with other ingredients to treat prostate problems. Traditional uses are also said to include testicular tumours, prostate hypertrophy and urinary infections. In recent years, the plant has become an important commercial source of extracts used in prostate preparations and in various tonics and so-called immune boosting preparations.
Tagetes minuta	Tall khaki bush	Leaves	Highly aromatic leaves have repellent properties of essential oils used by gardeners to keep plants disease free. Oil used in perfumery and as flavouring in foods, beverages and tobacco.
Pelargonium luridum	Wild geranium	Fleshy root stock	Water or milk decoctions of the tubers are used to treat diarrhoea and dysentery.
Scabiosa columbaria	Wild scabious	Leaves or fleshy roots	The plant is a remedy for colic and heartburn. Dried roasted roots are made into a wound-healing ointment, and the powdered roots are also used as a pleasant smelling baby powder.

A moderately low diversity of medicinal species is present, most of which are common and widespread and thus the proposed activities are not likely to pose a significant threat to medicinal species locally and regionally. If individuals of *Hypoxis hemerocallidea* or communities thereof are disturbed by mining activities, they must be relocated to suitable, similar habitat in close proximity to where they were removed from, but outside the disturbance footprint after obtaining the relevant permits from the Mpumalanga Tourism and Parks Agency (MTPA).

3 SENSITIVITY MAPPING

Figure 4 below conceptually illustrates the areas considered to be of increased ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for floral SCC, habitat intactness and levels of disturbance, threat status of the habitat type, the presence of unique landscapes and overall levels of diversity. The table below presents the sensitivity of each identified habitat unit along with an associated conservation objective and implications for development.

Table 4: A summary of sensitivity of each habitat unit and implications for development.

Habitat Unit	Sensitivity	Conservation Objective	Development Implications
Rocky Grassland	Intermediate	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	Mining activities in this area are unlikely to have a significant impact on the receiving environment, however floral SCC rescue and relocation programmes will have to be implemented prior to any activity within this habitat unit.
Disturbed Grassland	Moderately Low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	Mining activities in this area are unlikely to have a significant impact on the receiving environment, however floral SCC rescue and relocation programmes will have to be implemented prior to any activity within this habitat unit.
Wetlands	Moderately High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.	Any disturbance of this habitat unit is discouraged and may lead to denied environmental authorisation by authorities.
Agricultural Fields	Low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.	Although mining development in this area is unlikely to have a significant impact on the receiving environment, care must be taken to limit edge effects on the surrounding natural areas.

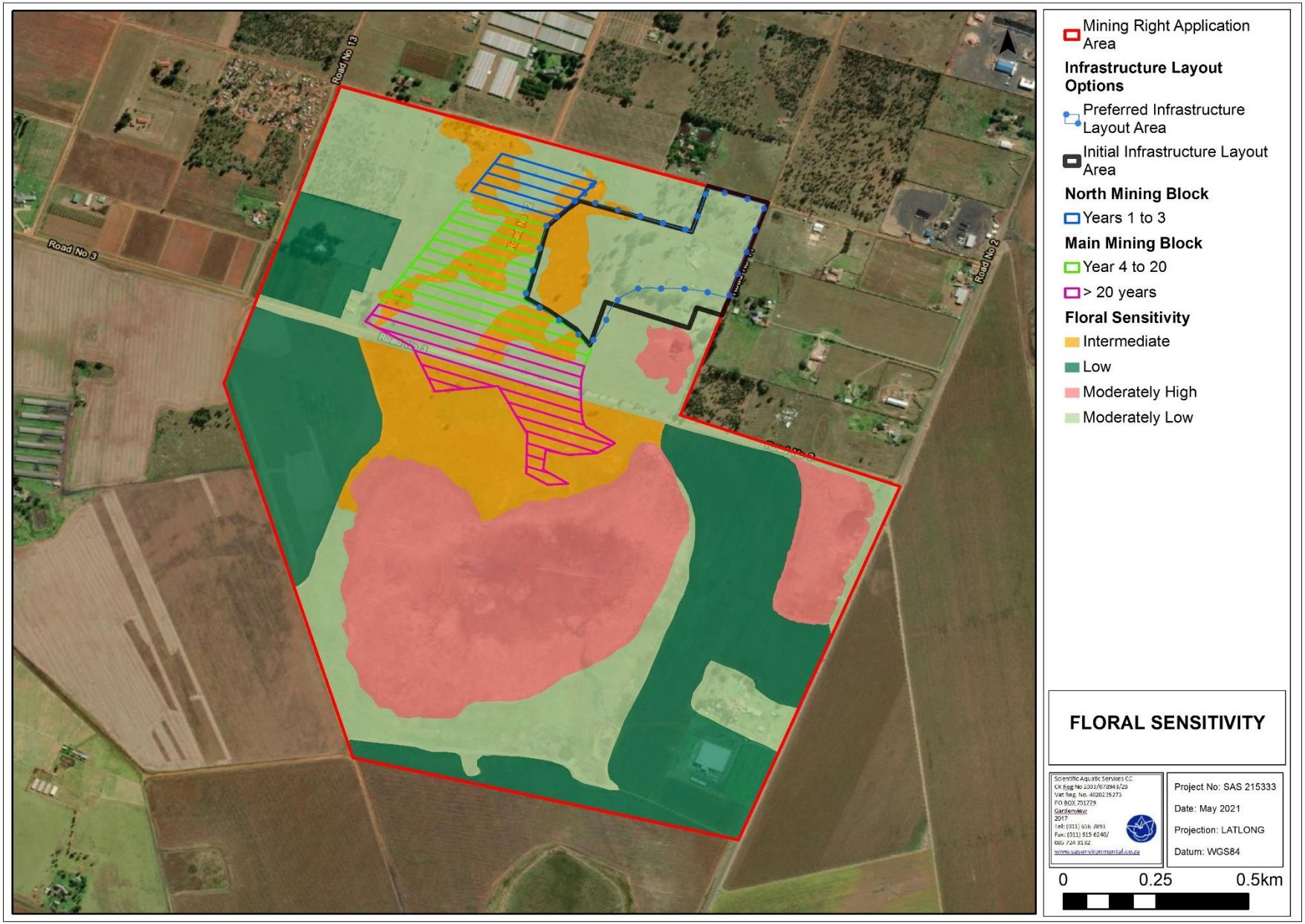


Figure 5: Floral sensitivity map for the MRA area

4 CONCLUSION

The findings of the field assessment indicate that the habitat associated with the MRA area is mostly of low to intermediate sensitivity, with only the wetland habitat unit being of a higher sensitivity rating. Much of the MRA area has been disturbed through agricultural activities and the proliferation of alien invasive species. The overall diversity and abundance of medicinal species was low, with most of the species being considered common and widespread. Furthermore, several floral SCC which are listed under Schedule 11 of the MNCA, namely *Hypoxis hemerocallidea, Gladiolus vinosomaculatus, Gladiolus permeabilis, Gladiolus crassifolius, and Habenaria galpinii* and *Crinum graminicola,* were encountered within the MRA area. Two other floral SCC listed by the SANBI PRECIS Red Data List for the MRA area (*Crinum bulbispermum* and *Kniphofia typhoides*) were not encountered, however it is likely that they may occur within the wetland habitat unit. MPTA has further indicated that *Brachycorythis conica subsp. transvaalensis* has been recorded on the farm Rietkol. Although it was not observed during the field assessment it is recommended that a floral walkthrough of the MRA be conducted during the flowering season (i.e., between January and April) of this species. Should this species be observed, proposed mining activities in that area are to be halted immediately and MPTA notified and consulted in order to determine the best way forward.

A number of potential risks to the receiving faunal environment as a result of the proposed mining operation have been identified which relate to faunal habitat integrity, faunal diversity and the impact on faunal SCC. These impacts have been assessed in detail in the impact assessment section (Section E), with mitigatory recommendations presented in line with the mitigation hierarchy. It is the opinion of the ecologists that this study provides the relevant information required in order to implement an Integrated Environmental Management (IEM) and to ensure that the best long-term decisions are made in terms of the ecological resources associated with the proposed pipeline in support of the principle of sustainable development.

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APPENDIX A - Floral method of Assessment

Floral Species of Conservational Concern Assessment

Prior to the field visit, a record of floral SCC and their habitat requirements was acquired from SANBI for the Quarter Degree Square in which the study area is situated, as well as relevant regional, provincial and national lists. Throughout the floral assessment, special attention was paid to the identification of any of these SCC as well as the identification of suitable habitat that could potentially support these species.

The Probability of Occurrence (POC) for each floral SCC is described:

- "**Confirmed'**: if observed during the survey;
- "**High**": if within the species' known distribution range and suitable habitat is available;
- "**Medium**": if either within the known distribution range of the species or if suitable habitat is present; or
- "**Low**": if the habitat is not suitable and falls outside the distribution range of the species.

Low POC	Medium POC	High POC	Confirmed

The accuracy of the POC is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Vegetation Surveys

Vegetation surveys were undertaken by first identifying different habitat units and then analysing the floral species composition that was recorded during detailed floral assessments using the step point vegetation assessment methodology. Different transect lines were chosen throughout the entire study area within areas that were perceived to best represent the various plant communities. Floral species were recorded and a species list was compiled for each habitat unit. These species lists were also compared with the vegetation expected to be found within the relevant vegetation types as described in Section 4, which serves to provide an accurate indication of the ecological integrity and conservation value of each habitat unit (Evans & Love, 1957; Owensby, 1973).

Floral Habitat Sensitivity

The floral habitat sensitivity of each habitat unit was determined by calculating the mean of five different parameters which influence floral communities and provide an indication of the overall floristic ecological integrity, importance and sensitivity of the habitat unit. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- **Floral SCC:** The confirmed presence or potential for floral SCC or any other significant species, such as endemics, to occur within the habitat unit;
- **Unique Landscapes:** The presence of unique landscapes or the presence of an ecologically intact habitat unit in a transformed region;
- **Conservation Status:** The conservation status of the ecosystem or vegetation type in which the habitat unit is situated based on local, regional and national databases;
- **Floral Diversity:** The recorded floral diversity compared to a suitable reference condition such as surrounding natural areas or available floristic databases; and
- **Habitat Integrity:** The degree to which the habitat unit is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the floral habitat sensitivity class in which each habitat unit falls. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the habitat unit in question. In order to present the results use is made of spider diagrams to depict the significance of each aspect of floral ecology for each vegetation type. The different classes and land-use objectives are presented in the table below:

Table 1a: Floral habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit limit development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX B - Floral Species of Conservation Concern

Table 1b: PRECIS RDL plant list for the MRA AREA (Raimondo *et al*., 2009; SANBI, www.sanbi.org).

Family	Species	Threat Status	Habitat
AMARYLLIDACEAE	*Crinum bulbispermum (Burm.f.)* Milne-Redh. & Schweick.	Declining	Near rivers, streams, seasonal pans and in damp depressions.
ASPHODELACEAE	*Kniphofia typhoides* Codd	NT	Low-lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands.

POC for RDL Floral SCC obtained from BODATSA, the Online National Environmental Screening Tool as well as from the MTPA Species Status Report

Table B1: Red Data Listed plant species recorded in the QDS 2628BA. Species list obtained from the new Plants of southern Africa (new POSA) online catalogue. Additional species were obtained from the National Web Based Screening Tool as well as the MTPA Species Status report for the QDS 2628BA. Information on species distributions and conservation status were derived from the Red List of South African Plants website (http://redlist.sanbi.org/index.php).

SCIENTIFIC NAMES	POC	HABITAT AND DIAGNOSTIC CHARACTERISTICS	CONSERVATION STATUS
Sensitive species 691	**Low**	Major habitats: Ithala Quartzite Sourveld, Soweto Highveld Grassland, Frankfort Highveld Grassland, Steenkampsberg Montane Grassland, Sekhukhune Montane Grassland, Paulpietersburg Moist Grassland, Eastern Highveld Grassland, Rand Highveld Grassland, Western Highveld Sandy Grassland Description: Undulating grasslands in damp areas. It occurs in rocky grassland in large colonies in eastern Gauteng and western Mpumalanga, in heavy clay soil associated with dolomitic limestone outcrops (Craib, 2002). Population trend: Decreasing Suitable habitat in study area: Eastern Highveld Grassland Subunit, Freshwater Habitat Unit	**VU**

Provincially Protected Flora

Table B3: Schedule 11 - PROTECTED PLANTS (SECTION 69 (1) (a)) of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998).

SCHEDULE 11 - PROTECTED PLANTS		
Common Name	**Scientific Name**	**POC**
All species of trees ferns, excluding the bracken fern	All species of the Genus: *Cyathea capensis and Cyathea dregei*	**Low**
All species of Cycads in Republic of South Africa and the seedling of the species of *Cycads* referred to in schedule 12	All species of the family Zamiaceae occurring in the Republic of South Africa and the seedlings of the species of *Encephalartos* referred to in Schedule 12	**Low**
All species of yellow wood	*Podocarpus spp.*	**Low**
All species of arum lilies	*Zantedeschia spp.*	**Low**

SCHEDULE 11 - PROTECTED PLANTS		
Common Name	**Scientific Name**	**POC**
"Volstruiskom"	*Schizobasis intricata* (now *Drimia intricata*)	**Medium**
"Knolklimop"	*Bowiea volubilis*	**Low**
All species of red-hot pokers	*Kniphofia spp.*	**Medium-High**
All species of *Aloes*, excluding: (a) All species not occurring in Mpumalanga and (b) The following species: all species of haworthias all species of *Agapanthus* all species of squill	Aloe spp., excluding: (a) All species not occurring in Mpumalanga (b) The following species: *Haworthia spp.* *Agapanthus spp.* *Scilla spp.* Suitable habitat is available for ***Aloe ecklonis*** within the Grassland Habitat Unit. This species can tolerate disturbed conditions. ***Aloe bergeriana*** and ***Aloe davyana*** was recorded on site	**Medium**
All species of pineapple flower	*Eucomis spp.* ***Eucomis autumnalis*** was recorded within the Intact Wetland Habitat Unit.	**Low**
All species of *dracaena*	*Dracaena spp.*	**Low**
All species of paint brush	*Haemanthus spp. and Scadoxis spp.*	**Low**
Cape poison bulb	*Boophane disticha* Recorded just outside of the study area within the Eastern Highveld Grassland Habitat Unit	**Medium**
All species of *Clivia*	*Clivia spp.*	**Low**
All species of *Brunsvigia*	*Brunsvigia spp.*	**Low**
All species of *Crinum*	*Crinum spp.* Suitable habitat is available for *Crinum graminicola* was observed on site. Attionally, suitable habitat for *Crinum bulbispermum* is likely to be located within the MRA	**Confirmed**
Ground lily	*Ammocharis coranica*	**Low**
All species of fire lily	*Cyrtanthus spp.*	**Low**
River lily	*Hesperantha coccinea*	**Low**
All species of *Watsonia*	*Watsonia spp.*	**Low**
all species of gladioli	*Gladiolus spp.* Three species of Gladioli were recorded on site. *Gladiolus vinosomaculatus, Gladiolus permeabilis, and Gladiolus crassifolius* were recorded within the MRA	**Confirmed**
Wild ginger	*Siphonochilus aethiopicus*	**Low**
All species of orchids	All species of the family Orchidaceae (*Habenaria galpinii)*	**Confirmed**
All species of the family Proteaceae	All species of the family Proteaceae	**Low**
All species of black stinkwood	*Ocotea spp.*	**Low**
Kiaat	*Pterocarpus angolensis*	**Low**
Tamboti	*Spirostachys africana*	**Low**
The following species of *Euphorbias*: *Euphorbia bernardii* and *Euphorbia grandialata*	The following species of euphorbias: *Euphorbia bernardii and Euphorbia grandialata*	**Low**
Common bersama	*Bersama tysoniana*	**Low**
Red ivory	*Berchemia zeyheri*	**Low**
Pepperbark tree	*Warburgia salutaris*	**Low**
All species of *Adenia*	*Adenia spp.*	**Low**
Bastard onion wood	*Cassipourea gerrardii*	**Low**
Assegai tree	*Curtisia dentata*	**Low**
All species of olive trees	All species of the Genus Olea	**Low**
All species of impala lilies	All species of the Genus Adenium	**Low**

SCHEDULE 11 - PROTECTED PLANTS		
Common Name	**Scientific Name**	**POC**
Kudu lily	*Pachypodium saundersii*	**Low**
All species of *Brachystelma*	*Brachystelma spp.*	**Low**
All species of *Ceropegia*	*Ceropegia spp.*	**Low**
All species of *Huerniopsis* and *Huernia*	*Huernipsis* and *Huernia spp.*	**Low**
All species of *Duvalia*	*Duvalia spp.*	**Low**
All species of *Stapeliads*	*Stapelia spp.*	**Low**
All species of *Orbeanthus*	*Orbeanthus spp.*	**Low**
All species of *Orbeas*	*Orbea spp.*	**Low**
All species of *Orbeopsis*	*Orbeopsis spp..*	**Low**

Table B4: Schedule 12 - SPECIALLY PROTECTED PLANTS (SECTION 69 (1) (b)) of the Mpumalanga Nature Conservation Act, 1998 (Act No. 10 of 1998).

SCHEDULE 12 - SPECIALLY PROTECTED PLANTS		
Common Name	**Scientific Name**	**POC**
(a) All plants, excluding seedlings, of the following species of cycads within the genus *Encephalartos*: *dolomiticus, dyer, middleburg, eugene marais, heenan, inopinus, laevifolius, lanatus, lebombo, ngoyanus, paucidentatus, modjadje and villosus* (b) All plants of the following. species of cycad within the *Encephalartos genus: cupidus* and *humilus* (c) all species of cycads in their natural habitat	(a) All plants, excluding seedlings, of the following species of the Genus *Encephalartos: E. dolomiticus, E. dyerianus, E. middleburgensis, E. eugene maraissii, E. heenanii, E. inopinus, E. laevifolius, E. lanatus, E. transvenosus and E. villosus and* many species derived from the above species *(b)* All plants of the following species of the Genus *Encephalartos: E. cupids and E. humilus* (c) All plants of the Genus *Encephalartos* in their natural habitat	**Low**

APPENDIX C - Floral Species Lists

Table 1c: Dominant species associated with each habitat unit encountered during the field assessment.

Grass species	Forb & Herb species	**Tree/Shrub Species**
Aristida adscensionis	**Bidens pilosa*	**Acacia dealbata*
Aristida congesta subsp. congesta	**Campuloclinium macrophalum*	**Celtis australis*
Aristida difusa	**Cirsium vulgare*	**Datura stramonium*
Aristida junciformis	**Conyza bonariensis*	**Eucalyptus grandis*
Brachiaria serrata	**Cosmos bipinnatus*	**Robinia pseudoacacia*
Cynodon dactylon	**Persicaria limbate*	**Schinus molle*
Diheteropogon amplectens	**Solanum mauritianum*	**Xanthium stramonium*
Elionurus muticus	**Tagetes minuta*	*Searsia lancea*
Eragrostis chloromelas	**Verbena bonariensis*	
Eragrostis curvula	**Verbena bonariensis*	
Eragrostis plana	**Verbena tenuisecta*	
Erogrostis gummiflua	**Zea mays*	
Heteropogon contorus	*Albuca sp.*	
Hyparrhenia hirta	*Ammocharis coranica*	
Melinis repens	*Berkheya seminivea*	
Panicum natalense	*Bulbine narcissifolia*	
Perotis patens	*Cleome maculata*	
Pogonarthria squarrosa	*Crinum graminicola*	
Schizachyrium sanguineum	*Cyprus rupestris*	
Schizachyrium sanguineum	*Dianthus mooiensis subsp. kirkii*	
Sporobolus africanus	*Eriospermum sp.*	
Themeda triandra	*Felicia muricata*	
Tricholaena monachne	*Gladiolus crassifolius*	
Trichoneura grandiglumis	*Gladiolus elliotii*	
Urochloa mosambicensis	*Gladiolus permeabilis*	
	Gladiolus vinosomaculatus	
	Habenaria galpinii	
	Helichrysum acutatum	
	Helichrysum cephaloideum	
	Helichrysum coriaceum	
	Hibiscus microcarpus	
	Hypoxis hemerocallidea	
	Hypoxis iridifolia	
	Hypoxis iridifolia	
	Ledebouria ovatifolia	
	Ledebouria revoluta	
	Lobelia flaccida	
	Nerine rehmannii	
	Nidorella anomala	
	Orchid	
	Pelargonium luridum	
	Scabiosa columbaria	
	Senecio scitus	
	Stoebe plumosum	

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FAUNAL, FLORAL AND FRESHWATER ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETKOL MINING OPERATION NEAR DELMAS WITHIN THE MPUMALANGA PROVINCE

Prepared for

Jacana Environmentals CC

April 2018 (Revised May 2021)

Section C: Faunal Assessment

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Report Reference: **SAS 215333**

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ACRONYMS

CR	Critically Endangered
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EN	Endangered
EW	Extinct in the Wild
GIS	Geographic Information System
GPS	Global Positioning System
IUCN	International Union for Conservation of Nature and Natural Resources
LC	Least Concern
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act, 1998 [Act No. 10 of 1998]
MTPA	Mpumalanga Tourism and Parks Agency
MRA	Mining Rights Application
NBA	National Biodiversity Assessment
NEMBA	National Environmental Management: Biodiversity Act, 2004 [Act No.10 of 2004]
NT	Near Threatened
NTBA	Not Yet Been Assessed
PES	Present Ecological State
POC	Probability of Occurrence
RE	Regionally Extinct
SABAP2	South African Bird Atlas Project 2
SANBI	South Africa National Biodiversity Institute
SAS	Scientific Aquatic Services
SCC	Species of Conservation Concern
TOPS	Threatened or Protected Species
VU	Vulnerable

GLOSSARY OF TERMS

Most definitions are based on terms and concepts elaborated by Richardson *et al*. (2011), Hui and Richardson (2017) and Wilson *et al*. (2017), with consideration to their applicability in the South African context, especially South African legislation [notably the National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004), and the associated Alien and Invasive Species (A&IS) Regulations, 2014].

Alien species (syn. exotic species; non-native species)	A species that is present in a region outside its natural range due to human actions (intentional or accidental) that have enabled it to overcome biogeographic barriers.
Biological diversity or Biodiversity (as per the definition in NEMBA)	The variability among living organisms from all sources including, terrestrial, marine, and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.
Critical Biodiversity Area (CBA)	A CBA is an area considered important for the survival of threatened species and includes valuable ecosystems such as wetlands, untransformed vegetation, and ridges.
Corridor	A dispersal route or a physical connection of suitable habitats linking previously unconnected regions.
Disturbance	A temporal change, either regular or irregular (uncertain), in the environmental conditions that can trigger population fluctuations and secondary succession. Disturbance is an important driver of biological invasions.
Endangered	Organisms in danger of extinction if causal factors continue to operate.
Endemic species	Species that are only found within a pre-defined area. There can therefore be sub-continental (e.g., southern Africa), national (South Africa), provincial, regional or even within a particular mountain range.
Ecological Support Area (ESA)	An ESA provides connectivity and important ecological processes between CBAs and is therefore important in terms of habitat conservation.
Ground-truth	Ground truth is a term used in various fields to refer to information provided by direct observation (i.e., empirical evidence) as opposed to information provided by inference.
Habitat (as per the definition in NEMBA)	A place where a species or ecological community naturally occurs.
Important Bird and Biodiversity Area (IBA)	The IBA Programme identifies and works to conserve a network of sites critical for the long-term survival of bird species that: are globally threatened, have a restricted range, are restricted to specific biomes/vegetation types or sites that have significant populations.
Integrity (ecological)	The integrity of an ecosystem refers to its functional completeness, including its components (species) its patterns (distribution) and its processes.
Least Threatened	Least threatened ecosystems are still largely intact.
Red Data listed (RDL) species	According to the Red List of South African plants (http://redlist.sanbi.org/) and the International Union for Conservation of Nature (IUCN), organisms that fall into the Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status.
Species of Conservation Concern (SCC)	The term SCC in the context of this report refers to all RDL and IUCN listed threatened species as well as protected species of relevance to the project.

1. INTRODUCTION

1.1 Background

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, freshwater and surface water quality ecological investigation as part of the environmental authorisation process for the proposed Rietkol Mining Operation (Rietkol Project), where mining of silica through opencast methods will occur. The proposed Rietkol Project is situated within Wards 8 and 9 of the Victor Khanye Local Municipality and the Nkangala District Municipality. The Mining Right Application (MRA) area is situated approximately 6km west of the town of Delmas/ Botleng. The MRA area is further situated approximately 900m southeast of the N12, 2.1 km southwest of the R50, and 2.7 km north of the R555.

The MRA area covers an area of 221 ha, and consists of following farm portions:

- 16 Modder East Agricultural Holdings on the farm Olifantsfontein 196IR;
- Portion 71 of the farm Rietkol 237 IR; and
- A portion of the remaining extent of Portion 31 of the farm Rietkol 237 IR.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The proposed Rietkol Project estimated life of mine (LOM) is 20 years, although further exploration drilling to be conducted during the operational phase, may increase the LOM and the depth of mining if resources proof viable (Jacana 2021: Final Scoping Report).
The following infrastructure is associated with the proposed project (Figure 1):

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening etc.);
- Product Stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc);
- Access Roads; and
- Clean and dirty water management infrastructure.

The infrastructure layout as proposed during the initial EIA phase for the proposed Rietkol mining operations near Delmas can be seen in Figure 1 below. The initial proposed infrastructure layout, hereafter referred to as the “Initial Infrastructure Layout” encroached into the buffer of a nearby Wetland. The initial Rietkol application for Environmental Authorisation lapsed in 2020 due to administration issues within the Department of Mineral Resources (DMR). As such a new mining right and environmental authorisation application has been

proposed. However, in the current application, the proposed infrastructure layout has been moved north, creating a 100m buffer between the proposed infrastructure and the wetland area to the south, hereafter referred to as the “Preferred Infrastructure Layout”. This report has been updated to illustrate the impacts associated with the preferred infrastructure layout.

The ecological assessment will fulfil the requirements of the Environmental Impact Assessment (EIA) as required in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA), the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and associated regulations, as well as other legal requirements applicable on both a national and provincial level, including the requirements of the National Water Act, 1998 (Act No. 36 of 1998) (NWA) and associated guidelines and regulations.

The purpose of this report is to define the ecology of the area including both terrestrial and wetland aspects as well as mapping of the resources and defining areas of increased Ecological Importance and Sensitivity (EIS) and to define the Present Ecological State (PES) of the MRA area. It is the objective of this study to provide detailed information to guide the activities associated with the proposed mining activities in the vicinity of the resources to ensure that the ongoing functioning of the ecosystem in such a way as to support local and regional conservation requirements and the provision of ecological services in the local area.

2.1 Assumptions and Limitations

The following assumptions and limitations are applicable to this report:

- The biodiversity desktop assessment is confined to the study area and does not include detailed results of the adjacent properties, although ecological important or sensitive areas according to the desktop databases of surrounding areas have been included on the relevant maps (see Part A);
- With ecology being dynamic and complex, some aspects (some of which may be important) may have been overlooked. It is, however, expected that most faunal communities have been accurately assessed and considered and the information provided is considered sufficient to allow informed decision making to take place and facilitate integrated environmental management;
- Due to the nature and habits of most faunal taxa, the high level of surrounding anthropogenic activities, it is unlikely that all species would have been observed during a field assessment of limited duration. Therefore, site observations were compared with literature studies where necessary;
- Sampling by its nature, means that not all individuals are assessed and identified. Some species and taxa within the footprint area may therefore have been missed during the assessment.

3 ASSESSMENT APPROACH

Four field assessments were undertaken as part of this study, notably the 4th and 16th of February 2016, in January 2017, and 24th March 2021, to determine the ecological status of the MRA area. A reconnaissance 'walkabout' was initially undertaken to determine the general habitat types found throughout the MRA area, following this, specific study sites were selected that were considered to be representative of the habitats found within the area, with special emphasis being placed on areas that may potentially support faunal Species of Conservation Concern (SCC). Sites were investigated on foot in order to identify the occurrence of fauna within the MRA area. In order to increase overall observation time within the MRA area, as well as increasing the likelihood of observing shy and hesitant species, motion sensitive camera traps were strategically placed within the MRA area. Sherman traps were also used to increase the likelihood of capturing and observing small mammal species, notably small nocturnal mammals.

A detailed explanation of the method of assessment is provided in Appendix A of this report.

The faunal categories covered in this assessment are mammals, avifauna, reptiles, amphibians, general invertebrates and arachnids.

3.1 Sensitivity Mapping

All the ecological features of the MRA area were considered and sensitive areas were assessed. In addition, identified locations of protected species were marked by means of Global Positioning System (GPS). A Geographic Information System (GIS) was used to project these features onto aerial photographs and topographic maps. The sensitivity map should guide the design and layout of the proposed open cast mining operations.

4 FAUNAL ASSESSMENT RESULTS

3.1 Habitat Description

After investigation it is evident that four primary faunal habitat units exist within the MRA area, namely (Figure 1):

- Rocky Grassland habitat;
- Wetland habitat;
- Disturbed Grassland habitat; and
- Agricultural lands.

The overall habitat availability of the MRA area is considered to be moderately low to intermediate. This is largely as a result of anthropogenic activities, hunting and snaring by local communities, loss and disturbance of habitat as well as limited habitat connectivity with surrounding areas. The wetland habitat unit is considered to be of highest importance for faunal species, with the grassland areas surrounding the wetland forming a suitable periphery habitat for a number of small mammal species. Historical evidence of mammal activity (burrows) was observed within both the Disturbed Grassland and the edges of the Rocky Grassland habitat units, however active hunting by the local communities as well as anthropogenic activities has resulted in a large loss of these species. The dashboard reports below discuss each faunal group in terms of species and overall habitat availability.

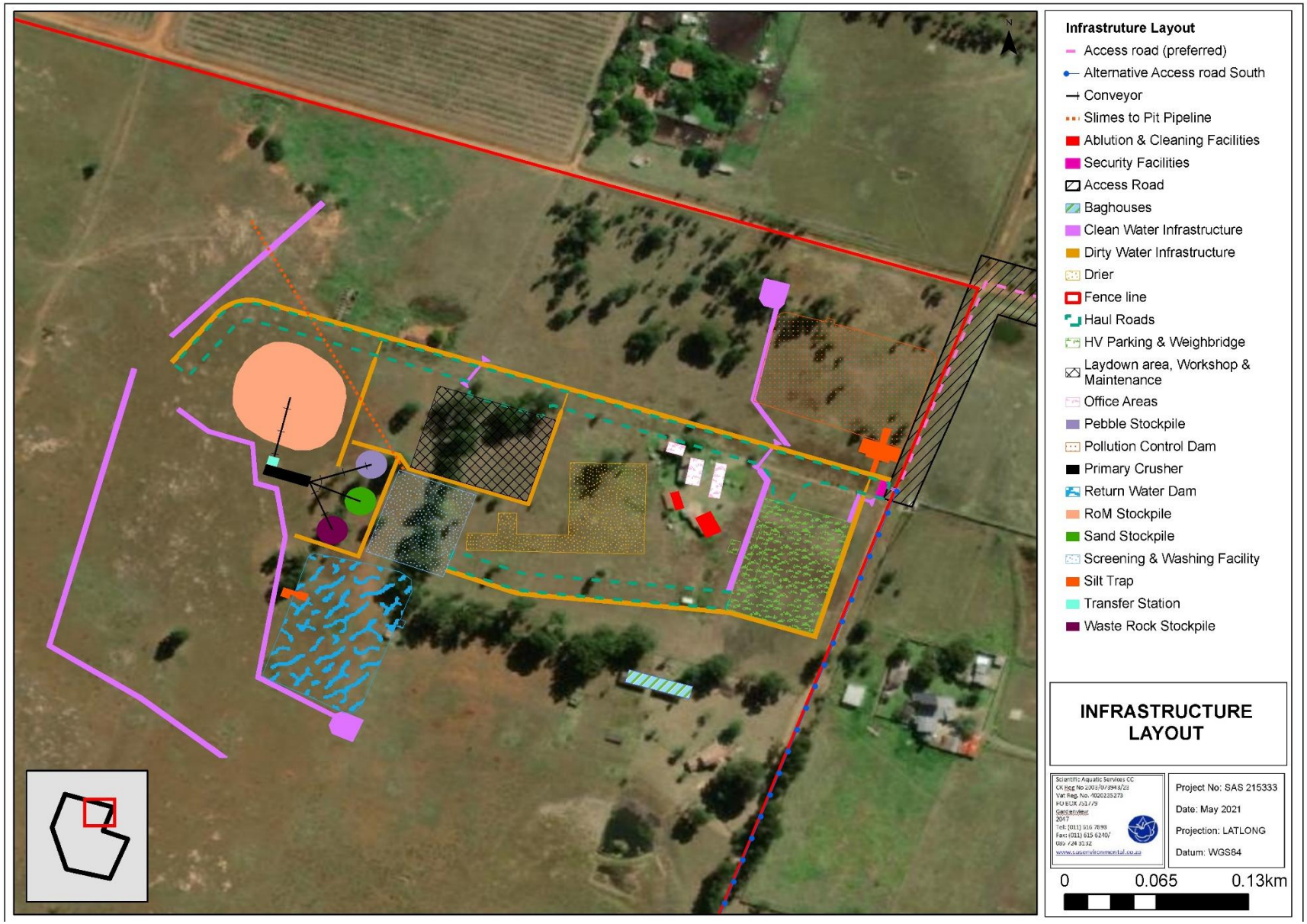


Figure 1: Proposed Infrastructure Layout associated with the MRA area.

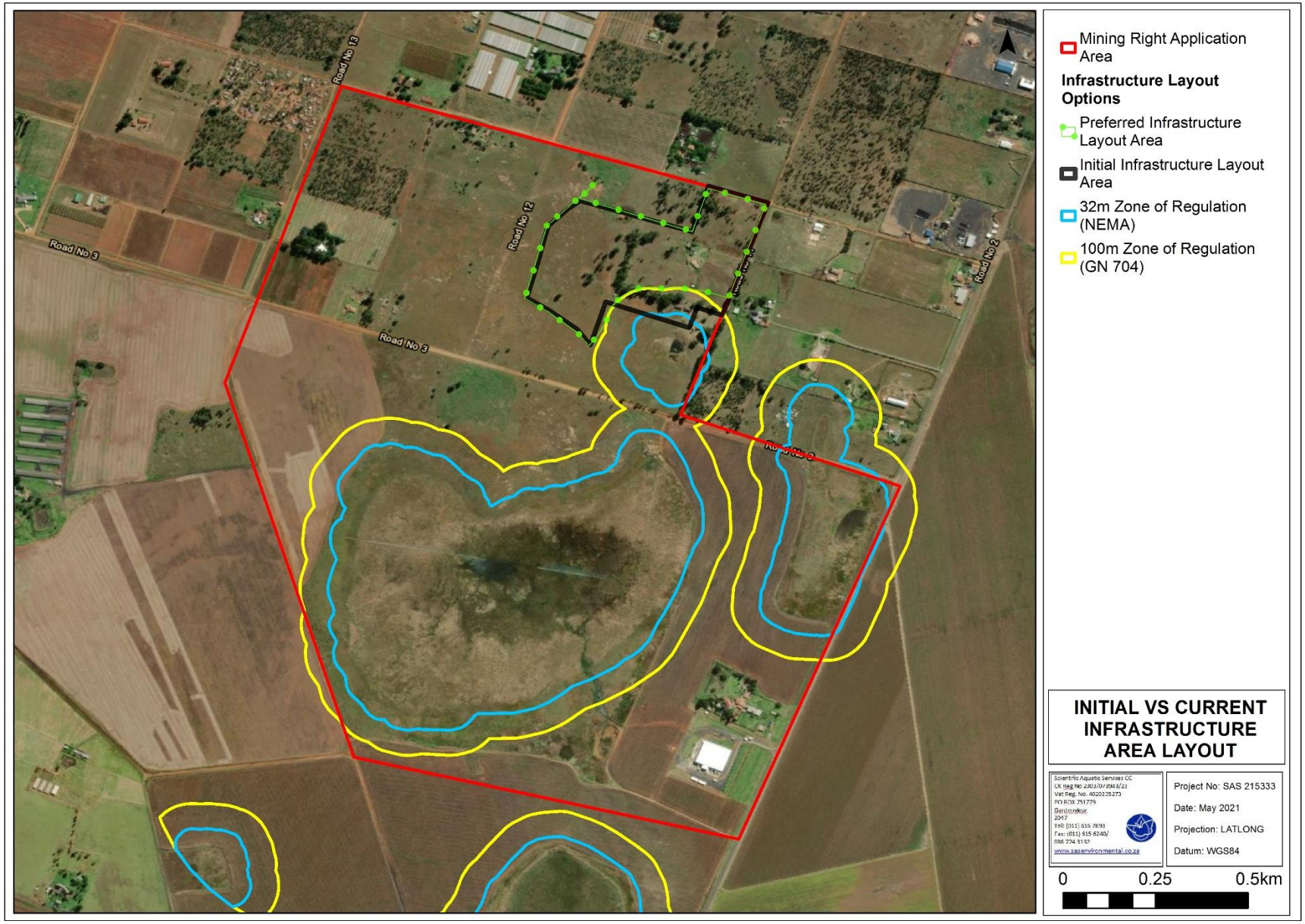
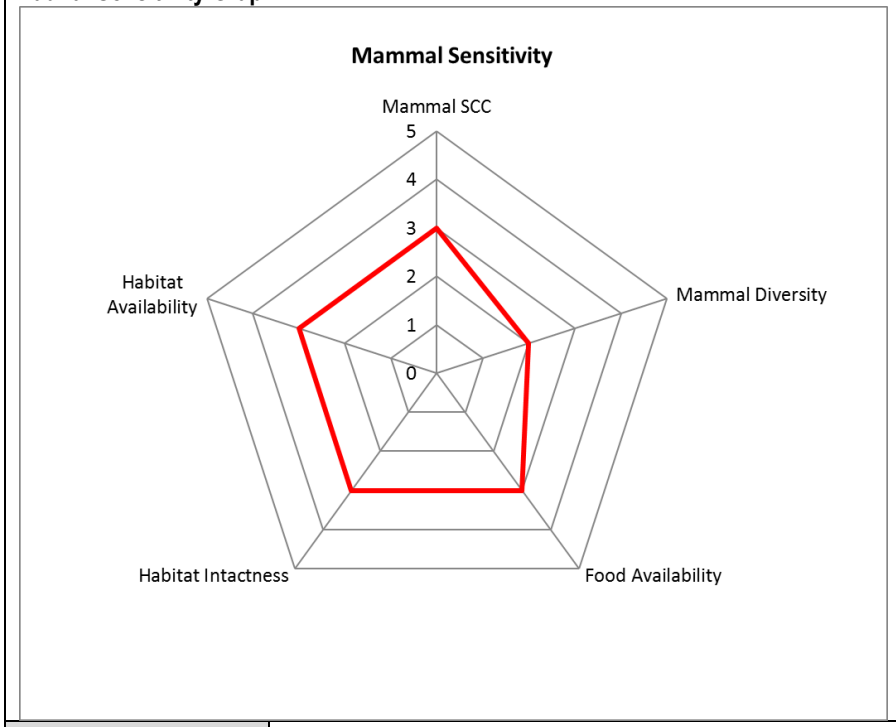


Figure 2: Initial Vs Current Infrastructure Layout Areas associated with the MRA.

3.2 Mammals

Faunal Class: Mammals	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: Top: *Aethomys chrysophilus* (Red Vlei Rat) captured in a Sherman Trap within the MRA area. Below: Skeletal remains of *Hystrix africaeaustralis* (African Porcupine) found near an old abandoned excavated burrow.	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	No mammal SCC were encountered during the site assessment. The onsite habitat potential of the MRA area in terms of SCC is considered to be low, with anthropogenic activities such as farming and localised subsistence hunting further limiting the probability of occurrence of SCC within the MRA area.

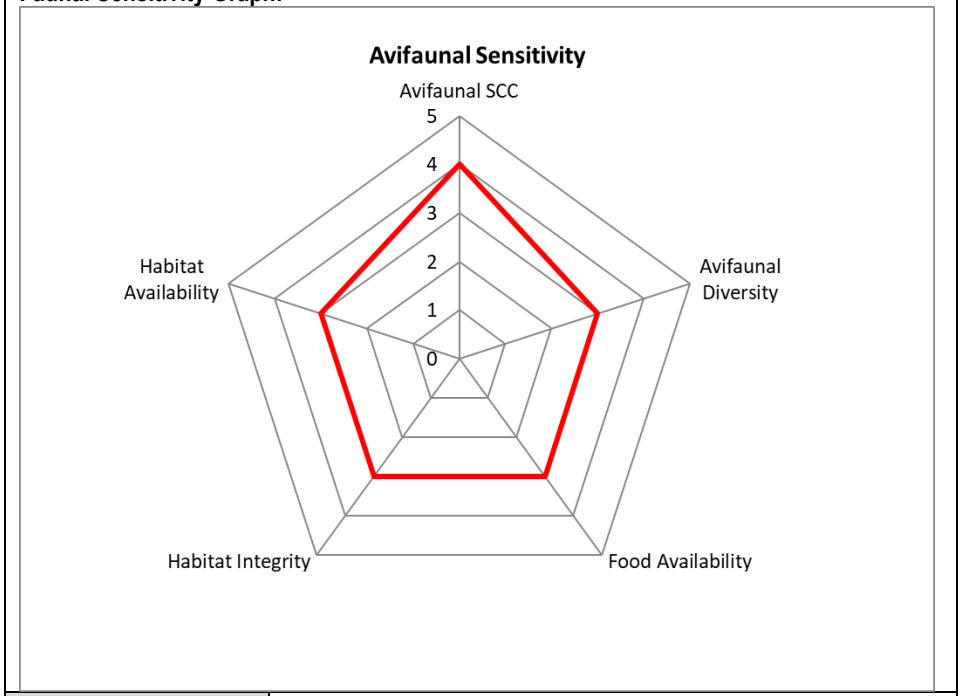
Photograph:

Faunal Diversity	The overall mammal diversity of the MRA area is considered to be moderately low. Information from local farmers as well as historic burrows and species remains (bones) indicate that the MRA area historically would have had an intermediate to moderately high mammal diversity, however impacts from farming activities and the local communities has resulted in a significant decrease in diversity.	**General comments (dominant faunal species/noteworthy records etc.):** Mammal species predominated around the wetland habitat units as well as the disturbed grasslands that surrounds the wetlands. The rocky grassland by nature is categorised as sourveld and as such very few mammal species will utilise this habitat unit. The rocky grassland habitat unit however does provide a connectivity corridor between the eastern and western portions of the MRA area, where mammal food resource availability is higher. Although local farmers made mention of a number of mammal species that used to occur within the MRA area, all evidence indicated that localized anthropogenic impacts as well as hunting activities by the local communities has resulted in a significant loss of mammal species within the MRA area and surrounds.	**Business Case, Conclusion and Mitigation Requirements:** The mammal habitat sensitivity is of an intermediate ecological sensitivity, notably within the wetland habitat. Any encroachment on these areas may have a negative impact on mammals within the MRA area. Further, mining of the rocky grassland is likely to result in a loss of habitat connectivity within the MRA area.
Food Availability	Food availability is restricted primarily to granivorous species and species that are able to utilise herbaceous material as a food source. Food availability was highest in the wetland areas. The remaining grasslands of the MRA area were noted to have an intermediate level of food availability for mammal species.		
Habitat Integrity	Habitat integrity is considered to be of an intermediate level. Historic farming activities as well as habitat modification has resulted in a significant loss of habitat integrity, however the overall ecological connectivity of the MRA area is still relatively intact.		
Habitat Availability	Primary mammal habitat is provided by the wetlands areas whilst the rocky grassland and disturbed grassland areas are considered to be secondary habitat. Mammal species were most abundant around the wetland fringes and immediate surroundings where food and water availability was also highest.		

3.3 Avifauna

Faunal Class: Avifauna	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: Top: *Euplectes afer* (Golden Bishop) observed in the wetland habitat unit. Bottom: *Mirafra Africana* (Rufous-naped Lark) observed within the rocky grassland	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	No avifaunal SCC were observed within the MRA area. Although the habitat within the MRA area have undergone disturbances, the short grass areas created by overgrazing may prove suitable to *Geronticus calvus* (Bald Ibis), as this species exhibits preference to short grassland habitat for foraging purposes. Additionally, *Sagittarius serpentarius* (Secretarybird, VU), *Tyto capensis* (African grass owl, VU) and *Phoenicopterus ruber* (Greater flamingo, NT) may occur in the southern portions of the MRA, in association with the larger pans.

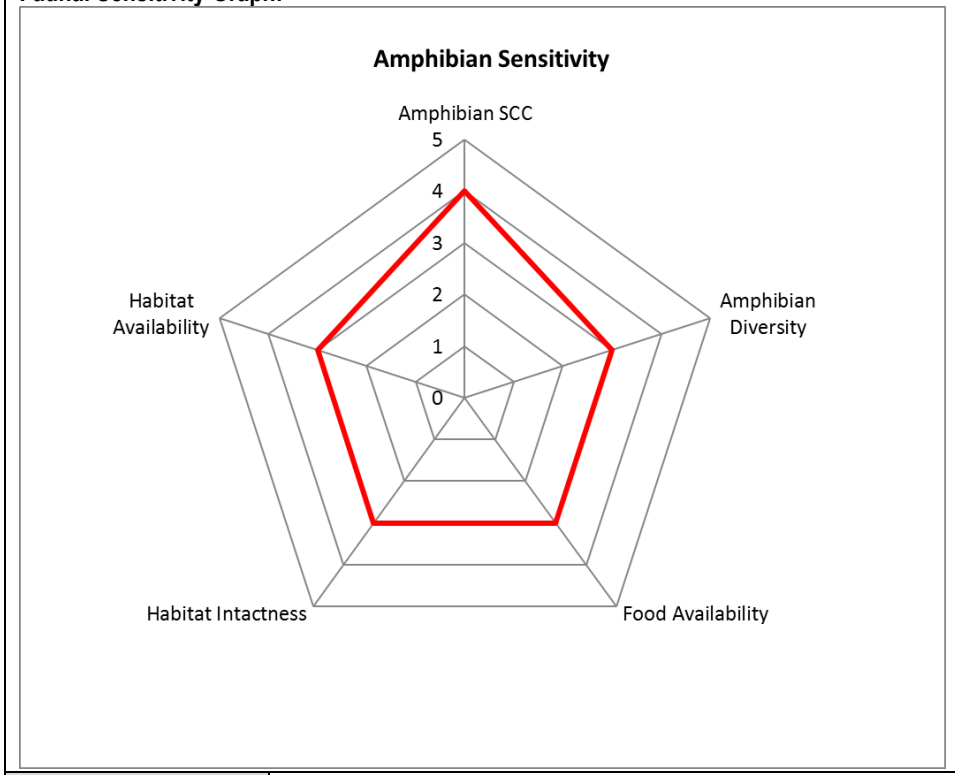
Photograph:

Faunal Diversity	Avifaunal diversity within the MRA area is considered to be intermediate, with a large majority of the species observed considered common and widespread.	**General comments (dominant faunal species/noteworthy records etc.):** The MRA areas avifaunal diversity was locally congregated around the wetland areas and the housing infrastructure. This is mainly attributable to the increase of food and water resources in these areas as well as roosting and nesting sites.	**Business Case, Conclusion and Mitigation Requirements:** The avifaunal habitat sensitivity for the MRA area is considered to be intermediate. Past farming activities, current grazing pressures and veld mismanagement has resulted in decreased habitat suitability of avifaunal species as well as SCC. The wetland habitat unit however is still considered important for avifaunal species and as such mining activities should not encroach upon this habitat unit.
Food Availability	The food provision capability of the MRA area is considered to be intermediate. The wetland and disturbed grassland habitat units are considered to be the most important habitats for avifaunal food resources.		
Habitat Integrity	Habitat integrity is considered to be intermediate. Anthropogenic and farming activities have lowered the overall habitat integrity of the MRA area.		
Habitat Availability	The wetlands and to a degree the surrounding disturbed grassland provided the most suitable habitat for avifaunal species within the MRA area. The rocky grassland and the remaining areas of the MRA area are utilised to an extent for foraging. Some of the dense tree stands (alien trees) surrounding the farm houses within the MRA area are used for nesting by species such as *Bostrychia hagedash* (Hadeda Ibis) and *Streptopelia capicola* (Cape Turtle Dove).		

3.4 Amphibians

Faunal Class: Amphibians	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: Top Representative image of the applicable amphibian habitat within the MRA area. **Bottom**-possible tadpoles of *Pyxicephalus adspersus* (Giant Bullfrog)	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	Only one amphibian SCC is expected to occur within the MRA area, namely *Pyxicephalus adspersus* (Giant Bullfrog, Vulnerable). Populations of this species are likely to occur around the wetland boundaries. Tadpoles of *Pyxicephalus adspersus* (Giant Bullfrog). were found in the large wetland in the southern portion of the MRA area.

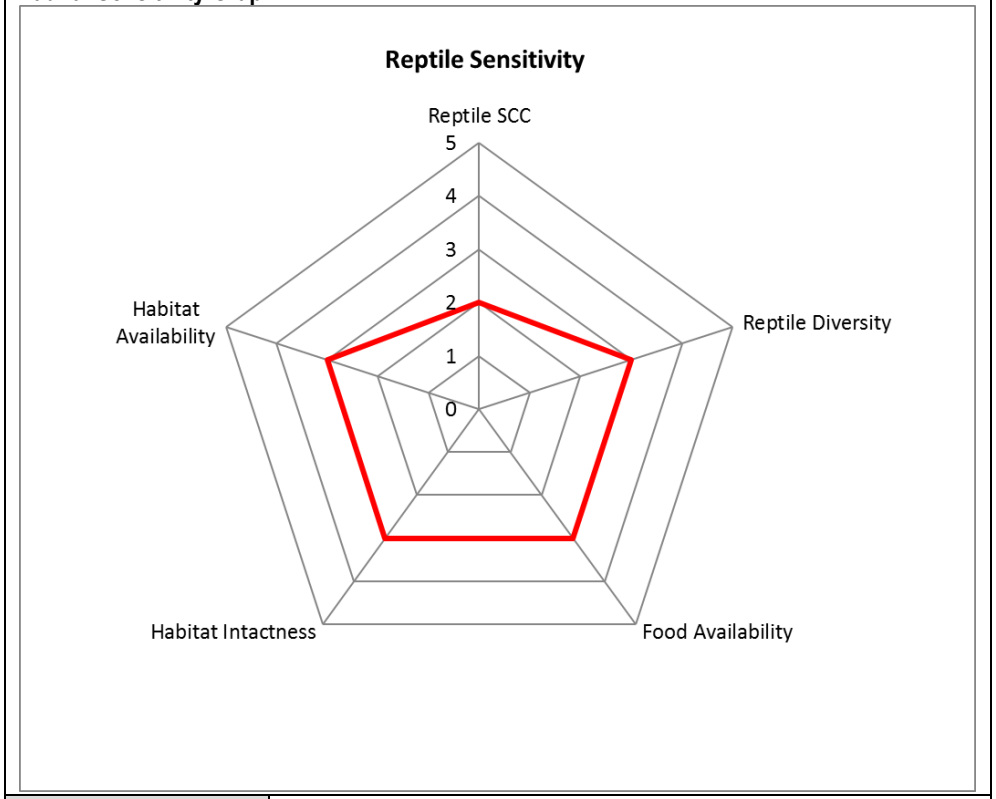
Photograph:

Faunal Diversity	Only the tadpoles of *Pyxicephalus adspersus* (Giant Bullfrog) were observed. No other species were observed during the time of the assessment due to the very thick vegetation cover within the wetland habitat unit as well as the cryptic nature of many amphibian species. No amphibians were heard vocalising; however, this cannot be used as a basis to exclude their likely occurrence. The wetlands and immediate surrounding grasslands are considered to be ideal habitat for amphibian species.	**General comments (dominant faunal species/noteworthy records etc.):** Amphibian populations are expected to be localised within the wetland and lower lying grassland areas surrounding the wetland habitat unit, where the soil moisture content was observed to be higher and where food resources were more accessible and abundant. Species that can be expected to occur within the MRA area include but are not limited to *Xenopus laevis, Amietophrynus gutturalis, Cacosternum boettgeri, Amietia angolensis*.	**Business Case, Conclusion and Mitigation Requirements:** The overall amphibian sensitivity for the MRA area is considered to be intermediate. The wetlands and immediately surrounding grasslands are ideal amphibian habitat, with known populations of *Pyxicephalus adspersus* (Giant Bullfrog) and as such edge effects need to be effectively managed so as to limit disturbances to these habitats, whilst retaining safe habitat connectivity paths between the wetland areas. Additionally, the preferred north road should be utilised so as to minimise the risk to *P. adspersus* which will likely move between the various wetlands.
Food Availability	The wetland and surrounding grasslands are capable of supporting suitable food resources in the form of invertebrates.		
Habitat Integrity	Amphibian habitat integrity is considered to be intermediate. The wetland and surrounding grassland however are relatively isolated in terms of amphibian movement, with the only other suitable amphibian habitat occurring approximately 500m south of the MRA area in the form of another large wetland. However, these two wetlands are separated not only by topography but also by old agricultural lands and a dirt road.		
Habitat Availability	The wetland provides suitable habitat for amphibian species that are more water dependant, whilst the grassland areas are suitable for amphibian species that are less water dependant. The south eastern section of the MRA area where the wetland habitat unit is located is expected to be a key location within the MRA area in terms of habitat provision.		

3.5 Reptiles

Faunal Class: Reptiles	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: Old farm buildings provide ideal habitat for a wide range of reptile species	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	No SCC were observed during the site assessment, nor are any expected to occur within the MRA area.

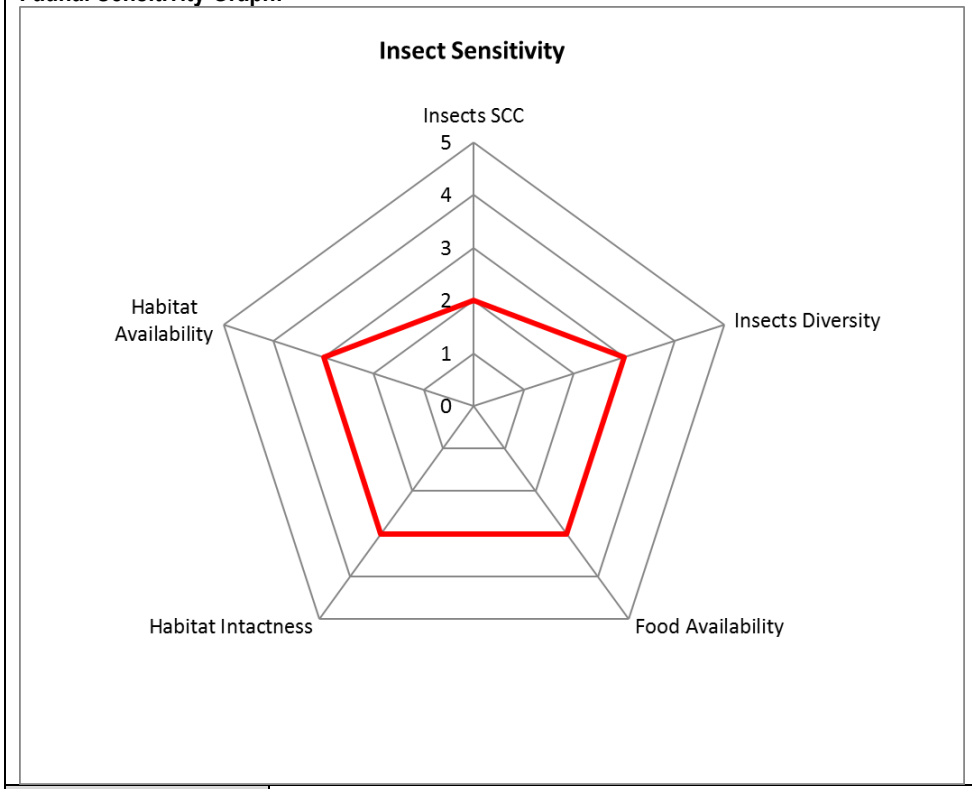
Photograph:

Faunal Diversity	A low reptile diversity was observed during the site assessment; however, this is likely attributable to the secretive nature of many reptile species and the unseasonably dry conditions experienced in the region during the assessment. It is likely that the MRA area will have an intermediate level of reptile diversity. A dead specimen of a *Naja mossambica* (Mozambique Spitting Cobra) was found near one of the houses in the south eastern portion of the MRA area. With the exception of the cobra only common skinks were observed around the MRA area, namely *Trachylepis punctatissima*.	**General comments (dominant faunal species/noteworthy records etc.):** Reptile species observed within the MRA area predominated around the existing infrastructure of farm houses and outbuildings. Reptiles are expected to concentrate around these areas as well as the wetland habitat unit as many of the food and water resources needed are found at these locations.	**Business Case, Conclusion and Mitigation Requirements:** The reptile habitat sensitivity for the MRA area is intermediate. Reptile species are expected to be relatively localised around the wetland areas, as well as current housing and farm infrastructures. The wetland habitat unit is expected to be a primary source of suitable food and water resources for many reptile species, and as such should be avoided. Further, it must be ensured that this habitat unit is not affected by edge effects as a result of mining activities within the MRA area.
Food Availability	Small mammals and amphibians within the MRA area will provide a suitable food resources for any predatory snakes, whilst small invertebrates are a suitable food resource for smaller reptiles.		
Habitat Integrity	Overall the habitat integrity of the MRA area was considered to be intermediate. Although there has been large scale habitat disturbance and transformation in areas, the overall ecological connectivity of the MRA area has not been severely affected, notably for reptile species.		
Habitat Availability	Much of the MRA area that would have been classified as natural reptile habitat has been disturbed and transformed, either through farming practices or the construction of houses and workshops. However, many reptiles are adept at adapting to new environments, notably snakes. Furthermore, outbuildings and sheds provide new suitable habitat areas for reptiles.		

3.6 Insects

Faunal Class: Insects	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: From top left to bottom: *Marasis rufolineatus* (Grass Stick Insect); *Palpares caffer* (Mottled Veld Antlion); *Spilostethus pandurus* (Milkweed Bug); *Myrmeleon* sp (Pit-building Antlions), *Junonia orithya* (Eyed Pansy)	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	No SCC were observed within the MRA area, however due to the presence of the wetland systems, there remains the possibility that the species *Metisella meninx* (Marsh Sylph) may occur in the wetland habitat.

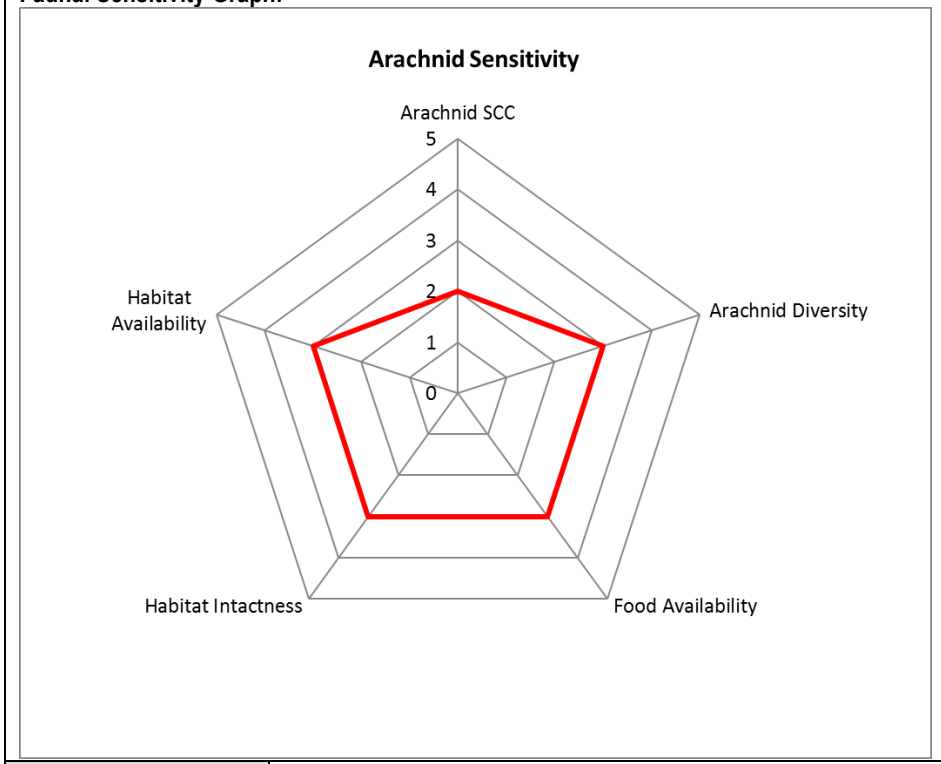
Photograph:

Faunal Diversity	Overall insect diversity of the MRA area is considered to be intermediate. The MRA appeared to be inhabited by a fairly large number of insects, however the diversity of species was not considered to be high. This may be attributed to the lower than normal rainfall, as well as later seasonal shifts. Species observed included *Belenois aurota* (Brown-veined White), *Junonia hierta* (Yellow Pansy), *Danaus chrysippus* (African Monarch) and *Pantala flavescens* (*Pantala flavescens*).	**General comments (dominant faunal species/noteworthy records etc.):** The wetlands and to a lesser extent the disturbed grassland, are considered important in terms of ongoing insect survival within the MRA area. A healthy and strong insect population is necessary to ensure a suitable and ongoing food resource for a number of other species, as well as the insects playing a vital role in terms of pollinating plant species.	**Business Case, Conclusion and Mitigation Requirements:** The insect habitat sensitivity is considered to be intermediate. The varying floral characteristics of the disturbed grasslands and wetlands provide a range of varying habitats for a variety of insect species. These species in turn are utilised as a food source by numerous other faunal species. As such, mining activities should not encroach upon the wetlands, and as far as possible impacts upon the disturbed grasslands should be minimised.
Food Availability	The grassland and wetland habitat units proved suitable habitat in terms of food provision for a number of insect species. The overall food availability for insects within the MRA area is considered to be intermediate.		
Habitat Integrity	Overall habitat integrity is considered to be intermediate, with much of the habitat units within the MRA area exhibiting a degree of connectivity.		
Habitat Availability	Both the wetlands and the disturbed grasslands provide suitable habitat to a number of insect species. The areas of decreased herbaceous layer, notably in the central areas of the rocky grassland had a decreased level of habitat provision for insect species.		

3.7 Arachnids

Faunal Class: Arachnids	Faunal Habitat Sensitivity	Intermediate
	Notes on Photograph: *Tibellus hollidayi* (Running Spiders) observed within the MRA area	

Faunal Sensitivity Graph:



Faunal SCC/Endemics/TOPS/	No arachnid SCC were observed within the MRA area, nor are any expected to occur due to anthropogenic activities.

Photograph:

Faunal Diversity	A small number of arachnid species were observed that are known to be commonly occurring in grassland areas. A combination of habitat disturbance, general secretive nature and small size often betrays the true diversity of arachnid species as they are not easily observed. The habitat and suitable insect population allows for the inference that the MRA is likely to have a healthy although probably not highly diverse arachnid population.	**General comments (dominant faunal species/noteworthy records etc.):** Anthropogenic activities and past farming, specifically ploughing activities has resulted in an altered arachnid species composition within the MRA area. However, there still appears to be a number of arachnid species present within the MRA area, which is to be expected due to suitable food resources for arachnid species being present. Although no scorpions were observed during the time of the assessment, it is likely that commonly occurring species, notably those that are known to occur around human habitation and disturbed habitats, will occur within the MRA area. Scorpion species expected to occur within the various habitats of the MRA area include *Pseudolychas pegleri* (Plain Pygmy-thicktail) and *Uroplectes triangulifer* (Highveld Lesser-thicktail).	**Business Case, Conclusion and Mitigation Requirements:** Arachnid habitat sensitivity is considered to be intermediate. The rocky areas within the grasslands and grassland surrounding the wetlands are of importance as these areas are considered to have an increased potential for the occurrence of arachnid species. Mining of the wetland areas should be avoided, whilst the overall footprint of the mine should be kept as small as possible in order to minimise the impacts on arachnid species.
Food Availability	The relatively high number of insects within the MRA area provide a suitable food source for many of the arachnid species.		
Habitat Integrity	Habitat integrity is considered to be intermediate as a result of habitat disturbance within the MRA area. There was very little variation in species observed throughout the MRA area, with all the habitat units appearing to be inhabited by similar species.		
Habitat Availability	The MRA area is considered to have an intermediate level of habitat availability for arachnid species. The MRA area provides habitat for different arachnid species, both web building and ground hunting spiders, as well as terrestrial based scorpions.		

3.8 Faunal Species of Conservational Concern Assessment

During field assessments it is not always feasible to identify or observe all species within the MRA area, largely due to the secretive nature of many faunal species, possible low population numbers or varying habits of species. As such, and to specifically assess an area for faunal SCC, a Probability of Occurrence (POC) matrix is used, utilising a number of factors to determine the probability of faunal SCC occurrence within the MRA area. Species listed in Appendix B whose known distribution ranges and habitat preferences include the MRA area were taken into consideration. The species listed below are considered to have a probability of occurring within the MRA area.

Scientific Name	Common Name	POC
Geronticus calvus	Bald Ibis	High
Pyxicephalus adspersus	Giant Bullfrog	Confirmed
Sagittarius serpentarius	Secretarybird	Medium
Tyto capensis	African grass owl	High
Phoenicopterus ruber	Greater flamingo	Medium
Metisella meninx	Marsh Sylph	High

From the above list of species, it is evident that the MRA area has the potential to provide habitat to a number number of faunal SCC. *Pyxicephalus adspersus* (Giant Bullfrog) is under threat as a result of habitat loss, namely wetlands and moist grassland. Further, in some areas of distribution *P. adspersus* is utilised as a food source, however this utilisation is not sustainable. Additionally, *P. adspersus* is at risk of vehicle related mortalities during the breeding seasons and following heavy rains, when individuals move between the wetlands in search of breeding partners and suitable breeding habitat. Likewise, *Metisella meninx* (Marsh Sylph) is known to breed and inhabit the wetland systems within Mpumalanga. This species largest threat is that of the loss and degradation of wetland ecosystems in the region. Although no individuals were found, it remains a possibility that this species may still occur within the MRA area. *Geronticus calvus* (Bald Ibis) is being faced with similar threats of natural habitat loss, however grazing activities that create short grasslands have proven to be favourable to this species. Although the MRA area provides no suitable breeding sites for *G. calvus*, it is considered suitable for foraging purposes. *Sagittarius serpentarius*, *Tyto capensis* and *Phoenicopterus ruber* are likely to occur within the MRA, but be localised around the southern pan systems, away from areas of increased anthropogenic activities. Additionally, these areas provide the most favourable habitat for these species, including potential breeding habitats. These avifaunal species are unlikely to venture into nor use the northern sections of the MRA due to unfavourable habitat and insufficient food resources.

4 SENSITIVITY MAPPING

The figure below conceptually illustrates the areas considered to be of increased faunal ecological sensitivity. The areas are depicted according to their sensitivity in terms of the presence or potential for faunal SCC, habitat integrity, levels of disturbance and overall levels of diversity. The table below presents the sensitivity of each area along with an associated conservation objective and implications for development.

Table 1: A summary of the sensitivity of each habitat unit and implications for development.

Sensitivity	Habitat Unit	Conservation Objective	Development Implications
Moderately High	Wetland	Preserve and enhance the biodiversity of the habitat unit, limit development and disturbance.	Any new development in this habitat unit is discouraged and may lead to denied environmental authorisation by authorities.
Intermediate	Rocky Grassland	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	Although mining development in this area is unlikely to have a significant impact on the receiving environment, faunal SCC and common faunal species will be impacted upon as a result of the loss of foraging areas
Intermediate	Disturbed Grassland	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.	Although mining development in this area is unlikely to have a significant impact on the receiving environment, faunal SCC and common faunal species will be impacted upon as a result of the loss of foraging areas
Low	Agricultural Lands	Optimise development potential.	Activities within this habitat unit must be optimised and limited to as small a footprint as possible. Care must be taken to limit edge effects on the surrounding natural areas.

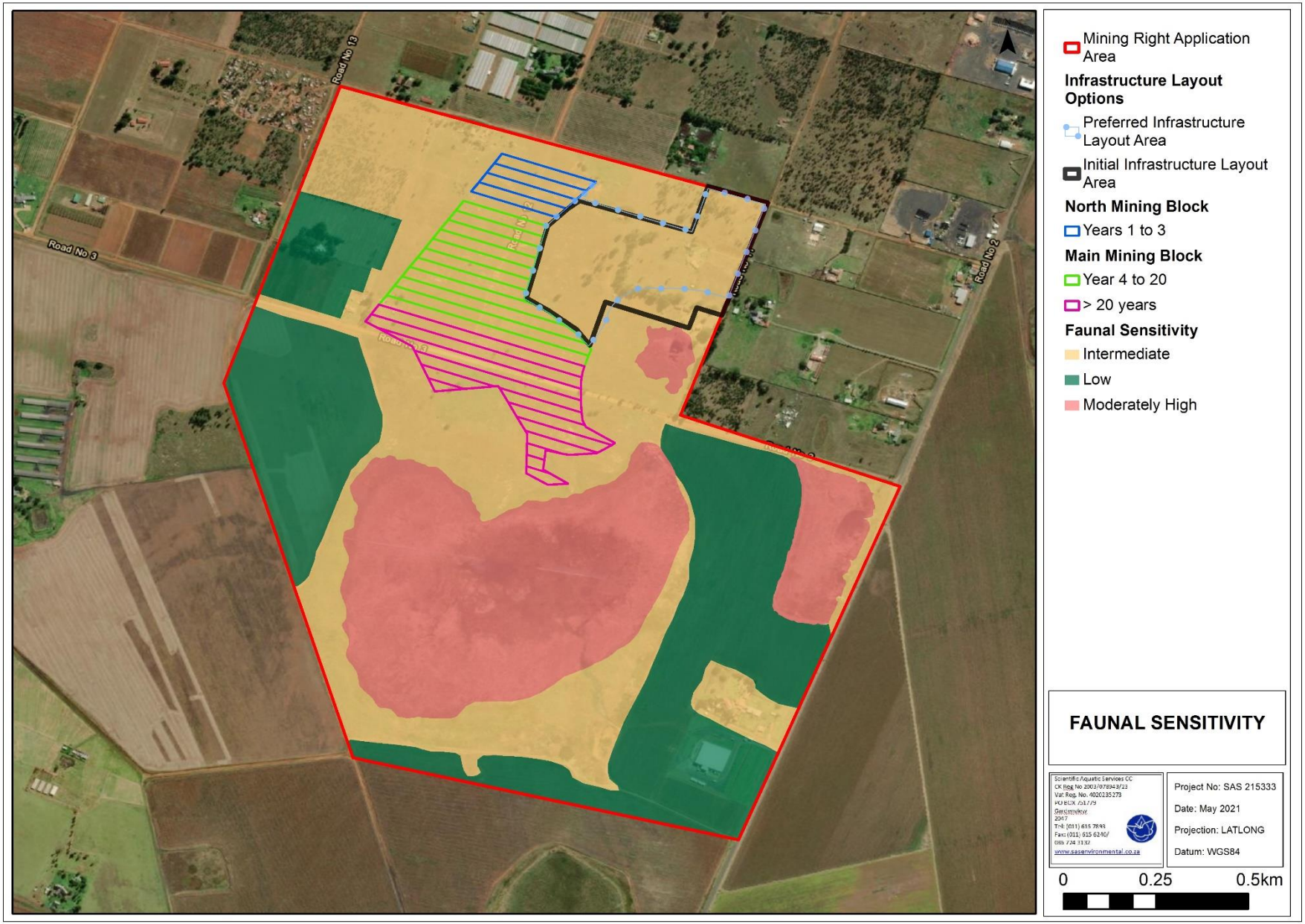


Figure 3: Sensitivity map for the MRA area

5 CONCLUSION

The findings of the field assessment indicate that the habitat associated with the MRA area is mostly of intermediate sensitivity, with the exception being that of the Wetland Habitat, which is considered to be moderately high. The overall disturbance of the MRA area is considered to be moderately high, notably as a result of past and current farming practices, as well as grazing by local herds of cattle. The MRA area provides habitat to a number of common faunal species. Additionally, the wetland systems have the potential to provide habitat to a higher number of species as well as and increased potential for faunal SCC.

A number of potential risks to the receiving faunal environment as a result of the proposed mining operation have been identified which relate to faunal habitat integrity, faunal diversity and the impact on faunal SCC. These impacts have been assessed in detail in the impact assessment section (Section E), with mitigatory recommendations presented in line with the mitigation hierarchy. It is the opinion of the ecologists that this study provides the relevant information required in order to implement an Integrated Environmental Management (IEM) and to ensure that the best long-term decisions are made in terms of the ecological resources associated with the proposed pipeline in support of the principle of sustainable development.

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APPENDIX A - Faunal Method of Assessment

It is important to note that due to the nature and habits of fauna, varied stages of life cycles, seasonal and temporal fluctuations along with other external factors, it is unlikely that all faunal species will have been recorded during the site assessment. The presence of human habitation nearby the study area and the associated anthropogenic activities may have an impact on faunal behaviour and in turn the rate of observations. In order to increase overall observation time within the study area, as well as increasing the likelihood of observing shy and hesitant species, camera traps were strategically placed within the study area. Sherman traps were also used to increase the likelihood of capturing and observing small mammal species, notably small nocturnal mammals.

Mammals

Small mammals are unlikely to be directly observed in the field because of their nocturnal/crepuscular and cryptic nature. A simple and effective solution to this problem is to use Sherman traps. A Sherman trap is a small aluminium box with a spring-loaded door (Figure A). Once the animal is inside the trap, it steps on a small plate that causes the door to snap shut, thereby capturing the individual. In the event of capturing a small mammal during the night, the animal would be photographed and then set free unharmed early the following morning. Traps were baited with a universal mixture of oats, peanut butter, and fish paste.

Figure A: Sherman trap and bait used to capture and identify small mammal species.

Medium to large mammal species were recorded during the field assessment with the use of visual identification, spoor, call and dung. Specific attention was paid to mammal SCC as listed in the Mpumalanga DACE, 2003 report in conjunction with the IUCN, 2015.

Avifauna

The Southern African Bird Atlas Project 1 & 2 database (http://sabap2.adu.org.za/) was compared with the recent field survey of avifaunal species identified on the study area. Field surveys were undertaken utilising a pair of binoculars and bird call identification techniques were utilised during the assessment in order to accurately identify avifaunal species. Specific attention was given to avifaunal SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Reptiles

Reptiles were identified during the field survey. Suitable applicable habitat areas (rocky outcrops and fallen dead trees) were inspected and all reptiles encountered were identified. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which reptile species are likely to occur on the study area. Specific attention was given to reptile SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Amphibians

Identifying amphibian species is done by the use of direct visual identification along with call identification technique. Amphibian species flourish in and around wetland, riparian and moist grassland areas. It is unlikely that all amphibian species will have been recorded during the site assessment, due to their cryptic nature and habits, varied stages of life cycles and seasonal and temporal fluctuations within the environment. The data gathered during the assessment along with the habitat analysis provided an accurate indication of which amphibian species are likely to occur within the study area as well as the surrounding area. Specific attention was given to amphibian SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Invertebrates

Whilst conducting transects through the study area, all insect species visually observed were identified, and where possible photographs taken. Furthermore, at suitable and open sites within the study area sweep netting was conducted, and all the insects captured identified. Due to the terrain, and shallow/ rocky soil structure pitfall traps were not utilised during the site assessment.

It must be noted however that due to the cryptic nature and habits of insects, varied stages of life cycles and seasonal and temporal fluctuations within the environment, it is unlikely that all insect species will have been recorded during the site assessment period. Nevertheless, the data gathered during the assessment along with the habitat analysis provided an accurate indication of which species are likely to occur in the study area at the time of survey. Specific attention was given to insect SCC listed on a regional and national level, as well as those identified by the International Union for the Conservation of Nature (IUCN).

Arachnids

Suitable applicable habitat areas (rocky outcrops, sandy areas and fallen dead trees) where spiders and scorpions are likely to reside were searched. Rocks were overturned and inspected for signs of these species. Specific attention was paid to searching for Mygalomorphae arachnids (Trapdoor and Baboon spiders) as well as potential SCC scorpions within the study area.

Faunal Species of Conservational Concern Assessment

The Probability of Occurrence (POC) for each faunal SCC is described:

- "**Confirmed'**: if observed during the survey;
- "**High**": if within the species' known distribution range and suitable habitat is available;
- "**Medium**": if either within the known distribution range of the species or if suitable habitat is present; or
- "**Low**": if the habitat is not suitable and falls outside the distribution range of the species.

The accuracy of the POC is based on the available knowledge about the species in question, with many of the species lacking in-depth habitat research.

Faunal Habitat Sensitivity

The sensitivity of the study area for each faunal class (i.e. mammals, birds, reptiles, amphibians and invertebrates) was determined by calculating the mean of five different parameters which influence each faunal class and provide an indication of the overall faunal ecological integrity, importance and sensitivity of the study area for each class. Each of the following parameters are subjectively rated on a scale of 1 to 5 (1 = lowest and 5 = highest):

- Faunal SCC: The confirmed presence or potential for faunal SCC or any other significant species, such as endemics, to occur within the habitat unit;
- Habitat Availability: The presence of suitable habitat for each class;
- Food Availability: The availability of food within the study area for each faunal class;

- Faunal Diversity: The recorded faunal diversity compared to a suitable reference condition such as surrounding natural areas or available faunal databases; and
- Habitat Integrity: The degree to which the habitat is transformed based on observed disturbances which may affect habitat integrity.

Each of these values contribute equally to the mean score, which determines the suitability and sensitivity of the study area for each faunal class. A conservation and land-use objective is also assigned to each sensitivity class which aims to guide the responsible and sustainable utilization of the study area in relation to each faunal class. The different classes and land-use objectives are presented in the table below:

Table 1: Faunal habitat sensitivity rankings and associated land-use objectives.

Score	Rating significance	Conservation objective
1> and <2	Low	Optimise development potential.
2> and <3	Moderately low	Optimise development potential while improving biodiversity integrity of surrounding natural habitat and managing edge effects.
3> and <4	Intermediate	Preserve and enhance biodiversity of the habitat unit and surrounds while optimising development potential.
4> and <5	Moderately high	Preserve and enhance the biodiversity of the habitat unit, l development and disturbance.
5	High	Preserve and enhance the biodiversity of the habitat unit, no-go alternative must be considered.

APPENDIX B - Faunal Species of Conservation Concern

Threatened mammal species that occur in the Mpumalanga Province (MP DACE, 2003).

English Name	Species	MP 2003 Status	IUCN Status
Cape mole rat	*Georychus capensis*	EN	LC
Sclater's golden mole	*Chlorotalpa sclateri montana*	CR	LC
Highveld golden mole	*Amblysomus septentrionalis*	VU	NT
Rough-haired golden mole	*Chrysospalax villosus rufopallidus*	CR	VU
Rough-haired golden mole	*Chrysospalax villosus rufus*	EN	VU
Juliana's golden mole	*Neamblysomus julianae*	EN	VU
Robust golden mole	*Amblysomus robustus*	VU	VU
Meester's golden mole	*Amblysomus hottentotus meesteri*	VU	NYBA
Laminate vlei rat	*Otomys laminatus*	VU	LC
Peak-saddle horseshoe bat	*Rhinolophus blasii empusa*	EN	LC
Lesser long-fingered bat	*Miniopterus fraterculus*	VU	LC
Welwitsch's hairy bat	*Myotis welwitschii*	EN	LC
Short-eared trident bat	*Cloeotis percivali australis*	EN	LC
Aardvark	*Orycteropus afer*	NE	LC
Oribi	*Ourebia ourebi*	VU	LC
African striped weasel	*Poecilogale albinucha*	NE	LC
Wild dog	*Lycaon pictus*	EN	EN
Pangolin	*Manis temminckii*	VU	LC
Aardwolf	*Proteles cristatus*	NE	LC
African Leopard	*Panthera pardus*	NE	NT
Natal red rock rabbit	*Pronolagus crassicaudatus ruddi*	NE	NYBA

EN = Endangered, CR = Critically Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, NYBA = Not yet been assessed

Threatened avifaunal species that occur in the Mpumalanga Province (MP DACE, 2003).

English Name	Species	Status	IUCN Status
Whitewinged Flufftail	*Sarothrura ayresi*	CR	CR
Rudd's Lark	*Heteromirafra ruddi*	CR	VU
Yellow-breasted Pipit	*Anthus chloris*	VU	VU
Bald Ibis	*Geronticus calvus*	VU	VU
Botha's Lark	*Spizocorys fringillaris*	EN	EN
Wattled Crane	*Bugeranus carunculatus*	CR	VU
Blue Crane	*Anthropoides paradiseus*	VU	VU
Grey Crowned Crane	*Balearica regulorum,*	VU	EN
Blue Swallow	*Hirundo atrocaerulea*	CR	VU
Pinkthroated Twinspot	*Hypargos margaritatus*	NT	LC
Chestnutbanded Plover	*Charadrius pallidus*	NT	NT
Striped Flufftail	*Sarothrura affinis*	VU	LC
Southern Ground Hornbill	*Bucorvus leadbeateri*	VU	VU
Black-rumped Buttonquail	*Turnix nanus*	EN	LC
Blue Korhaan	*Eupodotis caerulescens*	VU	NT
Stanley's Bustard	*Neotis denhami*	VU	NT
African Marsh Harrier	*Circus ranivorus*	VU	LC
Grass Owl	*Tyto capensis*	VU	LC
Whitebellied Korhaan	*Eupodotis cafra/ E. senegalensis*	VU	LC
Saddlebilled Stork	*Ephippiorhynchus senegalensis*	CR	LC

English Name	Species	Status	IUCN Status
Lappetfaced Vulture	*Torgos tracheliotos*	EN	VU
Whiteheaded Vulture	*Trigonoceps occipitalis*	EN	VU
Bateleur	*Terathopius ecaudatus*	VU	NT
Cape Vulture	*Gyps coprotheres*	VU	VU
Martial Eagle	*Polemaetus bellicosus*	VU	VU
Peregrine Falcon	*Falco peregrinus*	VU	LC
Taita Falcon	*Falco fasciinucha*	NT	NT

EN = Endangered, CR = Critically Endangered, VU = Vulnerable, NT = Near Threatened, LC = Least Concern, NYBA = Not yet been assessed

Reptile species that are priorities in Mpumalanga Province (MP DACE, 2003).

English Name	Species	Status	IUCN Status
Haacke's flat gecko	*Afroedura haackei*	EN	NYBA
Abel Erasmus Pass flat gecko	*Afroedura sp.*	EN	NYBA
Mariepskop flat gecko	*Afroedura sp.*	EN	NYBA
Rondavels flat gecko	*Afroedura sp.*	EN	NYBA
Natal purple glossed snake	*Amblyodipsas concolor*	VU	LC
Lowveld shieldnosed snake	*Aspidelaps scutatus intermedius*	VU	NYBA
Wolkberg Dwarf chameleon	*Bradypodion transvaalense* complex	VU	LC
Sungazer/ Giant girdled lizard	*Cordylus giganteus*	VU	VU
Barberton girdled lizard	*Cordylus warren barbertonensis*	VU	NYBA
Lebombo girdled lizard	*Cordylus warreni*	VU	NYBA
Swazi rock snake	*Lamprophis swazicus*	VU	NT
Transvaal flat lizard	*Platysaurus orientalis*	NT	NYBA
Wilhelm's flat lizard	*Platysaurus wilhelmi*	VU	NYBA
Montane burrowing skink	*Scelotes mirus*	LC	NYBA
Breyer's longtailed seps	*Tetradactylus breyeri*	VU	VU

EN= Endangered, VU = Vulnerable, NT = Near threatened, LC = Least Concern, NYBA = Not yet been assessed

Threatened amphibian species that occur in the Mpumalanga Province (MP DACE, 2003).

English Name	Species	Status	IUCN Status
Karoo Toad	*Vandijkophrynus gariepensis*	VU	LC
Natal Ghost Frog	*Hadromophryne natalensis*	VU	LC
Spotted Shovel-Nosed Frog	*Hemisus guttatus*	VU	VU
Yellow Striped Reed Frog	*Hyperolius semidiscus*	VU	LC
Plain Stream Frog	*Strongylopus wageri*	VU	LC
Giant Bullfrog	*Pyxicephalus adspersus*	VU	LC
Greater Leaf-Folding Frog	*Afrixalus fornasinii*	VU	NYBA
Whistling Rain Frog	*Breviceps sopranus*	VU	LC

VU = Vulnerable, LC = Least Concern, NYBA = Not yet been assessed

Threatened invertebrate species that occur in the Mpumalanga Province (MP DACE, 2003).

English Name	Species	Status	IUCN Status
Rossouw's Copper	*Aloeides rossouwi*	EN	VU
Barbara's Copper	*Aloeides barbarae*	EN	NYBA
Swanepoel's Blue	*Lepidochrysops swanepoeli*	EN	VU
Jeffery's Blue	*Lepidochrysops jefferyi*	EN	VU
Stoffberg Widow	*Dingana fraterna*	EN	NYBA
Marsh Sylph	*Metisella meninx*	VU	NYBA

English Name	Species	Status	IUCN Status
Cloud Copper	*Aloeides nubilus*	VU	EN
Catshead Sprite - Coenagrionidae	*Pseudagrion coeleste*	CR	LC
Balinsky's Sprite - Coenagrionidae	*Pseudagrion inopinatum*	VU	EN
Newton's Sprite - Coenagrionidae	*Pseudagrion newtoni*	VU	VU
Sjostedt's Sprite - Coenagrionidae	*Pseudagrion sjoestedti pseudojoestedti*	CR	NYBA
Elliot's Hawker-Aeshnidae	*Aeshna ellioti usambarica*	VU	NYBA
Unicorn Cruiser - Corduliidae	*Phyllomacromia monoceros*	CR	LC

EN = Endangered, VU = Vulnerable, NT = Near threatened, NYBA = Not yet been assessed

South African Bird Atlas Project 2 list for quadrant 2628BA

Avifaunal Species for the pentads 2605_2835 within the QDS 2628BA

http://sabap2.birdmap.africa/coverage/pentad/2605_2835

APPENDIX C - Faunal Species Lists

Mammal species observed

Scientific name	Common Name	IUCN Red List Status
Sylvicapra grimmia	Common Duiker	LC
Potamochoerus porcus	Bushpig	LC
Canis mesomelas	Black-backed Jackal	LC
Hystrix africaeaustralis	Porcupine	LC
Lepus saxatilis	Scrub Hare	LC
Galerella sanguinea	Slender Mongoose	LC
Aethomys chrysophilus	Red Vlei Rat	LC

LC = Least Concern, NT = Near Threatened

Avifaunal species observed

Scientific name	Common Name	IUCN Red List Status
Streptopelia capicola	Cape turtle Dove	LC
Trachyphonus vaillantii	Crested Barbet	LC
Euplectes orix	Southern Red Bishop	LC
Pycnonotus tricolor	Dark-capped Bulbul	LC
Asio capensis	Marsh Owl	LC
Crithagra atrogularis	Black-throated Canary	LC
Streptopelia senegalensis	Laughing Dove	LC
Cisticola juncidis	Zitting Cisticola	LC
Bubulcus ibis	Cattle Egret	LC
Lanius collaris	Southern Fiscal Shrike	LC
Crithagra atrogularis	Red-knobbed Coot	LC
Bostrychia hagedash	Hadeda Ibis	LC
Elanus caeruleus	Black-winged Kite	LC
Milvus aegyptius	Yellow-billed Kite	LC
Mirafra africana	Rufous-naped Lark	LC
Anthus cinnamomeus	African Pipit	LC
Cisticola fulvicapilla	Neddicky	LC
Passer domesticus	House Sparrow	LC
Coturnix	Common Quail	LC
Cossypha caffra	Cape Robin Chat	LC
Streptopelia semitorquata	Red-eyed Dove	LC
Numida meleagris	Helmeted Guineafowl	LC
Pternistis swainsonii	Swainson's Spurfowl	LC
Motacilla capensis	Cape Wagtail	LC
Estrilda astrild	Common Waxbill	LC
Euplectes progne	Long-tailed Widowbird	LC
Ardea cinerea	Grey Heron	LC
Threskiornis aethiopicus	Sacred Ibis	LC
Vanellus armatus	Blacksmith Lapwing	LC
Vanellus coronatus	Crowned Lapwing	LC

Scientific name	Common Name	IUCN Red List Status
Acridotheres tristis	Common Myna	LC
Quelea	Red-billed Quelea	LC
Passer melanurus	Cape Sparrow	LC
Lamprotornis nitens	Cape Glossy Starling	LC
Motacilla capensis	Cape Wagtail	LC
Oenanthe pileata	Capped Wheatear	LC

LC = Least concerned. NT = Near Threatened, NYBA = Not yet been assessed by the IUCN.

Amphibian species observed

Scientific name	Common Name	Mpumalanga Status
Pyxicephalus adspersus	(Giant Bullfrog)	VU

LC = Least concerned. NT = Near Threatened, VU = Vulnerable, NYBA = Not yet been assessed by the IUCN.

Reptile species observed

Scientific name	Common Name	IUCN Red List Status
Naja mossambica	Mozambique Spitting Cobra	LC
Trachylepis varia	Variable Skink	NYBA
Hemachatus haemachatus	Rinkhlas	LC

LC = Least Concerned, NYBA = Not yet been assessed by the IUCN.

Insect species observed

Scientific Name	Common Name	IUCN 2015 Status
Belenois aurota	Brown-veined White	NYBA
Eurema brigitta	Broad-bordered Grass Yellow	NYBA
Pontia helice	Meadow White	NYBA
Maransis rufolineatus	Grass Stick Insect	NYBA
Junonia hierta	Yellow Pansy	LC
Danaus chrysippus	African Monarch	NYBA
Junonia orithya	Eyed Pansy	LC
Papilio demodocus	Citrus Swallowtail	NYBA
Palpares caffer	Mottled Veld Antlion	NYBA
Cyligramma latona	Cream-striped Owl	NYBA
Acanthacris ruficornis	Garden Locust	NYBA
Orthoctha dasycnemis	N/A	NYBA
Truxaloides sp	N/A	NYBA
Oedaleus sp	N/A	NYBA
Spilostethus pandurus	Milkweed Bug	NYBA
Pantala flavescens	Wandering Glider	LC
Trithemis arteriosa	Red-veined Dropwing	LC
Myrmeleon sp	Pit-building Antlions	NYBA
Decapotoma lunata	Lunate Blister Beetle	NYBA
Mylabris oculata	CMR Bean Beetle	NYBA
Ammophila ferrugineipes	Thread-waisted Wasp	NYBA
Apis mellifera	Honey Bee	NYBA

NYBA = Not Yet Been Assessed, LC = Least Concern

Arachnid species observed

Scientific name	Common Name	IUCN Red List Status
Tibellus hollidayi	Running Spiders	NYBA

NYBA = Not Yet Been Assessed, LC = Least Concern

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FAUNAL, FLORAL, FRESHWATER AND SURFACE WATER QUALITY ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETKOL MINING OPERATION NEAR DELMAS WITHIN THE MPUMALANGA PROVINCE.

Prepared for

Jacana Environmental CC

April 2018 (Revised June 2021)

Section D: Freshwater Ecosystem Assessment

Prepared by: **Scientific Aquatic Services CC**
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Report Reference: **SAS 215333**
Date: **April 2018 (Revised June 2021)**

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GLOSSARY OF TERMS

Alien vegetation:	Plants that do not occur naturally within the area but have been introduced either intentionally or unintentionally. Vegetation species that originate from outside of the borders of the biome -usually international in origin.
Biodiversity:	The number and variety of living organisms on earth, the millions of plants, animals and micro-organisms, the genes they contain, the evolutionary history and potential they encompass and the ecosystems, ecological processes and landscape of which they are integral parts.
Buffer:	A strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area.
Catchment:	The area where water is collected by the natural landscape, where all rain and run-off water ultimately flows into a river, wetland, lake, and ocean or contributes to the groundwater system.
Delineation (of a wetland):	To determine the boundary of a wetland based on soil, vegetation and/or hydrological indicators.
Ecoregion:	An ecoregion is a "recurring pattern of ecosystems associated with characteristic combinations of soil and landform that characterise that region".
Facultative species:	Species usually found in wetlands (76%-99% of occurrences) but occasionally found in non-wetland areas
Fluvial:	Resulting from water movement.
Gleying:	A soil process resulting from prolonged soil saturation which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix.
Groundwater:	Subsurface water in the saturated zone below the water table.
Hydromorphic soil:	A soil that in its undrained condition is saturated or flooded long enough to develop anaerobic conditions favouring the growth and regeneration of hydrophytic vegetation (vegetation adapted to living in anaerobic soil).
Hydrology:	The study of the occurrence, distribution and movement of water over, on and under the land surface.
Hydrophyte:	Any plant that grows in water or on a substratum that is at least periodically deficient of oxygen as a result of soil saturation or flooding; plants typically found in wet habitats.
Indigenous vegetation:	Vegetation occurring naturally within a defined area.
Mottles:	Soil with variegated colour patterns are described as being mottled, with the "background colour" referred to as the matrix and the spots or blotches of colour referred to as mottles.
Obligate species:	Species almost always found in wetlands (>99% of occurrences).
Perched water table:	The upper limit of a zone of saturation that is perched on an unsaturated zone by an impermeable layer, hence separating it from the main body of groundwater
Perennial:	Flows all year round.
RAMSAR:	The Ramsar Convention (The Convention on Wetlands of International Importance, especially as Waterfowl Habitat) is an international treaty for the conservation and sustainable utilisation of wetlands, i.e., to stem the progressive encroachment on and loss of wetlands now and in the future, recognising the fundamental ecological functions of wetlands and their economic, cultural, scientific, and recreational value. It is named after the city of Ramsar in Iran, where the Convention was signed in 1971.
RDL (Red Data listed) species:	Organisms that fall into the Extinct in the Wild (EW), critically endangered (CR), Endangered (EN), Vulnerable (VU) categories of ecological status according to the International Union for Conservation of Nature (IUCN) Classification.
Seasonal zone of wetness:	The zone of a wetland that lies between the Temporary and Permanent zones and is characterised by saturation from three to ten months of the year, within 50 cm of the surface
Temporary zone of wetness:	the outer zone of a wetland characterised by saturation within 50 cm of the surface for less than three months of the year
Watercourse:	In terms of the definition contained within the National Water Act, a watercourse means: • A river or spring; • A natural channel which water flows regularly or intermittently; • A wetland, dam or lake into which, or from which, water flows; and • Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse; • and a reference to a watercourse includes, where relevant, its bed and banks
Wetland Vegetation (WetVeg) type:	Broad groupings of wetland vegetation, reflecting differences in regional context, such as geology, climate, and soil, which may in turn have an influence on the ecological characteristics and functioning of wetlands.

ACRONYMS

BAS	Best Attainable State
BGIS	Biodiversity Geographic Information Systems
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
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EI	Ecological Importance
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EPL	Ecosystem Protection Level
ES	Ecological Sensitivity
ESA	Ecological Support Area
ETS	Ecosystem Threat Status
FEPA	Freshwater Ecosystem Priority Areas
GA	General Authorisation
GIS	Geographic Information System
GN	Government Notice
GPS	Global Positioning System
HGM	Hydrogeomorphic
IAIA	International Association of Impact Assessors
IUCN	International Union for Conservation of Nature
IWUL	Integrated Water Use License
mm	Millimetre
m.a.m.s.l	Metres above mean sea level
MAP	Mean Annual Precipitation
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act
NEMBA	National Environmental Management: Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas
NWA	National Water Act
PES	Present Ecological State
REC	Recommended Ecological Category
RHP	River Health Program
RMO	Resource Management Objective
RQIS	Research Quality Information Services
SACNASP	South African Council for Natural Scientific Professions
SAIAB	South Africa Institute of Aquatic Biodiversity
SAIIAE	South Africa Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SAS	Scientific Aquatic Services
SASSO	South African Soil Surveyors Association
SQR	Sub quaternary catchment reach
subWMA	Sub-Water Management Area
WetVeg Groups	Wetland Vegetation Groups
WMA	Water Management Areas
WMS	Water Management System
WRC	Water Research Commission
WUA	Water Use Authorisation

1 INTRODUCTION

Scientific Aquatic Services (SAS) was appointed to conduct a faunal, floral, freshwater ecosystem and surface water quality ecological investigation as part of the environmental authorisation process for the proposed Rietkol Mining Operation (Rietkol Project), where mining of silica through opencast methods will occur. The proposed Rietkol Project is situated within Wards 8 and 9 of the Victor Khanye Local Municipality and the Nkangala District Municipality. The Mining Right Application (MRA) area is situated approximately 6 km west of the town of Delmas/ Botleng. The MRA area is further situated approximately 900 m southeast of the N12, 2.1 km southwest of the R50, and 2.7 km north of the R555. See Part A for detailed maps of the MRA.

The MRA area covers an area of 221 ha, and consists of the following farm portions:

- 16 Modder East Agricultural Holdings on the farm Olifantsfontein 196IR;
- Portion 71 of the farm Rietkol 237 IR; and
- A portion of the remaining extent of Portion 31 of the farm Rietkol 237 IR.

Silica is planned to be mined by means of conventional opencast methods to a depth of between 30 and 50 meters below surface (mbs). The proposed Rietkol Project estimated life of mine (LOM) is 20 years, although further exploration drilling to be conducted during the operational phase, may increase the LOM and the depth of mining if resources proof viable (Jacana, 2021: Final Scoping Report).

The following infrastructure is associated with the proposed project (Figure 1):

- Opencast pits;
- Processing plant (i.e. crushing, wash plant, screening etc.);
- Product Stockpiles;
- Administration office facilities (i.e. security building, administration and staff offices, reception area, ablution facilities, etc);
- Access Roads; and
- Clean and dirty water management infrastructure.

The infrastructure layout as proposed during the initial EIA phase for the proposed Rietkol mining operations near Delmas can be seen in Figure 1 below. The initial proposed infrastructure layout, hereafter referred to as the “Initial Infrastructure Layout” encroached into the buffer of a nearby wetland. The initial Rietkol application for Environmental Authorisation lapsed in 2020 due to administration issues within the Department of Mineral Resources (DMR). As such a new mining right and environmental authorisation application has been proposed. However, in the current application, the proposed infrastructure layout has been

moved north, creating a 100 m buffer between the proposed infrastructure and the wetland area to the south, hereafter referred to as the “preferred infrastructure layout”. This report has been updated to illustrate the impacts associated with the preferred infrastructure layout.

The purpose of this report is to define the baseline ecological function of the identified freshwater ecosystems within the proposed MRA area in order to guide the proposed mining activities and maintain the provision of ecological services, and to support local biodiversity conservation requirements. This assessment report was compiled in accordance with the requirements of the Environmental Impact Assessment (EIA) as required in terms of the National Water Act, 1998 (Act No. 36 of 1998), the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) (Act No. 28 of 2002), the National Environmental Management Act, 1998 (NEMA) (Act No. 107 of 1998) and other associated regulations.

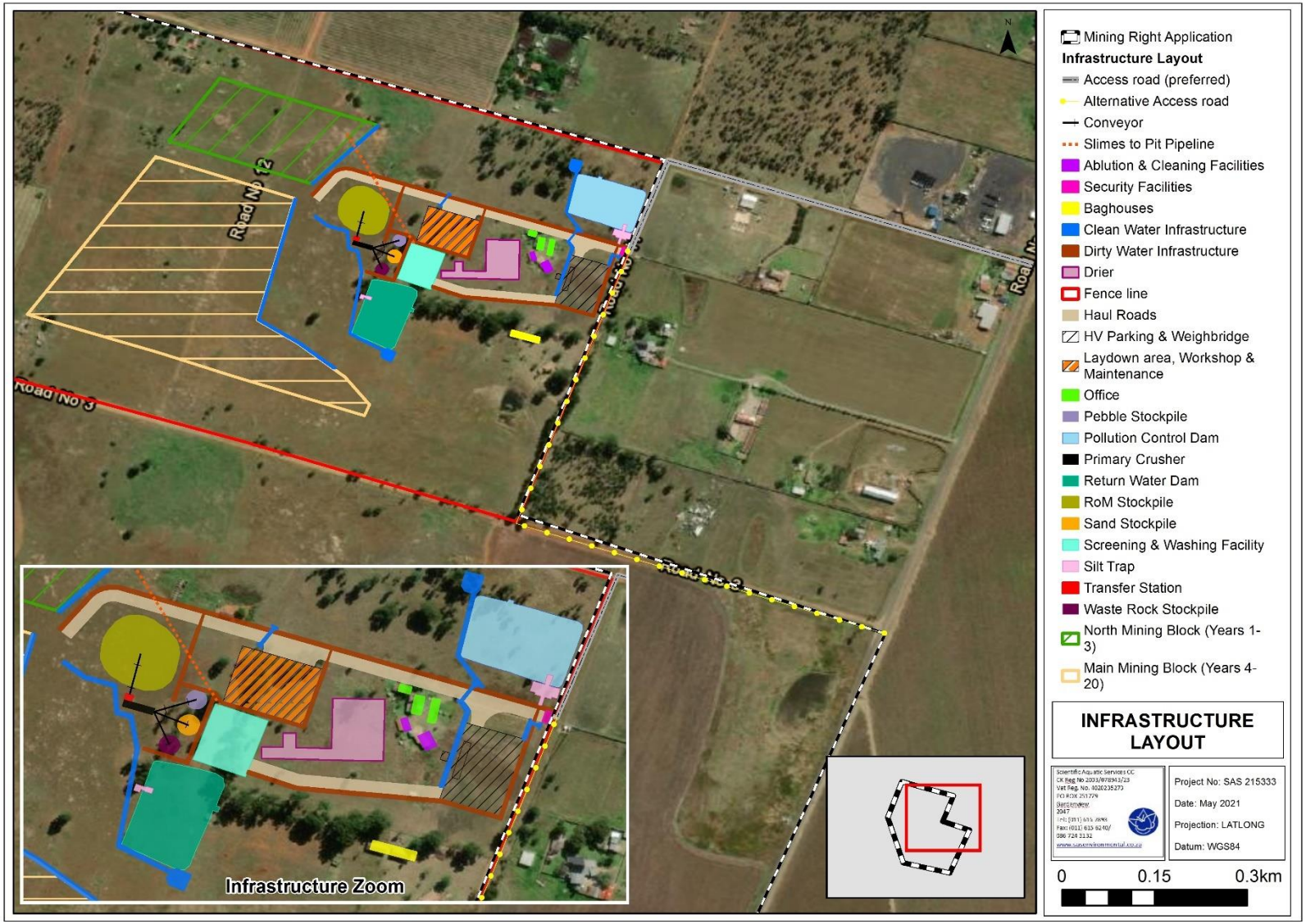


Figure 1: Proposed Infrastructure Layout associated with the MRA area.

1.1 Assumptions and Limitations

The indemnity specific terms of use of this report are discussed in detail under Appendix A. Furthermore; the following assumptions and limitations are applicable to this report:

- The freshwater ecosystem assessment was confined to the MRA area, however, adjacent neighbouring properties were considered as part of the desktop assessment;
- The freshwater ecosystem 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 freshwater ecosystem boundaries will need to be surveyed and pegged according to surveying principles;
- Limitations in the accuracy of the freshwater ecosystem delineation was experienced due to anthropogenic disturbances such as infilling, canalisation as well as extensive grazing and trampling are deemed possible;
- Wetlands and terrestrial zones create transitional areas where an ecotone is formed as vegetation species change from terrestrial to wetland species. Within this transition zone some variation of opinion on the wetland zone boundary may occur however if the Department of Water and Forestry (DWAF, 2008) method is followed, all assessors should get largely similar results; and
- With ecology being dynamic and complex, certain aspects (some of which may be important) may have been overlooked. It is, however, expected that the proposed development activities has been accurately assessed and considered, based on the field observations undertaken and the consideration of existing studies and monitoring data in terms of riparian and wetland ecology.

2 FRESHWATER ECOSYSTEM ASSESSMENT METHODOLOGY

2.1 Desktop Assessment

Prior to the commencement of the field assessment, a desktop literature review was conducted, which entailed review of existing aerial photographs, digital satellite imagery, as well as available provincial and national wetland databases in order to determine the ecoregion and eco-status of the larger aquatic system within which the MRA area is located (Please refer to Section A - Summary and Background Information).

2.2 In-situ Freshwater Ecosystem Delineation and Assessment

An initial wetland assessment was conducted during the summer season, comprising of two site visits undertaken on the 4th and 16th of February 2016 and a third site visit in January 2017. Subsequent to these, a fourth site visit was undertaken on the 24th of March of 2021. The freshwater ecosystems were classified according to the "Classification System for Wetlands and other Aquatic Ecosystems in South Africa" (Ollis *et al*., 2013) was adopted for the assessment of the identified wetland areas within the MRA area. The identified wetland features were delineated according to the method adopted from a "Practical Field Procedure for Identification and Delineation of Wetlands and Riparian Areas" published by the Department of Water Affairs and Forestry (DWAF[1]) in February 2005. An updated draft version of this report (DWAF, 2008) is also available and was therefore also considered during the delineation of the identified wetland features. The following characteristics were assessed to characterise the identified wetlands:

- The relative position on the landscape, which aids in identification of landscape positions where wetlands are most likely to occur;
- The presence of wetland vegetation species was used as a primary indicator, as the change in vegetation communities between terrestrial and wetland ecosystems is easily discernible;
- The presence of redoxymorphic soil features and soil saturation, which are morphological signatures that appear in soils with prolonged periods of saturation (i.e. soil types according to South African soil classification system); was used in conjunction with the vegetation indicator as a secondary indicator and
- The identified locations of wetland vegetation and soil types were marked by means of Global Positioning System (GPS), and a Geographic Information System (GIS) software was thereafter used to project these features onto aerial photographs and topographic maps to illustrate the delineated wetland boundaries and the associated buffer zones.

In addition to the delineation of the wetlands, a detailed assessment of the systems was undertaken in order to define the following important aspects of the wetland ecology (Refer to Appendix A for a detailed methodology):

- Wetland characterisation and classification was undertaken according to the method of Ollis *et al*. (2013);

[1] The Department of Water Affairs (DWA) is currently known as the Department of Water and Sanitation (DWS) and prior to being known as DWA, it was known as the Department of Water Affairs and Forestry (DWAF). For the purposes of referencing in this report, the name under which the Department was known during the time of publication of reference material, will be used.

- Wetland Present Ecological State (PES) definition according to either the Wetland IHI method or WET Health Ecostatus tool as applicable;
- Wetland Ecoservice provision by means of the application of the Wet Ecoservices Tool according to the method of McFarlane (2005); and
- Wetland Ecological Importance and Sensitivity (EIS) Assessment according to the method of DWAF (1999).

3 FRESHWATER ECOSYSTEM ASSESSMENT RESULTS

3.1 Wetland Characterisation

Three hydrogeomorphic (HGM) units were identified within the proposed Rietkol project MRA area, these were classified as depression (pan) and two seep wetlands. In addition, a wetland flat and another depression wetland was identified within the investigation area of the proposed MRA area. These wetlands relative to the proposed mining area and surface infrastructure is indicated in Figure 1.

The identified wetlands were classified as Inland systems falling within the Highveld Ecoregion and within the Mesic Highveld Grassland Group 4 wetland vegetation group, as presented in Table 1 below. Furthermore, additional system characterisation information is discussed in detail and included as part of the desktop assessment results in the accompanying Section A (Summary and Background Information) document of this project.

During the site assessment, it was noted that various land transformations have occurred throughout the MRA and the surrounding landscape. This has resulted in large alterations to the hydrological regime of some of the identified wetlands. Seep wetland 2 (discussed in further detail below) has been impounded throughout its extent (farm dams and an on-site impoundment within the wetland) which has altered the natural flow regime, pattern, and timing of water within the wetland. This has been exacerbated by infrastructure developments on the farm portions situated north of seep wetland 2, in which excavation activities to facilitate laydown of infrastructure have further altered flow regime, soil profiles and associated soil infiltration rates. As a result, soil identified was noted to be anthropogenically derived in various areas (anthrosols). Whilst it was noted that these anthrosols displayed some degree of saturation, indicators distinctly indicative of a fluctuating water table (such as mottles and gleying) could not be accurately discerned. As a result, it was the specialist opinion that the farm portions adjacent to the study area contained relic patches of wetland which have been severely altered due to the fragmentation and landscape transformation that has occurred.

These remnant patches, although displaying some attributes associated with wetlands, did not constitute wetland habitat as defined in the National Water Act, 1998 (Act No. 36 of 1998) and as such, were not included as part of the delineation or further assessment.

Table 1: SANBI Wetland Classification of the identified wetlands in the vicinity of the MRA area.

Level 1: System	Level 2: Regional Setting	Level 3: Landscape unit	Level 4: HGM unit
Inland: An ecosystem that has no existing connection to the ocean but which is inundated or saturated with water, either permanently or periodically.	**Ecoregion:** Highveld Ecoregion **NFEPA WetVeg Group:** Mesic Highveld Grassland Group 4	**Plain:** An extensive area of low relief, characterised by relatively level, gently undulating or uniformly sloping; with a very gentle (typically ≤ 1%) slope gradient.	**Seep:** A wetland area located on gently to steep sloping land and dominated by colluvial unidirectional movement of water and material downslope.
		Valley Floor: The typically gently sloping, lowest surface of a valley.	**Depression:** A wetland system with closed or near-closed elevation contours.

3.2 Wetland Vegetation

The wetland vegetation integrity is discussed in detail in Section B (Floral Assessment Report) and the wetland faunal component is discussed in Section C (Faunal Assessment Report) of the holistic study. The wetland habitat was observed to be modified in the seep wetlands with extensive modifications including artificial impounding of these features to enhance water collection for livestock and/or aesthetic purposes observed. The pan wetland (Pan 1) located within the southern portion of the MRA area was observed to be fairly intact, with moderate edge-effect modifications attributed to the adjacent cultivation activities and impounding on the western portion of the wetland.

Table 2: Dominant vegetation species identified during the delineation of the identified wetland features. Alien floral species are indicated with an asterisk (*).

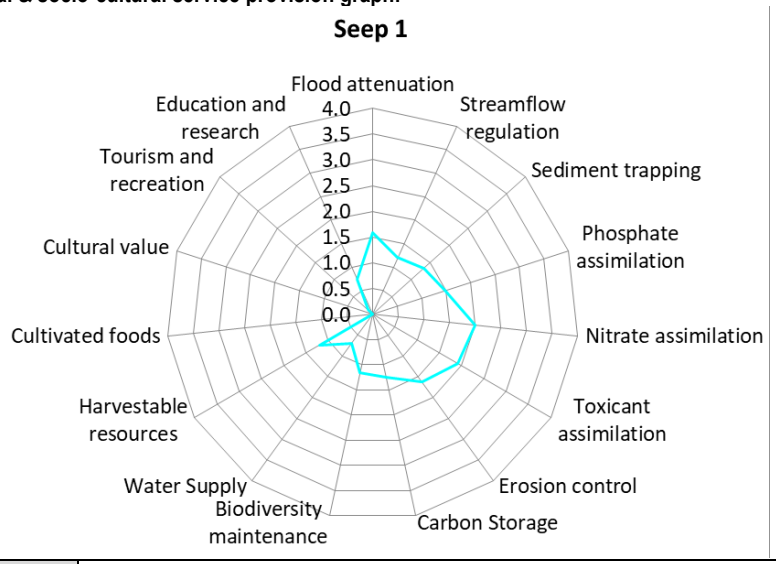
Terrestrial	Temporary Zone	Seasonal Zone	Permanent Zone
Commelina africana var. *krebsiana*	*Helichrysum kraussii*	*Eragrostis gummiflua*	*Imperata cylindrica*
Urochloa mossambicensis	*Nidorella anomala*	*Sporobulus africanus*	*Eleocharis dregeana*
Pennisetum clandestinum	**Seriphium plumosum*	*Pycreus mundtii*	
Digitaria eriantha	*Setaria sphacelata*	*Cyperus denudatus*	
Eragrostis curvula	**Cirsium vulgare*	*Hemarthria altissima*	
Hyperinia hirta	*Eragrostis gummiflua*	*Leersia hexandra*	
Aristida congesta	**Campuloclinium macrocephalum*	*Typha capensis*	
Melinis repens		*Kyllinga erecta*	
**Tagetes minuta*		*Berkaya radula*	
**Bidens pilosa*			
**Solanum pseudocapsicum*			
**Cirsium vulgare*			

3.3 Wetland Soil Classification

The identified soil types included the Pinedene (Pn) and Fernwood (Fw) soil forms associated with the seasonal and temporal zones of the seep wetlands, surrounded by well drained Clovelly (Cv) soil forms. Pan 1 on the other hand comprised of Willowbrook (Wo) soil form within the permanent zone, with distinct mottling observed on the topsoil (≤ 20 cm below ground surface) of shallow Mispah/Glenrosa (Ms/Gs) soil forms, associated with the seasonal and temporary zones.

Figure 2: Conceptual presentation of the delineated wetlands within the MRA area and the investigation area.

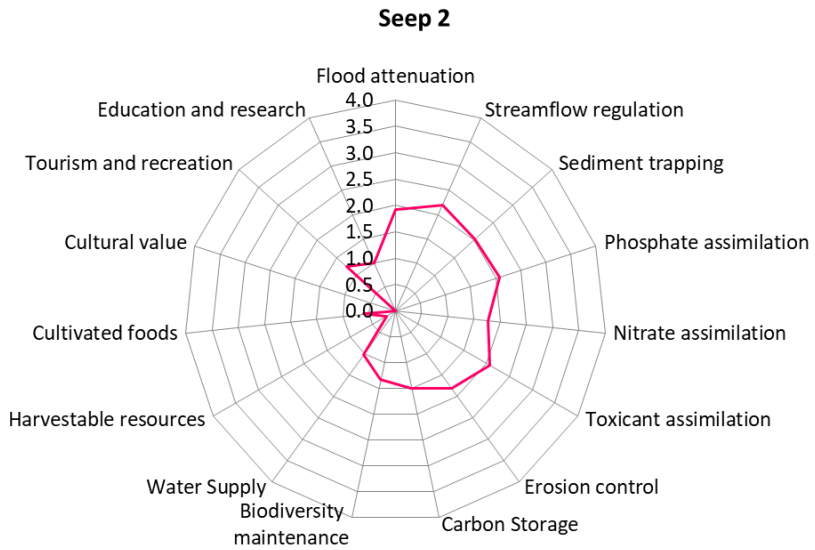
Table 3: Summary of results of the assessment of seep wetland 1.

<table>
<tr><td colspan="3">Freshwater ecosystem: Seep wetland 1 within MRA area</td><td colspan="4" rowspan="2"> 
</td></tr>
<tr><td colspan="3">Ecological & socio-cultural service provision graph:
 
</td></tr>
<tr><td>HGM Unit</td><td>Seep wetland 1 located within the north eastern portion of the MRA area</td><td>Fatal Flaw?</td><td>N</td><td>Photograph notes</td><td>Views seep wetland 1 and artificial impoundments within the wetland.</td></tr>
<tr><td>Ecoservices</td><td colspan="2">Moderately low: The seep provided a moderately low degree of ecological service provisioning with ecological services such as flood attenuation, streamflow regulation, sediment trapping, erosion control, carbon storage and the assimilation of phosphates, nitrates and toxicants the primary services supplied. The biodiversity maintenance of the seep was low owing to the frequent disturbance and alteration to the wetland over the years. The ability of the seep to supply socio-cultural services and direct human benefits was largely limited due to restricted access and degraded nature of the wetland.</td><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
The hydraulic regime of the seep has been largely affected by the impoundment which collects water, thus altering the wetland zonation and flow regime of the seep. The hydraulic regime has been further altered by the presence of an inlet pipe which contributes increased surface water into the seep It was inferred that seep wetland 1 is considered to be hydrologically isolated and not connected to other surface water resources, as inferred from the local micro-topography. As per the Hydropedological Assessment, the hillslope seeps within the MRA area are recharged by surface water from seasonal rainfall as well as via the interflow soils (SAS, 2018b). The soils are not driven significantly by groundwater. Surface water was observed at the time of assessment, and the hydrological regime seems to be significantly enhanced by the impoundment features within the wetlands.</td></tr>
<tr><td>PES</td><td colspan="2">PES Category: Largely Modified (D)
The seep wetland 1 is subject to various ongoing and historical impacts and is classified as largely modified. The hydrology of seep wetland 1 has been altered by an impoundment to enhance water collection for livestock and/or aesthetic purposes, thereby altering the natural wetland zonation and flow regime. The seep is considered likely to receive increased sediment as a result of the gently sloping gradient which contributes additional sediment runoff, thereby altering the geomorphology. The impoundment within the seep is also considered likely to have altered the natural movement of sediment within the seep. The seep was largely vegetated by hygrophilous</td><td colspan="4">b) Water quality
Sampling of water quality was undertaken within the impounded portion of seep wetland 1 at which surface water was present. In-situ parameters were measured including pH, temperature and Electrical Conductivity (EC). The pH of seep wetland 1 was 6.78 which is within the TWQR as per DWAF (1996). The temperature of surface water within seep wetland 2 was 19.5 ºC which was within the TWQR (DWAF, 1996) and noted to be largely natural for the time of day and season in which sampling took place. The EC of surface water within seep wetland 1 was 17 mS/m which was within the TWQR (≤ 75 mS/m) as per DWAF (1996). Overall, water quality of seep wetland 2 was considered natural at the time of sampling in March 2021.</td></tr>
</table>

	grasses such as *Eragrostis sp.*, *Themeda triandra* and *Sporobolis africanus* however, areas along the impounded portions were dominated by sedges such as *Schoenoplectus brachyeras* and grasses such as *Leersia hexandra* as well as the presence of woody species such as *Salix babylonica* which have occurred due to the presence of permanent standing water. Areas along the impounded portions of the seep have also become proliferated by AIP's such as *Pennisetum clandestinum*, *Verbena bonariensis* and *Conyza bonariensis* which have affected the condition of the seep.	**c)**	Geomorphology within the seep is considered to be driven by the gently sloping gradient of the seep which likely results in some runoff and sedimentation into the wetland. The impoundment within the wetland has also resulted in trapping accumulated sediment, resulting in alteration to the natural sediment transport that the wetland would experience.
		d)	The contribution of the seep to support habitat and biota was limited owing to the frequent anthropogenic disturbance and degraded nature of the wetland. During the site assessment, the seep was shown to provide habitat for avifauna such as the black headed heron (*Ardea melanocephala*) amongst others, as well as small mammals, reptiles and amphibians.
EIS and REC	**EIS REC Category: Low/Marginal** The seep was assessed to be of a low EIS due to the modified nature and disturbance surrounding the wetland. Potential breeding and foraging habitat for biota was noted to be limited due to the disturbance surrounding the seep.	**REC, RMO & BAS Category**	**REC: D /BAS: D/ RMO: Maintain** The RMO for the wetland based on the PES and EIS scores is to maintain the ecostatus of the seep wetland at a REC D. As such, any planned activities must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.
Extent of modification anticipated	The initial infrastructure layout has been moved outside of the 100 m GN 704 ZOR of seep wetland 1, with the exception of the baghouse, however, this is existing infrastructure located approximately 40 m north of the wetland. It is however, recommended that seep wetland 1 and 32 m ZOR (NEMA) are to be demarcated as 'no-go" areas as part of the proposed Rietkol project. No activities are planned to occur within the delineated boundary of seep wetland 1 which reduces the possibility of direct impacts occurring and impacting on the habitat and water quality of the wetland. Whilst no direct impacts are anticipated, the potential for edge-effects may still be likely and therefore, well designed and strictly implemented mitigation measures will prevent edge effects which should be fully reversible if they occur.		
AS APP			
Medium	As mentioned above, no direct impacts on seep wetland 1 is anticipated, however, the potential for edge effects is still considered likely. It must be ensured that mitigation measures to prevent indirect impacts are in place during all phases of construction and operation of the mining activities on the MRA. These include: • Ensuring that all exposed soil and mined material is protected for the duration of the construction and operational phase with a suitable geotextile (e.g. Geojute or hessian sheeting) in order to prevent erosion and sedimentation of seep wetland 1 located downgradient of these stockpiles.		

Note: for the purposes of this assessment, the geomorphological impacts of the artificial impoundments within the seep wetlands 1 and 2 were incorporated in the PES calculation, to ensure the resultant PES of these HGM units is unbiased, although the WetHealth methodology does not consider this applicable to non-floodplain HGM units.

Table 4: Summary of results of the assessment of seep wetland 2.

<table>
<tr><td colspan="3">Freshwater ecosystem: Seep wetland 2 within the MRA area</td><td colspan="4" rowspan="2">  </td></tr>
<tr><td colspan="3">Ecological & socio-cultural service provision graph:
 
</td></tr>
<tr><td>HGM Unit</td><td>Seep wetland 2 located within the eastern portion of the MRA area</td><td>Fatal Flaw?</td><td>N</td><td>Photograph notes</td><td>Various views of seep 2 wetland showing vegetation cover, disturbance and presence of a borehole within the seep.</td></tr>
<tr><td>Ecoservices</td><td colspan="2">Intermediate: The seep provided an intermediate degree of ecological service provisioning with ecological services such as flood attenuation, streamflow regulation, sediment trapping, erosion control, carbon storage and the assimilation of phosphates, nitrates and toxicants the primary services supplied. The biodiversity maintenance of the seep was low owing to the frequent disturbance and alteration to the wetland over the years. The ability of the seep to supply socio-cultural services and direct human benefits was largely limited due to restricted access and degraded nature of the wetland.</td><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
The hydraulic regime of the seep has been largely affected by the development of roadways, housing infrastructure, farm dams and various trenches which have cumulatively altered the connectivity of the wetland. A large impoundment within seep wetland has also captured a large amount of surface water and therefore altered the natural flow regime and zonation within seep wetland 2.</td></tr>
<tr><td>PES</td><td colspan="2">PES Category: Largely Modified (D)
Seep wetland 2 is subjected to various ongoing and historical impacts resulting in the wetland being classified as largely modified. The seep wetland 2 has been impacted by various changes within the landscape which have altered the natural flow regime and connectivity of the wetland within the landscape. These include the development of roadways, housing infrastructure, farm dams and various trenches which have cumulatively altered the hydrology, geomorphology and vegetation of seep wetland 2. A large impoundment within the seep has further altered the natural hydrology, flow regime and zonation of the wetland. flow. Increased floodpeaks and runoff from surrounding agriculture is also considered likely to contribute alterations to hydrology by means of increased surface water input and sediment into the wetland. Excavation activities related to the borehole and housing infrastructure have also altered the natural soil profiles, thus</td><td colspan="4">b) Water quality
Sampling of water quality was undertaken within the impounded portion of seep wetland 2 that contained surface water and in-situ parameters were measured including pH, temperature and Electrical Conductivity (EC). The pH of seep wetland 2 was 6.69 which is within the TWQR as per DWAF (1996). The temperature of surface water within seep wetland 2 was 19.2 ºC which was within the TWQR (DWAF, 1996) and noted to be largely natural for the time of day and season in which sampling took place. Seep wetland 2 was shown to have an EC of 25 mS/m which was within the TWQR (≤ 75 mS/m) as per DWAF (1996). Overall, water quality of seep wetland 2 was considered natural at the time of sampling in March 2021.
c) Geomorphology and sediment balance
Impacts to hydrology are considered likely to impact on the geomorphology of seep wetland 2. The major impacts to the seep geomorphology include agricultural runoff contributing increased sediment into the wetland whilst the</td></tr>
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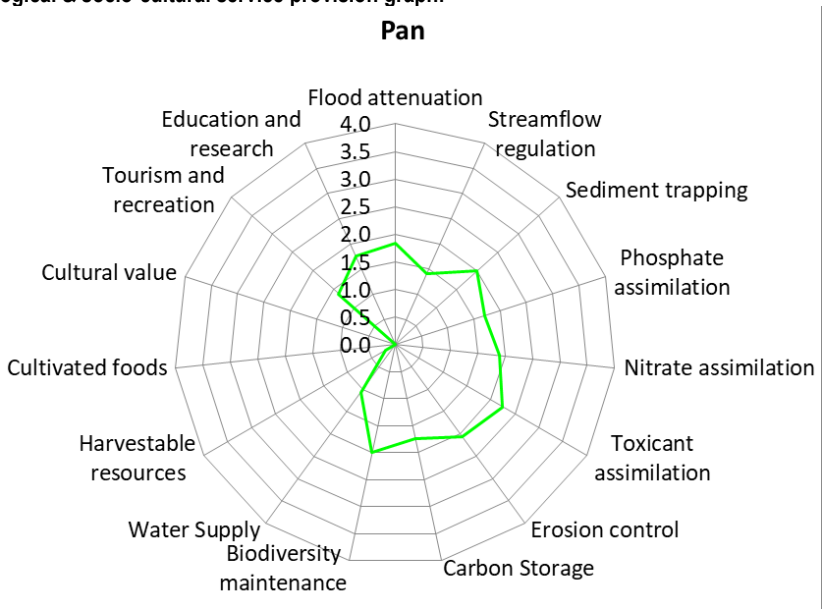
<table>
<tr><td></td><td>affecting the infiltration rates within the northernmost reaches of seep wetland 2. The extensive transformation of seep wetland 2 has resulted in the presence of numerous grasses, sedges and flowering plants to occur within the wetland. Seep wetland 2 is primarily dominated by Typha capensis and Leersia hexandra within the portions containing permanent surface water whilst the remaining portions were dominated by Themeda triandra, Cyperus sp. and Eragrostis sp. Extensive AIP's have also become proliferated within the disturbed portions of seep wetland 2 and were dominated by Verbena bonariensis, Conyza bonariensis, Campuclinum macrocephalum.</td><td colspan="2">impoundments within the seep have likely altered the transportation of sediment throughout the extent of the seep. The impoundment within the wetland has also resulted in trapping accumulated sediment, resulting in alteration to the natural transport of sediment that the wetland would experience under natural conditions.
d) Habitat and biota
The contribution of the seep to support habitat and biota was limited owing to the surrounding disturbance such as agriculture, roadways and housing developments. Whilst this is noted, the impounded portion of the seep containing surface water provides a greater diversity of habitat types which may provide habitat for avifauna, small mammals, reptiles and amphibians.</td></tr>
<tr><td>EIS and REC</td><td>EIS REC Category: Low/Marginal
Seep wetland 2 was assessed to be of a low EIS due to the various modifications and disturbance that the wetland is subjected to. Whilst the seep wetland is considered to provide some degree of breeding and foraging habitat for biota, ongoing disturbances such as agriculture and housing have likely reduced the potential for sensitive species within seep wetland 2.</td><td>REC, RMO & BAS Category</td><td>REC: D /BAS: D/ RMO: Maintain
The RMO for the wetland based on the PES and EIS scores is to maintain the ecostatus of the seep wetland at a REC D. As such, any planned activities must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Seep wetland 2 is indicated to be an Ecological Support Area (ESA) wetland according to the MBSP (2019). Due to the ecological importance of the seep wetland 2 as an ESA wetland, it is recommended that the delineated boundary of seep wetland 2 and associated 100 m MBSP setback buffer (applicable to ESA wetlands) are to be demarcated as "no-go areas" from the proposed Rietkol project as this will greatly reduce the significance of impacts that may occur to the wetland.</td></tr>
<tr><td colspan="4">Risk Assessment Outcome & Business Case:</td></tr>
<tr><td>Medium</td><td colspan="3">No direct impacts on seep wetland 2 is anticipated, however, mining activities occur within the catchment of the wetland and some indirect impacts is still considered likely. It must be ensured that mitigation measures to prevent indirect impacts are in place during all phases of construction and operation of the mining activities on the MRA.</td></tr>
</table>

Table 5: Summary of results of the assessment of Pan 1

<table>
<tr><td colspan="2">Freshwater ecosystem: Pan/Depression within the MRA area</td><td colspan="4" rowspan="2"> 
</td></tr>
<tr><td colspan="2">Ecological & socio-cultural service provision graph:
 
</td></tr>
<tr><td>HGM Unit</td><td>Depression (Pan 1) situated towards the central to southern portions of the MRA.</td><td>Fatal Flaw?</td><td>N</td><td>Photograph notes</td><td>View of the pan 1 located within the southern portion of the MRA area</td></tr>
<tr><td>Ecoservices</td><td colspan="2">Intermediate:
The pan was noted to provide an intermediate level of ecological service provisioning largely attributed to the hydro-functional importance it provides with services such as sediment trapping, erosion control, carbon storage, flood attenuation as well as the assimilation of phosphates, nitrates and toxicants which were considered particularly important owing to the relative locality of the wetland to the surrounding agricultural activities. Services such as streamflow scored low given that pans do not typically provide these services to a high degree. Socio-cultural services and direct human benefits provided by the pan were considered limited due to reliance on the national grid for majority of these. Biodiversity maintenance in particular, was considered important due to reliance on the pan by avifauna, small mammals, reptiles and invertebrates.</td><td colspan="4">Watercourse characteristics:
a) Hydraulic regime
This depression is considered to be hydrologically isolated from other surface water resources, as inferred from the local micro-topography in its vicinity. This pan is recharged by surface water from seasonal rainfall as well as subsurface flow (SAS, 2018b). Ground water is not anticipated to have a direct significant interaction with the surface and shallow sub-surface hydrogeological processes which drive this pan (SAS, 2018b). The surrounding agricultural activities is up to the edge of this pan, which have already reduced the catchment yield which enters this pan. Nevertheless, this pan is sustained by hydropedological interflow (subsurface water within the vadose zone of the pan).
b) Water quality
Water quality sampling was undertaken within the pan and in-situ parameters were measured including pH, temperature and Electrical Conductivity (EC). The pH within the pan was 7.17 which is within the Target Water Quality Requirements (TWQR) as per DWAF (1996). Temperature of the surface water within the pan was 18.5 ºC which was within the TWQR (DWAF, 1996) and is considered largely natural for the time of day and season in which sampling took place. EC within the pan was 38 mS/m which was within the TWQR (≤ 75 mS/m) as per DWAF (1996). Overall, water quality within the pan was considered natural at the time of sampling in March 2021.</td></tr>
</table>

<table>
<tr><td>PES</td><td colspan="3">PES Category: Moderately Modified (C)
The pan is situated within the central portion of the study area and will fall within the footprint of the proposed Rietcor mining activities. The pan is impacted by various industrial and land-use practices within the catchment and is considered moderately modified. The primary impacts to the hydrology of the pan are attributed to increased agricultural runoff, additional wastewater input and artificially impounded portion toward the west of the pan. These impacts are considered likely to have altered the natural wetland zonation and subsequently impacted on the geomorphology. Whilst naturally pans do not undergo extensive changes in geomorphology, increased surface water runoff and wastewater inputs are considered likely to contribute to additional sediment deposition into the pan. Use of the pan for grazing by livestock is also considered likely to contribute to some impacts on the wetland geomorphology. The vegetation community of the pan was largely dominated by Schoenoplectus sp., and Leersia hexandra within seasonal and permanent zones whilst some Alien invasive plants (AIP's) such as Verbena bonariensis were present along the temporary zone and transition into the terrestrial zone.</td><td>c) Geomorphology and sediment balance
The pan geomorphology was primarily altered by increased runoff and surface water input which has likely resulted in increased sediment deposition within the wetland. Diffuse flow from the surrounding catchment as well as livestock trampling is also considered likely to contribute additional sediment, albeit to a limited degree.

d) Habitat and biota
The pan habitat appears to be modified by agricultural activities and livestock grazing however, a predominantly intact vegetation cover was observed to persist throughout the pan which was largely dominated by sedges and grasses such as Schoenoplectus sp and Leersia hexandra. During the site assessment, the pan was shown to provide breeding and feeding habitat for Asio capensis (Marsh Owl) and has the potential to supply cover for other avifauna, small mammals, reptiles and amphibians.</td></tr>
<tr><td>EIS and REC</td><td>EIS Category: Moderate
The EIS of the pan was assessed to be moderate due to the biodiversity support and hydro-functional services provided by the wetland. During the site assessment it was noted that the pan provides feeding and breeding habitat for avifauna such as Asio capensis (Marsh owl), although not present during the site assessment, the pan was shown to present suitable habitat for Tyto capensis (African Grass Owl).</td><td>REC, RMO & BAS Category</td><td>REC: C /BAS: C/ RMO: Maintain
The RMO for the wetland based on the PES and EIS scores is to maintain the ecostatus of the pan at a REC C. As such, any planned activities must be managed to mitigate (in-line with the mitigation hierarchy) impacts to ensure that at a minimum the RMO is achieved.</td></tr>
<tr><td>Extent of modification anticipated</td><td colspan="3">Pan 1 is situated towards the southern portion of the study area is indicated to be an Ecological Support Area (ESA) wetland according to the MBSP (2019). Due to the ecological importance of the pan as an ESA wetland, it is recommended that the delineated boundary of the pan and associated 100 m MBSP setback buffer (applicable to ESA wetlands) are to be demarcated as "no-go areas" from the proposed Rietkol project as this will greatly reduce the significance of impacts that may occur to the wetland.</td></tr>
<tr><td colspan="4">Risk Assessment Outcome & Business Case:</td></tr>
<tr><td>Medium</td><td colspan="3">No direct impacts on the pan are anticipated, however, the mining activities occur within the catchment of the wetland and some indirect impacts is still considered likely..It must be ensured that mitigation measures to prevent indirect impacts are in place during all phases of construction and operation of the mining activities on the MRA. These include:
• It is considered important that water quality monitoring within wetlands (pan 1) be undertaken monthly by an Environmental Compliance Officer (ECO) to ensure that no leaching or contaminated runoff into the wetlands occur as a result of mining activities.</td></tr>
</table>

3.4 Delineation and Sensitivity Mapping

All wetlands within the MRA 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 wetland 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 MRA area.

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;
- The vegetation indicator was used in the identification of the freshwater feature boundaries through the identification of the distribution of facultative and obligate wetland vegetation. In some areas, the use of this parameter was limited due to extensive trampling and grazing. Nonetheless, in areas where the vegetation was considered intact, this was considered a useful indicator (Figure 4);
- The soil form indicator was used to determine the presence of soils that are associated with prolonged and frequent saturation, as well as variation in the depth of the saturated soil zone within 50 cm of the soil surface. This indicator was used to identify mottling (redoxymorphic features) within the soils which is associated with wetness (Figure 4).

Figure 3: A photograph depicting the distinct change between wetland vegetation and the terrestrial vegetation (orange arrows), indicating the boundary of Pan 1.

Figure 4: (Left) A representative photograph taken of a soil sample taken along the temporary and (right) seasonal zone of the wetlands, indicating extensive mottling and soil saturation, respectively.

3.4.1 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 important to provide protection of basic ecosystem processes (in this case, the protection of the 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 wetland species as well as for certain terrestrial species, and a range of ancillary societal benefits (Macfarlane *et. al,* 2015). It should be noted however that buffer zones are not considered to be effective mitigation against impacts such as hydrological changes arising from stream flow reduction, impoundments or abstraction, nor are they considered to be effective in the management of point-source discharges or contamination of groundwater, both of which require site-specific mitigation measures (Macfarlane *et. al,* 2015).

Legislative requirements were taken into consideration when determining a suitable buffer zone for the wetlands. The definition of applicable regulated zones for activity as well as buffer zone for the protection of the wetland can be summarised as follows:

- Listed activities in terms of the National Environmental Management Act, 1998 (Act 107 of 1998) (NEMA) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of

regulation. This must be determined by the EAP in consultation with the relevant authorities and the relevant applications made;

- In accordance with GN 509 of 2016 as it relates to the NWA, a regulated area of a watercourse for section 21 (c) and 21 (i) of the NWA, 1998 is defined as:
  - the outer edge of the 1 in 100 year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
  - in the absence of a determined 1 in 100 year flood line or riparian area the area within 100 m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench; or
  - A 500 m radius from the delineated boundary (extent) of any wetland or pan.
- 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 wetlands. If any activities are to take place within 100 m 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 No. 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.

The figures below conceptually depict the applicable legislative zones of regulation for the identified wetlands.

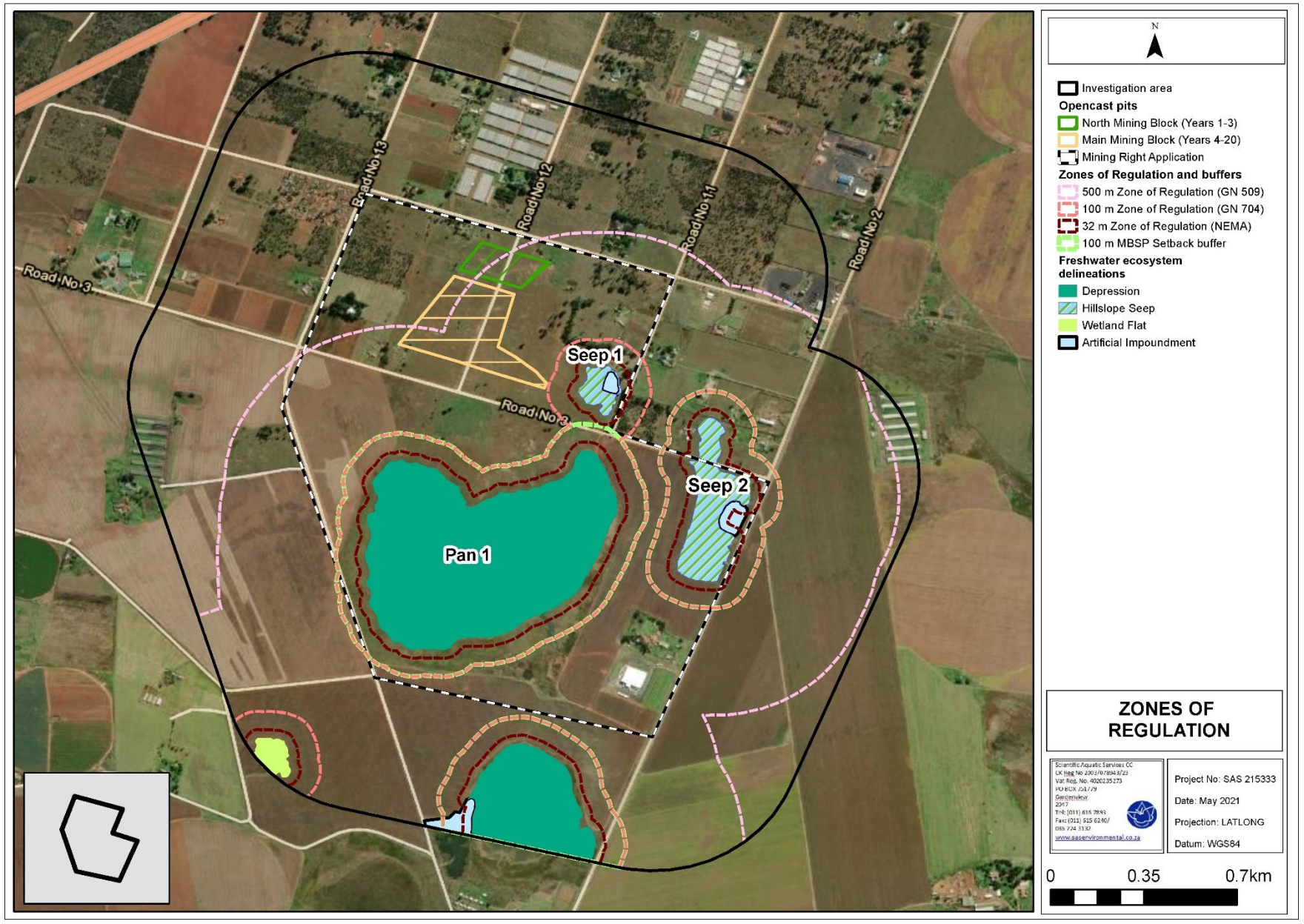


Figure 5: Map indicating the zones of regulation pertaining to the wetlands associated with the MRA area.

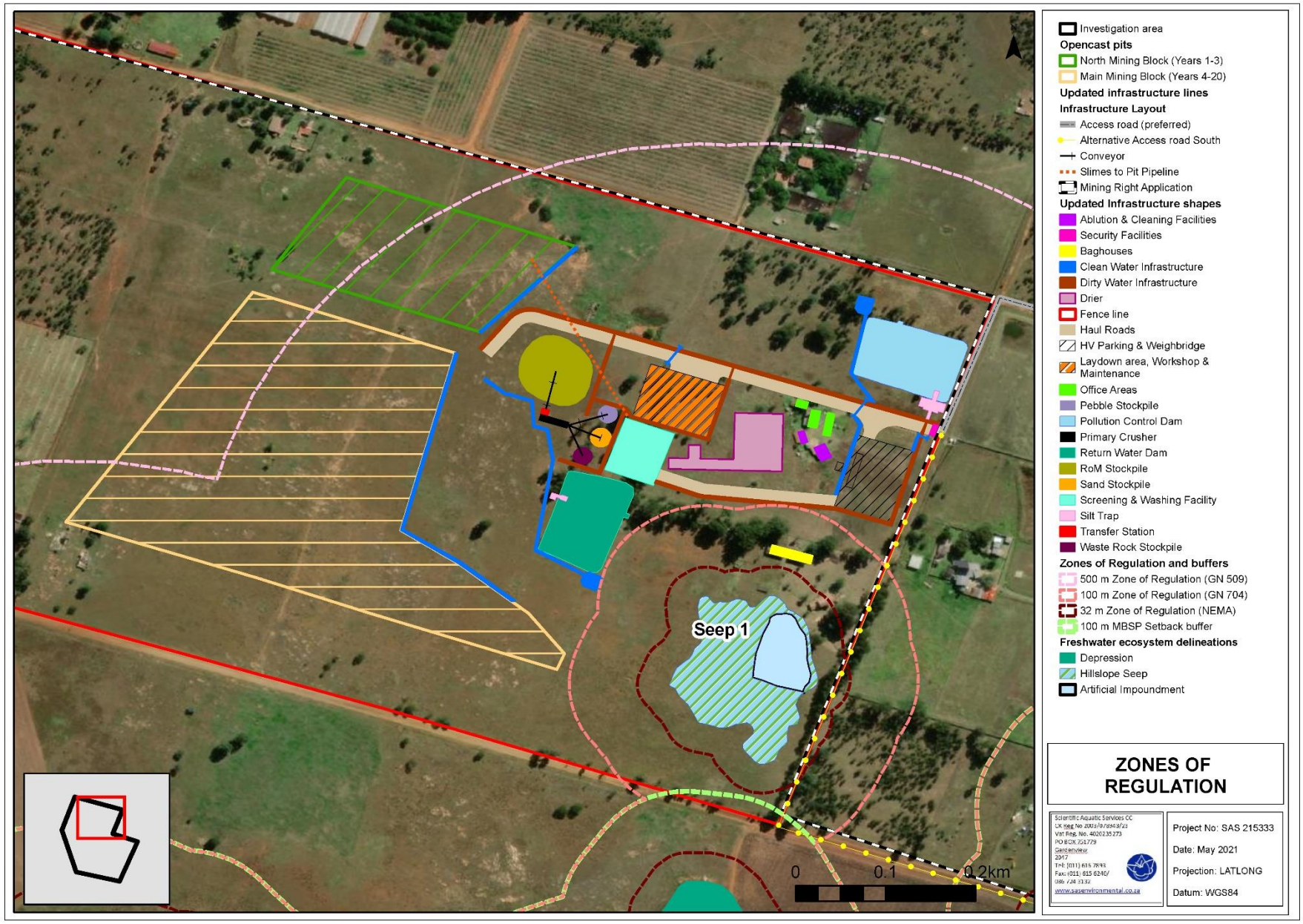


Figure 6: Zoomed in map indicating the zones of regulation pertaining to the wetlands associated with the MRA area.

4 CONCLUSION

A faunal, floral, freshwater ecosystem and surface water quality assessment was undertaken on the 24th of March 2021 as part of the Environmental assessment and authorisation process for the proposed Rietkol mining operation near Delmas within the Mpumalanga province. Three wetlands were identified within the MRA area which may be affected by the proposed mining activities. A summary of the assessment is presented in the table below.

Table 6: Summary of the results of the assessments applied to the wetlands located within the MRA area.

Freshwater ecosystem	PES	Ecoservices	EIS	REC / RMO / BAS
Seep wetland 1	D	Intermediate	Low/Marginal	D/Maintain/D
Seep wetland 2	D	Moderately low	Low/Marginal	D/Maintain/D
Pan 1	C	Intermediate	Moderate	C/Maintain/C

Following the freshwater ecosystem assessment, the DWS risk assessment matrix (2016) was applied to determine the significance of impacts of the proposed mining activities within the MRA on the receiving freshwater environment. Whilst seep wetland 1 will be affected by edge effect processes, pan 1 and seep wetland 2 may be indirectly impacted (as activities will occur within the catchment of these wetlands). The outcome of the Risk Assessment (please refer to Section E) indicates that the proposed Rietkol Project would pose a “Medium risk significance” to Seep wetland 1, seep wetland 2 and the pan wetland (for years 1 – 20 of the proposed mining project), with the implementation of mitigation measures. From a freshwater ecosystem perspective, the proposed Rietkol project can be considered acceptable, provided that the boundaries of seep wetland 1, seep wetland 2, pan 1 and associated 32 m NEMA ZOR, 100 m MBSP setback buffer (applicable to Ecological support wetlands namely pan 1 and seep wetland 2) are to be demarcated as “no-go areas” within the MRA of the proposed Rietkol Project.

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APPENDIX A: WETLAND ASSESSMENT APPROACH

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

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

Table A1: Classification System for Inland Systems, up to Level 3.

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

Table A2: Hydrogeomorphic (HGM) Units for the Inland System, showing the primary HGM Types at Level 4A and the subcategories at Level 4B to 4C.

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

FUNCTIONAL UNIT		
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT		
HGM type	Longitudinal zonation/ Landform / Outflow drainage	Landform / Inflow drainage
A	**B**	**C**
Seep	With channelled outflow	(not applicable)
	Without channelled outflow	(not applicable)
Wetland flat	(not applicable)	(not applicable)

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

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

Level 3: Landscape Setting
At Level 3 of the classification system for Inland Systems, a distinction is made between four Landscape Units (Table 1) 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 2), 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;

[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.

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

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

“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 A3: 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

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 A4: 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

Ecological Importance and Sensitivity (EIS)

The method used for the EIS determination was adapted from the method as provided by DWA (1999) for wetlands. The method takes into consideration PES scores obtained for WET-Health as well as function and service provision to enable the assessor to determine the most representative EIS category for the wetland feature or group being assessed.

A series of determinants for the EIS are assessed on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. The mean of the determinants is used to assign the EIS category as listed in the table below.

Table A5: Descriptions of the EIS Categories.

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 aquatic 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 A6: Description of REC classes.

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

Wetland Delineation

For the purposes of this investigation, a wetland is defined in the National Water Act (1998) as “land which is transitional between terrestrial and aquatic systems where the water table is at or near the surface, or the land is periodically covered with shallow water, and which in normal circumstances supports or would support vegetation typically adapted to life in saturated soil”.

The wetland zone delineation took place according to the method presented in the DWAF (2005) document “A practical field procedure for identification and delineation of wetlands and riparian areas. An updated draft version of this report is also available and was therefore also considered during the wetland delineation (DWAF, 2008). The foundation of the method is based on the fact that wetlands and riparian zones have several distinguishing factors including the following:

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

By observing the evidence of these features in the form of indicators, wetlands and riparian zones can be delineated and identified. If the use of these indicators and the interpretation of the findings are applied correctly, then the resulting delineation can be considered accurate (DWAF, 2005 and 2008).

Riparian and wetland zones can be divided into three zones (DWAF, 2005). The permanent zone of wetness is nearly always saturated. The seasonal zone is saturated for a significant periods 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 object of this study was to identify the outer boundary of the temporary zone and then to identify a suitable buffer zone around the wetland area.

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FAUNAL, FLORAL AND FRESHWATER ASSESSMENT AS PART OF THE ENVIRONMENTAL ASSESSMENT AND AUTHORISATION PROCESS FOR THE PROPOSED RIETKOL MINING OPERATIONS NEAR DELMAS WITHIN THE MPUMALANGA PROVINCE.

Prepared for

Jacana Environmental CC

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1.1 Principles of Decision making to mainstream biodiversity in mining projects

According to the Department of Mineral Resources (DMR) (2013) there are 6 key principles which should guide decision making with regards to any development and in particular mining. The six principles are defined as follows:

1. **Apply the Law:** the utilization of the law is viewed as the minimum requirement in ensuring biodiversity compliance. Attention has been given to all applicable legislation across government sectors including the Department of Water and Sanitation (DWS), the Department of Environmental Affairs (DEA) and the DMR.
2. **Utilize best available biodiversity information:** a wealth of information is available on South African biodiversity with sources of information coming from digital databases, spatial (GIS based) databases as well as extensive literature and technical reports. All these sources allow improved execution of biodiversity assessment projects from inception to finalisation and practical implementation. Specific mention is made of sources of information such as the SANBI GIS databases. During the consultation of desktop information, specific attention has been given to biodiversity priority areas which include:
   - Protected areas;
   - World Heritage Sites and their legally proclaimed buffers;
   - Critically endangered and endangered ecosystems;
   - Critical Biodiversity Areas;
   - River and wetland Freshwater Ecosystem Priority Areas (FEPAs);
   - 1km buffer of river and wetland FEPAs;
   - Ramsar Sites;
   - Important Bird Areas;
   - Protected area buffers;
   - Transfrontier Conservation Areas (remaining areas outside of formally proclaimed (PAs);
   - High water yield areas;
   - Coastal Protection zone;
   - Estuarine functional zones;
   - Ecological support areas;

- Vulnerable ecosystems; and
- Focus areas for land-based protected area expansion and focus areas for offshore protection.

The results of desktop assessments can then be used to categorise projects and define the significance of the development from a biodiversity conservation point of view. According to the DMR (2013) there are 4 categories of biodiversity importance into which any project could occur. The table below presents a description of each category and the implications for mining. The four categories can briefly be defined as:

- Legally protected areas;
- Areas of highest biodiversity importance;
- Areas of high biodiversity importance; and
- Areas of moderate biodiversity importance.

Table 1: Description of each category and the implications for mining

Category	Biodiversity priority areas	Risk of mining	Implications for mining
A. Legally protected	• Protected areas (including National Parks, Nature Reserves, World Heritage Sites, Protected Environments, Nature Reserves); • Areas declared under Section 49 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002).	**Mining prohibited**	Mining projects cannot commence as mining is legally prohibited. Although mining is prohibited in Protected Areas, it may be allowed in Protected Environments if both the Minister of Mineral Resources and Minister of Environmental Affairs approve it. In cases where mining activities were conducted lawfully in protected areas before Section 48 of the Protected Areas Act (No. 57 of 2003) came into effect, the Minister of Environmental Affairs may, after consulting with the Minister of Mineral Resources, allow such mining activities to continue, subject to prescribed conditions that reduce environmental impacts.
B. Highest biodiversity importance	• Critically endangered and endangered ecosystems; • Critical Biodiversity Areas (or equivalent areas) from provincial spatial biodiversity plans; • River and wetland Freshwater Ecosystem Priority Areas (FEPAs) and a 1 km buffer around these FEPAs; • Ramsar Sites.	**Highest risk for mining**	Environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licenses, and environmental authorisations. If they are confirmed, the likelihood of a fatal flaw for new mining project is very high because of the significance of the biodiversity features in these areas and the associated ecosystem services. These areas are viewed as necessary to ensure protection of biodiversity, environmental sustainability, and human well-being. An EIA should include the strategic assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. This assessment should fully take into account the environmental sensitivity of the area, the overall environmental and socio-economic costs and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts, and may specify biodiversity offsets that would be written into license agreements and/or authorisations.
C. High biodiversity importance	• Protected area buffers (including buffers around National Parks, World Heritage Sites* and Nature Reserves); • Transfrontier Conservation Areas (remaining areas outside of formally proclaimed protected areas); • Other identified priorities from provincial spatial biodiversity plans;	**High risk for mining**	These areas are important for conserving biodiversity, for supporting or buffering other biodiversity priority areas, and for maintaining important ecosystem services for particular communities or the country as a whole.

Category	Biodiversity priority areas	Risk of mining	Implications for mining
	• High water yield areas; • Coastal Protection zone; • Estuarine functional zone. *Note that the status of the buffer areas of World Heritage Sites is subject to a current intra-governmental process.		An EIA should include an assessment of optimum, sustainable land use for a particular area and will determine the significance of the impact on biodiversity. Mining options may be limited in these areas, and limitations for mining projects are possible. Authorisations may set limits and specify biodiversity offsets that would be written into license agreements and/or authorisations.
D. Moderate biodiversity importance	• Ecological support areas; • Vulnerable ecosystems; • Focus areas for protected area expansion (land-based and offshore protection).	**Moderate risk for mining**	These areas are of moderate biodiversity value. 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 license agreements and/or authorisations.

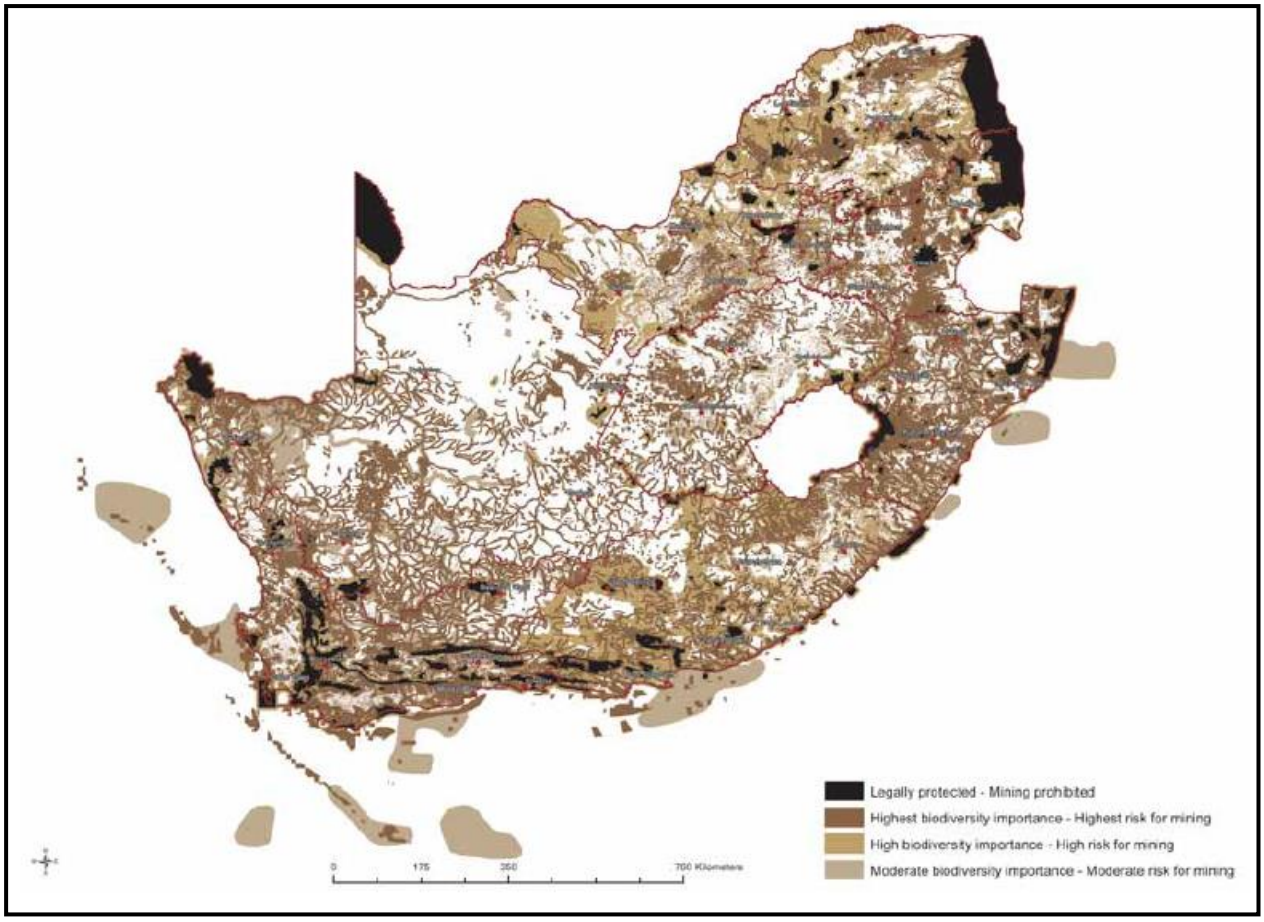

Figure 1: Levels of biodiversity importance in South Africa.

3. **Relevant stakeholder engagement in the assessment and decision making process:** biodiversity studies and plans should address the need for stakeholder engagement through consultation with local and provincial authorities, databases, reference material and where possible local and provincial experts.
4. **Environmental Impact Assessment:** the ecological baseline assessment should include assessments of:
   - The presence of and category of biodiversity priority areas;
   - The condition of ecosystems or habitat;
   - Vegetation type and ecosystem status;
   - The presence of any species of special concern;
   - The presence of any unique or special features;
   - Important spatial components of ecological processes (e.g. ecological corridors);
   - Any known or projected trends in both biodiversity and/or ecosystem services; and
   - Contextual analysis of the site/surrounding environment.

Ground-truthing (i.e. a baseline survey) of the biodiversity features in the affected area (receiving environment) is the preliminary requirement to identify environmental constraints.

Additional detailed specialist investigations should be carried out on site and in the wider area as appropriate and proportional to the levels of risk and significance of potentially impacted biodiversity and ecosystem services. The assessment and evaluation must (DMR 2013):

- Take into account any Spatial Development Frameworks approved by the provincial environmental authorities, any Environmental Management Frameworks, bioregional plans and/or other biodiversity plans prepared for the affected area;
- Enable differentiation between biodiversity priority areas and other natural areas, and areas where little to no natural habitat remains at a site scale. The type of biodiversity priority area and natural habitat remaining is important to informed application of the mitigation hierarchy during later phases of the project;
- Demonstrate that it has considered all potential impacts on biodiversity - direct impacts (occurring at the same time and in the same place as the prospecting or mining itself) as well as indirect impacts (occurring beyond or downstream of the prospecting or mining area within the 'area of influence' of the activity, and/ or may be manifest sometime after the activity e.g., groundwater pollution, acid mine drainage);
- Show that the potential impacts of this activity on biodiversity, particularly in biodiversity priority areas and on threatened species, have been evaluated in light of other similar activities that have been authorised and/ or are reasonably foreseeable in the area (i.e. cumulative impacts);
- Identify the current beneficiaries of ecosystem services, identify the biodiversity and ecosystems that underpin those services and any trends affecting them, and show that impacts on both the services and the beneficiaries have been addressed. Capturing the contribution of ecosystem services is important in the comparative evaluation of the significance of impacts (including cumulative impacts) of alternative development/land use activities. This requires understanding how development impacts on ecosystem services, who and where are the beneficiaries of those services who are likely to suffer a cost as a result of the activity (local communities and society), and evaluate the socioeconomic implications. Costs associated with the loss of ecosystem services should be added onto the project costs. Measures to mitigate impacts on ecosystem services must cover all steps of the mitigation hierarchy, giving particular attention to what may be irreplaceable or 'non offset able' ecosystem services. It is essential also to take into account the mining activity's dependence on ecosystem services, and the risks associated with a change in the quality or availability of these services during the life of the project;
- Consider both the normal operating conditions of the mine and ancillary facilities/activities, as well as emergency or unplanned events (e.g. involving

hazardous wastes, fire, toxic materials, accidental spillage of biocides, etc.); the latter require particular mitigation and management responses that should be incorporated into the EMP.

5. **Provide guidelines for the implementation of robust environmental management in line with the mitigation hierarchy:** The biodiversity assessment will aim to provide suitable mitigation measures in line with best practice while not exceeding costs in order to minimise impacts. In the contemplation of mitigation attention will be given to the mitigation hierarchy in order to provide mitigatory solutions in order of preference according to the mitigation hierarchy;
6. **Ensure and support for effective implementation:** The biodiversity assessment will aim to provide sufficient information to allow for successful, robust biodiversity management in line with the mitigation hierarchy. As far as possible consultants will remain available for post submission consultation in an advisory capacity.

1.2 Legislative, Policy and Best Practice Framework or Biodiversity Management

According to the DMR (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 DMR, (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 (DMR, 2013).

The primary environmental objective of the Mineral and Petroleum Resource 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 DMR (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[1]:

- 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 (DMR 2013):

[1] North West Province Environment Outlook. A Report on the State of the Environment, 2008. Chapter 4.

- **Direct impacts:** are impacts directly related to the project including project aspects such as site clearing, water abstraction and discharge of water from and to riverine resources respectively;
- **Indirect impacts:** are 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 in the identification of spatial biodiversity priorities, or biodiversity priority areas.

2. ECOLOGICAL RISK ASSESSMENT METHODOLOGY

For the Environmental Assessment Practitioner (EAP) to allow for sufficient consideration of all environmental risk, 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 Appendix A below.

3. TERRESTRIAL RISK ASSESSMENT

The terrestrial impact assessment was undertaken on all aspects of floral and faunal ecology likely to be affected by the proposed Rietkol Mining Operation (Rietkol Project). The sections below present the results of the findings per identified risk/ impact for the proposed surface development as well as opencast mining areas.

Activities which are likely to negatively affect the terrestrial habitat integrity, floral and faunal diversity and Species of Conservation Concern (SCC) associated with the Mining Right Application (MRA) area include, but are not limited to, the following:

- Placement of mining and related infrastructure within sensitive wetland habitat;
- Destruction of terrestrial habitat during construction, operational and closure/ decommissioning activities;
- Blasting (Noise, vibrations) and increased lighting;
- Dust generated by mining-related activities and increased traffic and transport of material;
- Alien floral invasion and erosion in disturbed areas;
- Pollution and siltation of wetlands leading to altered wetland habitat; and
- Increased human populations in the area leading to greater pressure on natural terrestrial habitat as well as species in the area.

3.1 Consideration of impacts and mitigation measures

Current land uses within the MRA area include crop cultivation, grazing, fallow lands and residential houses. The open cast mining blocks and mine infrastructure areas are located primarily within the Rocky and Disturbed Grassland habitats, which are utilised by the local community and small-scale farmers for grazing.

The Mpumalanga Biodiversity Sector Plan (MBSP, 2014) indicates that the majority of the MRA area is classified as “Other Natural Areas”, notably the northern and central portions of the MRA area. The depression wetland in the southern portion of the MRA area is classified as an ESA by the Mpumalanga Biodiversity Sector Plan (MBSP, 2014). The proposed mining activities will directly impact upon the central and northern portions of the MRA area. No mining activities are planned within the wetland areas, however, there remains the risk that the wetland systems may still be impacted upon as a result of edge effects associated with the proposed mining facility.

3.2 Impact discussion and mitigation measures

There are three key ecological impacts on the terrestrial that are anticipated to occur namely,

- Loss of faunal and floral habitat and ecological structure;
- Loss of faunal and floral species diversity and abundance; and
- Loss of faunal and floral SCC.

Placement, construction of the mining infrastructure and mining-related activities within the terrestrial habitat areas such as the Rocky and Disturbed Grassland Habitat Unit will result in the loss of floral and faunal species and habitat. Furthermore, activities in these habitats will impact upon floral SCC (*Hypoxis hemerocallidea, Gladiolus vinosomaculatus, Gladiolus permeabilis, Gladiolus crassifolius, and Habenaria galpinii* and *Crinum graminicola*) observed in these areas, as a large extent of the mining blocks is within these habitat areas. No mining activities are planned within the wetland habitat at present; however, storm water runoff, erosion and edge effects are considered to be a risk to the wetland systems, their functionality and ongoing biodiversity support especially if appropriate clean and dirty water separation systems are not in place.

Prior to mitigation, the proposed infrastructure development and operation is likely to have a low to medium impact on the terrestrial ecology, whilst the active mining activities are likely to have a medium to high impact. Should effective mitigation take place, these impacts are likely to be of a low to medium significance. The tables below provide an indication of the anticipated impact significance pre- and post-mitigation throughout the phases of the proposed mine.

Table 2: Summary of the Risk Assessment of the proposed Rietkol Mining Project on the Faunal and Floral ecology of the MRA area

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
Pre-Construction Phase														
1	Proposed Layout of surface infrastructure and opencast mining blocks	*Poor planning with regards to the placement of mining related infrastructure within close proximity to sensitive floral and faunal habitats; *Inadequate liaison and applications with MPTA with regards to floral SCC rescue and relocation permits; *Inadequate planning with regards to new site locations for floral SCC;	Negative	Long Term	Site specific	Improbable	Low	Medium	3	Low to Medium	27	*Proposed Infrastructure layouts must be optimised, ensuring that the proposed layout footprint is as small as possible; *Prior to construction/mining activities floral SCC that will be directly impacted upon need to be marked and removed to a suitable similar habitat as part of a rescue and relocation plan; *All relevant permits are to be obtained from MPTA prior to the removal of floral SCC; *All new infrastructure should be placed outside of the 100m buffer of the wetlands;	Medium	Low
Construction Phase														
2	Site preparation and clearing of vegetation for mine related infrastructure, contractor's laydown sites as well as the initial open cast mining blocks	*Loss of floral and faunal habitat; *Loss of floral and faunal species diversity; *Potential loss of floral SCC species; *Decreased faunal species habitat connectivity. *Proliferation of alien and invasive plant species in the disturbed areas.	Cumulative Negative	Long Term	Site specific	Highly Probable	High	MediumtoHigh	4	Medium	52	*All development footprint areas are to remain as small as possible and vegetation clearing must to be limited to what is essential; *All floral SCC species located within the proposed layout areas and mining blocks are to be removed as per the rescue and relocation plan, with the relevant permits from MPTA; *Implement an alien and invasive plant control plan; *Clearing of vegetation should take place in a phased manner so that faunal species are given the opportunity to naturally move off and relocate to the surrounding natural areas; *No indiscriminate driving through the veld may be permitted. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats; *Edge effects of all construction activities which may affect faunal and floral habitat within surrounding areas, need to be strictly managed.	Medium	Low to Medium
3	Removal of topsoil within proposed opencast mining area	*Loss of faunal and floral habitat as a result of increased erosion; *Risk of sedimentation of sensitive floral and faunal wetland habitat unit;	Negative	Long Term	Site specific	Definite	High	MediumtoHi gh	4	Medium	56	*Topsoil stockpiles are to be placed outside of sensitive habitat areas (wetlands); *Stockpiles are to be adequately protected to ensure that sediment is not carried off in stormwater runoff and deposited into the surrounding habitat and wetlands; *Erosion control measures are to be put in place. Berms are to be used in order to decrease water velocities;	Medium	Low to Medium

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
4	Increased vehicle movements within the construction areas	*Indiscriminate driving through the open veld leading to the loss of sensitive floral species; *Increased vehicle related mortalities of faunal species;	Negative	Medium Term	District	Probable	Medium	Medium	3	Low to Medium	36	*No indiscriminate driving through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats. *Speed restrictions to be placed on all vehicles within the MRA area to limit faunal and vehicle collisions; *Drivers to be educated about the presence and importance of faunal species and instructed to actively avoid collisions with faunal species, regardless of size.	Medium	Low to Medium
5	Disposal of construction related material	*Disposal/ dumping of construction related material in sensitive habitat areas such as wetlands; *Dumping of construction material in open space areas other than those demarcated for such waste, leading to increased habitat and species loss. *Proliferation of alien and invasive plant species in the disturbed areas.	Negative	Medium Term	Site specific	Probable	Medium	Medium	3	Low to Medium	30	*All construction related waste and material is to be disposed of at a registered waste facility; *No waste of construction rubble is to be dumped in the wetlands or surrounding habitats; *Implement an alien and invasive plant control plan;	Medium to High	Low
6	Increased personnel on site	*Increased risk of veld fires leading to loss of faunal and floral species as well as alteration of plant diversity; *Indiscriminate driving through veld; *Trapping of faunal species through the use of snares.	Negative	Long Term	District	Probable	High	Medium to High	4	Medium	56	*No indiscriminate driving through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats; *Ensure that the ecological footprint of the proposed infrastructure area is kept as small as possible. Ensure that the wetland areas are demarcated as no go zones for personnel and mine vehicles; *No uncontrolled or unsanctioned fires are allowed within the MRA area; *No hunting or trapping of faunal species is allowed within the MRA area.	Medium to High	Low to Medium
Operational Phase														

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
7	Blasting and removal of material from opencast pits	*Disturbance of faunal species in the vicinity of the mine leading to faunal species movement out of the MRA area as well as decreased breeding rates which will impact upon faunal diversity and abundance; *Dust and sediment from active mining areas may lead to the smothering of surrounding vegetation as well as increased silt loads within the nearby wetland systems.	Negative	Long Term	Site specific	Highly Probable	Medium	Medium	3	Low to Medium	36	*The footprint of open cast pits is to remain as small as possible whilst allowing for economical and optimal extraction of the material; *Blasting should ideally be done during mid-afternoon and not early mornings or late afternoon/ evenings when faunal species are most active; *The alien and invasive plant management plan must be adhered to in order to control and manage alien floral species in the disturbed areas; *Edge effects relating to open cast blocks must be suitably managed to ensure that the surrounding habitat is not impacted upon; *Innovative blasting techniques are to be employed in order to minimise ground and air vibrations and disturbances so as to minimise the impacts on surrounding faunal species;	Low to Medium	Low to Medium
8	Movement of operational vehicles within and outside of the active mining areas	*Increased risk of faunal mortality rates due to collisions with mine vehicles; *Increased risk to *Pyxicephalus adspersus* (Giant Bullfrog) moving between wetlands within the MRA area;	Negative	Long Term	District	Highly Probable	Medium	MediumtoHigh	4	Medium	56	*No indiscriminate driving through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats. *Speed restrictions to be placed on all vehicles within the MRA area to limit faunal and vehicle collisions; *Drivers to be educated about the presence and importance of faunal species and instructed to actively avoid collisions with faunal species, regardless of size. In particular drivers are to be aware of the increased risk of possible vehicle collisions with *Pyxicephalus adspersus* (Giant Bullfrog) which is listed as Vulnerable within the Mpumalanga Province. *It is recommended that the access road alternative to the north of the MRA area be considered as the preferred access route and not that of the preferred southern access road. This will decrease the threat of vehicles to faunal species, notably *Pyxicephalus adspersus*.	Medium	Low to Medium
9	Increased personnel on site	*Risk of uncontrolled fires leading to habitat modification, loss of floral and faunal species as well as impacting upon SCC; *Hunting and trapping of faunal species;	Negative	Long Term	Local	Highly Probable	High	MediumtoHigh	4	Medium	56	*No indiscriminate driving through the veld is allowed. As far as possible vehicles are to utilise the existing roads. Where this is not feasible, new roads are to be located in areas of existing high disturbance, and not encroach upon sensitive habitats; *Ensure that the ecological footprint of the proposed infrastructure area is kept as small as possible. Ensure that the wetland areas are demarcated as no go zones for personnel and mine vehicles; *No uncontrolled or unsanctioned fires are allowed within the MRA area; *No hunting or trapping of faunal species is allowed within the MRA area.	Medium to High	Low to Medium

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
10	Increased ambient lighting	*Increased lighting will result in the attraction of insects, which will inevitably attract a number of insectivorous predators, notably bats. This may result in increased risk of injury or mortality to such predatory species either from collision with operational machinery, infrastructure and vehicles, or as a result of direct human conflict.	Negative	Long Term	Local	Probable	Medium	Medium	3	Low to Medium	36	*Lighting pollution and its effect on fauna (with special mention of invertebrates, bats and avifauna) must be effectively mitigated with the following guidelines in mind with due cognizance take of health and safety requirements: • Downward facing lights must be installed and limited to absolutely essential areas; • Covers/light diffusers must be installed to lessen the intensity of illumination where possible; *Outside lights are to utilise bulbs of varying wave lengths that do not attract insects;	Low to Medium	Low to Medium
11	Year 1 - 9 open cast mining blocks	*Loss of floral SCC; *Loss of floral and faunal habitat; *Loss of habitat connectivity between the eastern and western portions of the MRA area. *Proliferation of alien and invasive plant species in the disturbed areas.	Negative	Long Term	Site specific	Definite	High	High	5	Medium to High	70	*Ecological footprint of open cast pits is to remain as small as possible whilst allowing for economical and optimal extraction of the material; *A rescue and relocation plan is to be implemented with regards to floral SCC; *Mining blocks are not to encroach upon sensitive habitat areas, notably the wetlands; *Erosion control and storm water management measures are to implemented to manage water runoff and mitigate sedimentation of the surrounding habitat and wetlands; *Control of alien and invasive plant species is to be carried out throughout the mining process; *It must be ensured that habitat connectivity between the MRA area and surrounding areas is not significantly compromised. As such fencing should still allow for the movement of faunal species whilst providing the necessary security for the mine;	Low to Medium	Medium
12	Year 9 - 20 open cast mining blocks	*Sedimentation of nearby wetland habitats as a result of storm water runoff carrying sediment from open cast mining areas. This will lead to a loss of wetland habitat for faunal and floral species; *Loss of floral and faunal SCC; *Loss of floral and faunal habitat; *Loss of habitat connectivity between the eastern and western portions of the MRA area. *Proliferation of alien and invasive plant species in the disturbed areas.	Negative	Long Term	Site specific	Definite	High	High	5	Medium to High	70	*The footprint of open cast pits is to remain as small as possible whilst allowing for economical and optimal extraction of the material; *Strict adherence to the requirements of Regulation GN704 must be implemented prior to mining activity commencing and clean and dirty water separation structures must be maintained throughout the life of mine; *Erosion control and storm water management measures are to implemented to manage water runoff and mitigate sedimentation of the surrounding habitat and wetlands; *Control of alien and invasive plant species is to be carried out throughout the mining process; *It must be ensured that habitat connectivity between the MRA area and surrounding areas is not significantly compromised. As such fencing should still allow for the movement of faunal species whilst providing the necessary security for the mine;	Low to Medium	Medium

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
13	Post year 20 open cast mining blocks	*Sedimentation of the downslope wetland habitat to the south as a result of storm water runoff carrying sediment from open cast mining areas. This will lead to a loss of wetland habitat for faunal and floral species; *Loss of floral and faunal SCC; *Loss of floral and faunal habitat; *Loss of habitat connectivity between the wetland in the southern portion of the MRA area and the wetland immediately north there-of. *Proliferation of alien and invasive plant species sin the disturbed areas.	Negative	Long Term	Site specific	Highly Probable	High	High	5	Medium to High	65	*The footprint of open cast pits is to remain as small as possible whilst allowing for economical and optimal extraction of the material; Strict adherence to the requirements of Regulation GN704 must be implemented prior to mining activity commencing and clean and dirty water separation structures must be maintained throughout the life of mine; *A rescue and relocation plan is to be implemented with regards to floral SCC; *Mining blocks are not to encroach upon sensitive habitat areas, notably the wetlands; *Erosion control and storm water management measures are to implemented to manage water runoff and mitigate sedimentation of the surrounding habitat and wetlands; *Control of alien and invasive plant species is to be carried out throughout the mining process; *It must be ensured that habitat connectivity between the large wetland system in the south of the MRA area and the wetland system adjacent to the mining infrastructure areas is maintained. In this regard, culverts should be used here road crossings occur and fencing should still allow for the movement of faunal species whilst providing the necessary security for the mine;	Low to Medium	Medium
Decommissioning and rehabilitation Phase														
14	Backfilling of open cast mining blocks	*Proliferation of alien and invasive plant species leading to ongoing floral and faunal habitat loss; *Improper rehabilitation of open cast mining blocks and disturbed areas leading to permanent floral and faunal habitat loss; *Increased risk of erosion in disturbed areas; *Increased sediment load in stormwater runoff resulting in the sedimentation of the surrounding habitat and wetlands;	Cumulative Negative	Long Term	Site specific	Definite	Medium	Medium	3	Low to Medium	39	*Ensure sound implementation of alien and invasive plant control plan; *Infilling of mining blocks should ideally utilise material that was originally excavated, alternatively material that has been locally sourced; *Where soils have been compacted that are to be ripped and where necessary reprofiled; *Indigenous grass species are to be used for revegetation of disturbed areas and the mining blocks; *Where necessary hessian sheets (or similar products) are to be used in order to stabilise the soil surface until complete revegetation has occurred; *Erosion mitigation measures are to be implemented to mitigate downslope sedimentation of wetlands and the hindrance of revegetation/ rehabilitation activities. *Where possible and feasible the open pit should be filled with tailings in order minimise pit depth. The sides of the open pits should be sloped in such a way as to create ease of access in and out for faunal species once mining activities in that block have ceased	Medium	Low to Medium

ID	Environmental Aspect	Potential Impact	Nature of Impact	Duration	Extent	Probability	Intensity	Weighting factor	Weigh value	Impact Significance	Significant Points	Proposed Mitigation measures	Mitigation Efficiency	Impact Significance
15	Decommissioning/ removal of surface infrastructure	*Highly compacted soils limiting the re-establishment of natural vegetation; *Increased sediment load in stormwater runoff resulting in the sedimentation of the surrounding habitat and wetlands; *Increased risk of erosion in disturbed areas; *Proliferation of alien and invasive plant species leading to ongoing floral and faunal habitat loss; *Improper rehabilitation of disturbed areas leading to permanent floral and faunal habitat loss; *Compaction of soils hampering revegetation.	Cumulative Negative	Long Term	Site specific	Definite	Medium	Medium	3	Low to Medium	39	*Ensure sound implementation of alien and invasive plant control plan; *Where soils have been compacted that are to be ripped and where necessary reprofiled; *Indigenous grass species are to be used for revegetation of disturbed areas and the mining blocks; *Where necessary hessian sheets (or similar products) are to be used in order to stabilise the soil surface until complete revegetation has occurred; *Erosion mitigation measures are to be implemented to mitigate downslope sedimentation of wetlands and the hindrance of revegetation/ rehabilitation activities; *All surface infrastructure is to be removed and waste material disposed of at a registered dump site. Waste and remnant mine related material is not to be dumped or left within the MRA area. During the removal of infrastructure and waste, remediation of contamination be found should be carried out, where this is not possible these soils are to be removed to an appropriate waste facility.	Medium to High	Low

3.3 Probable Latent Impacts

Even with mitigation, latent impacts on the receiving terrestrial ecological environment are deemed likely. The following points highlight the key latent impacts that have been identified:

- Alteration and/or loss of faunal and floral habitat;
- Impact on wetland habitats;
- Alteration and/or terrestrial species diversity;
- Alien floral invasion;
- Loss of floral and faunal SCC; and
- Disturbed areas are highly unlikely to be entirely rehabilitated to pre-development conditions of ecological functioning and loss of terrestrial habitat, species diversity and floral SCC in particular will likely be permanent.

4. FRESHWATER ECOSYSTEM IMPACT ASSESSMENT

4.1 Consideration of impacts and application of mitigation measures

Following the assessment of the wetlands associated with the MRA area, the DWS prescribed Risk Assessment Matrix (2016) was conducted to ascertain the significance of perceived impacts on the key drivers and receptors (hydrology, water quality, geomorphology, habitat, and biota) of the wetlands located within the MRA area of the Rietkol project area. These results are summarised in Table 3 presented at the end of Section 4.2 of this report.

The following aspects were taken into consideration when evaluating the potential impacts of the proposed activities associated with the Rietkol Mining Operation (Rietkol Project):

- As mentioned above, no proposed infrastructure would be located within the wetlands located within the MRA area. Nevertheless, the potential of edge effects as well as indirect impacts (stemming from mining activities that will occur within the catchment of these wetlands) are still anticipated from the construction and operation of the proposed activities could impact on the downgradient wetlands;
- The proposed North Mining Block (Years 1 to 3) and Main Mining Block (Years 4 to 20) are located west of seep wetland 1 and north west of seep wetland 2 and pan 1. Mining activities would first commence within the North Mining Block (year 1 to 3), then only in the Main Mining Block (year 4 to 20). As the entire extent of the Main Mining Block is not currently proposed to be mined (currently only years 4 – 20, further exploration drilling will be conducted during the operational phase, which may increase

the LOM (post year 20) and mining depth if the resource proofs viable(Jacana, 2021), the impacts expected as part of the open cast mining block activities (i.e. blasting) is expected to be limited on the wetlands within the MRA area during the first 20 years;

- As all of the proposed surface infrastructure is located approximately 100 m away from the wetlands (outside of the 100 m GN 704 ZoR), the impact of the construction and operation of these activities is considered negligible to the wetlands;
- The proposed activities are all highly site specific, not of a significant extent relative to the area of the wetlands assessed, and therefore impacts have a limited spatial extent;
- While the operation of the proposed surface infrastructure will be a permanent activity, the construction thereof is envisioned to take no more than a few months. However, the frequency of the construction impacts may be daily during this time; and
- Most impacts are considered to be easily detectable.

4.2 Impact discussion and essential mitigation measures

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

- Loss of freshwater habitat and ecological structure;
- Changes to the socio-cultural and service provision;
- Impacts on the hydrology and sediment balance of the wetlands; and
- Impacts on water quality (if present).

Various activities and development aspects may lead to these impacts, however, provided that the mitigation hierarchy is followed, these impacts can be avoided or adequately minimised where avoidance is not feasible. The mitigation measures provided in this report have been developed in consideration of the mitigation hierarchy, and the implementation and strict adherence to these measures will assist in minimising the significance of impacts on the receiving environment. Table 3, below presents a summary of the Risk Assessment conducted with regards to the different phases associated with the Rietkol Mining Project on the wetlands located within the MRA area.

Table 3: Summary of the Risk Assessment of the proposed Rietkol Mining Project (year 1- 20) on the wetlands located within the MRA area.

Phases	Activity	Aspect	Impact	Flow Regime	Physico & Chemical (Water Quality)	Habitat (Geomorph/Vegetation)	Biota	Severity	Spatial scale	Duration	Consequence	Frequency of activity	Frequency of impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating	Confidence level	Mitigation measures	PES and EIS of Watercourse Reversibility of impact	Reversibility of impact
Pre-construction phase	Site preparation prior to construction activities related to the clearing for the proposed surface infrastructure and open cast mining block areas, including placement of contractor laydown areas and storage facilities.	*Removal of vegetation within the catchment of the wetlands in order to allow construction equipment to be moved/stationed where required; and *Potential disturbance of the wetlands as a result of edge effects generated by construction equipment and movement of personnel surrounding the wetlands.	<u>Impacts to wetlands affected by edge effect processes (Seep wetland 1):</u> *Exposure of soil, leading to increased runoff, erosion and incision of the wetlands, and thus increased potential for sedimentation into the wetlands; *Increased sedimentation of wetland habitat, leading to changes in habitat and potentially altering surface water quality within the wetlands; *Decreased ecoservice provision of the wetlands; and	2	2	2	2	2	2	1	5	1	4	5	1	11	**55**	**L**	**80**	*The delineated wetland boundaries, 32 m NEMA ZOR and 100 m MBSP setback buffer for ESA wetlands (applicable to Pan 1 and seep wetland 2) should be clearly demarcated with danger tape by an ECO and marked as "no-go" areas. *The surface infrastructure footprint should be minimised as far as possible to reduce encroachment on the delineated	<u>Seep wetland 1</u> PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low	Fully reversible

			*Proliferation of alien invasive vegetation as a result of disturbance.																wetland boundaries and 32 m NEMA ZOR; *Site clearing must be limited to what is absolutely essential and should retain as much indigenous vegetation as possible; *All vehicle re-fuelling is to take place outside of the delineated wetland boundaries associated 32 m NEMA ZOR and 100 m MBSP setback buffer for ESA wetlands; *The footprint of the MRA is to remain as small as possible and vegetation clearing is to be limited to what is absolutely essential; *Exposed soil should be protected by means of a		
			Impacts to wetlands (Pan 1 and seep wetland 2) not directly affected by mining (activities will occur within the catchment of these wetlands): *Runoff with high sediment loads deposited into the wetlands, smothering the vegetation and thus altering the habitat of the wetlands. *Loss of catchment yield resulting from wetlands alteration and/or losses, leading to reduction in volume of water entering the wetlands.	2	2	1	1	1.5	2	1	4.5	1	2	5	2	10	**45**	**L**	**80**		Seep wetland 2 PES - Category D (Largely Modified) EIS - Intermediate Ecoservices - Moderately low Pan 1 PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	Fully reversible

																				suitable geotextile covering such as hessian sheeting; and *Taking into consideration the infrastructure layout within the MRA, it should be feasible to utilise existing roads to gain access to the site and crossing the wetlands in areas where no existing crossing is apparent is deemed unnecessary, and should be avoided as far as possible. In the event the creation of new road crossings are deemed essential to access the site, these are to be made at right angles so as to prevent disturbance and encroachment to the		

																				delineated wetlands.		
Construction and Operational Phase	Removal of topsoil from the proposed open cast mining block areas (in a sectional manner, thus starting at the north mining block (year 1 - 3), then to the main mining block (year 4 - 20).	*Increased potential for sedimentation and runoff into the wetlands, (with specific mention of seep wetland 1).	<u>Impacts to wetlands affected by edge effect processes (Seep wetland 1):</u> *Topsoil removal and the creation of temporary stockpiles causes: Increased risk of transportation of sediment from exposed soil in storm water runoff, leading to increased turbidity of surface water, sedimentation of wetlands, smothering of vegetation and/or altered vegetation composition.	1	2	2	2	1.75	2	2	5.75	5	3	5	1	14	**80.5**	**M**	**80**	*Temporary stockpiles must be protected by means of suitable geotextiles such as hessian sheeting, silt curtains, sandbags etc. to prevent contamination of runoff and sedimentation of the downgradient wetlands (specific mention of seep wetland 1) in the vicinity of the surface infrastructure;	<u>Seep wetland 1</u> PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low	Fully reversible

			Impacts to wetlands (Pan 1 and seep wetland 2) not directly affected by mining (activities will occur within the catchment of these wetlands): *Potential for the transportation of sediment from exposed soil in storm water runoff, leading to increased turbidity of surface water, sedimentation of wetlands, smothering of vegetation and/or altered vegetation composition.	1	1	2	1	1.25	1	1	3.25	5	2	5	2	14	**45.5**	**L**	**80**	*Immediate vegetation of all stockpiles which are to remain on site post-construction.	Seep wetland 2 PES - Category D (Largely Modified) EIS - Intermediate Ecoservices - Moderately low Pan 1 PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	Fully reversible
	Construction of surface infrastructure outside the 100 m Zone of Regulation (GN 704) of the wetlands.	*Excavation activities for the foundation of the surface infrastructure upgradient of the wetlands; *Mixing and casting of concrete to facilitate foundations upgradient of the wetlands; *Compaction of soil within the catchment of the wetlands (with	Impacts to wetlands affected by edge effect processes (Seep wetland 1): *Potential for sedimentation of seep wetland 1 situated downgradient of surface infrastructure; *Stockpiling of excavated soil upgradient of seep wetland 1; *Removal of vegetation and	1	2	2	2	1.75	2	2	5.75	5	2	5	1	13	**74.75**	**M**	**80**	*Limit excavations to ensure that the natural surface drainage patterns return to normal after construction activities has commenced; *Avoid placing any infrastructure within the 32m NEMA ZOR of the wetlands, which will ensure flow	Seep wetland 1 PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low	Fully reversible

		specific mention of seep wetland 1).	disturbance of soil upgradient of seep wetland 1, which may enable the recruitment of alien and invasive vegetation along the wetland; *Noise and anthropogenic disturbance to biota.																and connectivity is maintained by preventing fragmentation of the wetland habitat; *Fragmentation of the wetlands can be avoided by (for example) ensuring that the disturbance footprint remains as small as possible, that no solid strips are excavated surrounding the wetlands, *It must also be ensured that no canalisation or incision of the wetlands takes place; *Stockpiled soil must be reshaped to natural conditions as required during construction and post-construction to avoid sedimentation from runoff and revegetated		
			<u>Impacts to wetlands (Pan 1 and seep wetland 2) not directly affected by mining (activities will occur within the catchment of these wetlands):</u> *Sedimentation of the wetlands downgradient, specifically seep wetland 2 and pan 1; *Stockpiling of excavated soil within close proximity to the wetlands; *Potential for noise and anthropogenic disturbance to biota.	1	1	2	1	1.25	2	1	4.25	1	2	5	2	10	**42.5**	**L**	**80**		<u>Seep wetland 2</u> PES - Category D (Largely Modified) EIS - Intermediate Ecoservices - Moderately low <u>Pan 1</u> PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	Fully reversible

																				with indigenous vegetation; and *Compacted soil should be ripped, profiled and reseeded with indigenous vegetation following construction		
	Blasting and ore extraction from the open cast mining block areas (Year 1 - 3 approximately 385 m from seep wetland 1) (Year 4 - 20 approximately 110 m from seep wetland 1)	*Potential noise and physical disturbance of the wetlands (with specific mention of seep wetland 1).	<u>Impacts to wetlands affected by edge effect processes (Seep wetland 1):</u> *Increased dust levels during operational activities could enter the wetlands and increase the sediment load thereof; *Sediment laden stormwater runoff entering the downgradient wetlands; *Potential for runoff and entry of contaminants into the wetlands, resulting in the potential for impaired water quality and	2	2	2	3	2.25	2	2	6.25	4	3	5	1	13	**81.25**	**M**	**80**	*Stream flow continuity and environmental flow requirements need to be maintained downgradient of the areas to be mined (downgradient of the mining block areas) in order to ensure the on-going viability of the functioning of the wetlands and the provision of services by the wetlands; *Water quality (surface and groundwater) need to be managed, and	<u>Seep wetland 1</u> PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low	Fully reversible

			decreased ecoservice provision of the wetlands.																monitored in order to ensure that reasonable water quality occurs down gradient of the open cast mining block areas to allow for the on-going survival of the wetlands. It is considered important that water quality monitoring within wetlands (Seep wetlands 1, seep wetland 2 and pan 1) be undertaken monthly by an Environmental Compliance Officer (ECO) to ensure that no significant impact due to mining occurs in the receiving environment; *The footprint area of the two proposed mining block areas must remain as small as possible whilst		
			<u>Impacts to wetlands (Pan 1 and seep wetland 2) not directly affected by mining (activities will occur within the catchment of these wetlands):</u> *Increased dust levels during operational activities could enter the wetlands and increase the sediment load thereof; *Sediment laden stormwater runoff entering the downgradient wetlands; *Potential for runoff and entry of contaminants into the wetlands, resulting in the potential for impaired water quality and decreased ecoservice provision of the wetlands	2	2	2	3	2.25	2	2	6.25	4	3	5	1	13	**81.25**	**M**	**80**		<u>Seep wetland 2</u> PES - Category D (Largely Modified) EIS - Intermediate Ecoservices - Moderately low <u>Pan 1</u> PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	Fully reversible

																				allowing for economical and optimal extraction of the ore. Specific mention is made to limit the open cast activities associated with the main mining block, so as to not encroach into the 100 m MBSP setback buffers and 32 m NEMA ZOR as applicable to pan 1, seep wetland 2 and seep wetland 1, respectively.		
	Installation and operation of clean and dirty separation infrastructure around the footprint of the mining activities within the MRA.	*Potential changes to the water retention pattern, timing and flow into the wetlands; *Potential pollutants and toxicants entering into the wetlands; *Movement of construction machinery, personnel and equipment surrounding the wetlands;	Impacts to wetlands (Seep wetland 1, pan 1 and seep wetland 2) affected by edge effect process and wetlands not directly affected by mining (activities will occur within the catchment of these wetlands): *Loss of catchment yield due to stormwater	2	1	2	1	1.5	2	2	5.5	5	3	5	1	14	**77**	**M**	**80**	*Clean and dirty water areas should be kept separate; *Dirty water areas should be kept as small as possible and should be expanded progressively to ensure that the volume of clean surface runoff supplying the	Seep wetland 1 PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low Seep wetland 2 PES - Category D (Largely	Fully reversible

		*Potential excavations and ground clearing within proximity of the wetlands to facilitate laydown of clean and dirty water containment systems.	containment, leading to: *Increased flood peaks as a result of formalisation and concentration of surface runoff; *Potential for erosion of terrestrial areas as a result of the formation of preferential flow paths, leading to sedimentation of the downgradient wetlands; *Reduction in volume of water entering the wetlands, leading to loss of recharge of the downgradient wetlands and alteration of the wetland hydrological and geomorphological regimes; *Altered vegetation communities due to moisture stress; *Potential erosion and sedimentation of the wetlands as a result of dirty water discharges prompting the																	wetlands is optimised; *The dirty water systems should be adequately sized as per the GN 704 Regulatory Requirements, to prevent failure thereof and ultimately, discharge of contaminated water into the wetlands; *The associated Pollution Control Dam (PCD) must have capacity to cater for a 1:00 year flood occurring over a 24 hour period and the PCD must be lined with an appropriate liner; *Appropriate surge capacity must be maintained in the PCDs and PCDs should not function as process water storage facilities;	Modified) EIS - Intermediate Ecoservices - Moderately low <u>Pan 1</u> PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	

			potential for rill and gully erosion; *Potential entry of contaminants such as hydrocarbons from any potential dirty water inputs of the MRA into the wetland systems.																	*Clean water captured in the clean water system should be returned back into the surrounding wetland systems. However, the wetland systems must be protected against erosion arising from the discharge of clean water. Energy dissipating structures such as bioswales should be developed at discharge points of clean water back into the wetlands to prevent erosion. Water should also be distributed in a diffuse manner to prevent erosion incision and sedimentation. *Rainwater and stormwater falling on the open portions of the mining pits and		

																				infrastructure area will be collected as dirty water and be re-used. This dirty water will not form part of the natural stormwater runoff and will thus cause a reduction in catchment yield. To limit the impact as far as possible the footprint area of all the dirty water infrastructure will be minimised. Berms and/or drains on the highwall side of the open pits and infrastructure will prevent the influx of clean water into those dirty water areas. The impact of the dirty water areas on the runoff is therefore, considered insignificant.		

	Operation of the surface infrastructure within the catchment of the wetlands (and existing baghouse infrastructure within 100 m GN 704 ZoR of seep wetland 1).	*Potential for contaminated runoff into the wetlands as a result of mining activities within the MRA.	<u>Impacts to wetlands affected by edge effect processes (Seep wetland 1):</u> *Altered surface runoff patterns due to reduced vegetation cover and increased impermeable surfaces; *Increased water inputs to the downgradient wetlands; *Risk of contaminated stormwater runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces); *Possible erosion/incision of the wetlands due to concentration of stormwater runoff	1	1	2	1	1.25	1	2	4.25	5	2	5	1	13	**55.25**	**L**	**80**	*Pollution prevention through infrastructure design in order to prevent, eliminate and/or control potential pollution of soil, groundwater and surface water should be implemented; *Implement an environmental monitoring programme to detect and prevent the pollution of soil, surface water and groundwater that may affect the wetland systems; and *Overburden stockpiles should be located in areas where it would not impact on any of the local hydrological drivers of the wetlands.	<u>Seep wetland 1</u> PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low	Fully reversible
			<u>Impacts to wetlands (pan 1 and seep wetland 2) not directly affected by mining (activities will occur within the catchment of these wetlands):</u> *Altered surface runoff patterns	1	1	1	1	1	1	2	4	5	1	5	2	13	**52**	**L**	**80**		<u>Seep wetland 2</u> PES - Category D (Largely Modified) EIS - Intermediate Ecoservices - Moderately low	Fully reversible

			due to reduced vegetation cover and increased impermeable surfaces; *Increased water inputs to the downgradient wetlands; *Risk of contaminated stormwater runoff (e.g. hydrocarbons, sediment, originating from impermeable surfaces); *Possible erosion/incision of the wetlands due to concentration of stormwater runoff																		Pan 1 PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	
Decommissioning phase	Decommissioning/removal of surface infrastructure	*Potential noise and physical disturbance of the wetlands, (with specific mention of seep wetland 1) as a result of decommissioning activities.	Impacts to wetlands (Seep wetland 1, pan 1 and seep wetland 2) affected by edge effect process and wetlands not directly affected by mining (activities will occur within the catchment of these wetlands): *Compacted soil, latent impacts of vegetation losses, causing:	2	2	2	2	2	2	2	6	5	3	5	1	14	**84**	**M**	**80**	*Ensure that soil is replaced in the correct layers, ripped and re-profiled post-closure, and that vegetation is restored (revegetated with indigenous vegetation species) to a point where succession will lead to the same	Seep wetland 1 PES - Category D (Large Modified) EIS - Moderately low Ecoservices - Moderately low Seep wetland 2 PES - Category D (Largely	Fully reversible

			*Increased runoff volumes and formation of preferential surface flow paths as a result of compacted soil and unvegetated areas, leading to increased sedimentation, erosion, and increased water inputs to downgradient wetlands; *Proliferation of alien vegetation due to disturbances from decommissioning activities; Potential for increased sediment runoff and contamination of wetlands leading to decreased water quality and ecoservice provision as a result of decommissioning activities.															conditions as the pre-mining state as a minimum; *Rehabilitation measures stipulated in Maintenance and Management Plan (MMP) must be implemented. Implementation must be overseen by a suitably qualified ECO with experience with freshwater ecosystems and the ECO must sign off the rehabilitation before the relevant contractors leave site; *Minimum of ten year's post-closure monitoring to be undertaken.	Modified) EIS - Intermediate Ecoservices - Moderately low <u>Pan 1</u> PES - Category C (Moderately Modified) EIS - Intermediate Ecoservices - Moderately low	

5. MONITORING PROGRAM

5.1 Terrestrial Ecological Monitoring

A monitoring plan must be designed and implemented throughout all phases of the mining development, should it be approved. The following points aim to guide the design of the monitoring plan, and it must be noted that the monitoring plan must be continually updated and refined for site-specific requirements:

- Permanent monitoring plots must be established in areas surrounding the surface infrastructure and mining areas. These plots must be designed to accurately monitor the following parameters:
  - Impact of dust on the surrounding habitat;
  - Recruitment of indigenous species;
  - Recruitment of alien and invasive species;
  - Alien vs. Indigenous plant ratio;
  - Erosion levels and the efficacy of erosion control measures;
  - Vegetation community structure including species composition and diversity which should be compared to pre-development conditions; and
  - Presence, abundance and condition of floral SCC communities.
- Monitoring of rehabilitated North block in light of the above parameters must also take place throughout all phases of the proposed mine and for a period of 3 years after decommissioning and closure;
- Results of the monitoring activities must be taken into account during all phases of the proposed mining development and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent;
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results;
- It is recommended that a management and relocation plan for particularly *Pyxicephalus adspersus* (Giant Bullfrog) be developed in order to monitor the impacts of mining activities on this species;
- The following methods aim to guide the monitoring plan, although more detailed, site specific methods must be employed during the development and implementation of the monitoring plan:
  - Monitoring activities must take place on an annual basis as a minimum;
  - Sherman traps must be utilised to monitor small mammal diversity.

- Results of the monitoring activities must be taken into account during all phases of mine activities and action must be taken to mitigate impacts as soon as negative effects from mining related activities become apparent; and
- The method of monitoring must be designed to be subjective and repeatable in order to ensure consistent results.

5.2 Wetland Monitoring

Prudent monitoring of the wetlands within the MRA area is of utmost importance, as this will ensure a continual flow of data, enabling all parties involved to accurately assess and manage any potential impacts and any arising issues. To ensure the accurate gathering of data, the following techniques and guidelines should be followed:

- Site walk through surveys should be applied as the preferred method of monitoring (at specified frequencies) with specific focus on:
  - Erosion monitoring (for the duration of the raining season);
  - Sedimentation (for the duration of the raining season);
  - Alien and invasive vegetation proliferation (at the start and end of the growing season);
  - Spills events (regularly at the direction of the relevant engineer);
  - Surface water monitoring; and
  - Waste and litter problems.
- General habitat unit overviews should also be undertaken;
- Stability and appropriateness of stormwater controls;
- All data gathered should be measurable (qualitative and quantitative);
- Monitoring actions should be repeatable;
- Data should be auditable; and
- Reports should present and interpret the data obtained.

The table below illustrates data capturing for the monitoring plan. The monitoring plan comprises but is not limited to the following:

- Identification of areas of concern. These are areas that are affected by disturbances such as:
  - Erosion;
  - Waste dumping;
  - Alien vegetation species encroachment;

- Soil compaction; and

- Ensuring that the management measures are adhered to;
- A list of all alien vegetation species must be compiled as well as possible control methods such as manual, chemical or mechanical;
- Gathering all equipment required for the monitoring process; and
- Compiling a monitoring report.

This monitoring plan must be implemented by a competent person and submit the findings to the responsible authority for evaluation.

Table 4: Monitoring actions for the proposed development.

Aspect	Monitoring Location	Frequency of sampling	Frequency of Reporting	Report Content	Equipment
Overall Present Ecological State (PES)					
During all phases of the development	Assess all the wetland located within the MRA Area (as identified within the Freshwater Ecological Assessment Report)	PES assessment should be conducted annually (each assessment to be conducted within the same period of each year)	Report must be compiled following completion of the PES assessment	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Fixed point photography indicating the overall condition of the wetlands; and 5. Summary of the PES data, with comparison to the previous year's data	1. Camera 2. Notepad
Erosion					
Construction and operation phases	Cleared and compacted areas within close vicinity to the infrastructure footprint areas	Monitoring of erosion should occur during construction after every rainstorm and / flood, and during the operational phase monthly during first the wet season or during routine maintenance inspections, as applicable.	After every major rainstorm / flood. Monthly monitoring report compiled by the appointed ECO during the construction phase.	1. Brief indication of the method of assessment; 2. Assumptions and Limitations must be listed; 3. Fixed point photography an GPS point location taken of existing erosion (if applicable) within the wetlands; and 5. Map indicating where erosion is present.	1.GPS 2. Camera 3. Field Form 4. Measuring Tape
Surface Water Quality					
Pre-Construction	Water quality needs to be taken within the wetlands. GPS co-ordinates of the monitoring locality to be recorded.	Water must be tested at least once a month for a minimum of three months before construction commences. GPS co-ordinate of the monitoring point must be recorded so that monitoring takes place consistently at the same point.	Report must be compiled following completion of fieldwork.	Results of the following must be discussed in detail: Physio-Chemical Water Quality including pH, electrical conductivity, dissolved oxygen content as well as turbidity.	1.GPS 2. Camera 3. Field Form 4. Handheld multi probe 5. Clarity tube 6. DO Probe (only essential if high turbidity is apparent).
Construction	Monitoring must be undertaken at precisely the same locality as the pre-construction monitoring.	Water monitoring must be undertaken on a monthly basis in both the dirty water areas and the receiving environment.	Report must be compiled on a monthly basis for all data collected.	Compare results to pre-construction assessments and aspects as listed in pre-construction report content.	As listed in Pre-Construction Equipment
Operational Phase	Monitoring must be undertaken at precisely the same locality as the pre-construction monitoring.	Once every three months (quarterly) for the life of mine	A report must be generated every quarter (three months).	Compare results of pre-construction, construction and operational phase assessments and aspects as listed in pre-construction report content.	As listed in Pre-Construction Equipment
Alien Vegetation Control					

Aspect	Monitoring Location	Frequency of sampling	Frequency of Reporting	Report Content	Equipment
Pre-Construction, Construction and Operational Phase	All areas surrounding the wetlands, within its 32 m NEMA Zone of regulation	1. Regrowth of alien vegetation should be monitored monthly during the construction phase; and 2. Thereafter monitoring must be undertaken every three months during the operational phase, once at the end of the first growing season, and thereafter quarterly	Monthly monitoring report must be compiled by the appointed ECO during the construction phase and alien vegetation reported on at least quarterly	1. Provide a list of species occurring within the study area; 2. Discuss the density of invasion; 3. Wetland habitat integrity and risk to be discussed; 4. Fixed point photography (Taking photo at specific point at facing the same direction each time within priority area to show effect of alien vegetation control.); and 5. Map indicating where alien vegetation is present.	1. GPS; 2. Field Form; and 3. Camera

6. IMPACT STATEMENT

This report, after consideration and description of the ecological integrity of the MRA area and mining footprint area, must guide the Environmental Assessment Practitioner (EAP), authorities and potential developers, by means of recommendations, as to viability of the proposed mining development from an ecological point of view.

The MRA area comprises of agricultural lands, grazing fields, houses, and wetland areas. Within the MRA area, the wetland systems are considered to be the most sensitive, providing niche habitat to floral and faunal SCC. Although the Disturbed and Rocky Grasslands have been impacted upon by various agricultural land uses, they were noted to still provide habitat to several floral SCC. The proposed mining activities will have a direct impact on the Rocky and Disturbed Grasslands. Mining in these habitat areas will result in the loss of terrestrial habitat and floral SCC. A rescue and relocation plan for earmarked floral SCC is imperative in order to mitigate the overall loss of floral SCC diversity in the MRA area.

It must be ensured that the delineated boundaries of the wetlands and associated 32 m NEMA Zone of Regulation as well as the 100 m MBSP setback buffers are to be demarcated as 'no-go' areas, to prevent significant impact on the wetlands within the MRA area as a result of the proposed Rietkol project. It is worth mentioning that consultation of the hydropedological assessment of the wetlands should be undertaken in order to determine if any impacts to the wetland drivers (surface and subsurface recharge) may occur as a result of the proposed Rietkol project. Provided that all the mitigation measures as stated within the contents of the report are stringently implemented and impacts and edge effects are proactively monitored, the overall impacts on the terrestrial and freshwater ecosystems can be adequately mitigated for the life of the proposed Rietkol project.

Well managed water quality monitoring of dirty water infrastructure and wetlands within the MRA must be undertaken throughout the life of the mine (including post-closure) in order to ensure the health and functioning of the wetlands and associated terrestrial ecosystems are retained. Monitoring data must be utilised to proactively manage any identified emerging issues in a well-managed and overseen Biodiversity Action Management Plan (BAMP).

This impact assessment together with the studies on the ecological, physical and socio-cultural environment, serve to guide the Environmental Assessment Practitioner (EAP) and the relevant authorities in the application of the principles of Integrated Environmental Management (IEM) and the concept of sustainable development. The needs for conservation as well as the risks to other spheres of the physical and socio-cultural environment need to be

compared and considered along with the need to ensure economic development of the country. It is the opinion of the ecologists that this study provides the relevant information required in order to implement IEM and to ensure that the best long-term use of the resources in the MRA area will be made in support of the principle of sustainable development.

APPENDIX A - Jacana Risk Assessment Methodology

Impact Significance

Nature and Status

The 'nature' of the impact describes what is being affected and how. The 'status' is based on whether the impact is positive, negative or neutral.

Spatial Extent

'Spatial Extent' defines the spatial or geographical scale of the impact.

Category	Rate	Descriptor
Site	1	Site of the proposed development
Local	2	Limited to site and/or immediate surrounds
District	3	Victor Khanye Local Municipal Area
Region	4	Nkangalai District Municipal Area
Provincial	5	Mpumalanga Province
National	6	South Africa
International	7	Beyond South African borders

Duration

'Duration' gives the temporal scale of the impact.

Category	Rate	Descriptor
Temporary	1	0 – 1 years
Short term	2	1 – 5 years
Medium term	3	5 – 15 years
Long term	4	Where the impact will cease after the operational life of the activity either because of natural process or by human intervention
Permanent	5	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such a time span that the impact can be considered as transient

Probability

The 'probability' describes the likelihood of the impact actually occurring.

Category	Rate	Descriptor
Rare	1	Where the impact may occur in exceptional circumstances only
Improbable	2	Where the possibility of the impact materialising is very low either because of design or historic experience
Probable	3	Where there is a distinct possibility that the impact will occur
Highly probable	4	Where it is most likely that the impact will occur
Definite	5	Where the impact will occur regardless of any prevention measures

Intensity

'Intensity' defines whether the impact is destructive or benign, in other words the level of impact on the environment.

Category	Rate	Descriptor
Insignificant	1	Where the impact affects the environment is such a way that natural, cultural and social functions and processes are not affected. Localised impact and a small percentage of the population is affected
Low	2	Where the impact affects the environment is such a way that natural, cultural and social functions and processes are affected to a limited extent
Medium	3	Where the affected environment is altered in terms of natural, cultural and social functions and processes continue albeit in a modified way
High	4	Where natural, cultural or social functions or processes are altered to the extent that they will temporarily or permanently cease
Very High	5	Where natural, cultural or social functions or processes are altered to the extent that they will permanently cease and it is not possible to mitigate or remedy the impact

Ranking, Weighting and Scaling

The weight of significance defines the level or limit at which point an impact changes from low to medium significance, or medium to high significance. The purpose of assigning such weights serves to highlight those aspects that are considered the most critical to the various stakeholders and ensure that the element of bias is taken into account. These weights are often determined by current societal values or alternatively by scientific evidence (norms, etc.) that define what would be acceptable or unacceptable to society and may be expressed in the form of legislated standards, guidelines or objectives.

The weighting factor provides a means whereby the impact assessor can successfully deal with the complexities that exist between the different impacts and associated aspect criteria.

Spatial Extent	Duration	Intensity / Severity	Probability	Weighting factor	Significance Rating (SR - WOM) Premitigation	Mitigation Efficiency (ME)	Significance Rating (SRWM) Post Mitigation
Site (1)	Short term (1)	Insignificant (1)	Rare (1)	Low (1)	Low (0 – 19)	High (0.2)	Low (0 – 19)
Local (2)	Short to Medium term (2)	Minor (2)	Unlikely (2)	Low to Medium (2)	Low to Medium (20 – 39)	Medium to High (0.4)	Low to Medium (20 – 39)
District (3)							
Regional (4)	Medium term (3)	Medium (3)	Possible (3)	Medium (3)	Medium (40 – 59)	Medium (0.6)	Medium (40 – 59)
Provincial (5)	Long term (4)	High (4)	Likely (4)	Medium to High (4)	Medium to High (60 – 79)	Low to Medium (0.8)	Medium to High (60 – 79)
National (6)							
International (7)	Permanent (5)	Very high (5)	Almost certain (5)	High (5)	High (80 – 110)	Low (1.0)	High (80 – 110)

Impact significance without mitigation (WOM)

Following the assignment of the necessary weights to the respective aspects, criteria are summed and multiplied by their assigned weightings, resulting in a value for each impact (prior to the implementation of mitigation measures).

Equation 1:

Significance Rating (WOM) = (Extent + Intensity + Duration + Probability) x Weighting Factor

Effect of Significance on Decision-makings

Significance is determined through a synthesis of impact characteristics as described in the above paragraphs. It provides an indication of the importance of the impact in terms of both tangible and intangible characteristics. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required.

Rating	Rate	Descriptor
Negligible	0	The impact is non-existent or insignificant, is of no or little importance to decision making.
Low	1-19	The impact is limited in extent, even if the intensity is major; the probability of occurrence is low and the impact will not have a significant influence on decision-making and is unlikely to require management intervention bearing significant costs.
Low to Medium	20 – 39	The impact is of importance, however, through the implementation of the correct mitigation measures such potential impacts can be reduced to acceptable levels. The impact and proposed mitigation measures can be considered in the decision-making process
Medium	40 – 59	The impact is significant to one or more affected stakeholder, and its intensity will be medium or high; but can be avoided or mitigated and therefore reduced to acceptable levels. The impact and mitigation proposed should have an influence on the decision.
Medium to High	60 -79	The impact is of major importance but through the implementation of the correct mitigation measures, the negative impacts will be reduced to acceptable levels.
High	80 – 110	The impact could render development options controversial or the entire project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor and must influence decision making.

Mitigation

"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 because 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 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:

- 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 (reduce) impact: can be done through utilisation of alternatives that will ensure that impacts on biodiversity and eco-services provision are reduced. Impact minimisation is considered an essential part of any development project.
- Rehabilitate (restore) 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 toll 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 subject property 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 that 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 that 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 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 a last resort to compensate for residual negative impacts on biodiversity.

According to the DMR (2013) "Closure" refers to the process for ensuring that mining operations are closed in an environmentally responsible manner, usually with the dual objectives of ensuring sustainable post-mining land uses and remedying negative impacts on biodiversity and ecosystem services.

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.

Impact significance with mitigation measures (WM)

In order to gain a comprehensive understanding of the overall significance of the impact, after implementation of the mitigation measures, it is necessary to re-evaluate the impact.

Mitigation Efficiency (ME)

The most effective means of deriving a quantitative value of mitigated impacts is to assign each significance rating value (WOM) a mitigation effectiveness (ME) rating. The allocation of such a rating is a measure of the efficiency and effectiveness, as identified through professional experience and empirical evidence of how effectively the proposed mitigation measures will manage the impact. Thus, the lower the assigned value the greater the effectiveness of the proposed mitigation measures and subsequently, the lower the impacts with mitigation.

Equation 2: Significance Rating (WM) = Significance Rating (WOM) x Mitigation Efficiency (ME)

Mitigation Efficiency is rated out of 1 as follows:

Category	Rate	Descriptor
Not Efficient (Low)	1	Mitigation cannot make a difference to the impact
Low to Medium	0.8	Mitigation will minimize impact slightly
Medium	0.6	Mitigation will minimize impact to such an extent that it becomes within acceptable standards
Medium to High	0.4	Mitigation will minimize impact to such an extent that it is below acceptable standards
High	0.2	Mitigation will minimize impact to such an extent that it becomes insignificant

Significance Following Mitigation (SFM)

The significance of the impact after the mitigation measures are taken into consideration. The efficiency of the mitigation measure determines the significance of the impact. The level of impact is therefore seen in its entirety with all considerations taken into account.

APPENDIX B - Department of Water and Sanitation Risk Assessment Methodology

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

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

- An **activity** is a distinct process or task undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or infrastructure that is possessed by an organisation.
- An **environmental aspect** is an 'element of an organizations activities, products and services which can interact with the environment'[2]. The interaction of an aspect with the environment may result in an impact.
- **Environmental risks/impacts** are the consequences of these aspects on environmental resources or receptors of particular value or sensitivity, for example, disturbance due to noise and health effects due to poorer air quality. In the case where the impact is on human health or wellbeing, this should be stated. Similarly, where the receptor is not anthropogenic, then it should, where possible, be stipulated what the receptor is.
- **Receptors** can comprise, but are not limited to, people or human-made systems, such as local residents, communities and social infrastructure, as well as components of the biophysical environment such as freshwater features, flora and riverine systems.
- **Resources** include components of the biophysical environment.
- **Frequency of activity** refers to how often the proposed activity will take place.
- **Frequency of impact** refers to the frequency with which a stressor (aspect) will impact on the receptor.
- **Severity** refers to the degree of change to the receptor status in terms of the reversibility of the impact; sensitivity of receptor to stressor; duration of impact (increasing or decreasing with time); controversy potential and precedent setting; threat to environmental and health standards.
- **Spatial extent** refers to the geographical scale of the impact.
- **Duration** refers to the length of time over which the stressor will cause a change in the resource or receptor.

The significance of the impact is then assessed by rating each variable numerically according to the defined criteria (refer to the table below). The purpose of the rating is to develop a clear understanding of influences and processes associated with each impact. The severity, spatial scope and duration of the impact together comprise the consequence of the impact and when summed can obtain a maximum value of 15. The frequency of the activity, impact, legal issues and the detection of the impact together comprise the likelihood of the impact occurring and can obtain a maximum value

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

of 20. The values for likelihood and consequence of the impact are then read off a significance rating matrix and are used to determine whether mitigation is necessary[3].

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 (Act No. 107 of 1998) in instances of uncertainty or lack of information, by increasing assigned ratings or adjusting final model outcomes. In certain instances, where a variable or outcome requires rational adjustment due to model limitations, the model outcomes have been adjusted.

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

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

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

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

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

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

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4

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

More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

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

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

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

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

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

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

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

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

Table D8: Rating Classes

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	(L) Low Risk	Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.
56 – 169	M) Moderate Risk	Risk and impact on watercourses are notably and require mitigation measures on a higher level, which costs more and require specialist input. License required.
170 – 300	(H) High Risk	Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve License required.

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

Table D9: Calculations

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

The following points were considered when undertaking the assessment:

- Risks and impacts were analysed in the context of the *project's area of influence* encompassing:
  - Primary project site and related facilities that the client and its contractors develops or controls;
  - Areas potentially impacted by cumulative impacts for further planned development of the project, any existing project or condition and other project-related developments; and
  - Areas potentially affected by impacts from unplanned but predictable developments caused by the project that may occur later or at a different location.
- Risks/Impacts were assessed for construction phase and operational phase; and
  - Individuals or groups who may be differentially or disproportionately affected by the project because of their disadvantaged or vulnerable status were assessed.

Control Measure Development

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

- Mitigation and performance improvement measures and actions that address the risks and impacts[4] are identified and described in as much detail as possible. Mitigating measures are investigated according to the impact minimisation hierarchy as follows:
  - Avoidance or prevention of impact;
  - Minimisation of impact;
  - Rehabilitation; and
  - Offsetting.

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

- Measures and actions to address negative impacts will favour avoidance and prevention over minimisation, mitigation or compensation; and
- Desired outcomes are defined and have been developed in such a way as to be measurable events with performance indicators, targets and acceptable criteria that can be tracked over defined periods, wherever possible.

Recommendations

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

Table D10: Reversibility of impacts on the watercourses

Reversibility Rating:	**Irreversible** (the activity will lead to an impact that is permanent)
	Partially reversible (The impact is reversible to a degree e.g. acceptable revegetation measures can be implemented but the pre-impact species composition and/or diversity may never be attained. Impacts may be partially reversible within a short (during construction), medium (during operation) or long term (following decommissioning) timeframe
	Fully reversible (The impact is fully reversible, within a short, medium or long-term timeframe)