Environmental Impact Assessment Report
And
Environmental Management Plan

for Listed Activities Associated with the proposed Mogale Tailings Retreatment Operation, situated in the West Rand

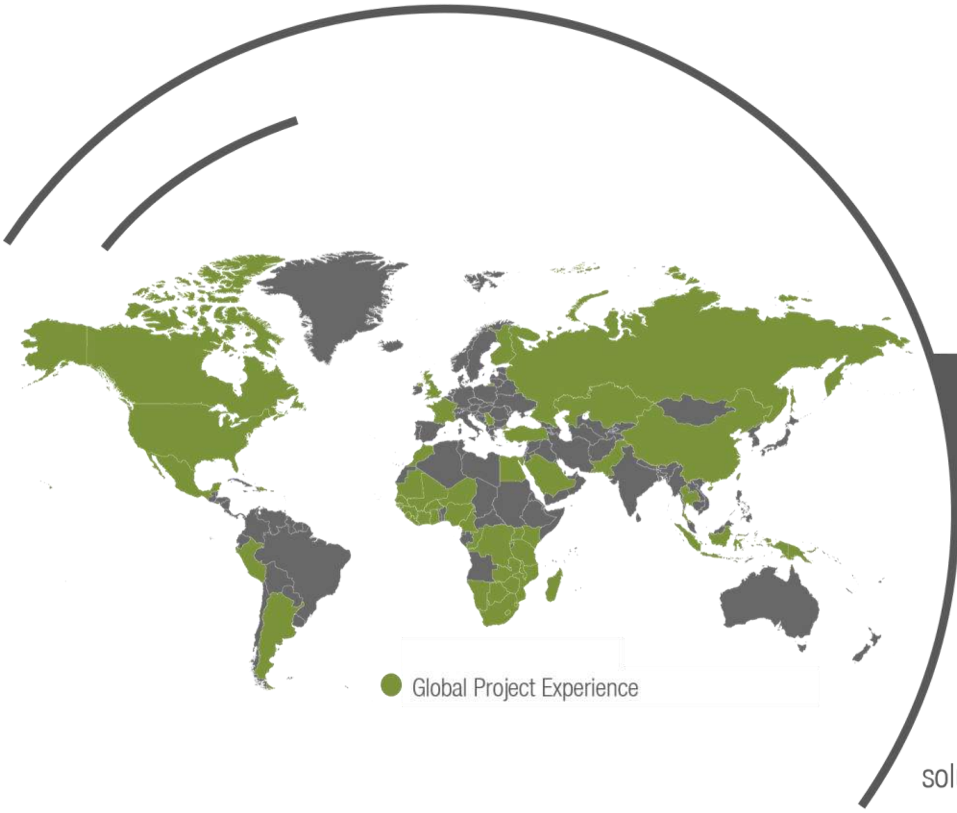
DMRE Reference Number GP30/5/1/2/2/ (206) MR

PART B

Environmental Authorisation in Support of the Mogale Tailings Retreatment Operation

SUBMITTED FOR ENVIRONMENTAL AUTHORISATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) (NEMA) AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 (ACT NO. 59 OF 2008) (NEM:WA) IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (ACT NO. 28 OF 2002) (MPRDA) (AS AMENDED).

Appendix D: Soils, Land Use and Land Capability Assessment



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Mogale Tailings Retreatment Operations Environmental Application Process

Soils, Land Use and Land Capability Impact Assessment

Prepared for:
Pan African Resources PLC (PAR)

Project Number:
PAR7273

December 2021

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This document has been prepared by Digby Wells Environmental.

Report Type:	Soils, Land Use and Land Capability Impact Assessment
Project Name:	Mogale Tailings Retreatment Operations Environmental Application Process
Project Code:	PAR7273

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I **Willnerie Janse van Rensburg**, 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, 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; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

November 2021

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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EXECUTIVE SUMMARY

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

Mogale Tailings Retreatment (Pty) Ltd (MTR) a wholly owned subsidiary of Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation to be completed by 30th September 2022. The proposed transaction has now been concluded and was announced on the 6th October 2022.

PAR has closed the transaction to acquire the total share capital and claims of Mogale Gold and Mintails SA Soweto Cluster Proprietary Limited (MSC), (collectively, the Sale Transaction). Both Mogale Gold and MSC are 100% owned by Mintails Mining SA Proprietary Limited (Mintails SA), which was placed in provisional liquidation during 2018. Based on this PAR has now acquired the assets associated with MR 206, based on the conclusion of the transaction noted above.

The project entails the reclamation of historical unlined Tailings Storage Facilities (TSFs). The reprocessed tailings will be first discarded into West Wit Pit and possibly other nearby small pits. Any extra processed tailings will be stored on a ground TSF (West Wits Pit TSF and 1L23-1L25 TSF). It is proposed that the footprint of 1L23-1L25 footprint will be lined and the footprint of West Wits Pit TSF will not be lined.

This report should be read in conjunction with the other specialist studies of the EA and constitutes the Soil, Land Use and Land Capability Impact Assessment in support of the EIA process and compilation of the EMPr, IWULA and IWWMP for the Project.

The site is located in the West Rand, in the Gauteng Province. The site was historically located within the Soweto Highveld Grasslands, however vegetation has almost completely been altered. The site comprises existing infrastructure such as Tailings Storage Facilities (TSFs), sand dumps, Lancaster Dam and an open pit. The reclamation project will entail the reprocessing of these TSFs. A process plant, overland pumping and piping inclusive of associated water management infrastructure will form part of the proposed infrastructure that will require an authorisation.

The area falls within the Witwatersrand Supergroup Formations. The topography of the Project Area, has been severely affected by the historical mining and current Artisanal and Small Mining (ASM) activities, with the West Wits Pit leaving a deep incision and the surrounding barren rock dumps altering the horizon. The average slope for the entire Project Area varies due to the high concentration of mining, urban developments and infrastructure in the area.

Soil

Baseline data suggested that the land types are predominantly of the Ba35 and Ba36 types, consisting of Witwatersrand quartzite, slate, grit and conglomerate predominantly with widespread dystrophic and/or mesotrophic and red soils. The soil forms identified on site includes Arcadia, Avalon, Bainsvlei, Bloemdal, Clovelly, Hutton, Katspruit, Kroonstad, Longlands, Pinedene, Dresden, Glencoe, Rensburg and Witbank (including tailings material, ASM impacted areas and anthropological impacted soils). ASM is currently a major activity / land use in the area, causing various impacts to the soils, geomorphology and land. The area is excavated to extensive depths, specifically within low lying areas and wetlands, affecting the functionality thereof and causing large areas of sedimentation and potential soil and water contamination.

Land Use

The current impacts to the soils, land use and land capability are dominantly associated with historical and current mining activities (i.e., mine pits, TSFs and infrastructure), anthropological activities (historical land fill sites, roads, dams, powerlines, pipelines, culverts, bridges) and agriculture. The area is heavily impacted with large areas of erosion gullies, sedimentation into the low-lying areas, tailings material scattered throughout the area, large excavations and infillings, informal mine pits and infrastructure. The land capability ranges from low to high, however is dominantly low due to the current conditions on site.

These land use activities has severely impacted the soil chemical and physical characteristics, impacting the land use and land capability of the area. There are clear evidence of potential contamination of the soils from the existing tailings dumps which will affect the rehabilitaiton success post-mining.

Land Capability

The dominant land capability of the area was rated as **Low** and **Medium**, including wildlife, light grazing and moderate grazing in some areas. The soil form, erosion potential, current land use and soil characteristics all form part in defining the land capability of each soil form. The soils within the capability classes are similar only with respect to the degree of limitations in soil use for agricultural purposes or with respect to the impact on the soils when they are so used. Soils that are capable to be used for cultivation will have a higher land capability than soils being used for mining or wildlife.

Conclusion

It is the opinion of the specialist that this project will have **negligible negative** impacts on the soils, land use and land capability. Moreover, it is in the opinion of the specialist that the mining of the tailings material with implementation of appropriate mitigation measures, as detailed in this report, may yield positive impacts. The Project could potentially have various advantages to the immediate area as well as the municipal area. The Project Area is currently heavily impacted, formal mining activities and the removal/ mining of the tailings material should reduce the current impacts to the environment.

Positive impacts to the soil, land use and land capability may include:

- Soil and tailings material remediation and rehabilitation, increasing the soil potential, fertility and basal cover;
- Removal and disposal of potential impacted soils;
- Removal of AIPs and increased soil and land potential;
- Increased soil, land use and land capability; and
- Additionally pipelines and plant facilities are located on already disturbed areas.

It is however recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential residual impacts to soils to maintain the land capability for future land use.

Recommendations are made to ensure that the rehabilitation plan, mitigation measures, and continuous monitoring measures are in place, and encourage a concurrent rehabilitation and monitoring plan.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degrees Celsius
ARC	Agricultural Research Council
ASM	Artisanal and Small Scale Mining
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CEC	Cation Exchange Capacity
CMA	Catchment Management Agency
Digby Wells	Digby Wells Environmental
EC	Electrical Conductivity
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPr	Environmental Management Programme
GPS	Global Positioning System
ha	Hectare
I&APs	Interested and Affected Parties
IFC	International Finance Corporation
ISCW	Institute for Soil, Climate and Water
km	Kilometre
L	Litre
m	Metre
m.a.m.s.l.	Metres above mean sea level
MCLM	Mogale City Local Municipality
Mintails	Mintails SA Mining SA (Pty.)
mm	Millimetre
MM	Mine Manager
MPRDA	Mineral and Petroleum Resources Development Act 2002 (Act No. 28 of 2002)
MR	Mining Right
MRA	Mining Right Area
NEM: WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)

NWA	National Water Act, 1998 (Act No. 36 of 1998)
OC	Organic Carbon
PAR	Pan African Resources
PPP	Public Participation Process
SANAS	South African National Accreditation System
SEP	Stakeholder Engagement Process
SSV	Soil Screening Values
TMP	Topsoil Management Plan
TSF	Tailings Storage Facility
WMA	Water Management Area
WRDM	West Rand District Municipality
WUL	Water Use License
WWP	West Wits Pit
Chemical Element Abbreviations	
Al	Aluminum
As	Arsenic
B	Boron
Ca	Calcium
Cl	Chlorides
Cu	Copper
F	Fluoride
Mg	Magnesium
Mn	Manganese
Hg	Mercury
Ni	Nickel
Pb	Lead
NH4, NH2	Nitrates-nitrite
P	Phosphorus
K	Potassium
Na	Sodium
Zn	Zinc
S	Sulphates

Legal Requirement		Section in Report
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	(i) and (ii)
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	(ii)
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	2.3
cA	And indication of the quality and age of the base data used for the specialist report;	6
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	9
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	6
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	6 and Appendix A
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	10
(g)	an identification of any areas to be avoided, including buffers;	10
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	2.2
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	8
(k)	any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	13
(l)	any conditions/aspects for inclusion in the environmental authorisation;	14
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	14
(n)	a reasoned opinion (Environmental Impact Statement) -	17

	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	15
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	12.3

1. Introduction

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

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Mogale Gold owns the right to extract and process gold from tailings recourses by reprocessing old gold mine slimes dams and sandy mine dumps left by the extensive historic mining activities that have taken place in the area since 1888. MTR (PAR) is only interested in the surface operations associated with Mining Right (MR) 206 (i.e., Tailings Storage Facilities (TSFs) for reclamation, processing and deposition), and therefore the focus of this application process.

The Project consists of 120 Mt of tailings to be reprocessed and firstly deposited into the West Wits Pit (current authorisation in place for in-pit deposition) and then undertake deposition of the footprint of 1L23-1L25 footprint (New Tailings Facility) once capacity has been reached within the West Wits Pit.

Alternatives are being considered for potential deposition of tailings material into the other pits in the area.

It must be noted that once the West Wits Pits reaches capacity the surface deposition will extend in a northern direction from the pit onto surface, expanding the deposition footprint associated with West Wits Pit.

There are six dumps being considered to be reprocessed, the largest of which amounts to 57.9 Mt, while the smallest contains 0.57 Mt. The primary location of processed tailings storage has been earmarked for deposition in the West Wits Pit.

This report should be read in conjunction with the other specialist studies of the Environmental Assessment (EA) and constitutes the Soil, Land Use and Land Capability Impact Assessment in support of the EIA process and compilation of the Environmental Management Program (EMPr), Integrated Water Use License Application (IWULA) and Integrated Wate Water Management Plan (IWWMP) for the Project, in accordance with the following relevant legislation:

- EIA Regulations, 2014 (General Notice (GN) R982 of 04 December 2014, as amended) (the "EIA Regulations, 2014) promulgated under the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- A Waste Management Licence (WML) in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA); and
- An Integrated Water Use Licence (IWUL) in terms of the National Water Act, 1998 (Act No. 36 of 1998) (NWA).

2. Project Description

Mogale plan to undertake activities relating to reclamation associated with gold-bearing TSFs through hydraulic reclamation. Digby Wells were appointed as the Independent Environmental Consultant to undertake the Environmental Impact Assessment (EIA) Application process which comprises of an Air Emission Licence (AEL) and Water Use Licence (WUL) for the proposed gold-bearing TSFs.

The site is located in the West Rand, in Gauteng Province. The site comprises of existing infrastructure such as sand dumps, Lancaster Dam and an open pit that will be used for the deposition of tailings materials. Tailings will be deposited into Lancaster pit. A process plant, overland pumping and piping inclusive of associated water management infrastructure will form part of the proposed infrastructure that will require an authorisation. Once the open pit is filled to capacity, a new TSF will potentially be constructed on the footprint area of one of the reclaimed TSF sites (1L23-1L25) (Figure 2-2). The footprint of the area is 2 923.3 hectares (ha) which considers MR 206 and associated infrastructure.

Ancillary infrastructure such as pipelines, powerlines and pumps will be required for the proposed reclamation activities and will be included in support of the Environmental Application Process, which will be undertaken.

2.1. Project Locality

The Mining Right Area of the Mogale Cluster includes: G1, G2 plant; Cams, North Sand; South Sand; 1L23-1L25; 1L28; 1L13-1L15; 1L8, 1L9; 1L10; West Wits Pit (WWP) and Lancaster Dam. The mining right is located on Portions 66 and 99 of the farm Waterval 174 IQ and portions 136 and 209 of the farm Luipaardsvlei 246 IQ.

The Project is within the Mogale City Local Municipality (MCLM), which is located within the West Rand District Municipality (WRDM). MCLM is the regional services authority and the area falls under the jurisdiction of the Krugersdorp Magisterial District.

The site is located in the catchment of the Upper Wonderfonteinspruit, quaternary catchment C23D, which forms part of the Vaal River Water Management Area (WMA) within the Vaal Catchment Management Agency (CMA). The project is about 4 km south of Krugersdorp and north-east of Randfontein, approximately 10 kilometres (km) off the N14 National Road in the Gauteng Province, in an area that has been transformed by past gold mining activities.

The Project locality of the site is illustrated in Figure 2-1 and Figure 2-2.

Table 2-1: Summary of the Project Area Project Location Details

Province	Gauteng
District Municipality	West Rand District Municipality
Local Municipality	Mogale Local Municipality
Nearest Town	Krugersdorp (4 km), Randfontein (4 km)
GPS Co-ordinates (relative centre point of Project Area)	26°07'45.54"S
	27°45'40.85"E

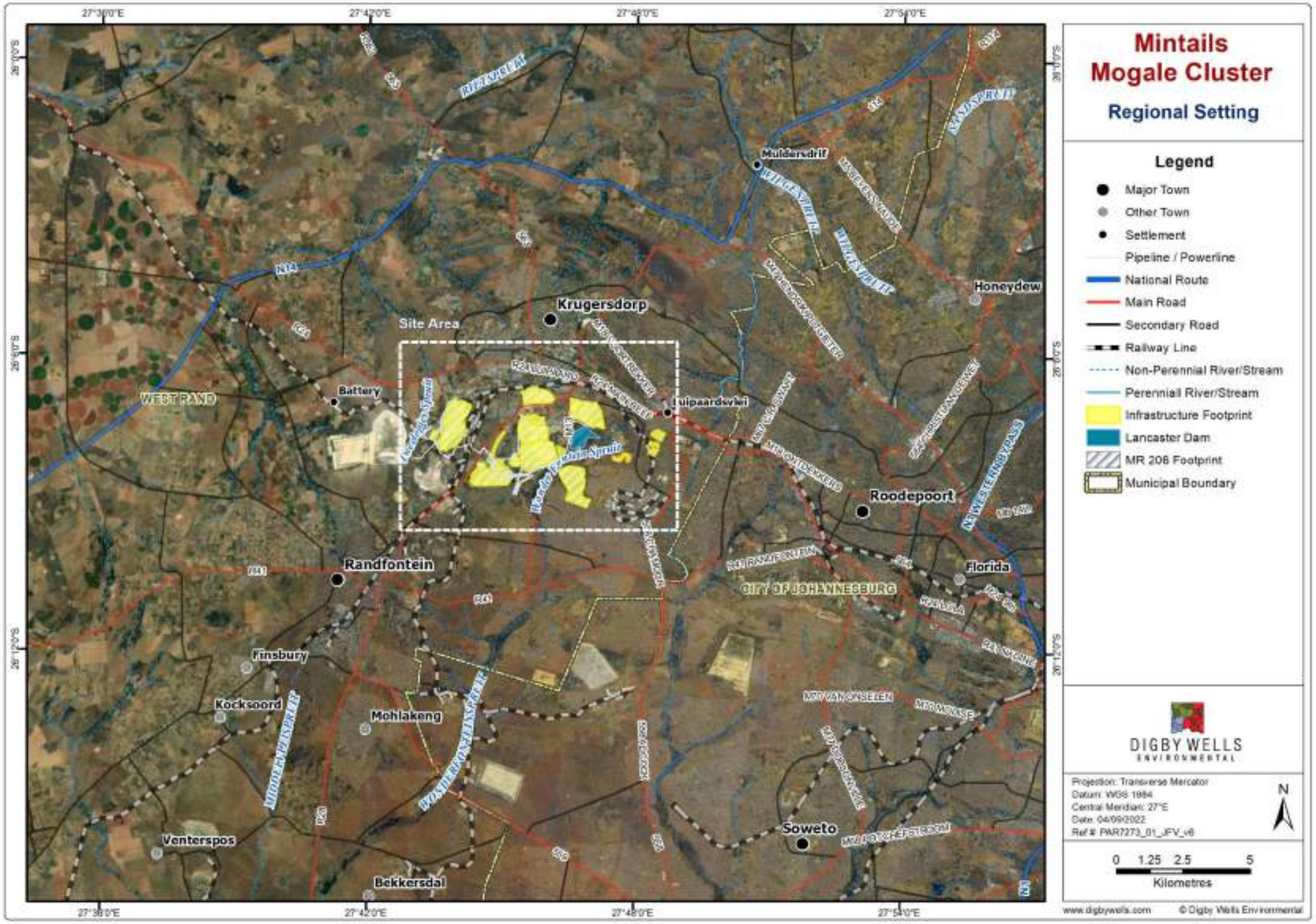

Figure 2-1: Regional Setting

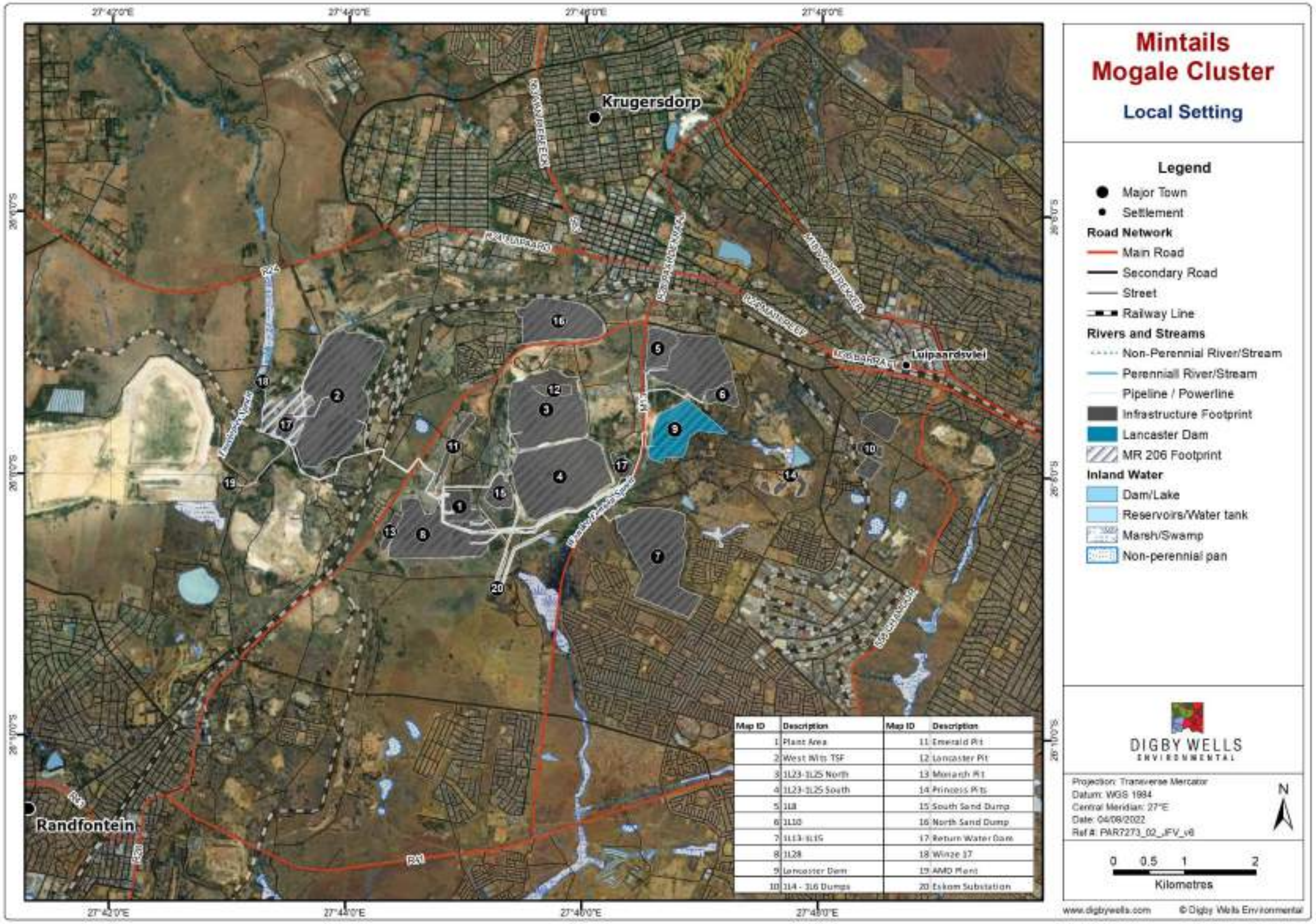

Figure 2-2: Local Setting

2.2. Proposed Infrastructure and Activities

The proposed infrastructure (Figure 2-3) and activities of the Project per phase are provided in Table 2-2 below.

Table 2-2: Project Phases and Associated Activities

Project Phase	Associated Activities
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.
	Operation of pump stations during the operational phase.
	Maintenance of pipeline routes during the operational activities.
	Infilling of processed tailings material into the West Pits Pit and other potential pits.
	Surface tailings deposition within the West Wits Pit.
	Tailings deposition onto the historic footprint of 1L23-1L25 (lined).
	Production of Gold.
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.
	Removal, decommissioning and rehabilitation of the processing plant footprint.
	Rehabilitation of the old TSF footprints.
	Rehabilitation of the old Mogale Processing Plant footprint.
	Final rehabilitation of the facility.
	General rehabilitation of the surrounding area, including wetland rehabilitation.

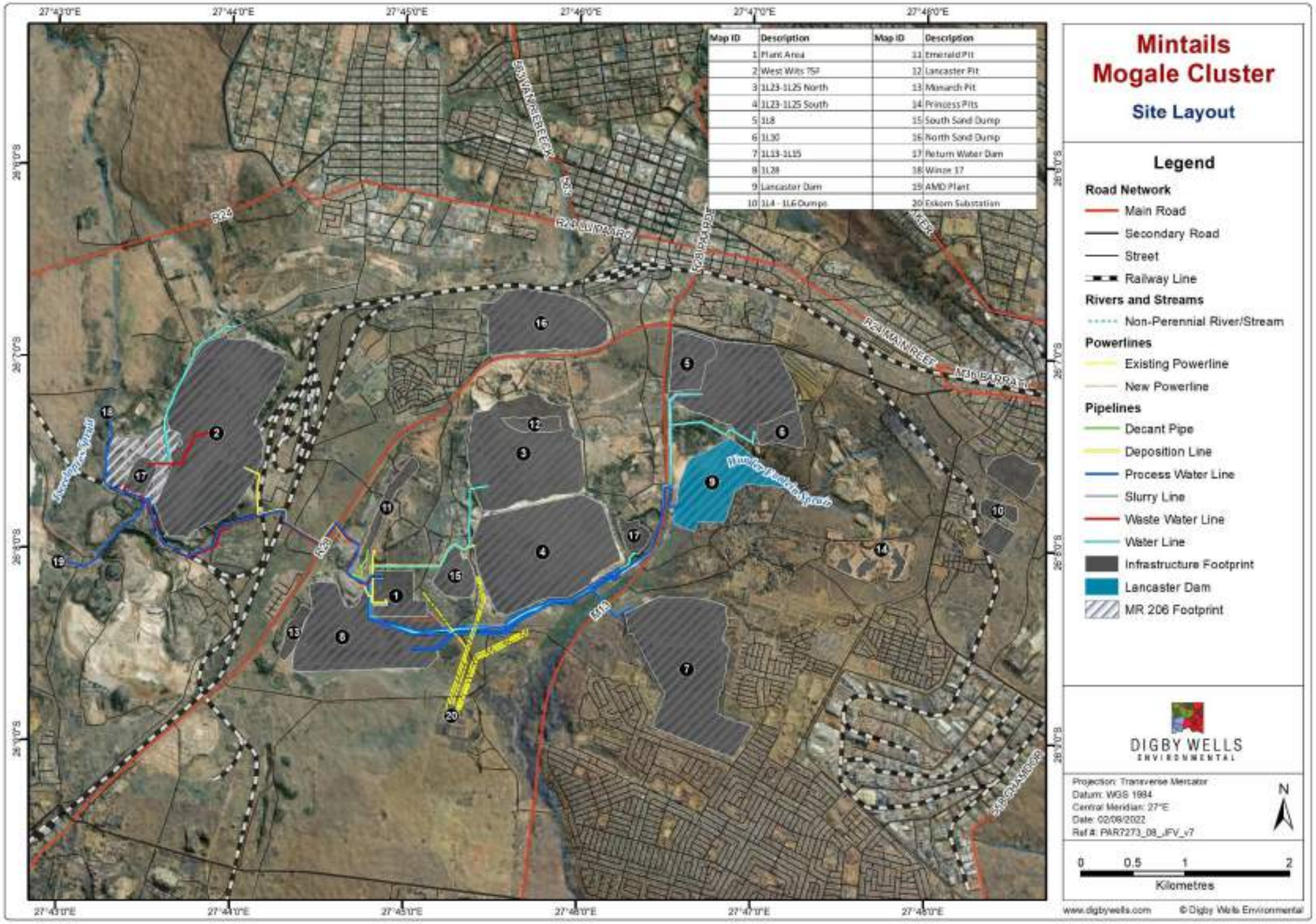

Figure 2-3: Proposed Site Layout of the Project Area

2.3. Scope of Work

The field assessment for the Soil, Land Use and Land Capability Impact Assessment was carried out on the 12th and 13th of October 2021 at the end of the dry season. The Scope of Work for the Impact Assessment include:

- **Desktop Review**: Review of all existing data for the collation of available information concerning the site and proposed work. Historical data of the Project Area was assessed regarding land use and identification of incidents (risks) that may have occurred, and could have impacted the soil, land use, and capability. Review of existing data relating to soil form, soil depth, soil texture, laboratory analysis data, and soil classification within the Project Area;
- **Soil Survey**: An initial soil desktop delineation was conducted before the site visit using historical data and Google Earth imagery. The soil delineation was verified during a two-day site visit. A hand soil auger was used to survey the soil depth and soil forms, with survey positions being recorded as waypoints. Due to time and access constrains, focus was given to the proposed surface infrastructure areas and sensitive areas, such as wetlands and low-lying areas;
- **Land Use**: Existing land use data was verified during the site visit. This was mapped in conjunction with existing soil survey data and land use/cover data;
- **Land Capability**: Land Capability was assessed using the soil classification, soil form, depth, drainage, terrain, and climatic features. A map delineating the areas was produced for a visual representation of the most suitable areas for crop production;
- **Impact Assessment**: Identification of historical, and current impacts on soils, land use, and land capabilities of the Project was assessed; and
- **Recommendations:** Mitigation recommendations to develop a rehabilitation and management plan for the Run of Mine (RoM) was assessed and are presented in this report.

3. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the National legislations, regulations, guidelines and by-laws. The guidelines directing the Soil, Land Use and Land Capability Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). NEMA (as amended) was set in place in accordance with Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24(1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment, must be considered, investigated and assessed prior to their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.	Activities that will influence the soil of the proposed Project Area are listed in Section 2.2 and has been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation prior to being undertaken. The EIA process was undertaken to identify potential impacts to the soil, land use and land capability, including erosion, soil depth, soil form and areas dominated by Alien Invasive Plants (AIPs). As part of the Assessment, applicable mitigation measures, monitoring plans and/or remediation were recommended to ensure that any potential impacts are managed to acceptable levels to support the rights as enshrined in the Constitution.
National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA). The NEM: WA seeks to regulate waste management to protect health and environment by providing reasonable measures, including the provision of the remediation of contaminated land. Section 7(2)(d) of the NEM: WA sets the National Norms and Standards for the remediation of contaminated land and soil quality.	A Soil Impact Assessment was undertaken as part of the EIA Phase. The Project activities were assessed to abide with the NEM: WA and the Soil Screening Values (SSV). The required mitigation measures are included in Section 1 to form part of the EMPr as part of the EIA.
The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA). The CARA is to provide control over the utilization of the natural agricultural resources to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants, and the matters connecting therewith. CARA defines the environmental conservation regulations as the protection of land against soil erosion, the	A Soil Impact Assessment was undertaken as part of the EIA Phase. The required mitigation measures are included in Section 1 to provide control over the natural agricultural resources to promote conservation of the soil, land use and land capability.

Legislation, Regulation, Guideline or By-Law	Applicability
prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained.	

4. Assumptions, Limitations and Exclusions

The compilation of this report is based on the assumptions and limitations in Table 4-1.

Table 4-1: Limitations and Assumptions with Resultant Consequences

Assumptions and Limitations	Consequences
Due to historical and current land use activities (dominantly historical and current mining and Artisanal and Small Scale Mining (ASM) activities) some areas have been highly impacted, specifically the naturally occurring soils, vegetation, hydrology and geomorphology	• Field verification was limited to areas where access was granted • Some discrepancies within the Project Area may occur such as the confidence level of soil delineations as soil types were extrapolated from scattered samples points taken during the assessment, contours, topography and specialist opinion • The impacts to the soils are evident from aerial imagery and were confirmed during the field surveys where the areas were accessible. Due to the nature of impacts and current land uses, some areas were inaccessible and were desktop delineated
Land suited for crop production (high agricultural capability) was assumed also to be suitable for other, less intensive uses such as pasture, natural grazing, forestry and wildlife	The land identified to be of high agricultural importance for crop production, are also suitable for lower land use classes
The soils within the capability classes are similar only with respect to the degree of limitations in soil use for agricultural purposes or with respect to the impact on the soils when they are so used	Not all soils have the same land use and are used according to their capabilities, each soil will react differently to the land use and impacts to the soils
Soils are contiguous hence differentiation is not abrupt, and the transition zone cannot be completely captured during any given soil survey.	The soil distribution map of the Project Area may not be absolutely accurate.

5. Details of the Specialists

The following is a list of Digby Wells' staff who were involved in the Soil Impact Assessment:

- **Arjan van 't Zelfde** is a Senior Consultant with 16 years' experience in soil science and hydrogeology. Arjan received a M.Sc. degree in Soil Science (SAQA approved) as part of the B.Sc./M.Sc. programme Soil, Water and Atmosphere, Wageningen University, The Netherlands. He specialises in soil capability assessments, soil contamination assessments and hydrogeological numerical groundwater flow modelling and has worked in multiple countries such as The Netherlands, Ireland, Senegal and South Africa. Arjan is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (Registration Number: 115656).

- **Kathryn Terblanche** is the Rehabilitation and Soils Manager at Digby Wells. She received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She also has received her M.Sc. in Restoration Ecology through the University of KwaZulu-Natal. Kathryn is an ecologist with fields of interest in wetlands, flora, restoration and rehabilitation. In her eight-year career she has undertaken various wetland delineations and assessments, flora assessments, rehabilitation assessments and audits, as well as project management of various implementation projects. She has also worked extensively with alien invasive species removal programmes, ecological restoration projects and sustainable development programmes within the Government Sector. She has published a variety of environmental documents/articles and presented at various South African and international conferences.
- **Willnerie Janse van Rensburg** is a Soil Scientist in the Rehabilitation, Closure and Soils Division at Digby Wells. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has five years' experience in the fields of Soil Science and Environmental Science. She has experience in completing soil surveys, land capability assessments, irrigation scheduling and provides recommendations on soil amelioration. Willnerie also completes wetland delineations and assessments. She has undertaken work in Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Aamirah Dramat** is a Junior Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments. Aamirah is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

- **Dennis Komape** is a Junior Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. He received his National Diploma and B-Tech in Nature Conservation from Tshwane University of Technology. He also received his MSc in Environmental Sciences through the North-West University. In his 8 year career he has undertaken Alien Invasive Plant (AIP) Assessments, Faunal and Floral Biodiversity Assessments, Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation Strategy and Implementation Plans (RSIPs) and long-term monitoring of rehabilitation trials. Dennis has conducted work throughout South Africa, Lesotho and Malaysia. Dennis is registered as a Certified Scientist with the South African Council for Natural Scientific Professions (SACNASP) and his registration number is 119325.
- **Pierre de Kock** is an Intern in Mine Closure and Rehabilitation Services Department where he specialises in Mine Closure and Rehabilitation. Pierre received his Bachelor of Science in, Environmental and Biological science as well as his Honours degree in Ecological Interactions and Ecosystem Resilience from the University of Potchefstroom.

6. Methodology

This section provides the methodology used in the compilation of the Soil, Land Use and Land Capability Impact Assessment. A detailed methodology is described in Appendix A and is summarized in Figure 6-1 below.

Desktop Assessment and Literature Review

The following sources were used to obtain baseline soil information such as generalised soil patterns and terrain types for the Project site:

- South African land type data by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006);
- Existing Land Type data (Land Type Survey Staff, 1972 - 2006) and
- Aerial imagery to determine areas that are most likely to be suitable for agriculture. The aerial imagery analysis focused on lower lying areas where suitable soils for agriculture are more likely to occur.

Soils and land use desktop delineation prior to the field surveys using aerial imagery.

Soil Classification

A hand soil auger was used to determine the soil properties to a maximum depth of 1.2 m or to the first restricting layer. Soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991) . Soil Properties included:

- Topography, aspect and slope;
- Soil form and family;
- Soil depth;
- Estimated soil texture;
- Soil structure, coarse fragments, calcareousness;
- Underlying material; and
- Vegetation.

Soil Physical and Chemical Analysis

Collection of representative soil samples with analysis at an accredited laboratory. In accordance with the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990), the samples were tested for:

- Soil fertility;
- Potential harmful elements;
- Heavy metals; and
- Soil particle distribution (Clay, Sand and Silt).

Land Use and Land Capability

Land use was identified by aerial imagery during the desktop assessment and verified during the site-inspection. Land use maps indicate delineated areas of similar land use.

Land capability is defined by the most suitable land use under rain-fed conditions. Land capability was determined by assessing a combination of soil, terrain and climate features. The land was rated into 8 classes with subgroups that have the same relative degree of limitation or potential.

Impact Assessment

The soil impacts were assessed based on the impact's magnitude and the receiving environment's sensitivity, which identified the most important impacts that require management. The following criteria were taken into consideration when potentially significant impacts were examined relating to soils:

- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

Mitigation recomendations

Provide recommendations to reduce adverse effects on the soil resources of the Project Area and develop a rehabilitation and monitoring plan for the Project.

Mitigation measures are provided to avoid, minimize and rehabilitate soils within the Project Area. The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented

Figure 6-1: Soil, Land Use and Land Capability Assessment Methodology

7. Regional Baseline Environment and Desktop Revie

Relevant literature was reviewed prior to the field assessment concerning the Soil, Land Use and Land Capability associated with the Project Area. Baseline and background information was researched and used to understand the Project Area prior to undertaking the fieldwork component and is described in Table 7-1 below.

Table 7-1: Baseline Environment of the Project Area

Characteristics of the Highveld Ecoregion (Kleynhans, Thirion, & Moolman, 2005)	
Terrain Morphology	The area has a low to moderate relief with plains, lowlands; hills, closed hills, open hills and mountains across the landscape.
Vegetation Types	The area consist of mixed bushveld (limited), rocky highveld grassland, dry sandy highveld grassland, dry clay highveld grassland, moist cool highveld grassland, moist cold highveld grassland, north-eastern mountain grassland, moist sandy highveld grassland, wet cold highveld grassland (limited), moist clay highveld grassland and patches Afromontane forest (very limited).
Altitude (m.a.m.s.l.) (modifying)	1667
Regional Slope (degrees)	0 to 79
Mean Annual Precipitation (MAP) (mm) (Secondary)	784
Coefficient of Variation (% MAP)	<20 to 35
Rainfall Seasonality	Early to late summer
Mean Annual Temp. (°C)	15.9
Mean Daily Summer Temp. (°C): February	10 to 32
Mean Daily Winter Temp. (°C): July	-2 to 22
Median Annual Simulated Runoff (mm)	5 to >250

Plant Species Characteristic of the Soweto Highveld Grasslands (Mucina & Rutherford, 2012) (Figure 7-1)	
Graminoids	*Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. planiculmis, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis subsp. galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra and Paspalum dilatatum.*
Herbs	*Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera var. aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium var. nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala and Wahlenbergia undulata.*
Geophytic Herbs	*Haemanthus humilis subsp. Hirsutus and H. montanus.*
Herbaceous Climber	*Rhynchosia totta.*
Low Shrubs	*Anthospermum hispidulum, A. rigidum subsp. pumilum, Berkheya annectens, Felicia muricata and Ziziphus zeyheriana.*
Status	Endangered.
Topography and Slope (Figure 7-2 and Figure 7-3)	
The topography of the Project Area, as depicted in Figure 7-2 has been severely affected by the historical mining and current ASM activities, with the West Wits Pit leaving a deep incision and the surrounding barren rock dumps altering the horizon (Golder Associates Africa (Pty) Ltd, 2014; Golder Associates Africa (Pty) Ltd, 2014a). The elevation of the Project Area ranges from 1 659-1 843 meters above mean sea level (m.a.m.s.l.) which equates to a range of 105 m between the lowest and highest points of elevation within the Project Area. The average slope for the entire Project Area varies due to the high concentration of mining, urban developments and infrastructure in the area (Figure 7-3).	
Geology and Lithology (Figure 7-4)	
The Project Area is situated within the Witwatersrand Supergroup Formations consisting of the following lithologies: • Rbo: Shale and subordinate quartzite;	

		• Rg: Quartzite, shale and minor/subordinate conglomerate; • Rjo: Quartzite, subordinate conglomerate, shale and amygdaloidal lava; • Rk: Tholeiitic basalt; • Rt: Quartzite and conglomerate; • Vbr: Quartzite, subordinate conglomerate and shale; and • Vma: Dolomite, subordinate chert, minor carbonaceous shale, limestone and quartzite.

Land Types and Dominant Soil Forms (Figure 7-5)			
Land Type	Soil Form	Geology	Characteristics
Ba35	• Avalon • Cartref • Clovelly • Dundee • Fernwood • Glencoe • Glenrosa • Hutton • Katspruit • Kroonstad • Longlands • Mispah • Rensburg • Westleigh • Willowbrook	• Witwatersrand quartzite, slate, grit and conglomerate predominantly; • Black Reef quartzite, shale, grit and conglomerate in the western part; • Ecca shale and sandstone with occasional dolerite sills in the east; • Sporadic occurrence of Basement Complex granite, dolomite and Ventersdorp lava mainly to the west; and • Pans occupy 1% of land type.	• Plinthic Catena: upland duplex and margalitic soils are rare with widespread dystrophic and/or mesotrophic and red soils; • Red and yellow, dystrophic/mesotrophic, apedal soils with plinthic subsoils; • Plinthic soils comprise >10% of the land type; and • Red soils comprise >33% of the land type.
Ba36	• Avalon • Cartref • Clovelly • Dundee • Fernwood • Glencoe • Glenrosa • Hutton • Katspruit • Kroonstad • Longlands • Mispah • Rensburg • Westleigh • Willowbrook	• Witwatersrand quartzite, slate, grit and conglomerate predominantly; • Black Reef quartzite, shale, grit and conglomerate in the western part; • Ecca shale and sandstone with occasional dolerite sills in the east; • Sporadic occurrence of Basement Complex granite, dolomite and Ventersdorp lava mainly to the west; and • Pans occupy 0.4% of land type.	

Land Capability (Figure 7-6)			**Land Use (Figure 7-7)**

Class	Classification	Dominant Limitation Influencing the Physical Suitability for Agricultural Use	The land use is described as:
			• Predominantly:
			  • Mine.
			• Minor Areas:
			  • Grassland;
			  • Wetlands;
			  • Bare (non-vegetated);
			  • Plantation;
			  • Commercial Area;
			  • Pans;
			  • Land-fills;
			  • Industrial Area; and
			  • Woodlands/forest.

III	Arable Land – Moderate Cultivation / Intensive Grazing	Soils have severe limitations that reduce the choice of plants or require special conservation practices, or both.	

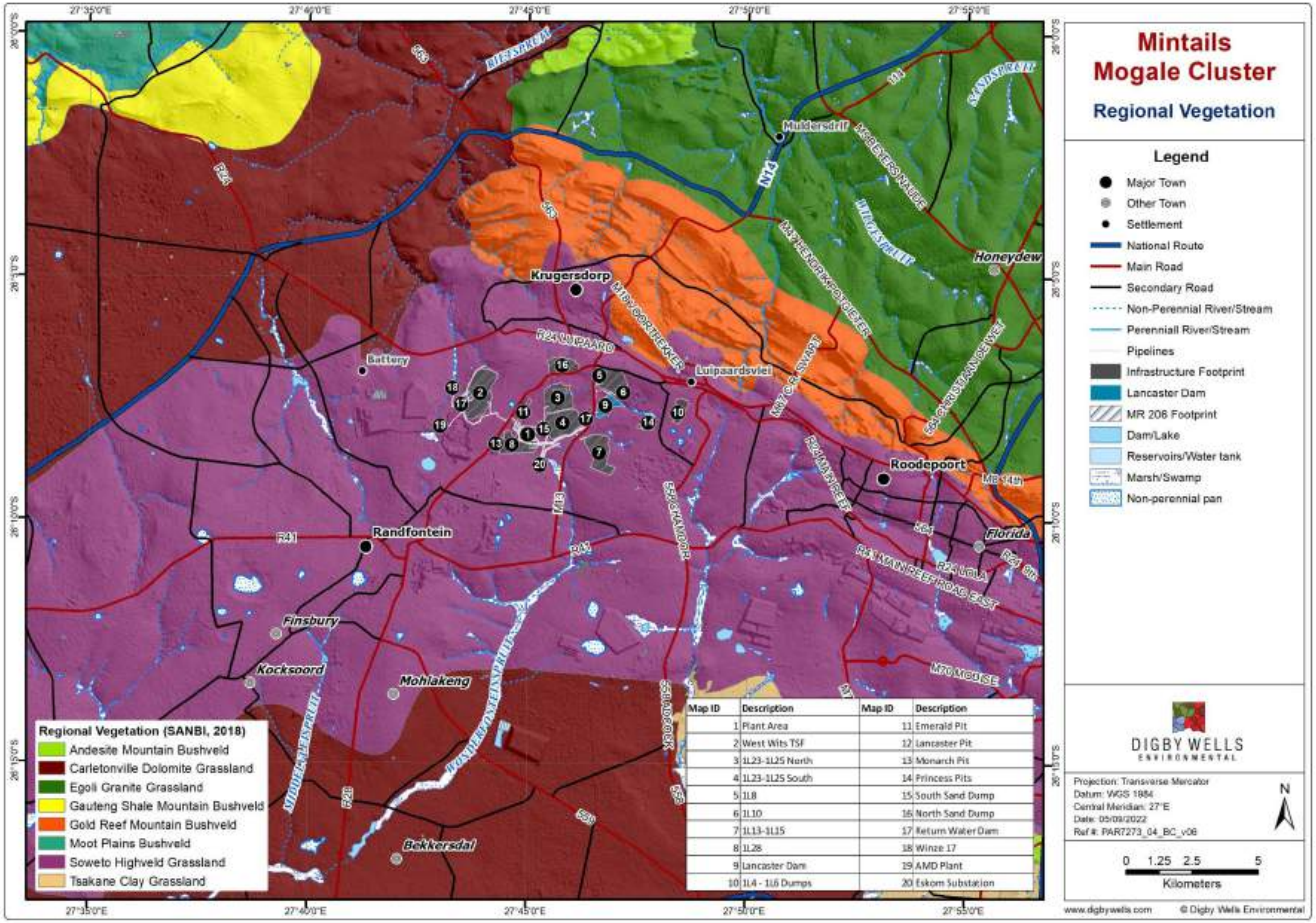

Figure 7-1: Regional Vegetation

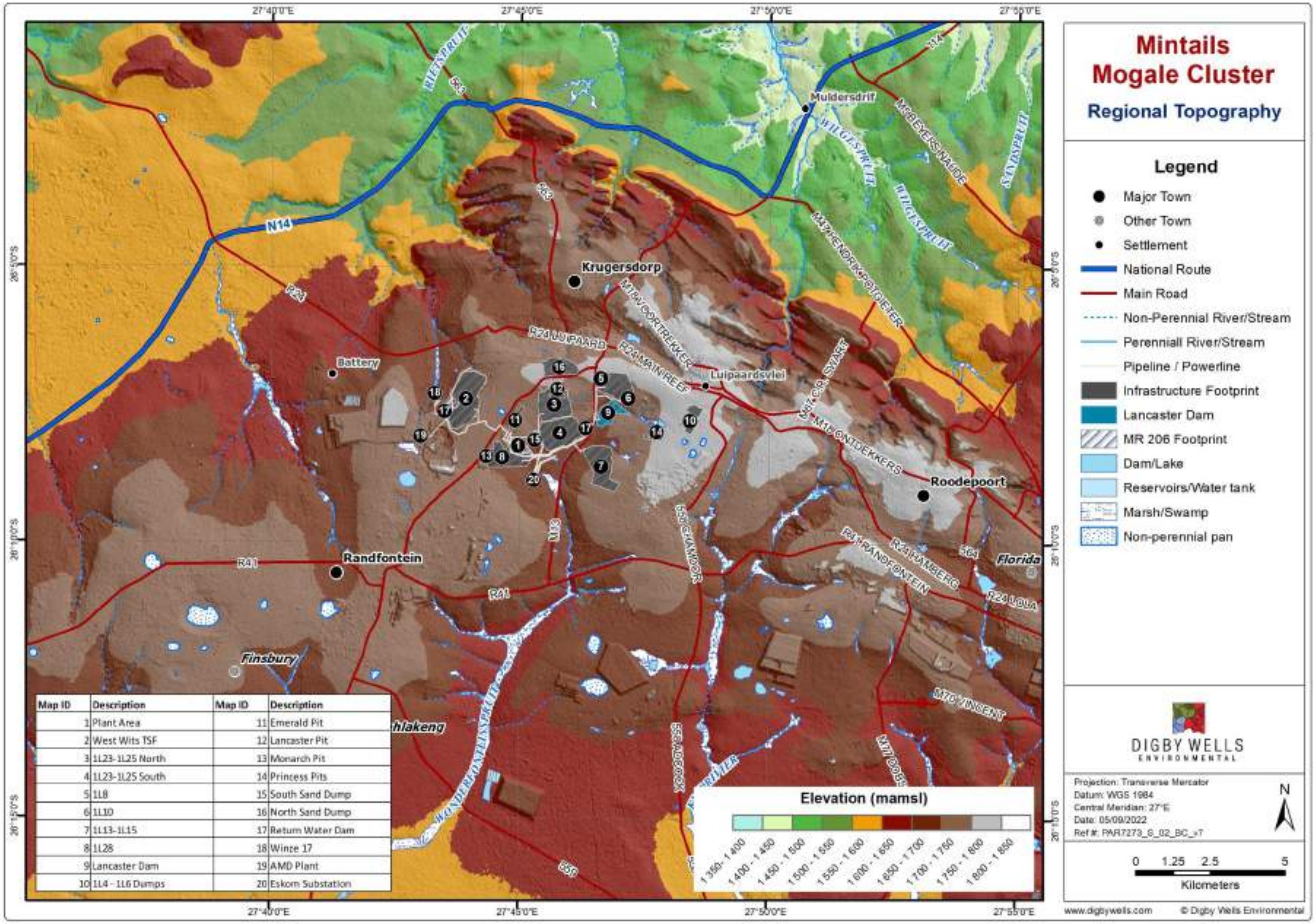

Figure 7-2: Regional Topography

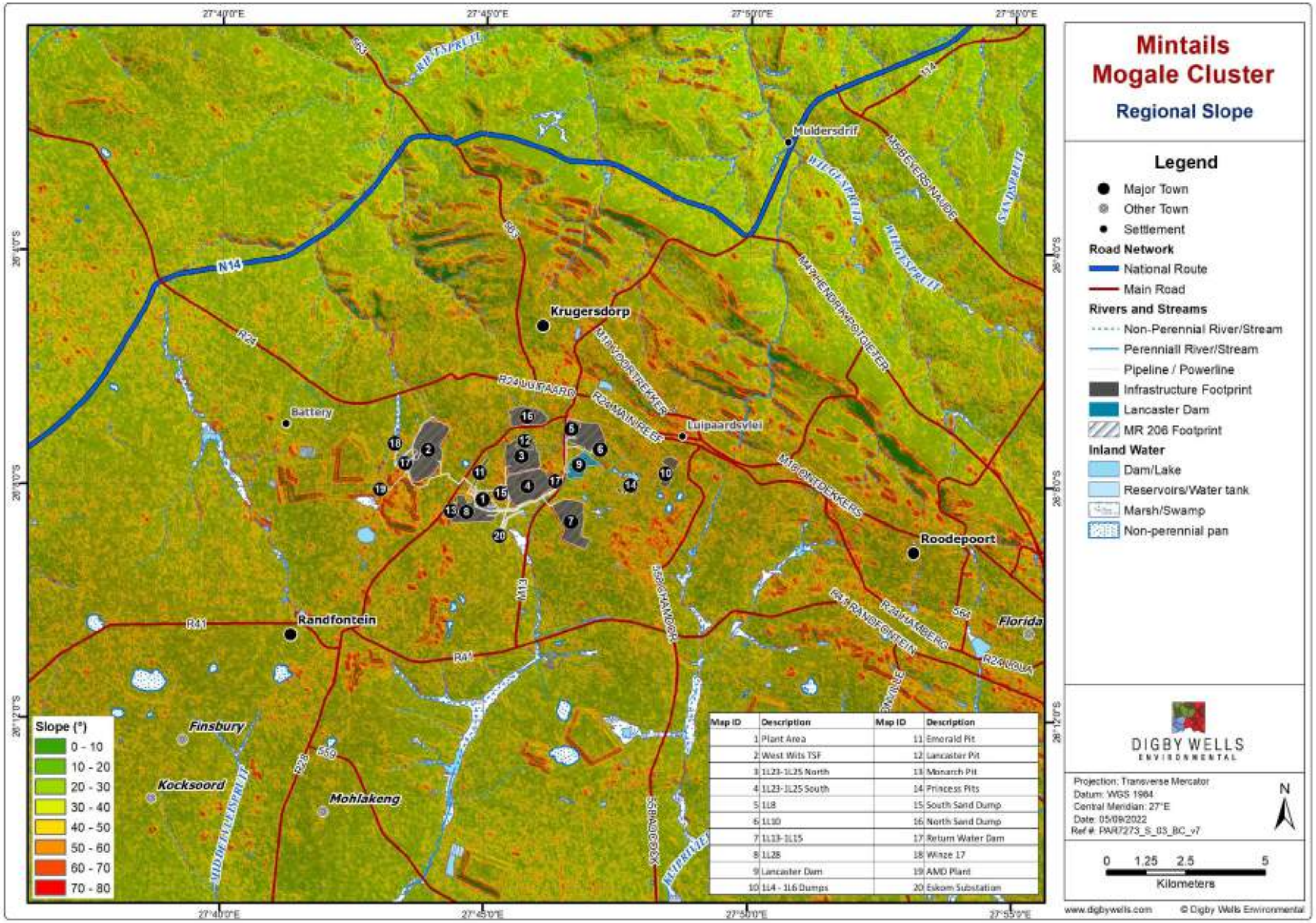

Figure 7-3: Regional Slope

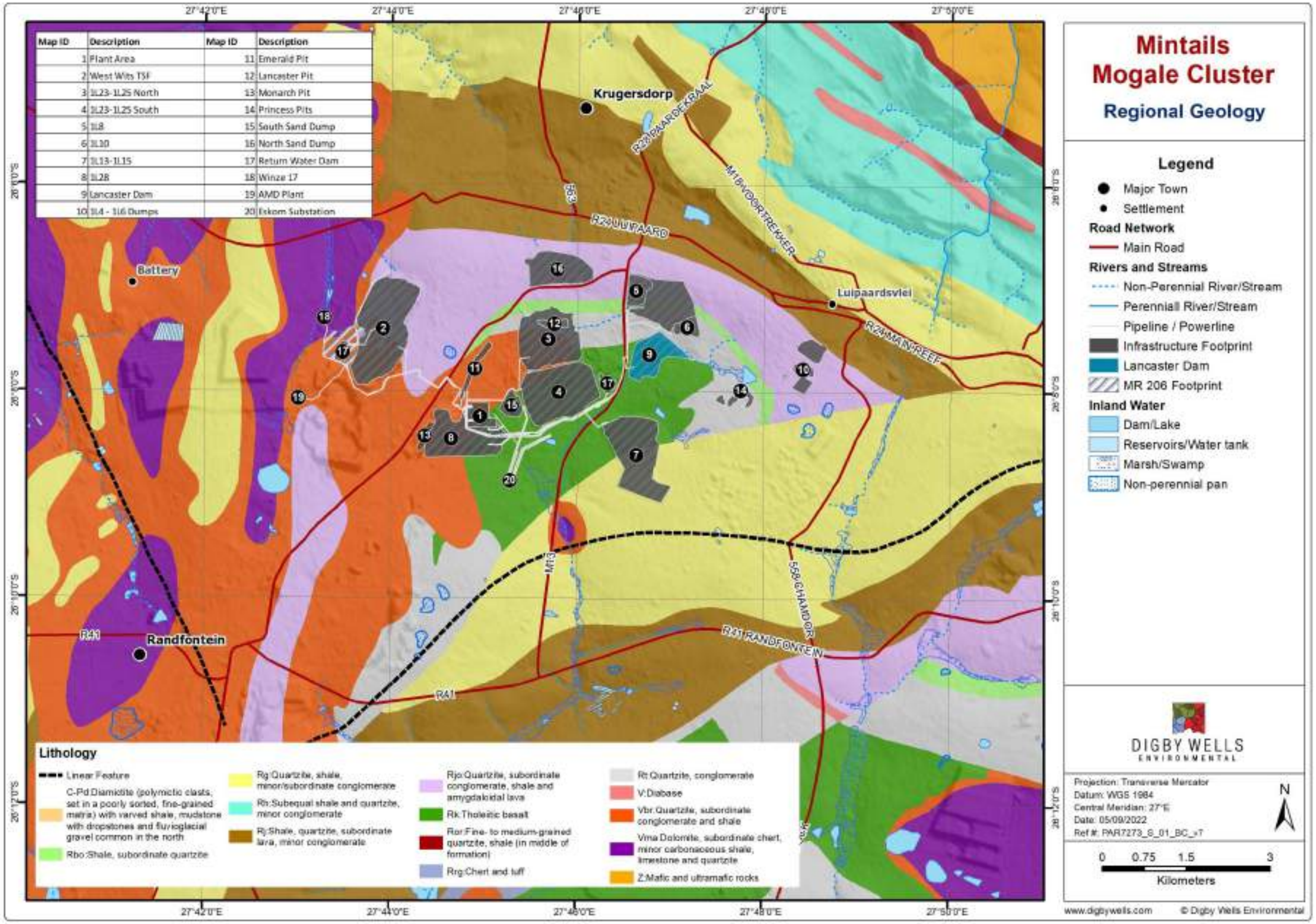

Figure 7-4: Regional Geology

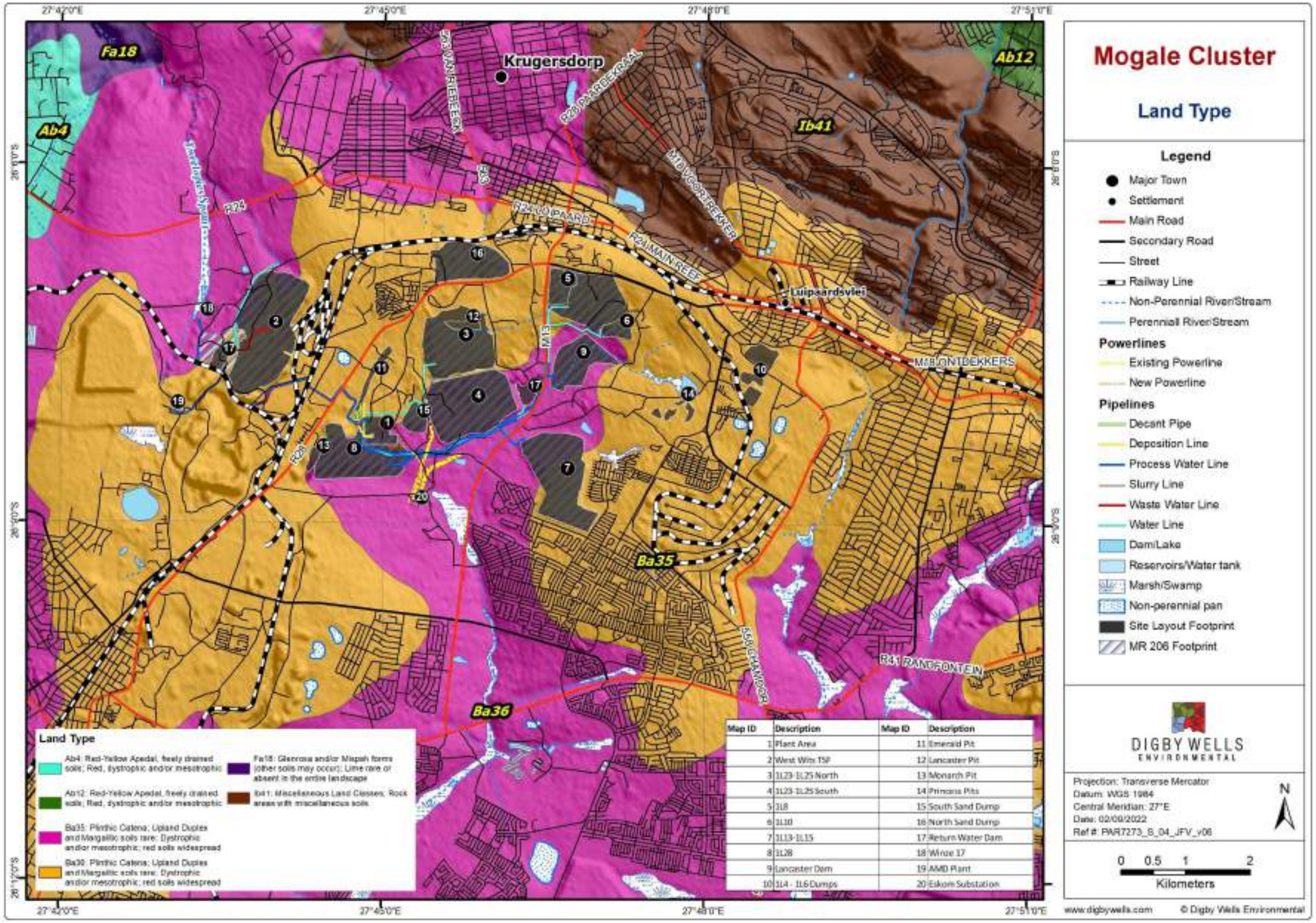

Figure 7-5: Land Types

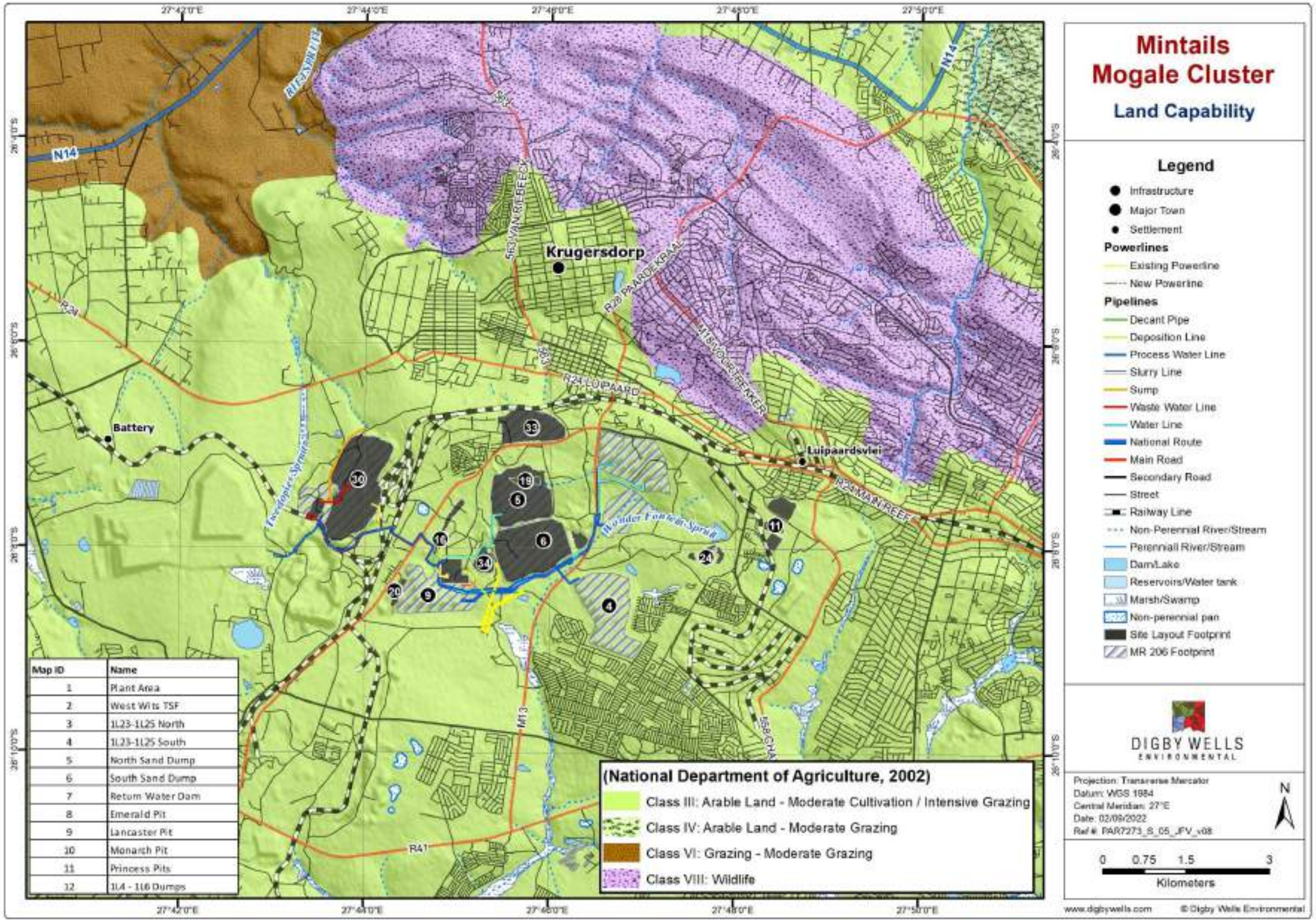

Figure 7-6: Land Capability

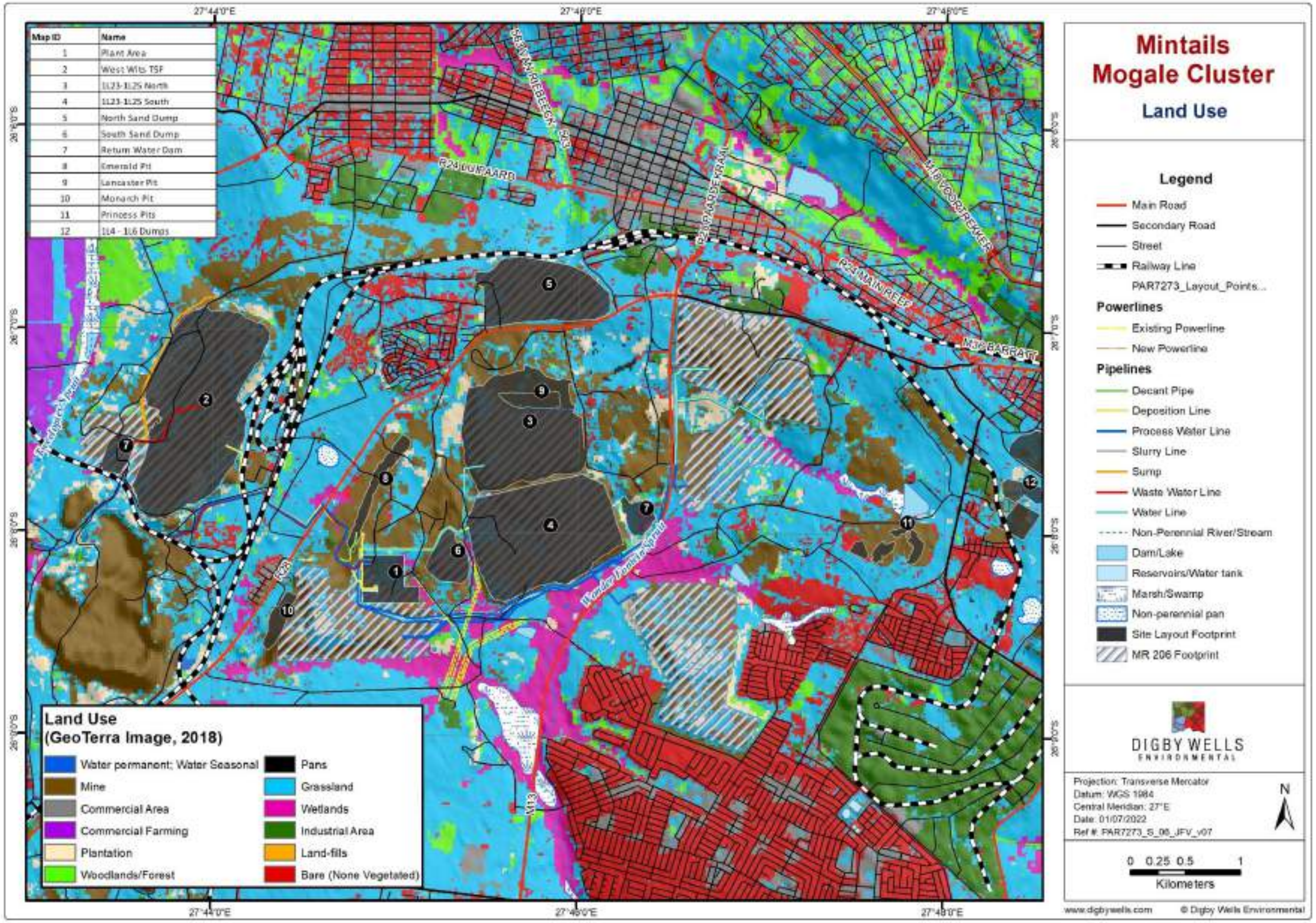

Figure 7-7: Land Use

8. Findings and Discussion

Notes

Soil forms are conceptual generalisations based on specific soil properties. Each soil form consists of soil horizons, uniquely combined and integrated. The soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991).

The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth where possible. Soils were investigated using a Bucket and Cradle auger to a maximum depth of 1.2 metre (m) or to the first restricting layer. Other features such as existing open trenches and diggings were helpful to determine soil form and depth. Mapping unit boundaries were determined by changes in topography with subsidiary indications from vegetation and parent material.

Avalon, Pinedene, Hutton, and Clovelly soils are typically deep soils, dominated by a red to Yellow-brown apedal (non-structure), sandy B-horizons with a clayey underlying material such as Soft-Plinthic and ferricrete. The clayey horizon increases the water holding capacity, organic material, and Cation Exchange Capacity (CEC) of the soil therefore increasing the agricultural potential.

Rensburg, Arcadia, Katspruit, Kroonstad and Longlands are often associated with low-lying areas and wetlands and are referred to as hydromorphic soils. These soils are saturated for long periods, has a fluctuating water table and very specific characteristics, including mottles, gleying and leaching.

Large portions of the MRA have historically been mined and are currently being mined through ASM. The Project Area consists of extensive areas of gold-bearing TSFs (tailings material) which the applicant are planning to re-mine through hydraulic reclamation.

The natural soils of the Project Area have been greatly impacted and the extent of naturally occurring soils are limited. The typical augured soil horizons in the less-impacted areas were:

- Orthic A-horizons, overlying Yellow-brown to Red Apedal B-horizons with a Plinthic or B-horizon in the upper catchment and Vertic and G-horizons in the low-lying areas (wetlands);
- The dominant soils in the upper catchment are sandy, deep, red soils and are generally used for cultivation and pastures; and
- Low-lying areas (wetlands), and scattered pans were identified on site, with typical soil horizons of Vertic-A overlying G-horizon and E-horizons overlying a G-horizon (Rensburg and Kroonstad soil forms) (Figure 8-1).

Historical mining and current ASM activities are contributing to the high sedimentation within the low-lying wetland areas. Large sections of the wetlands have been lost and are impacted by deep sedimentation, changing the natural geomorphology, hydrology and vegetation cover. The land use activities have also contributed to changes to the natural landscape, runoff, collection points and soils. This creates artificial wet areas thereby changing the soil properties and capabilities.

8.1. Soil Forms

The soil delineations are illustrated in Figure 8-1 with the dominant soil forms described in the subsections below. The soil delineations are based on background information and soil classification during the site assessment. Due to the size of the Project Area, focus was given on the proposed infrastructure areas and data extrapolated to delineate the rest of the Project Area. Soil forms that function the same and/ or were found within the same area were grouped together for ease of interpretation. The following soils were identified within the Project Area:

- Arcadia;
- Avalon;
- Bainsvlei;
- Bloemdal;
- Clovelly;
- Hutton;
- Katspruit;
- Kroonstad;
- Longlands;
- Pinedene;
- Dresden;
- Glencoe;
- Rensburg; and
- Witbank:
    - Tailings
    - Tailings/ASM
    - Tailings/ASM/Witbank

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Table 8-1: Soil Forms of the Project Area

Soil Form	Dominant Land Use	Description (Soil Classification Working Group, 1991)	Site Observations	
Rensburg → Vertic A → G-horizon Arcadia → Vertic A → Unspecified	• Wetlands; and • Cattle grazing	Rensburg and Arcadia soils consist of Vertic-A horizons with are dark in colour with very high clay and Organic Material (OM). The soils are often deep (>1000 mm) and identified as hydromorphic soils. The G-horizon subsoil has a grey or gleyic colour pattern (leached) which at times can be hints of green and blue due to the reduction of iron under permanent or periodic anaerobic conditions. The G-horizon has a firmer consistence than the overlying topsoil and is classified as a wetland soil.	• These soils were augured in pans and valley bottom wetlands within the Project Area; • The soils had a dark, black, clayey A-horizon (vertic) overlying a sandy-clay-loam, light colour G-horizon; • Soils were often deeper that 1200 mm; • These soils were permanently saturated with water, well vegetated and dominantly used for cattle grazing; • The soils are high in OM and fertility, however there are restrictions to cultivation due to saturation and waterlogging; and • Large sections of these areas were impacted by previous mining and current ASM activities due to tailings material having washed/leached into these areas thereby highly impacting them.	
Avalon → Orthic A → Yellow-brown Apedal → Soft Plinthic Pinedene → Orthic A → Yellow Brown Apedal B → Unspecified materials with sign of wetness	• Cultivation; • Cattle grazing; • Planted pastures; and • Wetlands.	Avalon soils are free draining and chemically active soils with high permeability and leaching potential. Clay, manganese and iron oxides accumulate with depth under conditions of a fluctuating water table forming localised mottles or soft iron concretions in the soft plinthic B horizon. These soils have a Yellow-brown B-horizon overlying a soft plinthic or unspecified horizon. The soils are deep, freely drained, sandy and often used for cultivation. Pinedene soils are generally fairly deep (700 – 1200 mm) and have a loamy-sand texture with up to 8% clay content. The soils are yellow-brown with minor drainage limitations in the upper horizons, however, usually contains very high clayey underlying material, limiting free drainage. Due to these high clay sub-horizons, drainage is limited causing waterlogging, potential for wetland formation and accumulation of nutrients, increasing the soil fertility. These soils are often cultivated and has a high land capability.	• These soils were dominantly associated with hillslope seep wetlands and low-lying areas, with **Fe** and **Mn** mottles from 20 cm depth; • The soil depths varied, however in some areas the soil was as deep as 1200 mm; • The soils were dominantly sandy in the topsoil, well drained and often cultivated or used for pastures due to the high agricultural potential; • Clay increased with depth and signs of wetness (mottles) were often present.	

Soil Form	Dominant Land Use	Description (Soil Classification Working Group, 1991)	Site Observations	
Bainsvlei → Orthic A → Red Apedal → Soft Plinthic Bloemdal → Orthic A → Red Apedal → Unspecified	• Historical cultivation; and • Cattle grazing.	Bainsvlei and Bloemdal soils are dark, red soils, freely draining, and chemically active. Manganese and iron oxides accumulate under conditions of a fluctuating water table forming localised mottles or soft iron concretions of the soft plinthic B horizon. Bloemdal soils often have a grey, low chroma matrix in the sub-horizon due to soil wetness causing leaching and reduction of iron.	• The soils in the Project Area were often deeper than 1 m. • The soils were very deep, sandy soils with a dark, red soil matrix. • The soils were historically cultivated and are currently being used for cattle grazing and found in the upper slopes. • Soil wetness increased with soil depth due to increasing clay content and the semi-permeable soft plinthic B2-horizon. Accumulation of clay, iron, and manganese was observed within 800 mm.	
Clovelly → Orthic A → Yellow-brown Apedal → Unspecified Hutton → Orthic A → Red Apedal → Unspecified	• Historical cultivation; • Cattle grazing; and • Planted pastures.	These soils have a Red to Yellow-brown B-horizon overlying an unspecified horizon. The soils are deep, freely drained, sandy and often used for intensive cultivation. Yellow-brown Apedal B-horizons form from leached Red Apedal B-horizons and are typically found in lower-lying areas. Yellow-brown soils are typically more wet, has higher permeability and lower fertility than red soils.	• The soils were deep, sandy and freely drained (>1200 mm); • High permeability and well suited for cultivation, however were not cultivated at the time; • The soils were compacted, historically cultivated and disturbed in most areas.	
Dresden → Orthic A → Hard Plinthic Glencoe → Orthic A → Yellow-brown Apedal → Hard Plinthic	• Cattle grazing; • Historically disturbed areas; and • Infrastructure areas	Dresden soils typically consist of a shallow Orthic A horizon overlying a hard plinthic layer. These soils are limited for agriculture production due to shallow soils and restricted water and air movement. The plinthic horizon consists of the accumulation of iron and manganese oxides with a strong developed structure. These horizons cannot be augured. Glencoe soils are naturally shallow and comprise Yellow-brown Apedal B-horizon overlying a Hard Plinthic layer. The underlying material restricts root development and contain increased iron-, and manganese oxides. These soils prevent free drainage and lower the agricultural potential of the soils.	• The soil depth of the Dresden soils were dominantly 200 mm, whereas the Glencoe soils were approximately 500 mm deep; • The soils were found in the upland landscapes used for mainly cattle grazing as these soils have restrictions for cultivation due to shallow soil depth; • The A-horizons are highly susceptible to erosion due to a lack of vegetation cover and stability. Large Iron and Manganese peds were observed on the surface of the soil; • The topsoil is sandy, freely drained and low in nutrients, overlying a restricted layer, therefore limiting cultivation; and • These soils are associated with crests and scarp topographies.	

Soil Form	Dominant Land Use	Description (Soil Classification Working Group, 1991)	Site Observations	
Katspruit/ → Orthic A → G-horizon Kroonstad → Orthic A → E-horizon → G-horizon Longlands → Orthic A → E Horizon → Soft Plinthic B	• Artificial wetness areas below TSFs; and • Wetlands.	Kroonstad, Katspruit and Longlands soils are referred to as hydromorphic soils due to waterlogging conditions and permanent wetness. These soils consist of a sandy, leached E-horizon overlying a G-horizon or Plinthic horizon with high clay content and clear signs of wetness (mottles/leaching). The soils are saturated for long periods, have a fluctuating water table and have noticeable clay accumulation in the deeper profile.	• The soils were dominantly identified in wetlands and low-lying areas where tailings material accumulate and therefore used for ASM activities. As a result, the soils were heavily impacted and may contain tailings material; • Soils were dominantly associated with hillslope seep wetlands, pans and valley bottom wetlands; • The soils were leached, very sandy in the A-horizon, overlying a high clayey B-horizon with **Fe** and **Mn** accumulation; • The soils contribute to subsurface water/ interflow into the wetlands; and • The soil depth varied, often deeper than 1200 mm.	
Witbank → Anthropologically impacted material	• Tailings material; • ASM activities; • Historically disturbed areas, such as land-fill sites and historically cultivated areas	Witbank soils are anthropologically impacted soils. These soils are combined and mixed soils with various properties and pedogenesis. These soils are altered from its natural state and are unnaturally formed. It includes landfill sites, sludge, mine spoils and intensively cultivated land.	• Large areas of the Project Area have been impacted by ASM activities, resulting in Witbank soils. The natural soil pedogenesis has been altered and therefore was unidentifiable in some areas, hence Witbank soils; and • Due to the mining activities, including crushing, grinding, washing and flushing of the material (soil), large areas of sediment, sludge and potential contaminated areas have formed, specifically in low-lying areas associated with wetlands. These activities has significant impacts on the natural environment and naturally occurring soils, land use and land capabilities.	

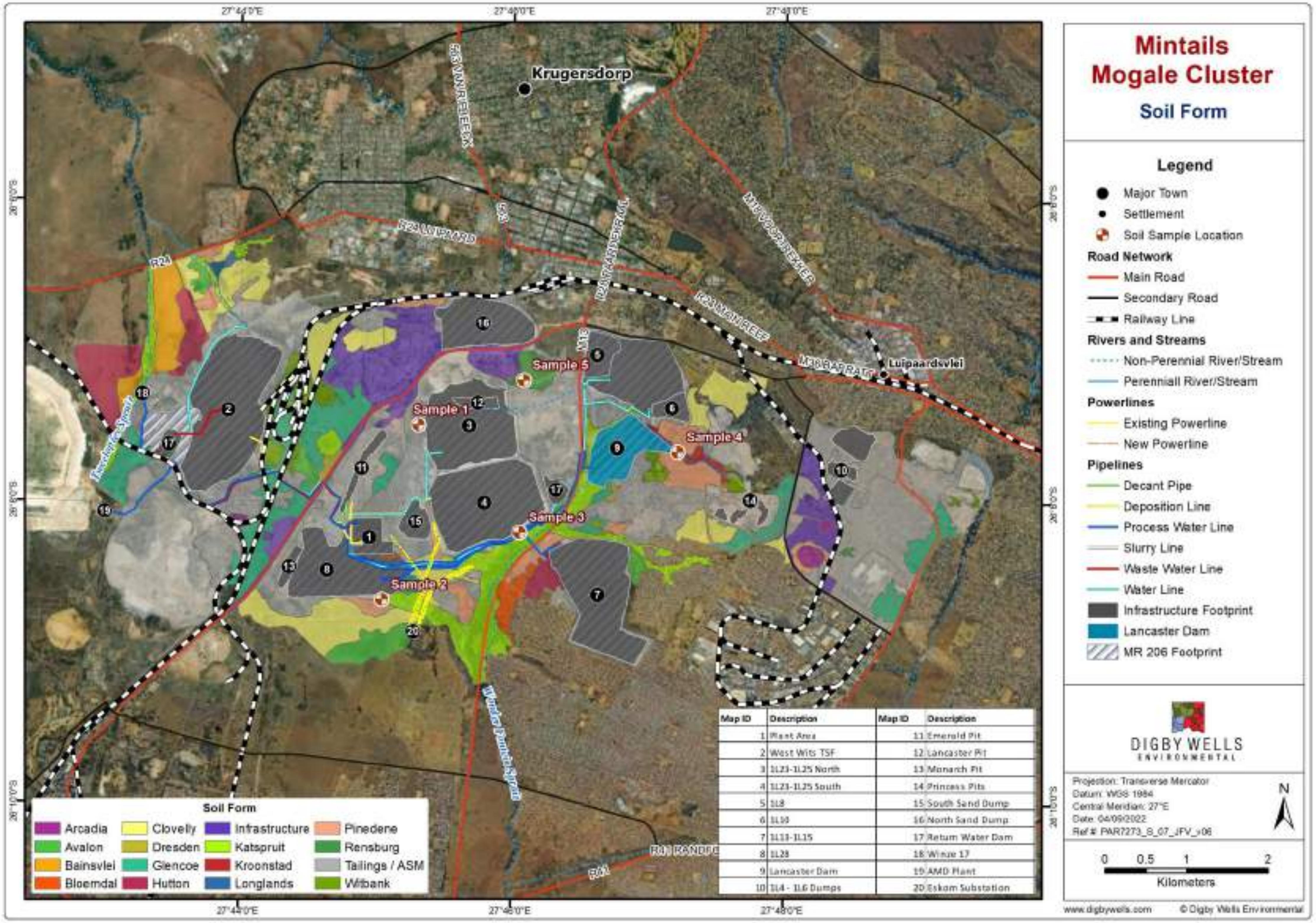

Figure 8-1: Soil Delineations and Sample Points

8.2. Soil Chemical and Physical Characteristics

The results of the soil analysis for the five (5) representative samples taken during the October 2021 survey are presented in Table 8-3. As a basis for interpreting the data, Soil Screening Values (SSV) and local soil fertility guidelines are presented in Table 8-2, together with the pH guidelines. Where local screening values were not available, international values were used to evaluate the baseline conditions.

Table 8-2: Soil Fertility Guidelines

Guidelines (mg per kg)			Source
Macro Nutrient	**Low**	**High**	
Aluminium (Al)	<10	>50	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
Arsenic		>5.8	South Africa Guidelines, (NEM:WA 2008)
Boron (B)	<0.5	>1.5	USA Guidelines, (Allison, et al., 1954)
Calcium (Ca)	<200	>3000	South Africa Guidelines, (NEM:WA 2008)
Chlorides (Cl)	-	>12000	South Africa Guidelines, (NEM:WA 2008)
Copper (Cu)	<36.0	>190	Dutch Guidelines, (Dutch VROM, 2000)
F (Fluoride)	-	>200	Canadian Guidelines, (CCME, 2007)
Magnesium (Mg)	<50	>300	South Africa Guidelines, (NEM:WA 2008)
Manganese (Mn)		740	South Africa Guidelines, (NEM:WA 2008)
Mercury		>0.93	South Africa Guidelines, (NEM:WA 2008)
Nickel (Ni)	-	>45	Canadian Guidelines, (CCME, 2007)
Lead (Pb)		>20	South Africa Guidelines, (NEM:WA 2008)
Nitrates-nitrite (NH_4,NH_2)		120	
Organic Carbon (OC)	< 2 %	>3 %	South Africa Guidelines, (du Preez, Mnkeni, & van Huyssteen, 2010)
Phosphorus (P)	<5	>35	South Africa Guidelines, (NEM:WA 2008)
Potassium (K)	<40	>250	South Africa Guidelines, (NEM:WA 2008)
Sodium (Na)	<50	>200	South Africa Guidelines, (NEM:WA 2008)
Zinc (Zn)	<140	>720	Dutch Guidelines, (Dutch VROM, 2000)
Sulphates (S)		4000	South Africa Guidelines, (NEM:WA 2008)
Electrical Conductivity (EC)	110 (mS/m)	570 (mS/m)	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)
Cation Exchange Capacity (CEC)	5	25	Australian Guidelines, (Department of Agriculture and Rural Affairs, 1986)

Guidelines (mg per kg)				Source	
Macro Nutrient		**Low**	**High**		
pH					
Very Acid	Acid	Slightly Acid	Neutral	Slightly Alkaline	Alkaline
<4	4.1-5.9	6-6.7	6.8-7.2	7.3-8	>8

Table 8-3: Soil Physico-Chemical Properties

Determinants	Units	Guidelines		SAMPLE 1 # 362	SAMPLE 2 # 374	SAMPLE 3 # 398	SAMPLE 4 # 440	SAMPLE 5 # 444
		Low	High					
Calcium (AmAc)	mg/kg	<200	>3000	3031	7966	1174	2048	427
Magnesium (AmAc)	mg/kg	<50	>300	77	57	211	126	86
Sodium (AmAc)	mg/kg	<50	>200	10	22	49	39	19
Potassium (AmAc)	mg/kg	<40	>250	102	192	8	105	224
Sulphates (AmAc)	mg/kg	-	4000	2044.40	3132.24	1785.12	464.33	358.86
Chloride	mg/kg	-	>12000	<25	<25	<25	<25	<25
Density	g/mℓ	-	-	1.1	0.79	0.97	0.63	1.0
Total Nitrogen	mg/kg	-	-	2.9	1.7	2.3	2.0	1.2
Nitrate	mg NO_3/kg	-	120	3.00	3.38	0.25	0.29	4.36
Sulphate	mg/kg	-	4000	1769	12883	5128	790	330
Calcium Percent (AmAc)	%	-	-	94.16	97.42	62.04	87.41	26.71
Magnesium Percent (AmAc)	%	-	-	3.93	1.15	18.31	8.84	8.87
Sodium Percent (AmAc)	%	-	-	0.28	0.24	2.27	1.45	1.04
Potassium Percent (AmAc)	%	-	-	1.62	1.20	0.21	2.29	7.16
Ca:Mg	-	-	-	23.93	84.98	3.39	9.88	3.01
Mg:K	-	-	-	2.42	0.95	87	3.86	1.24
Na:K	cmol(+)/kg	-	-	0.17	0.20	10.8	0.63	0.15
(Ca+Mg)/K	-	-	-	60	82	383	42	4.97
Acid Saturation	%	-	-	0.00	0.00	17.2	0.00	56
S-Value (AmAc)	cmol(+)/kg	-	-	16.09	40.89	7.83	11.71	3.50
T-Value (AmAc)	cmol(+)/kg	-	-	16.09	40.89	9.46	11.71	7.99
Cation Exchange Capacity (CEC)	cmol(+)/kg	5	25	7.38	13.36	3.65	11.12	11.40
Electrical Conductivity (Saturated Paste Extract) (EC)	mS/m	110	570	201.00	218.00	557.00	131.00	48.90
Exchangeable Acidity KCL	cmol(+)/kg	-	-	0.00	0.00	1.62	0.00	4.49
pH (KCL)	-	-	-	5.7	7.6	3.7	5.3	3.6
P (Bray I)	mg/kg	<5	>35	4	3	2	45	2
Sand	%	-	-	77	39	73	21	47

Determinants	Units	Guidelines		SAMPLE 1 # 362	SAMPLE 2 # 374	SAMPLE 3 # 398	SAMPLE 4 # 440	SAMPLE 5 # 444
		Low	High					
Clay	%	-	-	11	13	9	9	37
Silt	%	-	-	12	48	18	70	16
				Sandy-loam	Loam	Sandy-loam	Silt-loam	Sandy-clay

8.2.1. Soil Texture

Guidance Note:

The particle size distribution of the soil sampled in the Project Area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle. The size limits for sand, silt and clay used in the determination of soil texture classes are sand: 2.0 – 0.05 mm, silt: 0.05 – 0.002 mm and clay: < 0.002 mm.

Soil water retention characteristics are strongly affected by soil texture. A higher clay content results in greater water retention. Similarly, the higher the sand fraction, the less water is retained by the soil (Gebregiorgis, 2003). Soil macropores allow a greater volume of water to drain more rapidly than would be expected from a soil that is dominated by clay fractions. Generally, the ideal pore space is between 40 – 60% (NRCS-USDA, 2013).

The bulk density of soil is dependent on the sand-clay-silt ration. The higher the clay content the higher the bulk density. Bulk density represents the mass of dry soil (mass of solids) per unit volume of soil (White, 2003). A low bulk density implies a favourable soil structure for root penetration as it is not compacted (Karuku, et al., 2012). Generally, soils with bulk densities greater than 1.6 g/cm^{-3} are considered as compacted soils (Twum & Nii-Annang, 2015).

The particle size distribution of the soil sampled in the Project Area was classed into the percentages of sand, silt and clay present. The textural classes were obtained from plotting the three fractions on a textural triangle.

The average soil texture in the Project Area was Sandy-loam (Figure 8-2). Soil texture is a direct attribute from the parent material. The following characteristics are related to sand, clay and loam soils (Table 8-4):

Table 8-4 Soil Texture

Sandy soils	Loamy soils	Clay Soils
High infiltration and drainage rate (low water-holding capacity)	Moderate infiltration and drainage rate (moderate water-holding capacity)	Low infiltration and drainage rate (high water-holding capacity)
High leaching potential	Moderate leaching potential	Low leaching potential
Low soil fertility (OC, CEC, EC, pH)	High fertility status (nutrients and OM)	Very high fertility status (nutrients and OM)
High lying areas	Low-lying areas	Low-lying areas
Low erosion potential	High erosion potential	High erosion potential

The high clay soils in the low-lying areas (wetlands) contribute to low infiltration, water ponding, high erosion potential and high concentrations of chemicals. The higher the clay in the soil, the higher the EC, CEC, OC and pH.

The area is heavily impacted by ASM and historical activities where soils are crushed, washed thereby destroying the natural structure and contributing to high silt percentages.

Sample Number	Texture Classification
1	Sandy-loam
2	Loam
3	Sandy-loam
4	Silt-loam
5	Sandy-clay

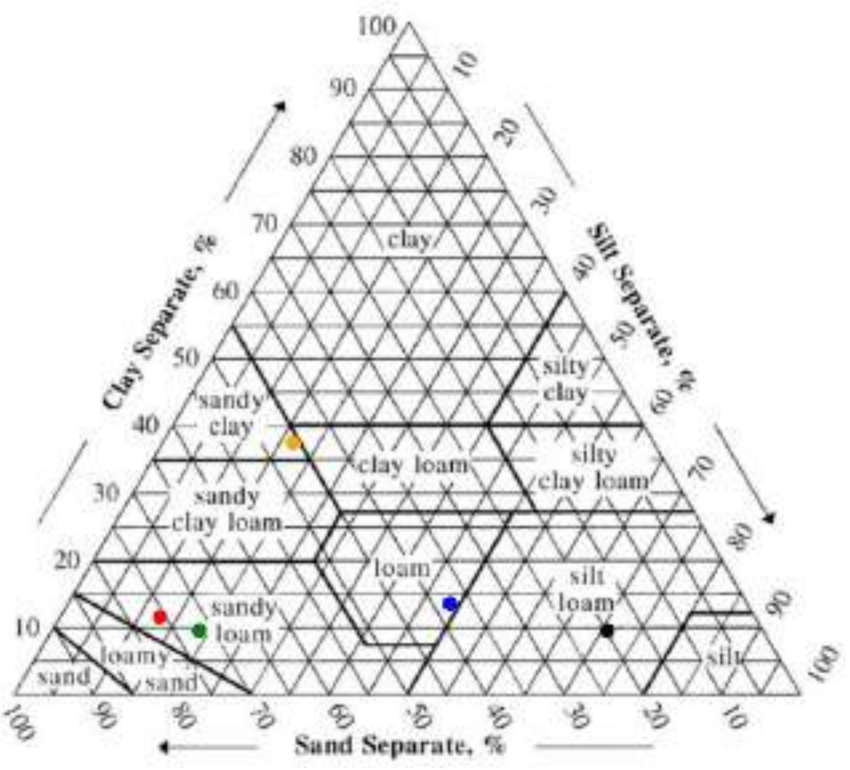

Figure 8-2 Texture Classification

8.2.2. Soil pH

Guidance Note:

The measurement of soil acidity is referred to as soil pH. The soil pH is determined in the supernatant liquid of an aqueous suspension of soil after having allowed the sand fraction to settle out of suspension. Soil pH influences soil chemical, physical and biological properties.

The interaction between soil particles, soil solution and dissolved ions have an important role in holding cations such as calcium (Ca^{+2}), magnesium (Mg^{+2}), potassium (K^{+}) and ammonium (NH_4^{+}) in the soil. The cations are important plant nutrients that are taken up by plants from the soil solution. When the concentration of the solution is out of proportion it will directly impact the biology of the soil as well as the growth of the vegetation. When the concentration is increased, by means of adding lime and fertilizers, the nutrient will first be absorbed by the soil particles until dissolved and released into the soil solution for plant availability. When the holding capacity of the soil particles are low (sandy soil), the nutrient will just leach out of the profile, inherently known as infertile soils whereas clayey soils have a much higher holding capacity for nutrient and thus are more fertile (Neina, 2019).

In addition to the cations in the soil is acid ions. The acid ions include hydrogen protons (H^{+}) and aluminium ions (Al^{+3} and $Al(OH)^{+2}$) causes an acidic reaction and therefore lower the pH of the soil solution (Farina & Channon, 1991).

The pH of the soil samples collected ranged from **3.6** to **7.6**, indicating that the soils are **very acidic to slightly alkaline**. This is a wide range, indicating potential disturbances to the natural state of the soils. The pH was measured against the optimal pH for agricultural crops ranging between 5.5 and 7.5. The following can be derived from the data:

- Samples 1 and 4 were sampled below TSF dumps, however within the SSV, ranging from 5.3 to 5.7. This is a slightly acidic, however falls within the optimal range for crop production. The acidity can be attributed to the low Sodium and Potassium levels as well as potential tailings material in the soils;
- Samples 3 and 5 were well below the SSV. These soils are very acidic and has various restrictions to vegetation growth and potential crop production (rehabilitation). Both samples were taken within wetland areas, Sample 3 within a Valley Bottom wetland and Sample 5 within a Pan wetland. The high acidity can therefore be attributed to runoff, erosion and sedimentation from the tailings material into the low-lying areas, accumulating in the wetlands; and
- Sample 2 were well above the SSV with a pH of 7.6. This is slightly alkaline and has various restrictions to vegetation growth and potential crop production (rehabilitation). The alkalinity can be attributed to the high Calcium and Sulphate concentrations and low Magnesium concentrations. The Ca:Mg ratios are therefore higher than recommended, affection the pH and adsorption of other elements.

8.2.3. Exchangeable Cations

Guidance Note:

The higher the CEC value (> 25) the higher the clay and/or organic material (OM) in the soil. Soils with a high clay and/ or OM content, with a high CEC will have high cation concentrations. Cations are adsorbed by the negatively charged clay and OM particles. Soils with a low CEC (< 5) is usually an indication of sandy soils with low soil fertility and OM.

The levels of the basic cations (**Ca**, **Mg**, **K** and **Na**) are determined in soil samples for agronomic purposes through extraction with an ammonium acetate solution. In general, the amounts of exchangeable cations normally follow the same trend as outlined for soil pH and texture. For most soils, cations follow the typical trend **Ca**>**Mg**>**K**>**Na**, **Ca** being the most reactive and **Na** less reactive.

In soil, dispersion and flocculation of soil particles are a chemical phenomenon which is driven by the balance of the exchangeable cations. Excess **Na** and **K** causes dispersion (soil is broken down in very fine particles which is particularly sensitive to erosion), whereas high levels of **Ca** would rather cause flocculation (soil particles adhere to each other to form clusters/flakes or clumps). Dispersion and flocculation have several impacts on soil development and responses which in return affects root development and plant growth (Chibowski, 2011).

The CEC concentrations ranged from **3.65** to **13.36** cmol(+)/kg. This is a wide range within the Project Area, indicating impacts from historical and current land uses. The following can be derived from the data regarding the CEC and the exchangeable cations:

- Despite the wide range of CEC values, all the samples, except for Sample 3, were within the SSV range;

- Sample 3 had slightly lower Potassium than the other samples, as well as very high Sulphates, impacting the CEC ratios. When an element is out of range, it affects the adsorption capacity of other elements onto the clay particles, therefore changing the CEC and buffer capacity;
- The exchangeable cations, pH and CEC also has an effect on the soil's EC. The EC of Sample 2 was well above the EC of the other samples, almost exceeding the SSV. It can therefore be assumed that the soils within the Sample 2 area are likely to be more contaminated than the other areas and this may limit rehabilitation efforts;
- The EC of Sample 5 was below the SSV, this can be attributed to the low pH and Sodium concentrations;
- The Sulphate concentrations of Samples 2 and 3 were well above the SSV, indicating potential contaminations as well as affecting the CEC of other elements in the soils;
- The silty nature of the soils and tailings material tend to adsorb nutrients and prevent infiltration of elements. The concentration of chemicals in the topsoil will therefore be higher than the subsoil due to low infiltration rates.

8.2.4. Phosphorus

Guidance Note:

Phosphorus (**P**) is required in plants for root development and promote plant sugars for more efficient ripening of fruits and promote larger flowers. Soil pH and depth are just as important to note as **P** is immobile in soil and will be higher at a depth where there is a free flow of water.

Excessive levels of phosphorus in a growth medium are not particularly harmful to plant health, however, may impede the uptake of **Zn** and Iron (**Fe**) even when there are adequate amounts of these nutrients in the material. Excessive levels of **P** are not easily remedied and takes a long time to lower. It is therefore important to avoid fertilisers containing phosphorus, such as NPK and cattle manure as fertiliser.

The Phosphorus in the samples ranged from **2** to **45** mg/kg. The following was derived from the data:

- All the samples, except for Sample 4 were below the SSV. These soils will require P-fertilizer for optimum rehabilitation and vegetation growth;
- The Phosphorus in Sample 4 was well above the SSV, indicating recent contribution of P-containing material or fertilizer within the area. Excessive Phosphorus in soils is not particularly harmful to plants, however will affect the CEC and EC of the soils, preventing other elements from being adsorbed;
- The low concentrations in the samples indicates that the Phosphorus in the soils is most likely fixed and has limited mobility in the soils. It can also be attributed to the sandy nature of the soils and the ASM activities, causing excessive leaching and washing of the soils;
- P-fertilizer would be required to increase the Phosphorus in the soils for optimum crop production, plant growth and vegetation cover (rehabilitation).

9. Land Use and Current Impacts

The dominant land uses were identified by aerial imagery during the desktop assessment and verified during the site survey. The dominant land uses include the following and are illustrated in Figure 9-1:

- Historical mining areas (including TSF tailings material, infrastructure, mine dams and artificial wetlands due to mining activities);
- Historical and current ASM areas (e.g. excavations, stockpiles, mine pits, infrastructure and scattered houses);
- Agricultural areas (grazing, historical and current cultivated areas, infrastructure, dams, roads, houses and feeding lot);
- Anthropological activities (e.g. infrastructure, developed areas, dump sites, roads, railways); and
- Wetlands / grazing areas.

The current impacts to the soils, land use and land capability are dominantly associated with historical and current mining activities (i.e., mine pits, TSFs and infrastructure), anthropological activities (i.e. historical land fill sites, roads, dams, powerlines, pipelines, culverts and bridges) and agricultural activities. The area is heavily impacted with large areas of erosion gullies, sedimentation into the low-lying areas, tailings material scattered throughout the area, large excavations and infillings, informal mine pits and infrastructure.

ASM is currently a major activity / land use in the area, causing various impacts to the soils, geomorphology and land. The area is excavated to extensive depths, specifically within low lying areas and wetlands, affecting the functionality thereof and causing large areas of sedimentation and potential soil and water contamination. Table 9-1 illustrates the various land uses and impacts to the soils, land use and land capability of the area.

Table 9-1: Land Use and Current Impacts

Historical mining areas (including TSF tailings material, infrastructure, mine dams and artificial wetlands due to mining activities)	

	Historical and current ASM areas (e.g. excavations, stockpiles, mine pits, infrastructure and scattered houses)
Agricultural areas (grazing, historical and current cultivated areas, infrastructure, dams, roads, houses and feeding lot)	
	Wetlands / grazing areas

Anthropological activities (e.g. infrastructure, developed areas, dump sites, roads, railways)	

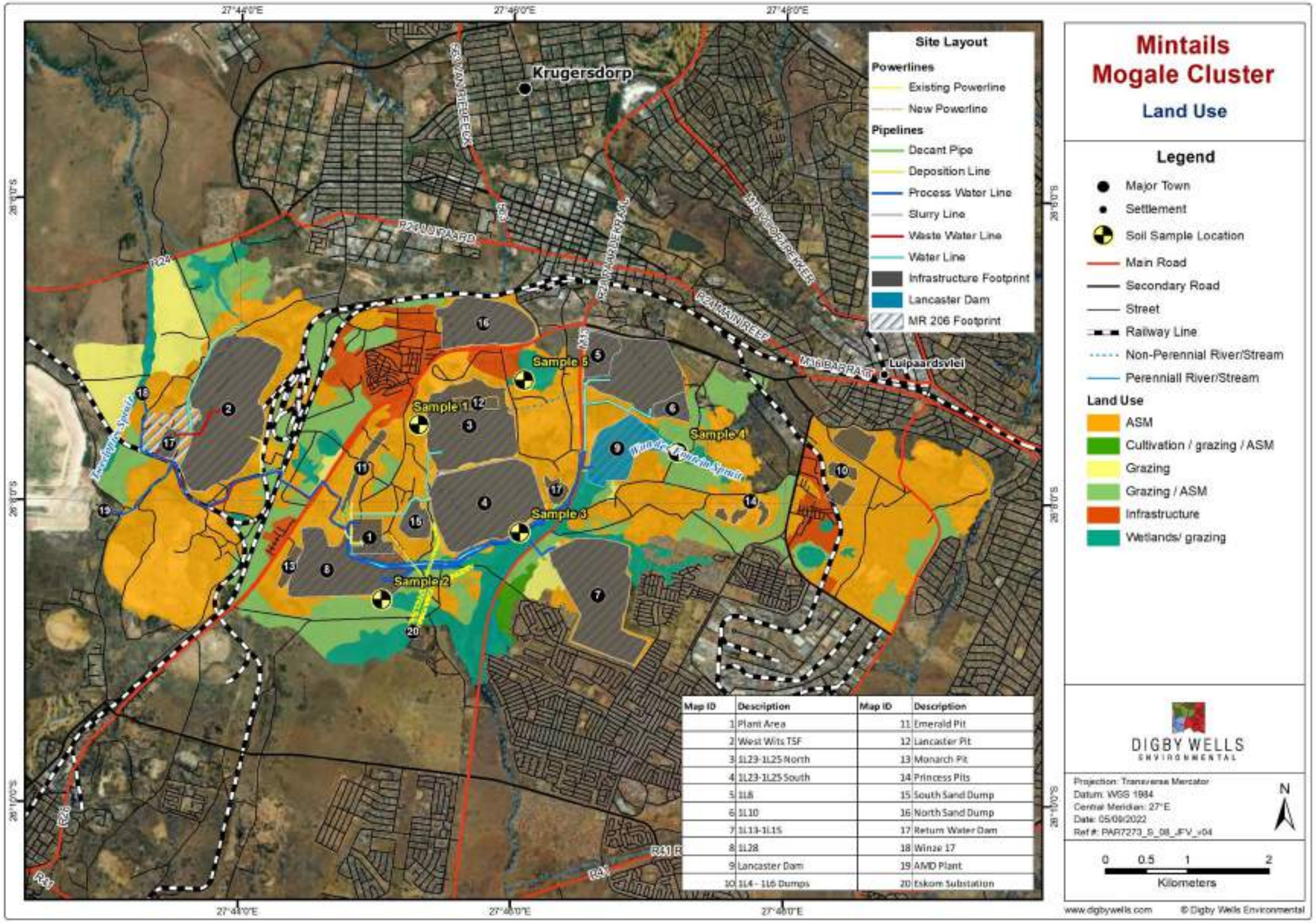

Figure 9-1: Current Land Use

10. Land Capability and Sensitivity Analysis

<u>Guidance Note:</u>

The sensitivity of soils varies due to soil physical, biological and chemical properties as well as land use, climate and underlying geology. These include soil type, depth, erosion potential, slope, texture and physico-chemical properties. Different soils have different land capabilities and sensitivities. The higher the land capability (agricultural potential), the higher the associated sensitivity. However, some soils are more susceptible to erosion, contamination, degradation, and pollution, regardless of the determined land capability, which affects the sensitivity.

Soils are contiguous hence differentiation is not abrupt, and the transition zone cannot be completely captured during any given soil survey. The soil type and their sensitivities can therefore not be captured completely and might vary from area, setting in the landscape, slope, and land use.

Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by U.S. Department of Agriculture (1973) and Schoeman et al. (2000) was used to assess the land capability. The classification system is made up of land capability classes and land capability groups.

Land Class	Increased Intensity of Use									Land Capability Groups	Sensitivity
I	W	F	LG	MG	IG	LC	MC	IC	VIC	Arable Land	High
II	W	F	LG	MG	IG	LC	MC	IC	-		
III	W	F	LG	MG	IG	LC	MC	-	-		
IV	W	F	LG	MG	IG	LC	-	-	-		
V	W	-	LG	MG	-	-	-	-	-	Grazing Land	Medium
VI	W	F	LG	MG	-	-	-	-	-		
VII	W	F	LG	-	-	-	-	-	-	Wildlife	Low
VIII	W	-	-	-	-	-	-	-	-		

W – Wildlife
F – Forestry
LG – Light Grazing
MG – Moderate Grazing
IG – Intensive Grazing
LC – Light Cultivation
MC – Moderate Cultivation
IC – Intensive Cultivation
VIC – Very Intensive Cultivation

Based on the soil delineations, land use and soil chemical and physical analysis, the following areas must be regarded as sensitive areas (Table 10-1) and are illustrated in Figure 10-2 below. The current land capability areas are illustrated in Figure 10-1.

The dominant land capability of the area was rated as **Low** and **Medium**, including wildlife, light grazing and moderate grazing in some areas. Land capability classes are defined as:

- Class IV – Severe limitations, low arable potential land and high erodibility soils;
- Class V – Watercourse and land with wetness limitations (wetlands). These areas include protection and control of water courses and the water table;
- Class VI - Limitations preclude cultivation and is suitable for perennial vegetation;
- Class VII – The land and soils include very severe limitations and only suitable for natural vegetation; and
- Class VIII - Extremely severe limitations and not suitable for grazing or afforestation.

The soil form, erosion potential, current land use and soil characteristics all form part in defining the land capability of each soil form. The soils within the capability classes are similar only with respect to the degree of limitations in soil use for agricultural purposes or with respect to the impact on the soils when they are so used. Soils that are capable to be used for cultivation will have a higher land capability than soils being used for mining or wildlife.

The higher the land capability, the higher the sensitivity of the soil and land use.

Table 10-1: Soil Sensitivity

Soil Form	Land Use (Dominant Current)	Land Capability (Dominant Current)	Land Class	Sensitivity
Arcadia	Wetlands/ grazing	W, LG, MG	V	Medium
Avalon	Wetlands/ grazing	W, LG, MG	V	Medium
Bainsvlei	Grazing	W, F, LG, MG	VI	Medium
Bloemdal	Cultivation / grazing / ASM	W, F, LG, MG, IG, LC	IV	High
Clovelly	Grazing / ASM	W, F, LG	VII	Low
Dresden	Grazing	W	VIII	Low
Glencoe	Grazing / ASM	W, F, LG	VII	Low
Hutton	Grazing	W, F, LG, MG	VI	Medium
Katspruit	Wetlands/ grazing	W, LG, MG	V	Medium
Kroonstad	Wetlands/ grazing	W, LG, MG	V	Medium
Longlands	Wetlands/ grazing	W, LG, MG	V	Medium
Pinedene	Grazing / ASM	W, F, LG, MG	VI	Medium
Rensburg	Wetlands/ grazing	W, LG, MG	V	Medium
Witbank (including tailings, ASM and anthropological soils)	ASM	W	VIII	Low

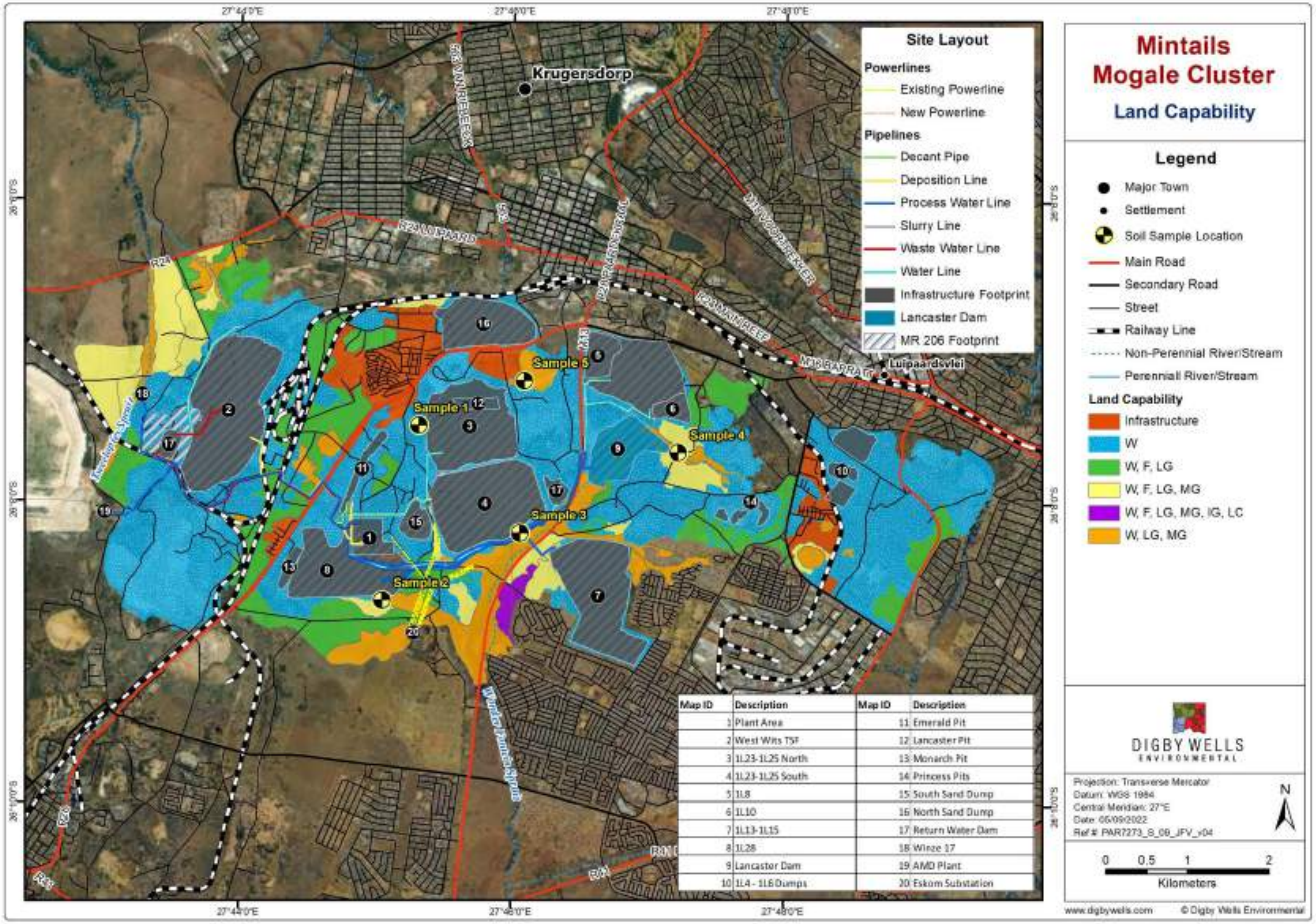

Figure 10-1: Current Land Capability

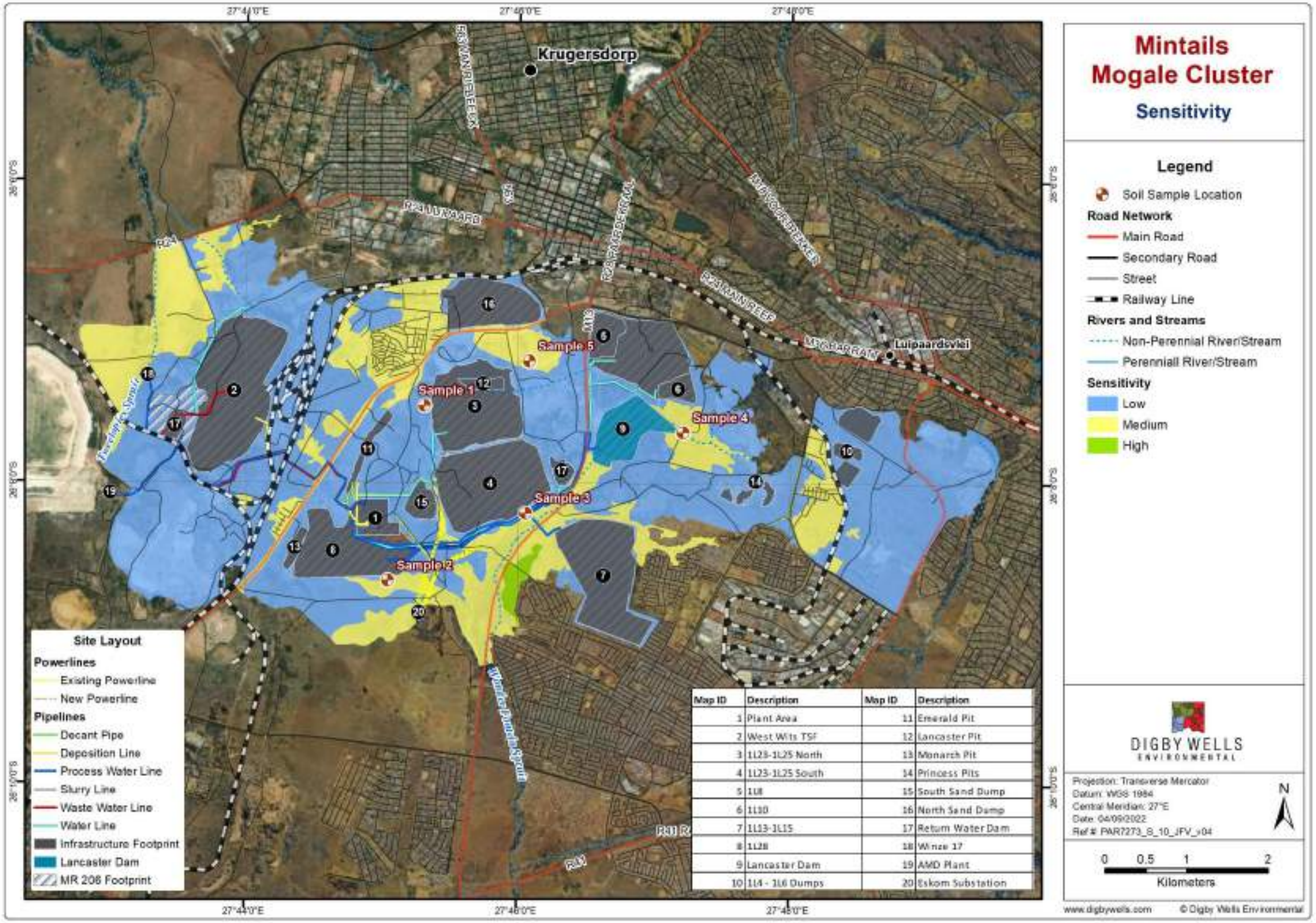

Figure 10-2: Current Land Sensitive Areas

11. Mitigation Hierarchy

Note

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate.

Land degradation is a major problem we currently have worldwide and will directly affect food security, water quality and quantity and sustainable land management.

It is not always possible to avoid or prevent an impact and therefore minimization and rehabilitation should be considered. When it is not possible and feasible to avoid mining land of high capability and sensitivity, Soil/Land offset should form part of the biodiversity (wetland) offset plan. This should be implemented to compensate for residual negative effects on the soil, land use and land capability after effort have been made to minimize, avoid and rehabilitate impacts.

The mitigation hierarchy followed during the assessment to minimise and avoid impacts to the soils, land use and land capability due to the proposed activities are described in Table 11-1.

Based on previous studies and similar projects it is inevitable that the proposed activities will pose impacts on the soil, land use and land capability, however it is anticipated that the impacts will be low and potentially positive, due to the current state of the soils, land use and land capability and the proposed activities to be undertaken.

Table 11-1: Mitigation Hierarchy

Mitigation Step	Actions
Avoid or Prevent	*Consider options to avoid impacts the soils, land use and land capability (e.g. project location, siting, scale, layout, technology and project phase). This is the best option, however not always possible. Where the social and environmental impacts are too high, mining should not take place as it would be unlikely to rely on the latter steps to prove effective remedy for impacts.*
	The proposed activities, including the mine pits, plant location, alternative plant location and mine dumps are avoiding all **High** and **Medium** sensitive areas (Figure 10-2).
Minimise	*Consider alternatives to minimise impacts on the soils, land use and land capability (e.g. project location, scale, technology and layout).*
	The proposed activities are approximately 170 m from areas of **High** sensitivity. Areas of **Medium** sensitivity should be minimised as far as possible, together with a protection buffer zone to avoid and minimize residual impacts to these areas. Residual impacts might include erosion, sedimentation, impacts to wetlands and other sensitive areas and potential contamination to the soils and groundwater.

Mitigation Step	Actions
Rehabilitate	*Rehabilitate areas where impacts were unavoidable. Measures must be taken to return impacted areas to conditions ecologically similar to their 'pre-mining natural state' or an agreed land use after mine closure. Rehabilitation is important and necessary, however even with significant resources and effort, rehabilitation is limited and almost always falls short of replicating the biodiversity and complexity of a natural system.*
	• The land capability should at least be rehabilitated to Grazing Land with the aim on wildlife, light grazing, moderate grazing and light cultivation; • Ensure concurrent rehabilitation with special attention to reshaping the areas and re-vegetating; • Landscape and reshape the Project Area to near natural topographies with at least 500 mm of topsoil; and • Contaminated soils must be disposed of at a registered landfill site prior to rehabilitation to prevent further soil and water contamination and increase the rehabilitation success. It is anticipated that the land capability will almost certainly be rehabilitated back to at least light grazing due to the proposed mining of the dumps and tailings material and thereafter rehabilitating these areas.
Offset	*Compensating for remaining and residual (unavoidable) negative impacts on the soils, land use and land capability. Offset should be implemented when every effort has been made to minimise and rehabilitate impacts with 'like-for-like' targets.*
	• Soil/Land Offset should form part of a biodiversity (wetland) Offset plan that will have to be developed and implemented after the residual impacts have been determined; and • Monitor and mitigate potential dewatering, decanting and contamination of soils and groundwater that will impact the land use and land capability.

12. Soil Impact Assessment

Guidance Note:

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities take place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the Project, i.e., the Construction Phase, Operational and Rehabilitation/Closure Phases where applicable.

Mitigation measures in this section are provided to avoid, minimize and rehabilitate soils within the Project Area (500 m buffer around the Protect Area). The mitigation hierarchy includes the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

Activities during the Construction, Operational and Rehabilitation Phases that may have potential impacts on the soils are described below. Direct and residual impacts to soils of **High** sensitivity should be to avoided and minimised as far as possible (Figure 12-1). When it is not possible to avoid impacts, the impacted areas need to be rehabilitated and or offset implemented.

The following are discussed below:

- Figure 12-1: Soil Form and Sensitivity Table;
- Table 12-1: Interactions and Impact of Activity;
- Table 12-2: Pre-Mitigation Impacts of Activity;
- Table 12-3: Mitigation Measures; and
- Table 12-4: Post-mitigation Impact Ratings.

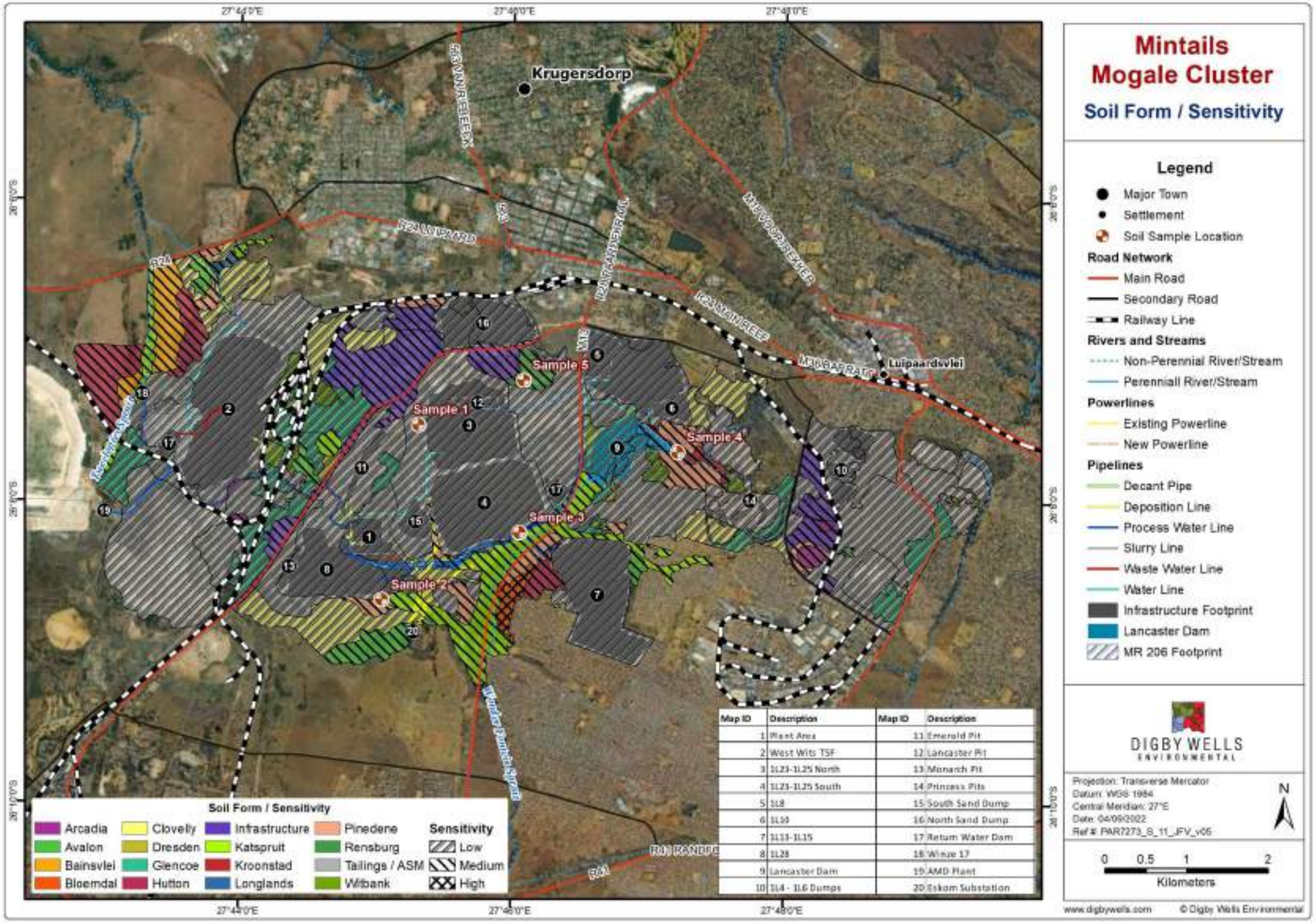

Figure 12-1: Soil Form and Sensitivity

Table 12-1: Interactions and Impacts of Activity

Project Phase	Associated Activities	Impact	Description
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Loss of soil resource (e.g., agriculture, rehabilitation, building material); • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Dust, erosion and sedimentation from stockpiles, dump and discard dump; • Soil contamination and deterioration; and • Soil compaction causing decreased soil depth for root penetration and increased runoff from hardened surfaces.	The site clearance, removal of vegetation, soil stripping (where applicable) and stockpiling will result in loss of potential useable soils for agropastoral activities. When soils are stripped, the physical and chemical properties are changed and the soils degrade. The land capability changes from high land capability to low land capability / industrial. When the organic material is removed, either by the clearing of an area for development of infrastructure or by erosion, the soil fertility status is reduced and may result in soil acidification. Exposed surfaces may result in dust, erosion and sedimentation into the low-lying areas. The proposed mine areas compose of historical tailings material which may potentially be harmful to the environment and humans and may therefore potentially lead to various residual impacts. Vehicles and machinery will lead to soil compaction, increased surface runoff, erosion and loss of vegetation (organic material). This reduces infiltration rates, and the ability for plant roots and water to penetrate the soil. Once the soil is eroded it reduces the overall soil depth, soil fertility rate, and as a result the land capability. During the topsoil excavation and stockpiling, the topsoil's seed bank and natural fertility balance is diluted. This will affect the regrowth of vegetation using the stockpiled topsoil. Soils should be handled with care from the construction phase through to the decommissioning and rehabilitation phase. The sandy nature of the soils and tailings material are particularly vulnerable to wind and water erosion when exposed during site clearance and stockpiling. An intact vegetation cover is needed to reduce impact from raindrops, slows down surface run-off, filters sediment and binds the soil together for more stability. The potential for chemical pollution and soil contamination exists during site preparation and construction when spills or leaks of fuels, oils and lubricants from construction vehicles or machinery occur. Fluids used for vehicles and machinery may spill during filling or direct leakage.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.		
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.	Negative impacts: • Soil erosion and sedimentation into low-lying areas due to increased runoff and hardened surfaces; • Soil quality contamination and deterioration due to potential spills and leakages; and • Loss of usable soil for agriculture. Positive impacts: • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal and disposal of potential impacted soils; and • Increased land capability.	Various unplanned and residual impacts to the soils might occur due to the surface infrastructure such as soil deterioration, pollution/contamination, erosion and compaction. This may lead to loss of useable soil for agricultural purposes and impacts to wetlands and low-lying areas. Unprotected soil surfaces and soil stockpiles may lead to erosion and sedimentation. Erosion could transpire and result in sedimentation, hydromorphic changes and loss of vegetation cover. Chemical contamination dependent on the size of the spill and the permeability/infiltration rate into the soils. Contaminants and potential impacted soils transported by water into the soils would rapidly infiltrate into sandy soils which are dominant across the Project Area. However, due to the nature of the activities to be undertaken (mining of historical gold tailings material), impacts from the operational and decommissioning phases may be positive. Mining of the tailings material will reduce the amount of tailings material currently in the area. Progressive rehabilitation will be undertaken to reduce exposed areas. Once the open pit is filled to capacity with the residual material, a new TSF will potentially be constructed on the footprint area of one of the reclaimed TSF sites. The footprint of the current dumps, tailings and infrastructure will be reduced significantly, potentially increasing the land capability and land use.
	Operation of pump stations during the operational phase.		
	Maintenance of pipeline routes during the operational activities.		
	Infilling of processed tailings material into the West Pits Pit and other potential pits.		
	Surface tailings deposition within the West Wits Pit.		
	Tailings deposition onto the historic footprint of 1L23-1L25.		
	Production of Gold.		
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.		

Project Phase	Associated Activities	Impact	Description
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints. Removal, decommissioning and rehabilitation of the processing plant footprint. Rehabilitation of the old TSF footprints. Rehabilitation of the old Mogale Processing Plant footprint. Final rehabilitation of the facility. General rehabilitation of the surrounding area, including wetland rehabilitation.	Negative impacts: • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Soil contamination and deterioration, decreasing the soil fertility; • Increased AIPs due to soil disturbances, decreasing the land capability and soil potential; and • Source topsoil from other areas for rehabilitation purposes, impacting other areas. Positive impacts: • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal of AIPs and increased soil and land potential; • Removal and disposal of potential impacted soils; and • Increased soil, land use and land capability of the entire area.	During the decommissioning and rehabilitation activities, the soils could potentially be compacted, leading to increased erosion, loss of effective rooting depth, water and root penetration, water holding capacity and soil fertility. The movement of heavy machinery on the soil surface causes compaction, which reduces the vegetation's ability to grow and as a result erosion. Soils might be lost due to erosion from unprotected surfaces. Rehabilitation activities will cover the extent of the infrastructure footprint areas and will include ripping, spreading of overburden and topsoil and establishment of vegetation. The first phase of the rehabilitation plan (demolishing of infrastructure) will have a negative effect on the soil, land use and land capability, however when rehabilitation of these areas commence, the land capability status will increase, being an positive effect. It would be the optimal to rehabilitate the Project Area to at least cattle grazing and wildlife. The activities will reduce the current impacted area significantly as well as focus on rehabilitating the area. This will have significant positive impacts on the soils, land use, land capability, environment, water and overall functionality of the area.

12.1. Impact Ratings

Table 12-2 and Table 12-4 presents the impact ratings associated the Project for all the phases prior and post mitigation, whereas Table 12-3 presents the mitigation measures to be implemented to avoid, reduce, and rehabilitate impacts to the soil, land use and land capability.

Table 12-2: Pre-Mitigation Impacts of Activity

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Loss of soil resource (e.g., agriculture, rehabilitaiton, building material); • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Dust, erosion and sedimentation from stockpiles, dump and discard dump; • Soil contamination and deterioration; and	Long term (4)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -40
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.		Project Life (5)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -44

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
		• Soil compaction causing decreased soil depth for root penetration and increased runoff from hardened surfaces.						
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.	Infrastructure areas and operation: • Soil erosion and sedimentation into low-lying areas due to increased runoff and hardened surfaces; • Soil quality contamination and deterioration due to potential spills and leakages; and • Loss of usable soil for agriculture. Progressive Rehabilitation: • Soil erosion and sedimentation due to exposed surfaces; and • Soil quality contamination and deterioration due to potential spills and leakages from equipment. Positive impacts: • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal and disposal of potential impacted soils; and • Increased land capability.	Permanent (7)	Municipal Area (4)	Noticeable (7)	Definite (7)	Positive	Major +126
	Operation of pump stations during the operational phase.		Medium term (3)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -36
	Maintenance of pipeline routes during the operational activities.		Short term (2)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -18
	Infilling of processed tailings material into the West Pits Pit and other potential pits.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
	Surface tailings deposition within the West Wits Pit.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
	Tailings deposition onto the historic footprint of 1L23-1L25.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
	Production of Gold.		Project life (5)	Local (3)	Moderate loss (3)	Likely (5)	Negative	Minor -55
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.		Beyond project life (6)	Municipal Area (4)	On-going (5)	Likely (5)	Positive	Moderate +75
Rehabilitation Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.	Negative impacts: • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Soil contamination and deterioration, decreasing the soil fertility; • Increased AIPs due to soil disturbances, decreasing the land capability and soil potential; and • Source topsoil from other areas for rehabilitation purposes, impacting other areas. Positive impacts:	Short term (2)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -18
	Removal, decommissioning and rehabilitation of the processing plant footprint.		Short term (2)	Limited (2)	Moderate loss (3)	Unlikely (3)	Negative	Negligible -21
	Rehabilitation of the old TSF footprints.		Beyond project life (6)	Municipal Area (4)	On-going (5)	Likely (5)	Positive	Moderate +75
	Rehabilitation of the old Mogale Processing Plant footprint.		Beyond project life (6)	Municipal Area (4)	On-going (5)	Likely (5)	Positive	Moderate +75
	Final rehabilitation of the facility.		Permanent (7)	Region (5)	On-going (5)	Almost certain (6)	Positive	Moderate +102

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
	General rehabilitation of the surrounding area, including wetland rehabilitation.	• Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal of AIPs and increased soil and land potential; • Removal and disposal of potential impacted soils/tailings; and • Increased soil, land use and land capability of the entire area.	Permanent (7)	Region (5)	On-going (5)	Almost certain (6)	Positive	Moderate +102

Table 12-3: Mitigation Measures

Project Phase	Mitigation Measures
Construction Phase	• If the destruction of soils with a **High** land capability is unavoidable, disturbance must be minimised and appropriately rehabilitated; • Topsoil stockpiles must be vegetated and allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction; • Monitor infrastructure, stockpiles and dumps to ensure no runoff, erosion and sedimentation and decreased land capability; • If any erosion occurs on site, corrective actions such as erosion berms and silt traps must be taken to minimise any further erosion from taking place; • Minimise the period of exposure of soil surfaces through dedicated planning; • A Storm Water Management Plan (SWMP) should be implemented. This should consider all wetlands and other watercourses adjacent and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses. The SWMP should also convey contaminated water to silt traps to limit erosion and subsequent contaminants into soils and groundwater; and • Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary.

Project Phase	Mitigation Measures
Operational Phase	• All vehicle maintenance and refuelling must occur within designated areas and inspected regularly for leaks; • All spills must be cleaned up immediately to prevent contaminants to enter the soils and groundwater. Monitoring must take place at least for three months after the spill have occurred to determine any contamination; • Culverts, roads, conveyors, powerlines and river crossings must be maintained, cleared and monitored; • Topsoil and tailings stockpiles should be monitored and vegetated (if possible) to ensure no runoff, erosion, sedimentation and loss of soil fertility; • Topsoil stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • Monitor the processing plant, wash plant and other infrastructure areas, if spills have occurred, clean up immediately and implement a monitoring program for at least three months after the spill has occurred; • Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; • Re-vegetate cleared areas and stockpiles to avoid wind and water erosion; • Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; • A Topsoil Management Plan (TMP) must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014); • Long term stockpiles should be revegetated to minimise loss of soil quality. This will minimise AIPs, maintain soil organic matter levels, maintain soil structure, and microbial activity; and • Compacted areas are to be ripped to loosen the soil structure.
Decommissioning Phase	• Rehabilitation and decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation; • Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation; • Implement and maintain a AIP Management Plan for the duration of the rehabilitation phase and into closure; • Rehabilitation must be done as soon as any impacts are observed and potential contamination from mining activities; • Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; • Ensure proper storm water management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs; • Continue with Concurrent Rehabilitation, and implement land rehabilitation measures; • Address compacted areas by deep ripping to loosen the soil, and revegetate the area; • Implement a Radiation Assessment to determine potential radiation from the stockpiles and rehabilitated areas; • The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions; and. • Should the end land use be set for industrial development the area will still need to be re-vegetated to prevent open, bare soils to avoid erosion, sedimentation and loss of soil fertility.

Table 12-4: Post-mitigation Impact Ratings

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	After avoidance, minimisation, mitigation and rehabilitation of the site, impacts should be Moderate to Minor, however impacts might still arise over time due to the construction phase:	Short term (2)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -18

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Erosion; • Sedimentation; • Compaction and increased runoff; • Mixing of subsoil and topsoil; and • AIPs proliferation.	Immediate (1)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -15
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.	• Potential soil contamination from the processing plant and infill into the pits; • When rehabilitation, mitigation and monitoring is done correctly, impacts from infrastructure and monitoring should be positive; • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal and disposal of potential impacted soils; and • Increased land capability.	Permanent (7)	Municipal Area (4)	Noticeable (7)	Definite (7)	Positive	Major +126
	Operation of pump stations during the operational phase.		Short term (2)	Limited (2)	Minor loss (2)	Unlikely (3)	Negative	Negligible -18
	Maintenance of pipeline routes during the operational activities.		Immediate (1)	Very limited (1)	Minimal loss (1)	Rare (2)	Negative	Negligible -6
	Infilling of processed tailings material into the West Pits Pit and other potential pits.		Permanent (7)	Municipal Area (4)	Noticeable (7)	Definite (7)	Positive	Major +126
	Surface tailings deposition within the West Wits Pit.		Permanent (7)	Municipal Area (4)	Noticeable (7)	Definite (7)	Positive	Major +126
	Tailings deposition onto the historic footprint of 1L23-1L25 (lined).		Permanent (7)	Municipal Area (4)	Noticeable (7)	Definite (7)	Positive	Major +126
	Production of Gold.		Project life (5)	Local (3)	Moderate loss (3)	Probable (4)	Negative	Minor -44
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
Rehabilitation Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.	• Impacts from rehabilitation and monitoring is rare/negligible. However, there is a possibility for soil and water contamination that will most probably impact soils and the current land capability after mine closure; • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal of AIPs and increased soil and land potential; • Removal and disposal of potential impacted soils/tailings; and • Increased soil, land use and land capability of the entire area.	Immediate (1)	Very limited (1)	Minor loss (2)	Rare (2)	Negative	Negligible -8
	Removal, decommissioning and rehabilitation of the processing plant footprint.		Immediate (1)	Very limited (1)	Minor loss (2)	Rare (2)	Negative	Negligible -8
	Rehabilitation of the old TSF footprints.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
	Rehabilitation of the old Mogale Processing Plant footprint.		Permanent (7)	Municipal Area (4)	Great improvement (6)	Almost certain (6)	Positive	Moderate +102
	Final rehabilitation of the facility.		Permanent (7)	Region (5)	Great improvement	Almost certain (6)	Positive	Moderate +108

Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
					(6)			
	General rehabilitation of the surrounding area, including wetland rehabilitation.		Permanent (7)	Region (5)	Great improvement (6)	Definite (7)	Positive	Major +126

12.2. Cumulative Impacts

The land uses within and adjacent of the Project Area have contributed to major losses of soil, land use and land capabilities. Historical and current mining activities, ASM, infrastructure, and cattle grazing has led to major geomorphological and hydrological impacts, vegetation loss, overgrazing, contamination of soil and water resources and increased surface inflows.

The historical formal mining activities, current and historical ASM and agropastoral activities within the catchment has led to land degradation, changing the land capability in large areas. The alteration of vegetation and surface flow has led to the onset of erosion and spread of tailings material and may be perpetuated further by the proposed activities. In addition to mining and agropastoral activities were linear infrastructures such as roads, dams, powerlines, and fences. The impacts include the creation of preferential flow paths, erosion, sedimentation and compaction of soils.

Mining and associated activities impacting the soil resources include changes to the physico-chemical properties of the soil. Impacts include:

- Geomorphological changes to the natural soils and landscape;
- Loss of habitat, vegetation and growth medium;
- Erosion, destruction of agricultural land, loss of topsoil and organic material;
- Sedimentation and pollution of water courses (wetlands); and
- Soil contamination through acid and sulphate, mine impacted water (decant water) and heavy metals.

The cumulative impacts have a significant effect on the soil resources and therefore impacting the land use and land capability of the Project Area. Contaminated soil directly impact the water quality and quantity as well as vegetation and soil fertility.

12.3. Unplanned and Low Risk Events

The entire Project Area are planned to be lost/mined out. However, there is a risk that the adjacent and downstream soils, land use and land capability will be impacted due to the proposed activities. Table 12-5 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed Project.

Table 12-5: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Erosion from the additional infrastructure	• Ensure proper stormwater management, including culverts and road design; • Monitor erosion; • Maintain infrastructure; and

Unplanned Risk	Mitigation Measures
	• Install silt traps, re-vegetate area after construction and ensure proper slopes (avoid water ponding and steep slopes).
Spillage from moving machinery and pipelines conveying the material to the plant site	• Pipelines, machines and trucks must be maintained and checked regularly; • Access roads and the bridge crossing must be maintained, if impacts are observed it must be rehabilitated immediately; • Ensure emergency response plans are in place; • Contractors must ensure that all employees are aware of the procedure for dealing with spills and undergo training on site; and • Contaminated soils must be disposed in a registered and licensed Waste Land Facility.
Hazardous substance spillage from pipelines or waste storage.	• If a spill occurs it is to be cleaned up (Drizit spill kit/ Zupazorbtype spill kit, oil or chemical spill kit) immediately and reported to the appropriate authorities; • Ensure emergency response plans are in place; • Contractors must ensure that all employees are aware of the procedure for dealing with spills and leaks and undergo training on site; • All machines are to be serviced and refuelled in demarcated bunded areas, workshops or at appropriate off-site locations; • Contaminated soils must be disposed in a registered and licensed Waste Land Facility; and • Conduct monitoring after spills if and where necessary to prevent secondary impacts to the adjacent and downstream soils.
Sedimentation from stockpiles and tailings dumps	• Install silt traps, re-vegetate the material if possible and ensure proper slopes (avoid water ponding and steep slopes) to reduce increased runoff; and • Waste material must be contained to prevent it from entering wetlands and other low-lying areas as it will contaminate the soils, water and affect the vegetation of these areas.

13. Environmental Management Plan

An Environmental management Plan (EMP) is generally considered an environmental management tool that is implemented with the objective of mitigating the undue, or reasonably avoidable adverse impacts, associated with the development of a project. The EMP must consider each activity and its potential impacts during the construction, operational, decommissioning and post closure phases. The EMP must address all potentially significant impacts during these phases. The EMP is described in Table 13-1 below.

Table 13-1: Environmental Management Plan

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc. Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Loss of soil resource (e.g., agriculture, rehabilitaiton, building material); • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Dust, erosion and sedimentation from stockpiles, dump and discard dump; • Soil contamination and deterioration; and • Soil compaction causing decreased soil depth for root penetration and increased runoff from hardened surfaces.	• **Control and prevent**. If the destruction of soils with a **High** land capability is unavoidable, disturbance must be minimised and appropriately rehabilitated; • **Control and prevent**. Topsoil stockpiles must be vegetated and allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • **Remedy**. Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction, • **Control and prevent**. Monitor infrastructure, stockpiles and dumps to ensure no runoff, erosion and sedimentation and decreased land capability; • **Remedy**. If any erosion occurs on site and adjacent of the Project Area, corrective actions (erosion berms) must be taken to minimise any further erosion from taking place; • **Control and minimize.** Minimise the period of exposure of soil surfaces through dedicated planning; • **Control and prevent**. A Storm Water Management Plan (SWMP) should be implemented. This should consider all wetlands and other watercourses adjacent and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses. The SWMP should also convey contaminated water to silt traps to limit erosion and subsequent contaminants into soils and groundwater; and • **Control and prevent**. Spill containment and clean up kits should be available onsite and clean-up from any spill must be in place and executed at the time of a spillage with appropriate disposal as necessary.	Concurrent rehabilitation through the life of mine	Life of Construction Phase
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps. Operation of pump stations during the operational phase.	Infrastructure areas and operation: • Soil erosion and sedimentation into low-lying areas due to increased runoff and hardened surfaces; • Soil quality contamination and deterioration due to potential spills and leakages; and • Loss of usable soil for agriculture. Progressive Rehabilitation:	• **Control and prevent**. All vehicle maintenance and refueling must occur within designated areas and inspected regularly for leaks; • **Control, prevent and remediate**. All spills must be cleaned up immediately to prevent contaminants to enter the soils and groundwater. Monitoring must take place at least for three months after the spill have occurred to determine any contamination; • **Control and prevent.** Culverts, roads, conveyors, powerlines and river crossings must be maintained, cleared and monitored;	Concurrent rehabilitation through the life of mine	Life of Operational Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
	Maintenance of pipeline routes during the operational activities. Infilling of processed tailings material into the West Pits Pit and other potential pits. Surface tailings deposition within the West Wits Pit. Tailings deposition onto the historic footprint of 1L23-1L25. Production of Gold. Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.	• Soil erosion and sedimentation due to exposed surfaces; and • Soil quality contamination and deterioration due to potential spills and leakages from equipment. Positive impacts: • Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal and disposal of potential impacted soils; • Increased land capability	• **Control and prevent.** Topsoil and tailings stockpiles should be monitored and vegetated (if possible) to ensure no runoff, erosion, sedimentation and loss of soil fertility; • **Control and prevent.** Topsoil stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater; • **Control, prevent and remediate**. Monitor the processing plant, wash plant and other infrastructure areas, if spills have occurred, clean up immediately and implement a monitoring program for at least three months after the spill has occurred; • **Control and prevent.** Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible; • **Control and prevent.** Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; • **Remediate.** Re-vegetate cleared areas and stockpiles to avoid wind and water erosion; • **Control, prevent and remediate**. Preserve looseness of stockpiled soil by executing fertilisation and seeding operations by hand; • **Control and prevent.** A Topsoil Management Plan (TMP) must be prepared to demonstrate how topsoil will be preserved in a condition as near as possible to its pre-mining condition to allow successful mine rehabilitation (Statham, 2014); • **Control, prevent and remediate**. Long term stockpiles should be revegetated to minimise loss of soil quality. This will minimise AIPs, maintain soil organic matter levels, maintain soil structure, and microbial activity; and • **Remediate.** Compacted areas are to be ripped to loosen the soil structure.		
Rehabilitation Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints. Removal, decommissioning and rehabilitation of the processing plant footprint. Rehabilitation of the old TSF footprints. Rehabilitation of the old Mogale Processing Plant footprint.	Negative impacts: • Increased risk to soil erosion and sedimentation due to exposed soils and surfaces; • Soil contamination and deterioration, decreasing the soil fertility; • Increased AIPs due to soil disturbances, decreasing the land capability and soil potential; and • Source topsoil from other areas for rehabilitation purposes, impacting other areas. Positive impacts:	• **Control, prevent and remediate**. Rehabilitation and decommissioning should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation; • **Remediate.** Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation; • **Control, prevent and remediate**. Implement and maintain a AIPs Management Plan for the duration of the rehabilitation phase and into closure; • **Control, prevent and remediate**. Rehabilitation must be done as soon as any impacts are observed; • **Control, prevent and remediate.** Implement a Radiation Assessment to determine potential radiation from the stockpiles and rehabilitated areas;	Concurrent rehabilitation through the life of mine and after mine	Life of Rehabilitation Phase

Phase	Project Activity	Potential Impacts	**Mitigation Measures**	**Mitigation Type**	**Period for Implementation**
	Final rehabilitation of the facility. General rehabilitation of the surrounding area, including wetland rehabilitation.	• Soil remediation and rehabilitation, increasing the soil potential, fertility and basal cover; • Removal of AIPs and increased soil and land potential; • Removal and disposal of potential impacted soils/tailings; and • Increased soil, land use and land capability of the entire area.	• **Control, prevent and remediate.** Should the end land use be set for industrial development the area will still need to be re-vegetated to prevent open, bare soils to prevent erosion • **Control, prevent and remediate**. Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion; • **Control, prevent and remediate**. Ensure proper storm water management designs are in place and should be kept in place until all infrastructure is removed. Where infrastructure will remain, stormwater and culverts should be maintained and monitored for erosion and AIPs; • **Control, prevent and remediate**. Continue with Concurrent Rehabilitation, and implement land rehabilitation measures; • **Remediate.** Address compacted areas by deep ripping to loosen the soil, and revegetate the area; and • **Remediate.** The backfilled, reprofiled landscape should be top soiled and revegetated to allow free drainage close to the pre-mining conditions.		

14. Monitoring Programme

Note

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

Soil monitoring should be done in terms of:

- EIA Regulations, 2014 (GN R 982 of 4 December 2014 as amended by GN R326 of 7 April 2017) promulgated under the NEMA;
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM:WA); and
- The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983) (CARA).

Results of chemical analyses of soils obtained must be measured against the SSV and reference samples and clearly demonstrate that the selection of guideline values is consistent with the principles of the framework.

The Mine Manager (MM) and the EP are responsible to report on results of the monitoring program.

Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 14-1 describes the monitoring plan which should be followed from the Construction Phase through to the Rehabilitation and Monitoring phase. The table includes each element of monitoring together with the frequency of monitoring and person responsible thereof.

Table 14-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Phase	Responsibility	Duration
Topsoil stockpiles (height, erosion, compaction, low vegetation cover)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Stockpile update report and recommendations for impact mitigation, if any.	Twice every year and after storm events	Construction	Environmental Officer	Up to Rehabilitation
				Operational		
			N/A	Rehabilitation		
Soil health and fertility	Implementation of intervention / mitigation / rehabilitation measures.	Soil update report and recommendations for impact mitigation, if any.	Once every year	Construction	Environmental Officer	3 years after Rehabilitation
				Operational		
			Twice a year	Rehabilitation		
Soil physical attributes (vegetation, erosion, sedimentation)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of impacted areas and record any impacts seen.	Once every year	Construction	Mine Environmental Manager.	3 years after Rehabilitation
				Operational		
			Twice every year	Rehabilitation		
Soil contamination assessment	Report any irregularities to the Environmental Officer for assessment and mitigation/remediation measures.	Take soil samples for laboratory analysis, measuring heavy metals and potential harmful elements. Measure against the baseline data and SSV.	Only after a spill has occurred	Construction	Environmental Officer	3 months after (monthly) the spill has occurred
				Operational		
			Twice every year	Rehabilitation		3 years after Rehabilitation
Potential radiation	Report any irregularities to the Environmental Officer for assessment and mitigation/remediation measures.	Take soil samples for laboratory analysis, measuring for radiation (ranium-238 (238 U) and Thorium-232 (232 Th)). Measure against the baseline data and SSV.	Once every year	Construction	Environmental Officer	3 months after (monthly) the spill has occurred
				Operational		
			Twice every year	Rehabilitation		3 years after Rehabilitation

15. Stakeholder Engagement Comments Received

Notes

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that I&APs are informed about the Project;
- To provide I&APs with an opportunity to engage and provide comment on the Project;
- To draw on local knowledge by identifying environmental and social concerns associated with the Project;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

The Public Participation Process (PPP) has been completed in part, as a process separate to the Soil Impact Assessment.

Please refer to the Comments and Response Report, attached as Appendix C of the EIA Report for comments raised and responses provided.

16. Recommendations

The following actions are recommended to reduce adverse effects on the soil resources of the Project Area (Table 16-1):

Table 16-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations
Soil disturbance (erosion), and decreasing biodiversity resulting in increased sedimentation and increased erosion.	• Improved vegetation cover native to the area; • Remove AIPs; and • Reduced risk of erosion and sedimentation through vegetation and installation of silt traps.
Loss of the soil resource due to: • Change in land use, and removal of the soil; and • Erosion from unprotected soils.	• Reduce the risk of erosion, compaction, and the creation of preferential flow paths by re-vegetating exposed areas, maintaining linear infrastructure and culverts and installing sediment traps and erosion berms; • Rehabilitated areas must be fenced, and animals should be kept off the area until the vegetation is self-sustaining; and • Runoff must be controlled and managed using proper stormwater management measures.
Change in soil characteristics (soil texture) due to	• Restriction of vehicle movement over sensitive areas to reduce compaction;

Possible Impacts	Recommendations
compaction of areas and associated mine infrastructure.	• Only the designated access routes are to be used to reduce any unnecessary compaction; and • Deep rip compacted areas, cover with at least 500 mm of topsoil and revegetate.
Contamination of the soil resource due to hydrocarbons spillages.	• If soil is polluted, treat the soil using in-situ bioremediation; • If in-situ treatment is not possible then the polluted soil must be classified according to the minimum requirements for the handling, classification, and disposal of hazardous material, and disposed at an appropriate, permitted or licensed disposal facility; • All vehicles and machines must be parked within hard park areas, and must be checked daily for fluid leaks; • Re-fueling must take place on a sealed surface area away from soils to prevent seepage of hydrocarbons into the soil; • Place drip trays where vehicles or machinery leaks are occurring; • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits; • Any contractors on site must ensure that all employees are aware of the procedure for dealing with spills, and leaks, and undergo training on-site; and • Soil pollution monitoring after spills should be conducted at selected locations on the project site to detect any extreme levels of pollutants.

17. Reasoned Opinion Whether Project Should Proceed

Based on the baseline information and impact assessment significance ratings, it is the opinion of the specialist that this project will have **negligible** impacts on the soils, land use and land capability. In fact, it is in the opinion of the specialist that the mining of the tailings material and when the mitigation measures and recommendations are incorporated, the impacts will be positive and should have various advantages to the immediate area as well as the municipal area. The Project Area is currently heavily impacted, formal mining activities and the removal/ mining of the tailings material should reduce the current impacts to the environment.

Positive impacts to the soil, land use and land capability will include:

- Soil and tailings material remediation and rehabilitation, increasing the soil potential, fertility and basal cover;
- Removal and disposal of potential impacted soils;
- Removal of AIPs and increased soil and land potential; and

- Increased soil, land use and land capability of the entire area.

It is however recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise potential residual impacts to soils to maintain the land capability for future land use.

Soil management measures and monitoring requirements as set out in Section 13 and Section 14 should form part of the conditions for environmental authorisation, especially in areas of high land capability and in wetlands as these soils are highly erodible and has a potential to deteriorate rapidly.

18. Conclusion

The Project Area is characterized by a climate that is typical of that of the Highveld Ecoregion characterized by warm, rainy summers and dry winters (South African Weather Bureau, 1986) whereas the topography has been severely affected by the historical mining and current ASM activities, with the West Wits Pit leaving a deep incision and the surrounding barren rock dumps altering the horizon. The average slope for the Project Area varies due to the high concentration of mining, urban developments and infrastructure in the area. The geology falls within the Witwatersrand Supergroup Formations.

Existing Land Type and soil data was used to obtain generalised soil patterns and terrain types. Baseline data suggested that the land types are predominantly of the **Ba35** and **Ba36** types, consisting of Witwatersrand quartzite, slate, grit and conglomerate predominantly with widespread dystrophic and/or mesotrophic and red soils.

The current impacts to the soils, land use and land capability are dominantly associated with historical and current mining activities (i.e., mine pits, TSFs and infrastructure), anthropological activities (historical land fill sites, roads, dams, powerlines, pipelines, culverts, bridges) and agriculture. The area is heavily impacted with large areas of erosion gullies, sedimentation into the low-lying areas, tailings material scattered throughout the area, large excavations and infillings, informal mine pits and infrastructure. The land capability ranges from **low** to **high**, however is dominantly **low** due to the current conditions on site.

ASM is currently a major activity / land use in the area, causing various impacts to the soils, geomorphology and land as these activities are being undertaken unlawfully without any regulations or rehabilitation in place. The area is excavated to extensive depths, specifically within low lying areas and wetlands, affecting the functionality thereof and causing large areas of sedimentation and potential soil and water contamination.

Based on the baseline information and impact assessment significance ratings, it is the opinion of the specialist that this project will have **negligible** impacts on the soils, land use and land capability. In fact, it is in the opinion of the specialist that the mining of the tailings material and when the mitigation measures and recommendations are incorporated, the impacts will be **positive** and should have various advantages to the immediate area as well as the municipal area. The Project Area is currently heavily impacted, formal mining activities and the removal/ mining of the tailings material should reduce the current impacts to the environment.

Recommendations are made to ensure that the rehabilitation plan, mitigation measures, and continuous monitoring measures are in place, and encourage a concurrent rehabilitation and monitoring plan. Based on the baseline information, and impact assessment significance ratings, it is the opinion of the specialist that this project will have positive impacts on the land use and land capability if managed and mitigated correctly.

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Appendix A: Methodology

Desktop Assessment and Literature Review

Digby Wells conducted a desktop review of the baseline data and findings related to the soil surveys and other relevant existing documentation:

- Baseline soil information was obtained from the South African land type data published with maps at a scale of 1:250 000 by the Institute for Soil, Climate and Water (ISCW) of the Agricultural Research Council (ARC) (ARC, 2006). These maps indicate delineated areas of relatively uniform terrain, soil pattern, and climate (Land Type Survey Staff, 1972 - 2006). These maps and their accompanying reports provide a statistical estimate of the different soils that can be expected in the area;
- Aerial imagery was analysed to determine areas that are most likely to be suitable for agriculture. The aerial imagery analysis focused on lower lying areas where suitable soils for agriculture are more likely to occur; and
- Land use and land capability were described with specific reference to the interaction between water and land use through a review of existing studies conducted in the area as well as publicly available information.

Soil Classification

A soil assessment on the Project Area was conducted during a field visit in October 2021.

The site was traversed by vehicle and on foot. A hand soil auger was used to determine the soil type and depth. Soils were investigated using a Bucket and Cradle auger to a maximum depth of 1.2 metres (m) or to the first restricting layer. Survey positions were recorded as waypoints using a handheld Global Positioning System (GPS). Other features such as existing open trenches and diggings were helpful to determine soil form and depth. Mapping unit boundaries were determined by changes in topography with subsidiary indications from vegetation and parent material.

The soils were classified using the Soil Classification: A Taxonomic System for South Africa (Soil Classification Working Group, 1991). The following attributes were included at each observation:

- Topography, aspect and slope;
- Soil form and family;
- Soil depth;
- Estimated soil texture;
- Soil structure, coarse fragments, calcareousness;
- Underlying material; and
- Vegetation.

Soil Physical and Chemical Analysis

Five (5) representative soil samples (0 to 0.6 m) were collected from the proposed areas for soil chemical and physical analysis. The soil samples were stored in plastic bags and sent for analysis at a South African National Accreditation System (SANAS) accredited laboratory. In accordance with the methodology given in the Handbook of Standard Soil Testing Methods for Advisory Purposes (Soil Science Society of South Africa, 1990), the soil samples were tested for the following parameters:

- Cation Exchangeable Capacity (CEC);
- Electrical Conductivity (EC);
- pH (KCl);
- Exchangeable cations (Ca, Mg, K and Na);
- Phosphorus (Bray 1 extractant);
- Macro-elements (F and Cl); and
- Soil texture (Sand, Silt and Clay fractions).

Fertility analysis was used to provide recommendations for fertilisation and liming that is mostly used for soil management and remediation.

Soil texture is defined as the relative proportion of sand, silt and clay particles found in the soil. The relative proportions of these 3 fractions (clay, sand and silt) as illustrated in Figure 1, determines 1 of 12 soil texture classes, for example sandy loam, loam, sand, sandy clay loam etc. The different texture class zones are demarcated by the thick black line in the diagram.

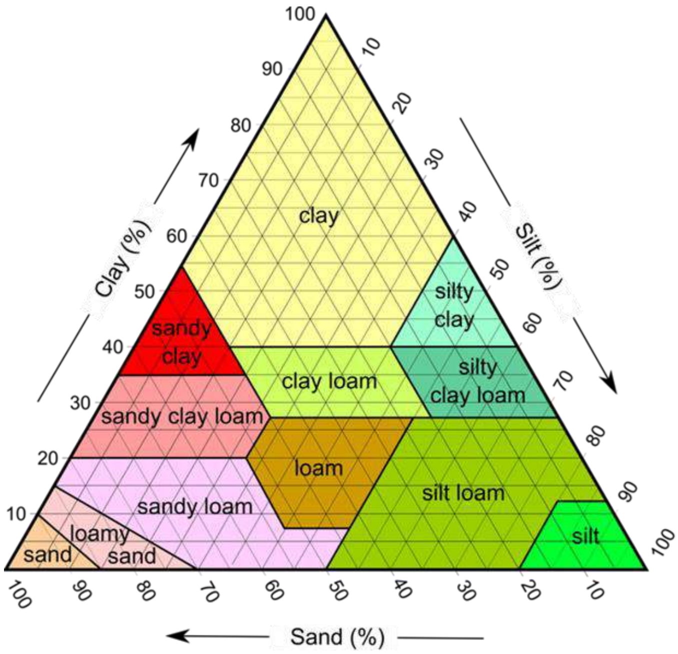


Figure 1: Soil Textural Diagram

(Source: (South African Sugar Association, 1999)

Land Use

The current land use was identified by aerial imagery during the desktop assessment and by on-site inspection during the EIA phase. The maps indicate delineated areas of similar land use (Land Type Survey Staff, 1972 - 2006). Land use categories are split into:

- Plantations;
- Natural;
- Waterbodies;
- Mines;
- Urban built-up; and
- Agriculture.

Land Capability

Land capability was determined by assessing a combination of soil, terrain and climate features. Land capability is defined by the most suitable land use under rain-fed conditions. The approach by U.S. Department of Agriculture (1973) and Schoeman et al. (2000) was used to assess the land capability. The classification system is made up of land capability classes and land capability groups (Table 1). The land will be rated into eight classes which include group of capability units or subgroups that have the same relative degree of limitation or potential. These classes range from I to VIII in order of decreasing agricultural potential based on limiting factors that include erosion hazard (e), excess water (w), soil root zone (s) and climatic (c) limitations. Classes I-IV represent arable land and Classes V-VIII represent non-arable land according to the guidelines (Soil Conservation Service: U.S. Department of Agriculture, 1973; Schoeman, et al., 2000).

Table 1: Land Capability Classes

<table>
<tr><th>Class</th><th colspan="9">Increased Intensity of Use</th><th>Land Capability Groups</th><th>Sensitivity</th><th rowspan="9">W – Wildlife
F – Forestry
LG – Light Grazing
MG – Moderate Grazing
IG – Intensive Grazing
LC – Light Cultivation
MC – Moderate Cultivation
IC – Intensive Cultivation
VIC – Very Intensive Cultivation</th></tr>
<tr><td>I</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>VIC</td><td rowspan="4">Arable Land</td><td rowspan="4">High</td></tr>
<tr><td>II</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>IC</td><td>-</td></tr>
<tr><td>III</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>MC</td><td>-</td><td>-</td></tr>
<tr><td>IV</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>IG</td><td>LC</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>V</td><td>W</td><td>-</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Grazing Land</td><td rowspan="2">Medium</td></tr>
<tr><td>VI</td><td>W</td><td>F</td><td>LG</td><td>MG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>VII</td><td>W</td><td>F</td><td>LG</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td rowspan="2">Wildlife</td><td rowspan="2">Low</td></tr>
<tr><td>VIII</td><td>W</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

Land Suitability (Agricultural Potential)

The process of land suitability classification is the grouping of specific areas of land in terms of their suitability for a defined land use. Soil agricultural potential or suitability mapping was determined by considering the soil forms, land capability classes, soil analysis results, the hydrology of the site and the current land use. The process involved allocating terrain factors (topography and slope) and soil factors (depth, texture, internal drainage and mechanical limitations) which define soil forms, to an area of land. The soil chemical analysis, which includes pH, cations and phosphorus compositions, was considered in determining the final suitability of the soil. The suitability guidelines according to Schoeman et al., (2000) were used.

Soil chemical, physical and biological processes depends on five soil forming factors, including time, topography, organic material, climate and parent material. These soil forming factors changes the soil characteristics and therefore are considered when soils are grouped into land capability and suitability. Depending on which of these are limiting, the soils fall under one of the following suitability classes (Table 2):

Table 2: Land Classes – Descriptions and Suitability

Class	Definition	Conservation Need	Use-Suitability
I	• No or few limitations. • Very high arable potential. • Very low erosion hazard.	Good agronomic practice.	Annual cropping.
II	• Slight limitations. • High arable potential. • Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%).
III	• Moderate limitations. • Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50%).
IV	• Severe limitations. • Low arable potential. • High erosion hazard.	Intensive conservation practice.	Long term leys (75%).
V	• Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife.
VI	• Limitations preclude cultivation. • Suitable for perennial vegetation.	Protection measures for establishment e.g. Sod-seeding.	Veld and/or afforestation.
VII	• Very severe limitations. • Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation.
VIII	• Extremely severe limitations. • Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife.

Impact Assessment

The soil impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on national guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to soils:

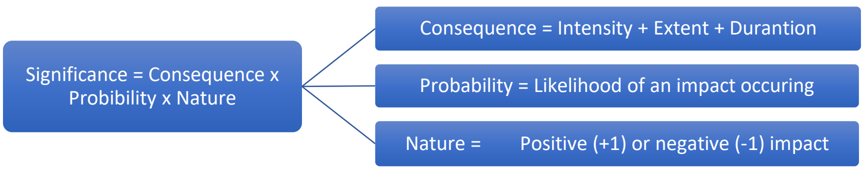
- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

Significance Rating

Impacts and risks have been identified based on the description of the activities to be undertaken. Once the impacts were identified, a numerical environmental significance rating process was undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a specific environmental impact.

The severity of an impact was determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact was then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures were incorporated into the EMP. Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:



Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts

The matrix calculated the rating out of 147, whereby intensity, extent, duration and probability were each rated out of seven as indicated in Table 4. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

Parameter Rating

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 3, which is extracted from Table 4. The description of the significance ratings is discussed in Table 5.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 3.

Table 3: Mitigation Hierarchy

↓	**Avoid or Prevent**	Refers to considering options in Project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the other steps in the mitigation.
	Minimize	Refers to considering alternatives in the Project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable, and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Rehabilitation can, however, fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimize and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 4: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	Positive Impacts (Nature = +1)			
7	**Irreplaceable loss** or damage to biological or physical resources or **highly sensitive** environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the Project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	**Irreplaceable loss** or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond Project Life: The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Almost Certain/Highly Probable: It is most likely that the impact will occur. >65 but <80% probability.
5	**Serious loss** and/or damage to physical or biological resources or **highly sensitive** environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the Project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	**Serious loss** and/or damage to physical or biological resources or **moderately sensitive** environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long Term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.
3	**Moderate loss** and/or damage to biological or physical resources of **low to moderately sensitive** environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediate surrounding area.	Medium Term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur. <25% probability.
2	**Minor loss and/or effects** to biological or physical resources or **low sensitive** environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short Term: Less than 1 year and is reversible.	Rare/Improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and/or social benefits felt by a very small percentage of the baseline.	Very Limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly Unlikely/None: Expected never to happen. <1% probability.

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Table 5: Probability/Consequence Matrix

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	Consequence																																					

Table 6: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and/or social environment.	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and/or social environment.	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and/or social environment.	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and/or social environment.	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the Project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

Appendix E: Fauna and Flora Assessment

DIGBY WELLS
ENVIRONMENTAL

Your Preferred Environmental and Social Solutions Partner

Providing innovative and sustainable solutions throughout the resources sector

Mogale Tailings Retreatment Operations Environmental Application Process

Fauna and Flora Specialist Study

Prepared for:
Pan African Resources PLC (PAR)

Project Number:
PAR7273

November 2021

Digby Wells and Associates (South Africa) (Pty) Ltd
Company Registration: 2010/008577/07

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*Non-Executive

This document has been prepared by Digby Wells Environmental.

Report Type:	Fauna and Flora Specialist Study
Project Name:	Mogale Tailings Retreatment Operations Environmental Application Process
Project Code:	PAR7273

Name	**Responsibility**	**Signature**	**Date**
Lisa Hester	Field Surveyor and Report Compiler		September 2021
Carole Small	Field Surveyor		September 2021
Julia Ndou	Report Compiler		April 2022
Stephen Burton	Report Review		April 2022
Brett Coutts	Report Review		July 2022

DETAILS AND DECLARATION OF THE SPECIALIST

Digby Wells and Associates (South Africa) (Pty) Ltd

Contact person: Lisa Hester

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Tel: 011 789 9495
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E-mail: lisa.hester@digbywells.com

Full name:	Lisa Hester
Title/ Position:	Ecologist
Qualification(s):	BSc Hons
Experience (years):	4
Registration(s):	SACNASP 125725

I, Lisa Hester , 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, 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; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

10/12/21

Signature of the Specialist *Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

No form of this report may be amended or extended without the prior written consent of the author and/or a relevant reference to the report by the inclusion of an appropriately detailed citation.

Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

Mogale Tailings Retreatment (Pty) Ltd (MTR) a wholly owned subsidiary of Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation to be completed by 30th September 2022. The proposed transaction has now been concluded and was announced on the 6th October 2022.

PAR has closed the transaction to acquire the total share capital and claims of Mogale Gold and Mintails SA Soweto Cluster Proprietary Limited (MSC), (collectively, the Sale Transaction). Both Mogale Gold and MSC are 100% owned by Mintails Mining SA Proprietary Limited (Mintails SA), which was placed in provisional liquidation during 2018. Based on this PAR has now acquired the assets associated with MR 206, based on the conclusion of the transaction noted above.

The project entails the reclamation of historical unlined Tailings Storage Facilities (TSFs). The reprocessed tailings will be first discarded into West Wit Pit and possibly other nearby small pits. Any extra processed tailings will be stored on a ground TSF (West Wits Pit TSF and 1L23-1L25 TSF). It is proposed that the footprint of 1L23-1L25 footprint will be lined and the footprint of West Wits Pit TSF will not be lined.

The Project Area falls within the Soweto Highland Grassland (Endangered vegetation type identified by Mucina & Rutherford (2006), the). Four major vegetation types were noted within the Project Area: Modifed Grassland, Wetland Vegetation, Rocky Grassland and Transformed Habitat (Figure 8-1).

A total of 109 plant species were recorded during a single season visit during September 2021. Of these, no Species of Conservation Concern (SCC) were encountered Forty (40) invasive or alien species were recorded and categorised according to the Alien and Invasive Species Lists, 2014 (GN R599 in *GG* 37886 of 1 August 2014) of the NEMBA (Act 10 of 2004). No faunal SCC were observed however the identified habitats and vegetation support habitat for faunal SCC, expected faunal SCC are listed and described in Section 7.1.3.

Majority of the site has sustained heavy modifications and almost all vegetation types identified have endured impacts from historical and current land use practices. Anthropogenic impacts in the form of previous land modifications and alien invasive proliferation were observed throughout each vegetation unit. The Project Area does include some unique habitat features and units. The Rocky Grassland and Wetland vegetation communities constitute to a moderate sensitivity owing to the ecosystem services they provide and their irreplaceability as unique biodiversity features.

Impacts on the fauna and flora associated with the proposed TSF mining activities and associated ancillary infrastructure include the loss of vegetation communities, biodiversity (loss of faunal and floral species of conservation concern) and ecosystem functioning (wetlands). If no mitigation is introduced, significance of the impacts ranges from minor to negligible negatives. If mitigation measures are adhered to significance of the impacts range from positive to minor negatives (see Section 9 Impact Assessment). Section 10 and 11 describes a management plan for the rehabilitation and monitoring during the construction, operational, and decommissioning phase of the project. It is highly recommended to ensure that these management measures be followed to limit the impacts to the fauna and flora of the Project Area.

Based on the understanding of the Project while considering the results of the impact assessment, Digby Wells does not object to the Project from a faunal and floral perspective; taken into consideration the provided Environmental Management Plan, Monitoring Program, and Recommendations are adopted

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
AIP	Alien Invasive Plant
AMD	Acid Mine Drainage
cm	Centimetre
CPP	Central Processing Plant
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMR	Department of Mineral Resources
DWS	Department of Water and Sanitation, previously Department of Water Affairs and Forestry (DWAF)
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMP	Environmental Management Plan
EMPr	Environmental Management Program
EP	Environmental Practitioner
GDARD	Gauteng Department of Agriculture and Rural Development
ha	Hectare
I&APs	Interested and Affected Parties
IUCN	International Union for Conservation of Nature
IWULA	Integrated Water Use License Application
km	Kilometre
m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation
mm	Millimetre
MM	Mine Manager
MR	Mining Right
MRA	Mining Right Area

NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
OC1	Open Pit
PCD	Pollution Control Dam
PPP	Public Participation Process
ROM	Run of Mine
RWD	Return Water Dam
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SEP	Stakeholder Engagement Process
TSF	Tailings Storage Facility
WML	Water Management License
WRC	Water Research Commission
WUL	Water Use License
WWF	Worldwide Fund for Nature

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Refer to Details and Declaration of Specialist
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Refer to Details and Declaration of Specialist
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Refer to Section 2 and 5
cA	And indication of the quality and age of the base data used for the specialist report;	Refer to Section 5

Legal Requirement		**Section in Report**
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Refer to Section 7,8 and Section 9
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Refer to Section 8
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Refer to Section 5
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	Refer to Section 7 and 8
(g)	an identification of any areas to be avoided, including buffers;	Refer to Section 7 and 8
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Refer to Section 7 and 8
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Refer to Section 4
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Refer to Section 7,8 and Section 9
(k)	any mitigation measures for inclusion in the EMPr;	Refer to Section 10
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Refer to Section 13
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Refer to Section 11
(n)	a reasoned opinion (Environmental Impact Statement) -	Refer to Section 14
	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Refer to Public Participation in the EIA Report
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to Appendix C of the EIA Report

Legal Requirement		Section in Report
(q)	any other information requested by the competent authority.	Refer to Appendix C of the EIA Report

1. Introduction

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

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Mogale Gold owns the right to extract and process gold from tailings recourses by reprocessing old gold mine slimes dams and sandy mine dumps left by the extensive historic mining activities that have taken place in the area since 1888. MTR (PAR) is only interested in the surface operations associated with Mining Right (MR) 206 (i.e., Tailings Storage Facilities (TSFs) for reclamation, processing and deposition), and therefore the focus of this application process.

The Project consists of 120 Mt of tailings to be reprocessed and firstly deposited into the West Wits Pit (current authorisation in place for in-pit deposition) and then undertake deposition of the footprint of 1L23-1L25 footprint (New Tailings Facility) once capacity has been reached within the West Wits Pit.

Alternatives are being considered for potential deposition of tailings material into the other pits in the area.

It must be noted that once the West Wits Pits reaches capacity the surface deposition will extend in a northern direction from the pit onto surface, expanding the deposition footprint associated with West Wits Pit.

There are six dumps being considered to be reprocessed, the largest of which amounts to 57.9 Mt, while the smallest contains 0.57 Mt. The primary location of processed tailings storage has been earmarked for deposition in the West Wits Pit.

2. Project Description

Mogale plan to undertake activities relating to reclamation associated with gold-bearing TSFs through hydraulic reclamation. Digby Wells were appointed as the Independent Environmental Consultant to undertake the Environmental Impact Assessment (EIA) Application process which comprises of an Air Emission Licence (AEL) and Water Use Licence (WUL) for the proposed gold-bearing TSFs.

The site is located in the West Rand, in Gauteng Province. The site comprises of existing infrastructure such as sand dumps, Lancaster Dam and an open pit that will be used for the deposition of tailings materials. A process plant, overland pumping and piping inclusive of associated water management infrastructure will form part of the proposed infrastructure that will require an authorisation. Once the open pit is filled to capacity, a new TSF will potentially be constructed on the footprint area of one of the reclaimed TSF sites (1L23-1L25) (Figure 1-1). The footprint of the area is 2,923.3 ha which considers MR 206 and associated infrastructure.

Ancillary infrastructure such as pipelines, powerlines and pumps will be required for the proposed reclamation activities and will be included in support of the Environmental Application Process, which will be undertaken.

2.1. Project Locality

The Mining Right Area of the Mogale Cluster includes: G1, G2 plant; Cams, North Sand; South Sand; 1L23-1L25; 1L28; 1L13-1L15; 1L8, 1L9; 1L10; West Wits Pit (WWP) and Lancaster Dam. The mining right is located on Portions 66 and 99 of the farm Waterval 174 IQ and portions 136 and 209 of the farm Luipaardsvlei 246 IQ.

The project is within the Mogale City Local Municipality (MCLM), which is located within the West Rand District Municipality (WRDM). MCLM is the regional services authority and the area falls under the jurisdiction of the Krugersdorp Magisterial District.

The site is located in the catchment of the Upper Wonderfonteinspruit, quaternary catchment C23D, which forms part of the Vaal River Water Management Area (WMA) within the Vaal Catchment Management Agency (CMA). The project is about 4 km south of Krugersdorp and north-east of Randfontein, approximately 10 km off the N14 National Road in the Gauteng Province, in an area that has been transformed by past gold mining activities.

The summary of project location details in Table 2-1 and locality of the site is illustrated in Table 2-2 Figure 2-2.

Table 2-1: Summary of the Mogale Project Location Details

Province	Gauteng
District Municipality	West Rand District Municipality
Local Municipality	Mogale Local Municipality
Nearest Town	Krugersdorp (4 km), Randfontein (4 km)
GPS Co-ordinates (Relative centre point of study area)	26°07'45.54"S
	27°45'40.85"E

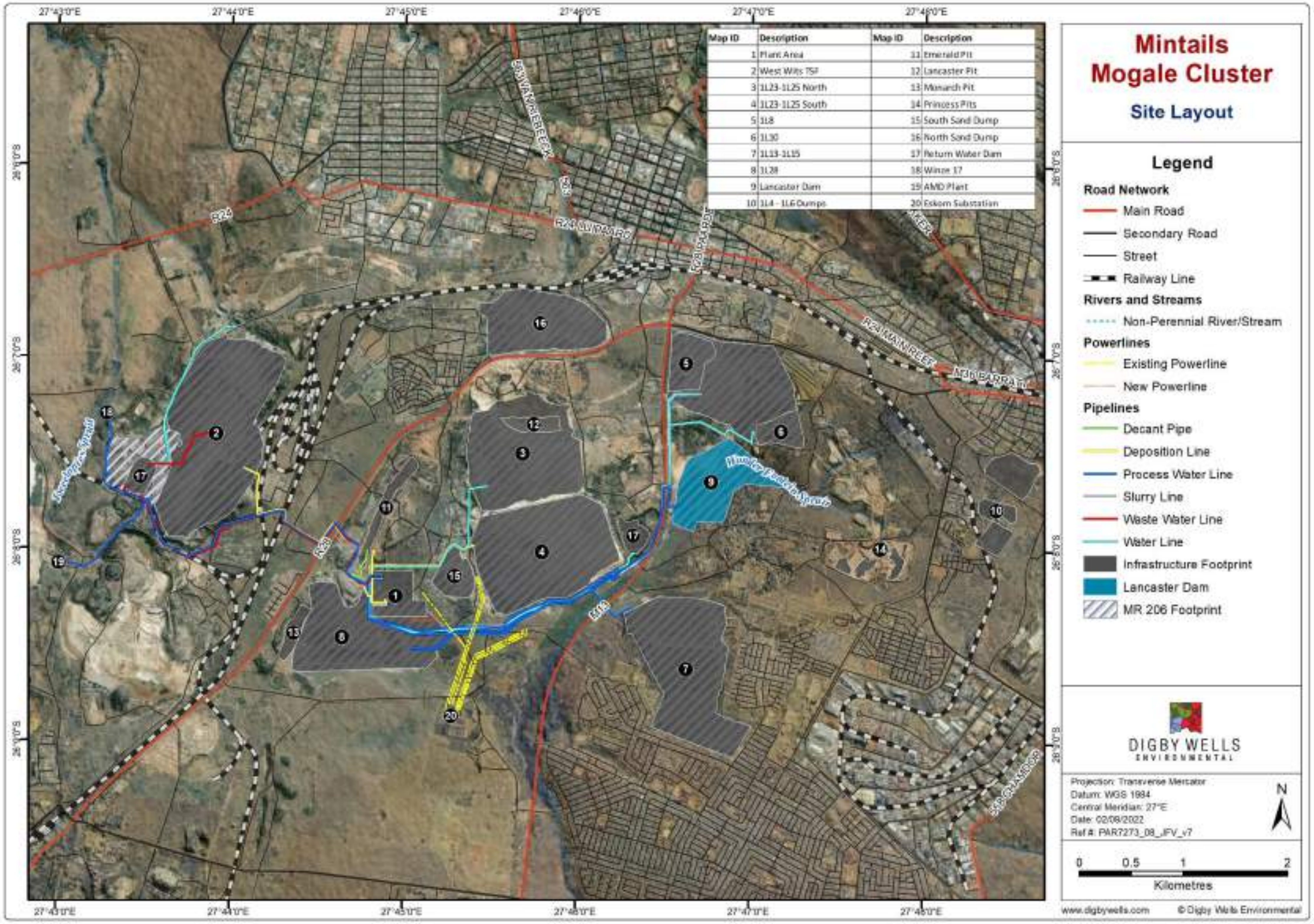


Figure 2-1: Project Locality

2.2. Proposed Infrastructure and Activities

The proposed infrastructure (Figure 2-2) and activities of the Project per phase are provided in Table 2-2 below.

Table 2-2: Project Phases and Associated Activities

Project Phase	Associated Activities
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.
	Operation of pump stations during the operational phase.
	Maintenance of pipeline routes during the operational activities.
	Infilling of processed tailings material into the West Pits Pit and other potential pits.
	Surface tailings deposition within the West Wits Pit.
	Tailings deposition onto the historic footprint of 1L23-1L25 (lined).
	Production of Gold.
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.
	Removal, decommissioning and rehabilitation of the processing plant footprint.
	Rehabilitation of the old TSF footprints.
	Rehabilitation of the old Mogale Processing Plant footprint.
	Final rehabilitation of the facility.
	General rehabilitation of the surrounding area, including wetland rehabilitation.

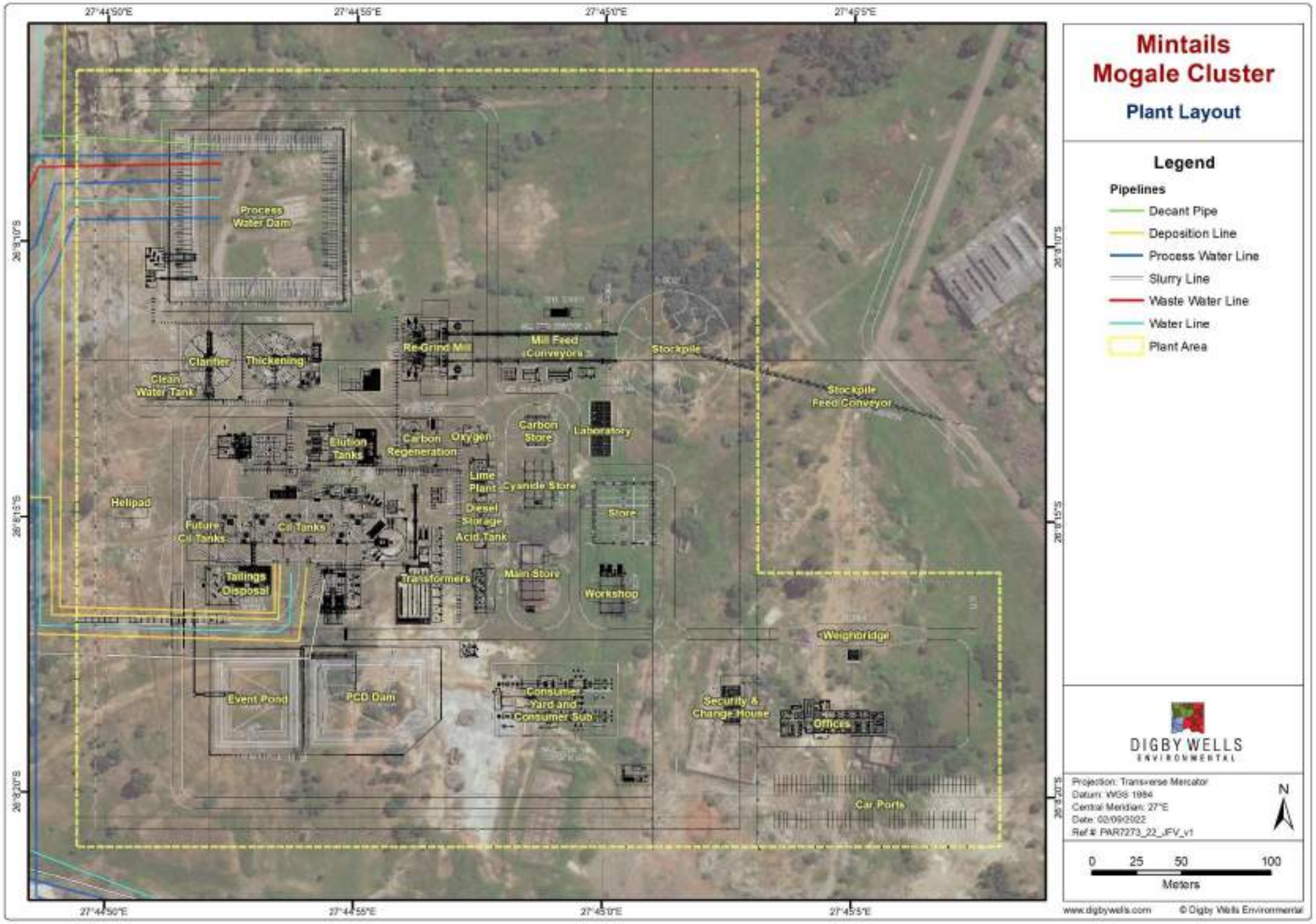


Figure 2-2: Infrastructure Layout

3. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the National legislations, regulations, guidelines and by-laws. The guidelines directing the Fauna and Flora Environmental Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) The NEM:BA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: • Alien and Invasive Species Lists, 2020 (terms of GNR 1003 in GG 43726 dated 18 September 2020 – effective from 18 October 2020); • Threatened and Protected Species Regulations; and • National list of Ecosystems Threatened and in need of protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GNR 1002, 9 December 2011).	• A Fauna and Flora Basic Assessment has been undertaken; • The Project activities will be set out to abide by the guidelines set out in NEM:BA; • Areas of concern will be indicated and possible alternatives to avoid these areas; and • Required mitigation measures will be included in the Environmental Management Plan (EMP) in this report.
Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996) Wetlands are protected under the Act that states that everyone has the right to an environment that is not harmful to their health or wellbeing. It also states that the environment must be protected for the benefit of present and future generations through responsible legislative measures. The Act: • Prevents pollution and ecological degradation; • Promote conservation and secure ecological sustainability; and • Promote justifiable economic and social development using natural resources.	• A Fauna and Flora Basic Assessment; • Environmental Management Plan and Monitoring Program is included in this report; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.

Legislation, Regulation, Guideline or By-Law	Applicability
The National Water Act, 1998 (Act No. 36 of 1998) (NWA) • Section 19 of the National Water Act (NWA), 1998 (Act 36 of 1998) that include the prevention and remediation of the effects of pollution; and • Section 21 (c), (g) and (i) of the National Water Act (Act 36 of 1998) that include the use of water.	• A Fauna and Flora Basic Assessment was undertaken. • Environmental Management Plan and Monitoring Program is in this report; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). NEMA (as amended) was set in place under Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24 (1)(a) and (b) of NEMA state that: *The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment must be considered, investigated and assessed before their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity.* The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.	• Activities that will influence the Fauna and Flora of the proposed Project Area are listed and have been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation before being undertaken.
Gauteng Conservation Plan Version 3.3 (C-Plan 3.3) A living document and component of the Gauteng Department of Agriculture and Rural Development (GDARD) produced the Gauteng Conservation Plan Version 3 (C-Plan 3) in December 2010. The purpose of the C-Plan: • to serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process; • to inform protected area expansion and biodiversity stewardship programmes in the province; and • to serve as a basis for development of Bioregional Plans in municipalities within the province.	• Provides background information about the ecology of the province and natural resource management as well as tools that can be used to guide decisions around biodiversity management.

Legislation, Regulation, Guideline or By-Law	Applicability
<u>The Mineral and Petroleum Resources Development Act (Act No.28 of 2002) (MPRDA) intends:</u> • to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources; and • to provide for matters connected therewith.	• A Fauna and Flora Basic Assessment was undertaken • Environmental Management Plan and Monitoring Program is included in this report; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
<u>SANBI, National Biodiversity Assessment (NBA) 2018</u> The NBA is a collaborative effort to synthesise the best available science on South Africa's biodiversity to inform policy and decision making in a range of sectors and contribute to national development priorities. It is used for the following: • The NBA is used to inform policy in the biodiversity sector, such as the National Biodiversity Framework and the National Protected Area Expansion Strategy, as well as informing policies and strategies of a range of other sectors that rely on natural resources, such as the water, agriculture and mining sectors. • The NBA provides information to help prioritise the often-limited resources for managing and conserving our biodiversity – actions can focus on preventing further loss and degradation of ecosystems and ecological infrastructure, on consolidating and expanding the protected areas network; and on interventions require to restore areas in bad condition so they become functional again. • The NBA provides context and information that feeds into strategic planning processes such as strategic Environmental Assessments and bioregional planning. • The NBA provides information for a range of national level reporting processes such as the South Africa Environment Outlook and ensures that the DEA has the necessary biodiversity information to meet the international reporting commitments to the Convention on Biological Diversity (CBD).	• The guideline provides practical guidance for determining the current state of the biodiversity and ecosystem identified within the area of interest as well as providing indication of threat status and protection level for both species and ecosystems.

4. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 4-1.

Table 4-1: Limitations and Assumptions with Resultant Consequences of this Report

Assumptions and Limitations	Consequences
This fauna and flora study forms part of a larger EIA and should be read in conjunction with the EIA and other related specialist studies.	This report does not include any other specialist studies other than the fauna and flora assessment. This report cannot be used as a stand-alone report in the application for Environmental Authorisation
No form of this report may be amended or extended without the prior written consent of the author and/or a relevant reference to the report by the inclusion of an appropriately detailed citation. Any recommendations, statements, or conclusions drawn from or based on this report must cite or reference this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.	The fauna and flora report cannot be used as a stand-alone report in the application for an Environmental Authorisation.

5. Methodology

The methodology is described for this Impact Assessment. To complete the proposed scope of work, several tasks needed to be completed, these tasks are explained separately below.

5.1. Desktop and Literature Review

The purpose of the literature survey is to gather as much relevant information regarding the baseline environment of the Project Area. Data including potential natural vegetation, species diversity, species composition, and threatened and Red Data listed species project a broad environmental setting of the proposed Project Area. The study on available literature encompassed includes the following:

- Relevant and available historical studies that have been conducted within or surrounding the Project Area;
- The South African National Biodiversity Institute (SANBI);
- The Mpumalanga Biodiversity Sector Plan (MBSP) (Lötter, 2015); and
- The Vegetation Types of South Africa provided by Mucina and Rutherford, 2016.

5.1.1. Data Review

The following ecological databases were researched in line with the locality of the Project Area guided by the QDS (2627BA and 2627BB):

- The South African Bird Atlas Project 2 (SABAP2) database for expected bird species;
- The SANBI Plants of South Africa (NEWPOSA) for expected floral species to occur; and
- The Animal Demographic Unit Virtual Museum database (http://vmus.adu.org.za) for expected faunal species to occur.

5.1.2. Maps and Aerial Imagery Review

Aerial imagery, Google Earth and topographical maps have been reviewed to assess the potential occurrence of different habitat types within the Project Area. this will assist in preparation for field work and identify sensitive or protected areas. Areas are protected or classified as sensitive if they support a unique ecological system and / or provide habitat for keystone species or Red Data species.

5.1.3. Species List

The species list was compiled from both the description of the vegetation type of the Study Area supplied by Mucina and Rutherford (2006) as well as the SANBI PRECIS (National Herbarium Pretoria (PRE) Computerised Information System) list.

5.1.4. Species of Conservation Concern

From the collected species list, a list of Species of Conservation Concern (SCC) can be recorded. In order to be fully comprehensive, this list includes plants that have been characterised by the following:

- The SANBI Red List of South African plants version 2012.1.
- National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) listed species;
- National Forests Act, 1998 (Act No. 84 of 1998) (NFA) Protected Trees;
- Gauteng Conservation Plan Version 3 (C-Plan v3.3); and
- The South African Red Data defined by the International Union of Conservation Concern (IUCN) – the various threat categories can be seen in Table 5 1.

Table 5-1: Red Data Categories (IUCN, 2010)

Category		Description
Extinct	(EX)	No known individuals remaining.
Extinct in the Wild	(EW)	Known only to survive in captivity.

Critically Endangered	(CR)	Extremely high risk of extinction in the wild.
Endangered	(EN)	High risk of extinction in the wild
Vulnerable	(VU)	High risk of endangerment in the wild.
Near Threatened	(NT)	Likely to become endangered in the near future.
Least Concern	(LC)	Lowest risk. Does not qualify for a more at-risk category. Widespread and abundant taxa are included in this category.
Data Deficient	(DD)	Not enough data to make an assessment of its risk of extinction.
Not Evaluated	(NE)	Has not yet been evaluated against the criteria.

5.2. Site Survey

A single wet season survey was conducted in September 2021 and the following components were covered.

5.2.1. Vegetation Analysis

5.2.1.1. *Sample Plots*

An adapted Braun-Blanquet method was used for the listing of species and their associated cover. The Braun-Blanquet method is the standard for phytosociological studies (plant description and mapping) in South Africa and is an internationally recognised method of surveying.

5.2.1.2. *Vegetation Communities*

Vegetation communities were broadly defined based on a preliminary site visit. Communities were defined by their dominant species, terrains and habitat features. A complete list of expected plant species can be found in the Appendix A.

5.2.2. Fauna

Lists of expected faunal species were drawn up from several different sources and the IUCN Red Data species likely to be found on site, was determined. Lists were drawn up for mammals, birds, reptiles, and amphibians. Complete lists of expected species can be found in Appendix C, Appendix D, Appendix E, Appendix F and Appendix G, respectively.

Fauna sampling methods included opportunistic sightings (predominantly for avifauna), sweep netting (for invertebrates, particularly Lepidoptera), as well as the use of baited Sherman traps, and pitfall traps (for invertebrates and small reptiles). Large mammals were recorded using tracks and signs, as well as opportunistic sightings.

Table 5-2 describes the reference information which was used in the identification of the SCC for the Project area.

Table 5-2: Reference Sources for Species of Conservation Concern

Reference	Description
Red List South Africa	Listed species of flora and fauna are regarded as species whose representation in the wild, has declined to such an extent that drastic action is needed to ensure their survival.
PRECIS	The Pretoria Computerised Information System (PRECIS) list was obtained from the South African National Biodiversity Institute (SANBI) which lists all the Red Data plant species officially recorded by SANBI. This list represents only those species that may occur in the grid in which the sites fall, thus it is regarded as a guideline as to what is likely to occur. The sites sampled are only a very small portion of the whole grid and habitats suitable for certain species in these PRECIS lists may not be present at the sites sampled. It is therefore not unusual for species in the PRECIS list to be absent from the sampling sites
IUCN	The IUCN Red List of Threatened Species provides taxonomic, conservation status and distribution information on plants and animals that have been globally evaluated using the IUCN Red List Categories and Criteria. This system is designed to determine the relative risk of extinction, and the main purpose of the IUCN Red List is to catalogue and highlight those plants and animals that are facing a higher risk of global extinction (i.e. those listed as Critically Endangered, Endangered and Vulnerable). Plants and animals that have been evaluated to have a low risk of extinction are classified as Least Concern. (IUCN.org).
CITES	Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival (CITES.org). CITES works by subjecting international trade in specimens of selected species to certain controls. All import, export, re-export and introduction from the sea of species covered by the Convention has to be authorized through a licensing system. Each Party to the Convention must designate one or more Management Authorities in charge of administering that licensing system and one or more Scientific Authorities to advise them on the effects of trade on the status of the species (CITES.org). Specimens are divided into the following appendices according to the restriction on trade.
National and Provincial Legislation	Identified SCC during the field investigations were all protected trees listed by the South African National Forest Act, 1998 (Act No. 84 of 1998). All flora and fauna species, listed by the National Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004).

6. Biophysical Baseline Environment

6.1. Climate

The Project Area is characterised by a climate that is typical of the Gauteng Province with warm, rainy summers and dry winters (South African Weather Bureau, 1986). The town of Krugersdorp, which is 4 km from the Project Area, is generally warm and temperate with an average annual temperature of approximately 16.1 Degree Celsius (°C) (Climate-data.org). The climate here is classified as Cwb (Subtropical highland climate or monsoon-influenced temperate oceanic climate) by the Köppen-Geiger system (Koppen & Geiger, 2021). The mean annual rainfall is approximately 716 millimetres (mm) with the bulk of precipitation occurring in summer (November, December and January) with frequent thunderstorms. Annual average maximum, minimum and mean temperatures for the study area are given in Figure 6 1 below.

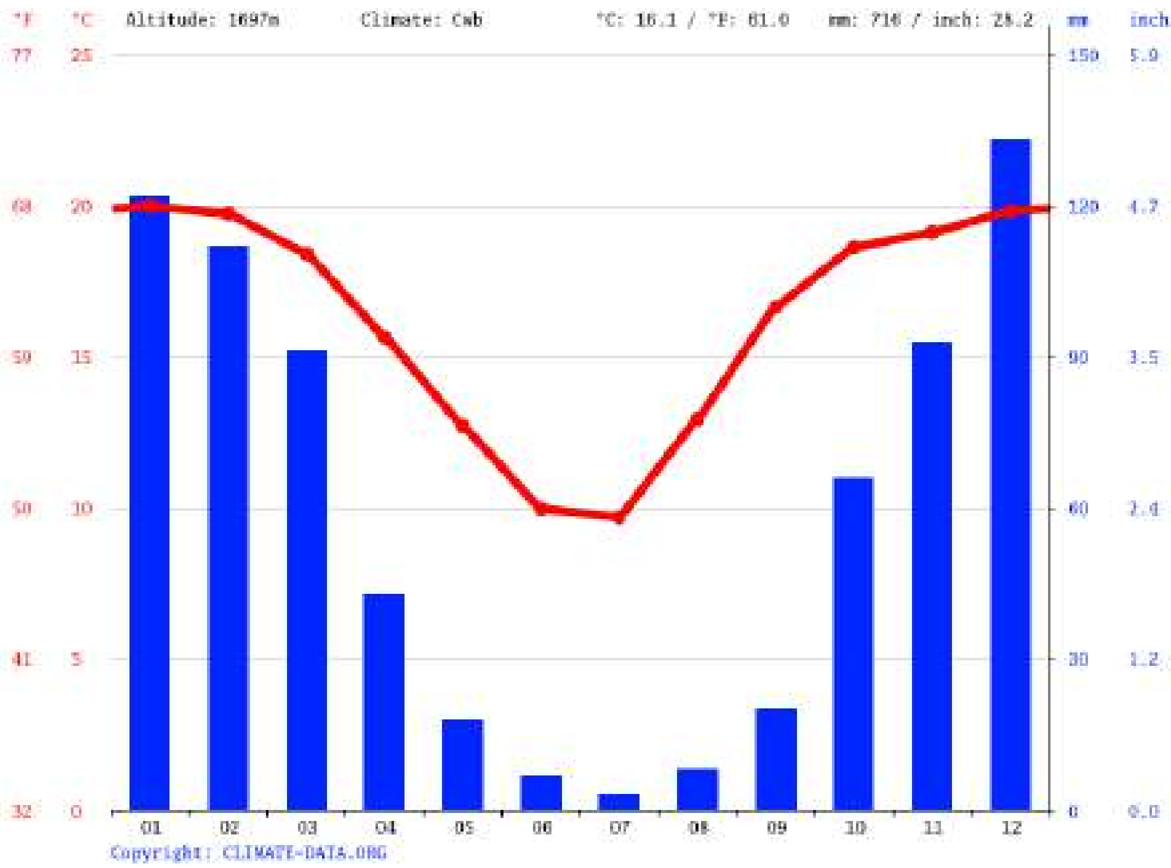


Figure 6-1: Annual Climate Trends in Krugersdorp (Source: Climate-data.org)

6.2. Ecoregion

Ecoregions are regions characterised by a relative similarity in the type of ecosystems and ecosystem components, i.e. biotic and abiotic, aquatic and terrestrial. The Project Area is located within the Highveld Ecoregion (Level II Ecoregion 11.02). It is characterised by plains with a moderate to low relief and soils that are mostly coarse, sandy and shallow. There are various grassland vegetation types (with moist types present towards the east and drier types towards the west and south). Table 6-1 provides a summary of the main attributes of the Highveld Ecoregion (Kleynhans & Hill, 1999; Kleynhans, Thirion, & Moolman, 2005).

Table 6-1: Main Attributes of the Highveld Ecoregion

Main Attributes	Highveld Ecoregion
Terrain morphology: Broad division (dominant types in bold) (Primary)	**Plains; Low Relief; Plains; Moderate Relief**; Lowlands; Hills and Mountains; Moderate and High Relief; Open Hills; Lowlands; Mountains; Moderate to high Relief Closed Hills. Mountains; Moderate and High Relief.
Vegetation types (dominant types in bold) (Primary)	Mixed Bushveld (limited); Rocky Highveld Grassland; **Dry Sandy Highveld Grassland**; Dry Clay Highveld Grassland; **Moist Cool Highveld Grassland**; Moist Cold Highveld Grassland; North Eastern Mountain Grassland; Moist Sandy Highveld Grassland; Wet Cold Highveld Grassland (limited); Moist Clay Highveld Grassland; Patches Afromontane Forest (very limited).
Altitude (metres above mean sea level (m.a.m.s.l.)) (modifying)	1 100-2 100, 2 100-2 300 (very limited)
Mean Annual Precipitation (MAP) (mm) (Secondary)	400 to 1 000
Coefficient of Variation (% of annual precipitation)	<20 to 35
Rainfall concentration index	45 to 65
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	12 to 20
Mean daily max. temp. (°C): February	20 to 32
Mean daily max. temp. (°C): July	14 to 22
Mean daily min. temp. (°C): February	10 to 18
Mean daily min temp. (°C): July	-2 to 4
Median annual simulated runoff (mm) for quaternary catchment	5 to >250

6.3. Regional Vegetation

The Project Area falls within the Soweto Highveld Grassland vegetation type (Mucina & Rutherford, 2006), as illustrated in Figure 6 2. The Grassland Biome (Mucina & Rutherford,

2006) is one of the nine South African plant Biomes and the second most bio-diverse biome in South Africa. The Grassland Biome is situated primarily on the central plateau of South Africa, and the inland areas of Kwa-Zulu-Natal and the Eastern Cape provinces. This biome is rich in flora and fauna diversity but is under threat due to rapid urbanisation and expansion of mining and industrial activities.

The Soweto Highveld Grassland is characterised by short to medium-high, dense, tufted grassland (Mucina & Rutherford, 2006). It is considered Endangered on the National List of Threatened Terrestrial Ecosystems (Mucina & Rutherford, 2006), with a conservation target of 24%. The vegetation of the landscape is dominated almost entirely by *Themeda triandra* and is accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix* (Mucina & Rutherford, 2012).

Table 6-2 below lists the species characteristic of the Soweto Highveld Grassland.

Table 6-2: Plant Species Characteristic of the Soweto Highveld Grassland

Plant Form	Species
Graminoids	*Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. planiculmis, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis subsp. galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra, Paspalum dilatatum.*
Herbs	*Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera var. aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium var. nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala, Wahlenbergia undulata.*
Geophytic Herbs	*Haemanthus humilis subsp. hirsutus, H. montanus.*
Herbaceous Climber	*Rhynchosia totta.*
Low Shrubs	*Anthospermum hispidulum, A. rigidum subsp. pumilum, Berkheya annectens, Felicia muricata, Ziziphus zeyheriana.*

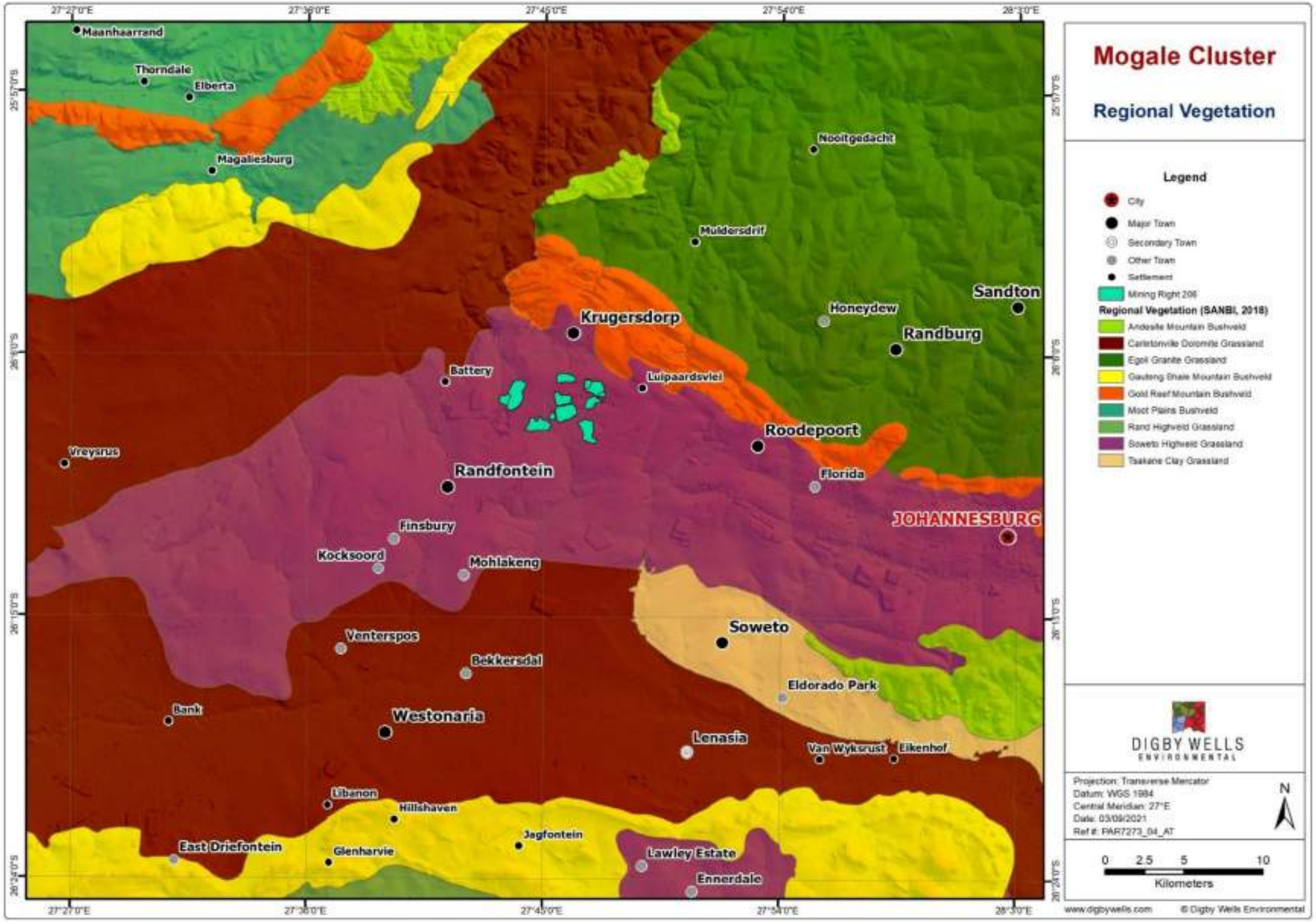


Figure 6-2: Regional Vegetation

6.4. Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by South African National Biodiversity Institute (SANBI), the DEA, the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum (2013). The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorizations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining Project. The country has been mapped into biodiversity priority areas including the four categories each with associated risks and implications (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013) (Table 6-3).

Table 6-3: Mining and Biodiversity Guideline Categories (DEA et al., 2013)

Category	Risk and Implications for Mining
Legally Protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: The Environmental Impact Assessment (EIA) process must confirm significance of the biodiversity features that may be a fatal flaw to the proposed Project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision-making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

Most of the Project Area is classified as **High Biodiversity Importance – High Risk for Mining** with the remaining area classified as **Moderate Biodiversity Importance – Moderate Risk for Mining** (). A large area near IL28, South Sand and IL23-IL25 is classified as Highest Biodiversity Importance – Highest Risk for Mining.

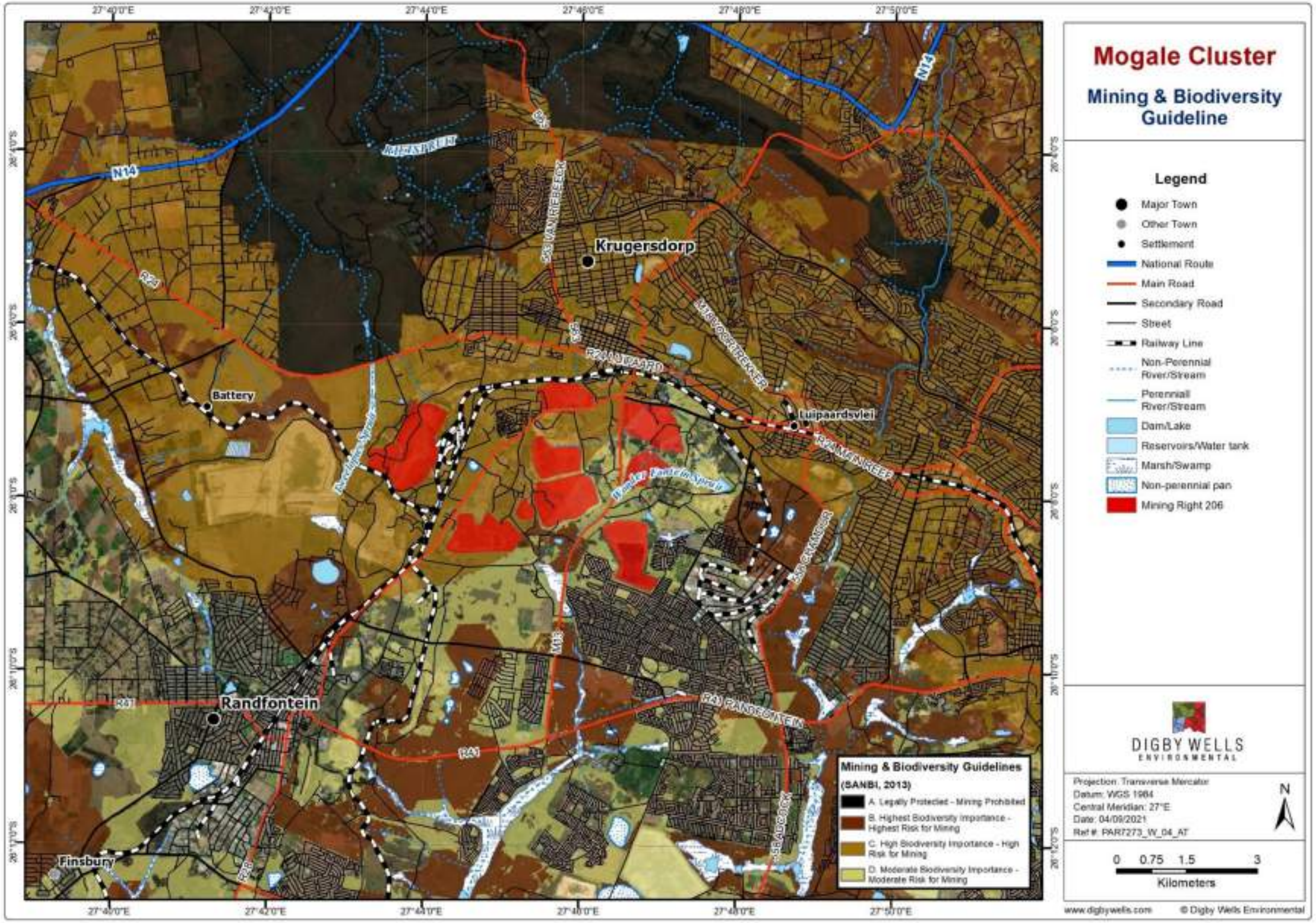


Figure 6-3: Mining and Biodiversity Guideline of the Project Area

6.5. Gauteng Conservation Plan

Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (GDARD), produced the Gauteng Conservation Plan Version 3 (C-Plan 3) in December 2010. The latest version is C-Plan 3.3 which became available in October 2011 (GDARD, 2011), with a technical report being released in March 2014 (GDARD, 2014). The Plan is based on the systematic conservation protocol developed by Margules and Pressey (2000) of the principles of complementarity, efficiency, defensibility and flexibility, irreplaceability, retention, persistence and accountability. C-Plan 3.3 is a valuable tool to ensure adequate, timely and fair service delivery to clients of GDARD, and will be critical in ensuring adequate protection of biodiversity and the environment in the Gauteng Province.

The main purposes of the C-Plan 3.3 are:

- To serve as the primary decision support tool for the biodiversity component of the EIA process;
- To inform protected area expansion and biodiversity stewardship programmes in the province; and
- To serve as a basis for development of Bioregional Plans in municipalities within the province.

Review of the C-Plan provided an understanding of the conservation priority of the Project area. The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Table 6-4).

Table 6-4: Gauteng Conservation Plan Categories

Map Category	Definition	Desired Management Objectives
PA	Those areas that are proclaimed as Provincial Nature Reserves, Municipal Nature Reserves, other state owned protected area, Private Nature Reserves and Natural Heritage Sites with management plans that have biodiversity conservation as the primary objective.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Any natural or near-natural terrestrial or aquatic area required to meet targets for biodiversity pattern and/or ecological processes. Divided into Irreplaceable Areas and Important Areas.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.

Map Category	Definition	Desired Management Objectives
ESAs	Natural, near-natural or degraded areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. Areas with no natural habitat remaining, but which retain potential importance for supporting ecological processes.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorization process that ensures the underlying biodiversity objectives are not compromised.

The Lancaster Dam, and surrounding area associated with the Wonderfonteinspruit, is classified as an ESA (Figure 6-4). Minor northern areas of the West Wits Pit are classified as CBAs and ESAs with areas surrounding the pit also classified as ESAs and CBAs. Outside of the Project Area, a large area adjacent to IL28, South Sand and IL23-IL25 is classified as a CBA. Two areas classified as ESAs are located adjacent to North Sand.

6.6. Gauteng Ridges

Ridges are characterized by high spatial heterogeneity due to the range of differing aspects, slopes, altitude which influences the soil profile, drainage and hydrological conditions (Pfab, M., 2001). Temperature and humidity regimes of the microsites constantly vary (Samways, 2000). Variations in aspect, soil drainage and altitude have been associated as important predictors of biodiversity. Thus, protection of ridges will contribute significantly to the conservation of biodiversity in Gauteng. The diversity of plant communities on ridges is easily observed, with having grassland communities on the crests of hills and the southern slopes, while the hardier woody species habituate on the warmer northern slopes (Lowrey, 1987). In Gauteng, 71% of endemic plant species have been recorded on ridges and furthermore to this 41% of the Gauteng plant endemics are confined solely to the ridge habitat (Pfab, M., 2001). Ridges form vital habitat for many Red Data or threatened species of plants and animals.

The demarcation of ridges within Gauteng are governed by GDARDs Ridge Policy to promote sustainable development and use of ridges (GDARD, 2019). The quartzite ridges of Gauteng are recognized as important natural assets and provide habitat for an array of unique biodiversity (Red Listed and endemic species) as well as valuable ecosystem services. GDARD has classified the ridges of Gauteng into four classes, based on the existing extent and percentage of area converted to urban development or other human development or other human activities. According to GDARD, Class 2 ridges are within the MRA and in close proximity to the mine tailings (Figure 6-5). Class 2 ridges are classified as ridges in respect of which ≥ 5% of the ridge has been transformed by human activity. Therefore, biodiversity is expected to be intact and support threatened species and ecosystems. The site visit will verify the extent of damage to the sensitive ridges.

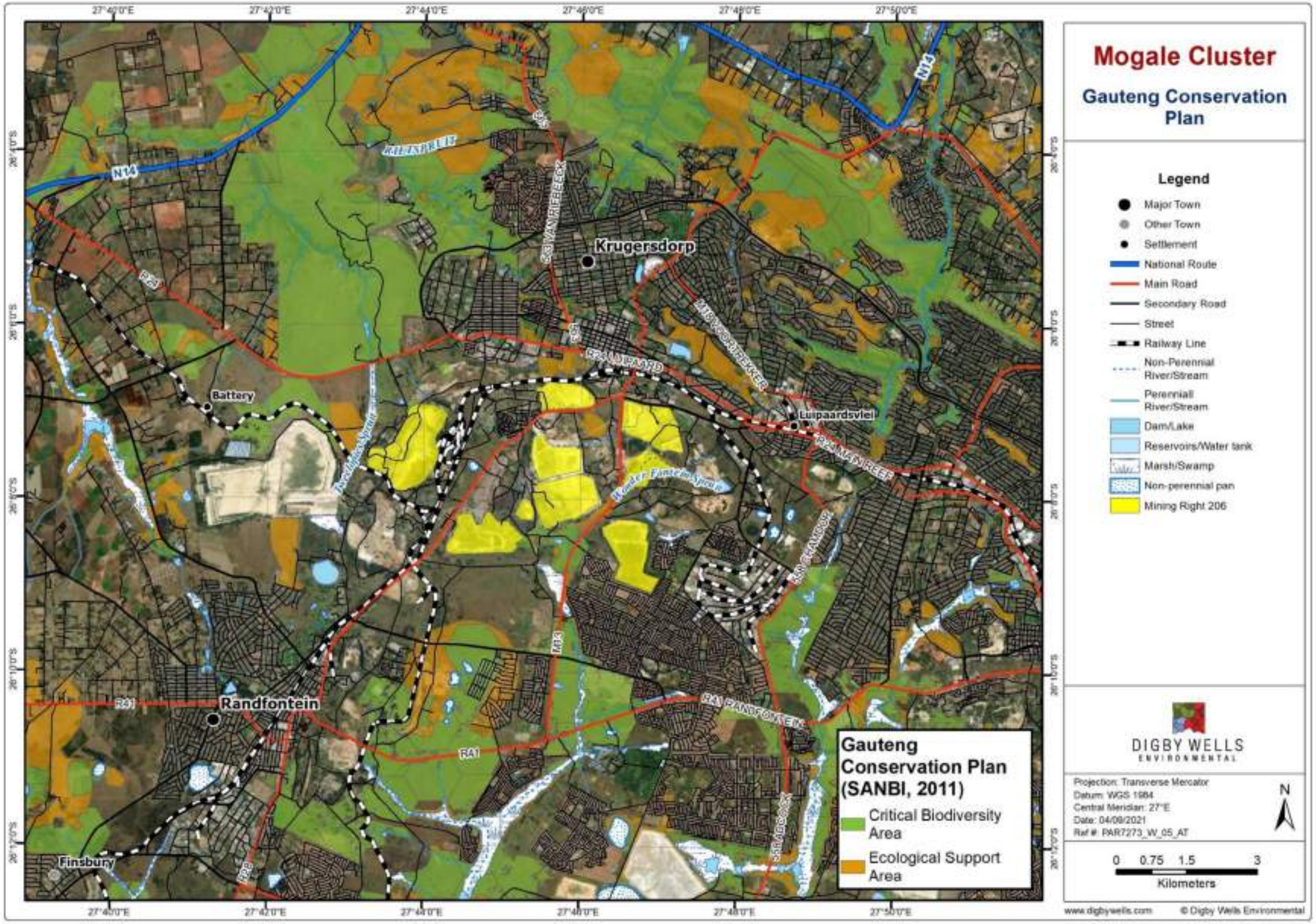


Figure 6-4: Gauteng Conservation Plan

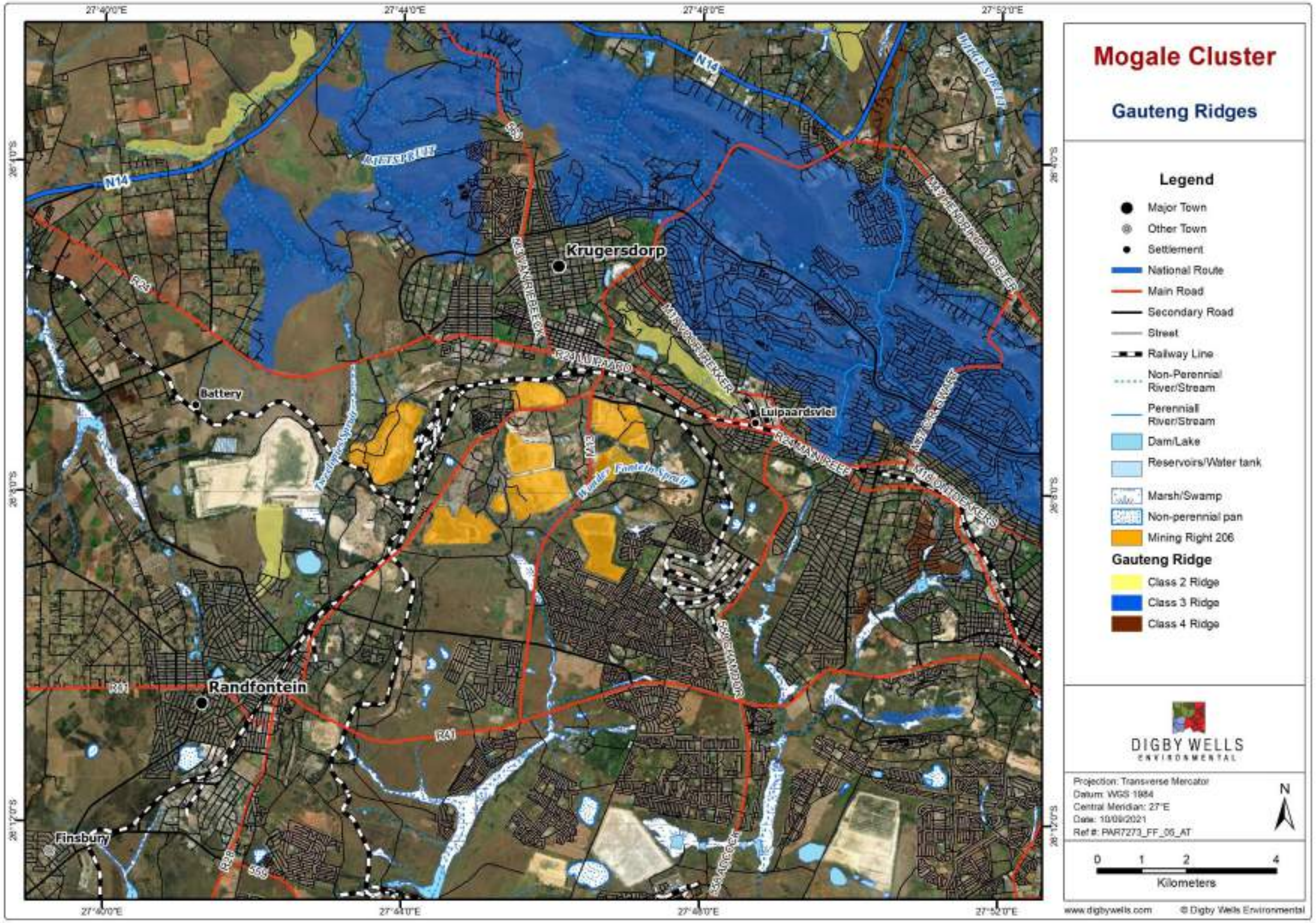


Figure 6-5: Gauteng Ridges

6.7. Protected Areas

As depicted Figure 6-6, five (5) Protected Areas are situated within close proximity to the Project Area. These areas include the Cradle of Humankind (World Heritage Site), Krugersdorp Municipal Nature Reserve, Blougat Municipal Nature Reserve, Walter Sisulu National Botanical Garden and the Ruimsig Municipal Nature Reserve. The nearest being the Krugersdorp Nature Reserve, 1.7 km northwest of the Project Area. It ranges over approximately 1,500 ha of land. The reserve hosts several different vegetation communities including grasslands, rock outcrops and forest that allow it to sustain a variety of biodiversity (fauna and flora). A biodiversity study conducted in 2015 (Short, 2015) concluded that the the reserve provides an array of different habitats (terrestrial, arboreal, wetland and rupicolous [rocky]). Of these, the terrestrial component is the largest and has potential to host vast diversity of fauna and flora. The reserve is an important crossroads of bird distribution, as it is located at the transisition of savanna and grassland biomes. The reserve was described as a well-connected biosphere with adjacent grasslands and provides important refuge for birds and acts as corridor migration for most faunal species. It was noted that the current biodiversity and ecosystem integrity is threatened by acid mine drainage (AMD) (from surrounding mining activities). Due to the reserve's close proximity to the Project Area, it is imperitive that the prevention of further degradation of surrounding sensitive environments is upheld by future activities within the described Mogale Project Area. Remediation measures to prevent decline in the surrounding environment will be recommended in the impending impact assessment.

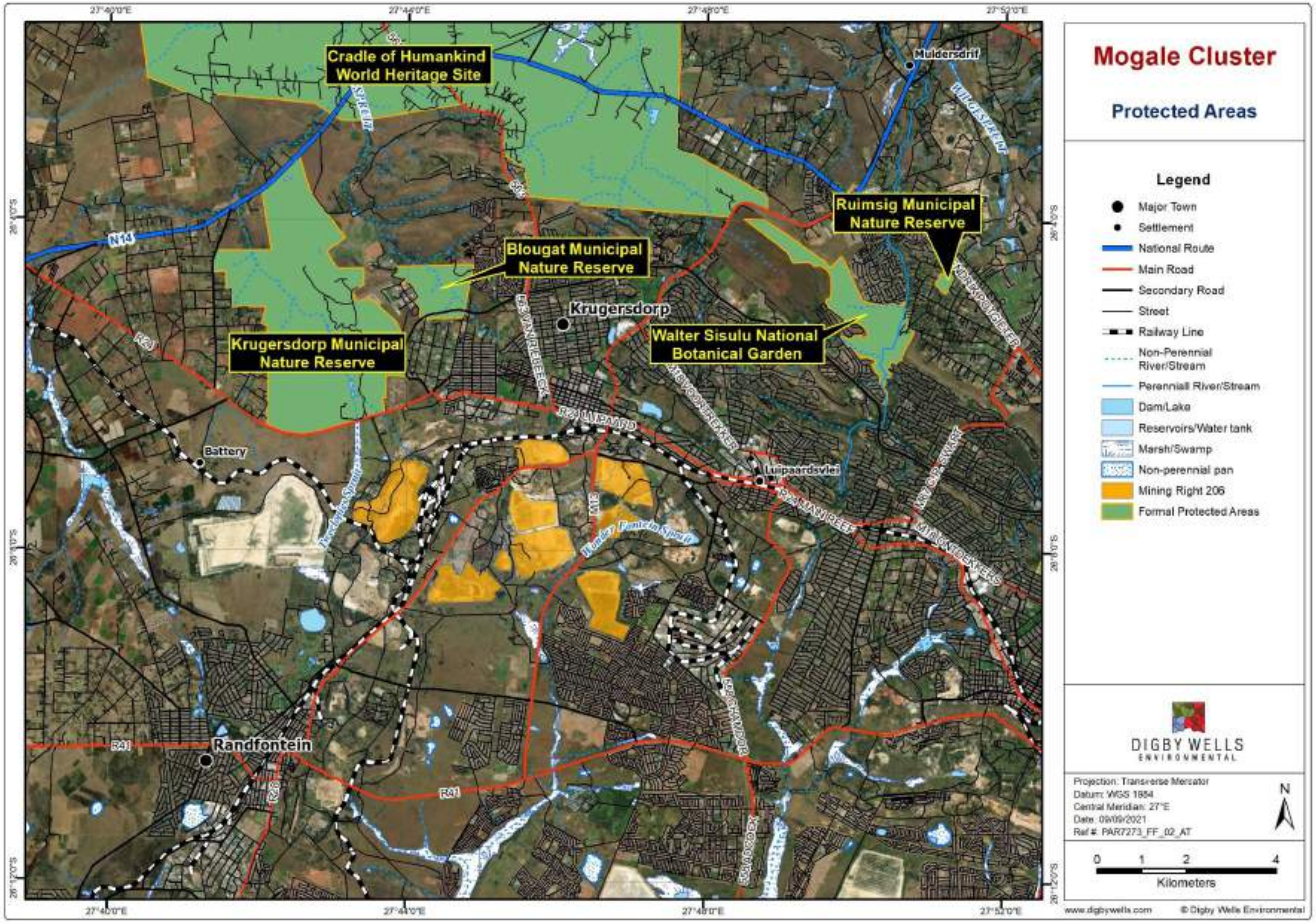


Figure 6-6: Protected Areas

6.8. Important Bird Areas

The Magaliesburg Important Bird Area (IBA) is located approximately 4.5km north of the Project Area (Figure 6-7). This IBA is large and extends along the Magaliesbrug range on the Gauteng and North West border (BirdLife, 2021). The southern portion of this IBA lies approximately 4.5 km north of the Project Area. It also falls within the Magaliesburg Protected Natural Environment and is legally conserved under the Environmental Protection Act. Within the IBA, several publicly owned protected areas occur, including the Diepsloot Nature Reserve, Hartebeespoort Dam and the Rustenburg Nature Reserve. The key bird biodiversity sustained within this IBA include breeding colonies of Cape Vultures (*Gyps coprothres*) situated at Skeerpoort (25°45'S 27°45'E) and Roberts Farm (25°50'S 27°17'E). Other birds of interest include White-backed Vultures (*Gyps africanus*), Lappet-faced Vultures (*Torgos tracheliotus*) and Blue Cranes (*Grus paradisea*). The major threats to the biodiversity involve the widespread, indiscriminate use of poison by small-stock farmers to combat mammalian predators such as Jackals, Caracals and domestic dogs. The haphazard use of poison poses a major threat to the vulture colonies which scavenge on the carcasses set for "vermin". Most natural populations of large ungulates, and their associated predators, have disappeared from the Magaliesberg. It is hypothesized that depleted food supply, and the loss of vital nutrients in the diet, have resulted in increased vulture mortalities as a result of metabolic bone disease, osteodystrophy, and other physiological abnormalities.

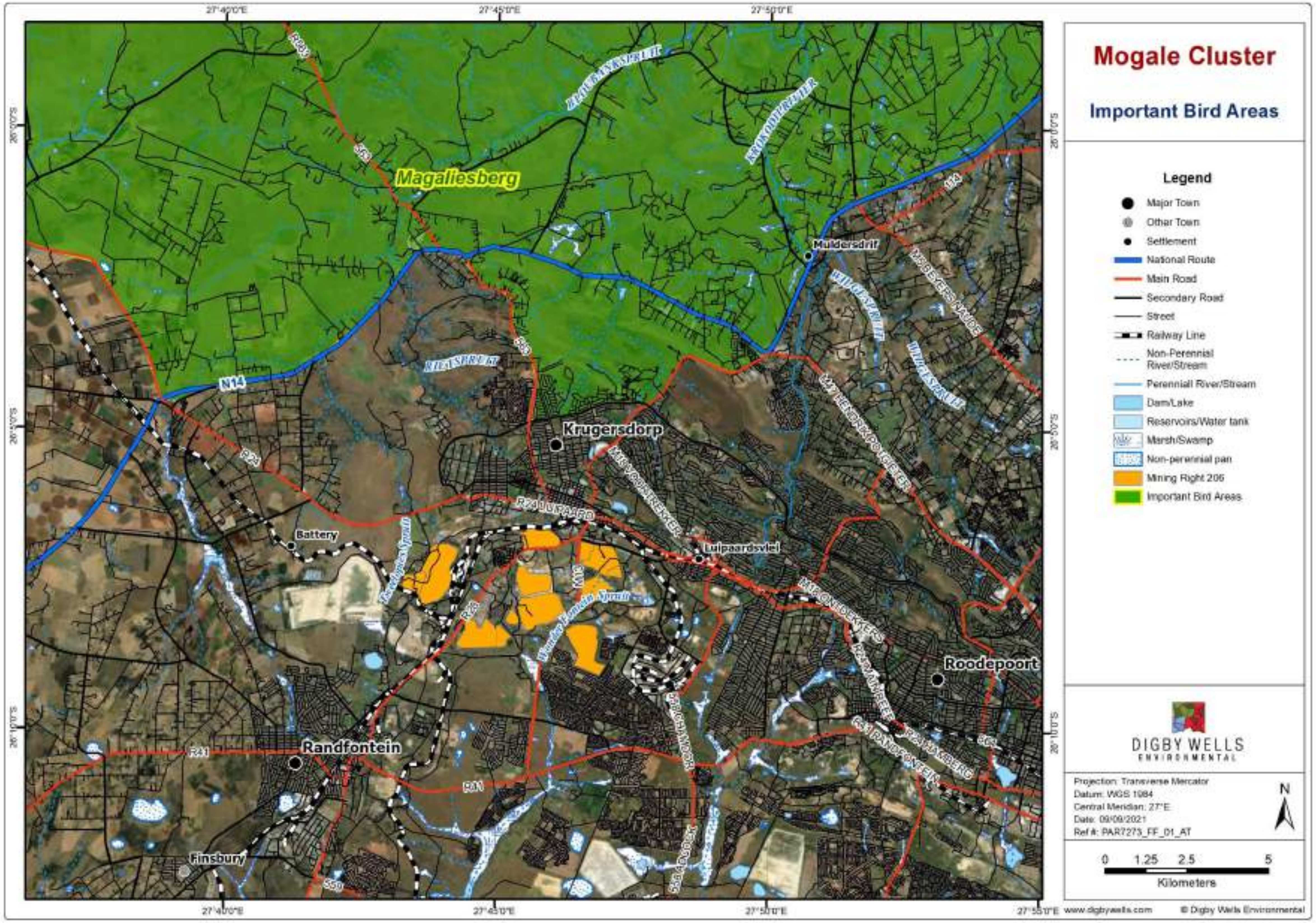


Figure 6-7: Important Bird Area

7. Fauna and Flora Desktop Analysis

This section elaborates on the pre-existing data of the fauna and flora that may occur in the Project Area. It describes the current biodiversity status through various database resources.

7.1. Species of Conservation Concern

7.1.1. IUCN Red Data Species

The proposed project area lies within two Quarter Degree Square (QDS) 2627BA and 2627BB. According to PRECIS several Red Data listed species are expected to be present within the identified QDS.

7.1.2. Protected Flora

The New Plants of South Africa (NEWPOSA) species list was obtained from the South African National Biodiversity Institute (SANBI) (https://posa.sanbi.org/), it lists all the Red Data plant species officially recorded by SANBI for South African QDS grid. In order for a flora species to be included in this list, a specimen collected in this grid must be supplied to SANBI to be verified and recorded. This list is therefore not a comprehensive list representing only those species that may occur in the aforementioned grids, but rather a guideline as to what is to be expected. Generally, the sites sampled are small portions of the whole grid and habitats suitable for certain species. It is therefore not unusual for species in the POSA list to be absent from the sampling sites.

The flora species list obtained from the NEWPOSA indicate that five species are classified as Vulnerable (VU) or Near Threatened (NT), might occur within in the Project Area. The species are considered Species of Conservation Concern (SCC) and are listed in Table 7-1 below. Over 360 floral species have previously been recorded within the designated QDS and are listed in Appendix A (SANBI NEWPOSA, 2021).

Table 7-1: Potentially occurring floral SCC

Family	Species	SANBI (2016)
Aizoaceae	*Delosperma leendertziae*	*NT*
Orchidaceae	*Holothrix randii*	*NT*
Aizoaceae	*Khadia beswickii*	*VU*
Fabaceae	*Melolobium subspicatum*	*VU*
Fabaceae	*Pearsonia bracteata*	*NT*

7.1.3. Fauna

This section will cover various groups of animals including mammals, birds, reptiles, amphibians and invertebrates.

7.1.3.1. Mammals

Mammals form a vital component of ecosystems. Not only are they important for nutrient cycling, habitat modification, consumers of plants and seed dispersal but they're also a considerable component of predators in healthy ecosystems.

Mammals expected to occur are listed in Appendix C. It has been noted that 13 of these potentially occurring species have been assigned a Red Data status, as part of the SANBI Red Data list. The protected species are tabulated below in Table 7-2.

Table 7-2: Red Data Mammal species likely to be found in the Project Area

Family	Species Name	Common Name	Conservation Status
Erinaceidae	*Atelerix frontalis*	Southern African Hedgehog	NT
Felidae	*Acinonyx jubatus*	Cheetah	VU
Felidae	*Leptailurus serval*	Serval	NT
Felidae	*Panthera pardus*	Leopard	VU
Hipposideridae	*Cloeotis percivali*	Percival's Short-eared Trident Bat	EN
Muridae	*Otomys auratus*	Southern African Vlei Rat	NT
Mustelidae	*Aonyx capensis*	African Clawless Otter	NT
Mustelidae	*Poecilogale albinucha*	African Striped Weasel	NT
Nesomyidae	*Mystromys albicaudatus*	African White-tailed Rat	VU
Rhinolophidae	*Rhinolophus blasii*	Blasius's Horseshoe Bat	NT
Soricidae	*Crocidura maquassiensis*	Makwassie Musk Shrew	VU
Soricidae	*Crocidura mariquensis*	Swamp Musk Shrew	NT
Vespertilionidae	*Pipistrellus rusticus*	Rusty Pipistrelle	NT

7.1.3.2. Birds

Birds have been viewed as good ecological indicators, since their presence or absence tends to represent conditions pertaining to the proper functioning of an ecosystem. Bird communities and ecological condition are linked to land cover. As the land cover of an area changes, so do the types of birds in that area. Land cover is directly linked to habitats within the study area. The diversity of these habitats should support many different species.

According to the South African Bird Atlas Project 2 (SABAP2), 207 species of birds have been identified in the area (see Appendix D); the majority of these birds are comprised of grassland species. Of these species, 3 have been assigned a Red Data status and are listed in Table 7-3 below.

Table 7-3: Red Data bird species likely to be found in the Project Area

Species	Common Name	Regional Status	Global Status
Aquila verreauxii	*Verreaux's Eagle*	*VU*	*LC*
Mirafra cheniana	*Melodious Lark*	*LC*	*NT*
Gyps coprotheres	*Cape Vulture*	*EN*	*VU*

7.1.3.3. Reptiles

Reptiles are ectothermic (cold-blooded) meaning their internal basal temperature is influenced by their surrounding external environment, as a result, reptiles are dependent on environmental heat sources. Thus, many reptiles regulate their body temperatures by basking in the sun, or warmer surfaces (or substrates). Substrates are an important determining factor for identifying which habitats are suitable for which species of reptile. Rocky outcrops and suitable woody vegetation would increase habitat and intern diversity of reptiles within the Project Area.

Reptiles expected to occur on site are listed in Appendix E. Of these species two have been assigned Red Data status and presented in Table 7-4 below.

Table 7-4: Red Data reptile species that may occur in the Project Area

Species	Common Name	SARCA (2014) Status	Global
Chamaesaura aenea	*Coppery Grass Lizard*	*NT*	*LC*
Crocodylus niloticus	*Nile Crocodile*	*VU*	*LC*

7.1.3.4. Amphibians

Amphibians are viewed to be good indicators of changes to the whole ecosystem as they are sensitive to changes in the aquatic and terrestrial environments (Waddle, 2006). Most species of amphibians are dependent on the aquatic environment for reproduction. Additionally, amphibians are sensitive to water quality and ultraviolet radiation because of their permeable skin (Gerlanc, 2005).

Wetland clusters are groups of wetlands (within a 1 km buffer) that are considered to function as a unit in the landscape, allowing for important ecological processes such as migration of frogs and insects between wetlands to take place. According to the Digby Wells Wetland Scoping Report (Digby Wells, 2021) the Lancaster Dam is demarcated as a Seep NFEPA Wetland with additional subsidiary seep wetlands identified by the IL28 dump and southern portion of the West Wits Pit. Previous recordings of amphibians within the identified QDS state that the SCC, Giant African Bullfrog (*Pyxicephalus adspersus*), has been noted in the area. Together with the presence of wetlands an assumption can be made that the SCC Giant African Bullfrog (*Pyxicephalus adspersus*) may potentially occur. The ideal time to monitor the presence of this SCC is after sufficient rains preferably in December. This is considered an

SCC due to the loss of habitat from negative anthropogenic activities, the Giant African Bullfrog is globally listed as Least Concern (LC) and regionally listed as Near Threatened (NT) in South Africa. Expected amphibian species to occur are listed in Appendix F.

8. Findings and Discussions

8.1. Flora

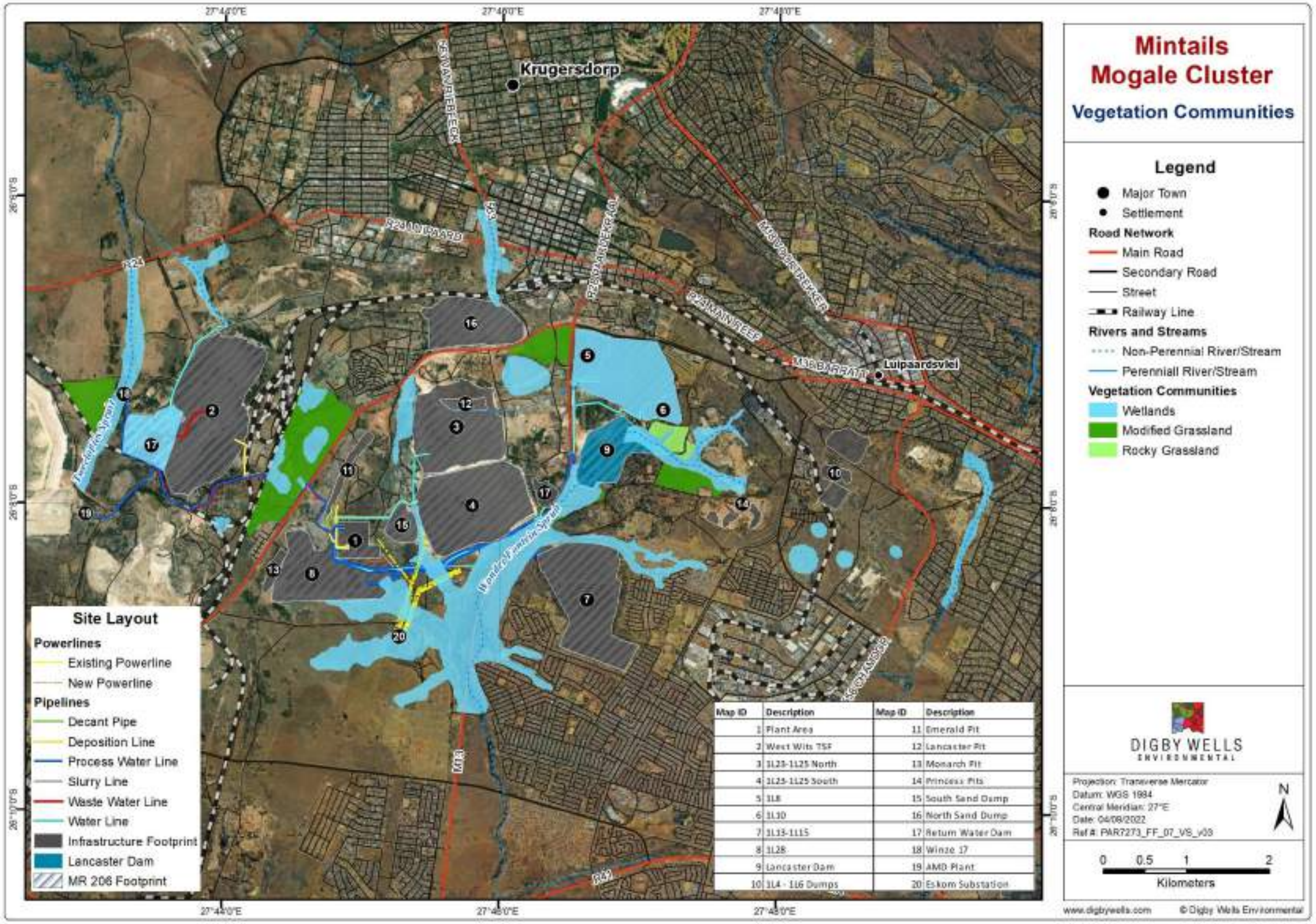
The Mogale Cluster Project Area is considered to be in a heavily modified state. The landscape has endured numerous historic anthropogenetic alterations such as extensive gold reef mining resulting in large unexploited mine dumps. These alterations have modified the landscape from its natural grassland state. Within certain areas adjacent to the disturbed portions, patches of grassland vegetation can be found which is interspersed with rocky outcrops and riparian vegetation. Albeit, the area has endured numerous impacts from historic land practices, the identified pockets of vegetation provide unique habitat and refuge for numerous floral and faunal species.

The current and historical land use practises have resulted in fragmentation of the vegetation communities. previous mining activities and current illegal mining activities have and continue to degrade the state of the vegetation. Urban sprawl from the nearby metropolitan developments has increased the pressure of habitat fragmentation. The cumulative impacts of the land and habitat alterations have resulted in the establishment of Alien Invasive Plant (AIP) species in the transformed habitats as well as within identified vegetation communities. The identified communities are described below.

The Project Area is situated in the Soweto Highveld Grassland (Mucina & Rutherford, 2006). This vegetation was previously classified as the veld type *Themeda*-veld by Acocks (1988). *Themeda* veld comprises a dense grassland dominated by the grass the climax grass *Themeda triandra* (Red Grass). Other dominant grasses include *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. This veld type is known to occur in association with black turf soils and frost in winter and the occurrence of trees are limited. This could explain the limited indigenous woody plant cover within the Project Area. Although a dominant grassland vegetation, shrubland can occur on rocky outcrops where they are protected from fire and grazing (Mucina & Rutherford, 2006). In general, the higher the rock cover, the higher the relative cover of woody species to herbaceous species.

8.1.1. Vegetation Communities

A site visit was conducted in September 2021, revealed vegetation communities within the Project Area including portions of natural vegetation communities and largely transformed vegetation units. Four units have been described and include Modified Grassland, Wetland Vegetation, Rocky Grassland and Transformed vegetation communities and are discussed below (Figure 8-1).



Map ID	Description	Map ID	Description
1	Plant Area	11	Emerald Pit
2	West Wits TSF	12	Lancaster Pit
3	1L23-1L25 North	13	Monarch Pit
4	1L23-1L25 South	14	Princess Pits
5	1L8	15	South Sand Dump
6	1L10	16	North Sand Dump
7	1L13-1L15	17	Return Water Dam
8	1L28	18	Winze 17
9	Lancaster Dam	19	AMD Plant
10	1L4 - 1L6 Dumps	20	Eskom Substation

Figure 8-1: Vegetation Communities within the Project Area

8.1.1.1. Grassland (Modified) Community

The grassland is composed of a dominant graminoid component as well as a moderate forb component. At the time of the site visit it was noted that the grassland has endured heavy grazing and was recently burned. Numerous AIPs were recorded and a high frequency of Increaser I[1] and II[2] were noted. Species included *Aristida congesta, Loudetia simplex, Eragrostis lehmanniana, E. chloromelas, Cynodon dactylon, Hypparrhenia hirta,* and *Pogonarthria squarrosa* as well as bush encroacher shrub *Seripheum plumosum* (Bankrupt Bush) which tends to increase in overgrazed veld (Van Wyk & Malan, 1997). The mesic grasslands of South Africa harbour a diverse community of herbaceous perennial forbs. Several forb species indicative of the represented vegetation type where identified, namely *Hilliardiella oligocephalai, Hermannia depressa* and *Haplocarpha scapose.* A high density of AIPs were recorded within the grounds of the grassland. Herbaceous invasives included *Bidens Pilosa, Tagetes minuta, Datura stramonium* and *Solanum sisymbriifolium* observed throughout this vegetation community (see Figure 8-2). Although degraded, these grasslands are ecological important as they provide grazing for numerous faunal species and protect the soils from eroding. Other ecosystem services provided by grasslands include (SANBI, 2013):

- Water production, water purification and flood attenuation;
- Nutrient cycling and carbon sequestration and storage;
- Pollination services;
- Support for livelihoods such as thatching and weaving;
- Medicinal and food plants; and
- Deep and nutrient rich soils.

[1] Grasses which increase when the veld is rested from grazing and is not burned for many years.

[2] These grasses increase with heavy grazing, often combined with frequent fire. Many of the grasses have moderate grazing value and can form the backbone of grazing in moderate condition veld.

Figure 8-2: Modified Grassland

8.1.1.2. Rocky Grassland

The Rocky Grasslands community occurs across the dolomite and quartzite geology of the area. This community is dominated by Increaser II *Eragrostis* species (E. chloromelas and E. curvula) and is abundant with Increaser II and III grasses such as *E. plana, Setaria sphacelata, Aristida junciformes, A. congesta* subsp *congesta, Heterpogon contortus,* and *Loudetia simpelx.* This veld condition is indicative of overgrazed veld. A variety of herbaceous species were recorded within this community. The species occurrence varied accordingly to the soil substrate. The most common forbs included: *Albuca sp., Hypoxis obtusa, Kohautia amatymbica* and *Cyanotis speciosa.* The higher rocky areas included a species diversity of *Xerophyta viscosa, Asclepias stellifera, Lasiosiphon kraussiana, Vernonia galpinii* and ferns *Pallaea calomelanos* and *Cheilanthus viridus.* The steeper rocky areas included small shrubs of *Protea welwtichii, Lopholaena coriifolia* and *Aloe greatheadii*. Although not encountered during the site visit, this plant community has potential to provide habitat for SCC, such as the declining geophyte *Boophone disticha* (Poison Bulb). In addition, this habitat type may suit the needs of several other floral SCCs, listed in Table 8-1.

Table 8-1: Threatened species that may occur within the Rocky Grassland community

Species	Conservation status
Bowiea volubilis subsp. volubilis	*Vulnerable*
Brachycorythis conica subsp. Transvaalensis	*Vulnerable*
Callilepis leptophylla	*Declining*
Cleome conrathii	*Near Threatened*
Delosperma gautengense	*Vulnerable*
Delosperma leendertziae	*Near Threatened*
Drimia sanguinea	*Near Threatened*
Gladiolus robertsoniae	*Near Threatened*
Habenaria mossii	*Endangered*
Holothrix randii	*Near Threatened*
Hypoxis hemerocallidea	*Declining*
Ilex mitis var. mitis	*Declining*
Khadia beswickii	*Vulnerable*
Lithops lesliei subsp. lesliei	*Near Threatened*
Melolobium subspicatum	*Vulnerable*
Pearsonia bracteata	*Near Threatened*

Under optimum management practices this grassland has a high ecological functioning and is likely to support an even higher species diversity than what was noted at the time of the assessment, and it could potentially support a number of protected plant species. Representative images of this community is presented in Figure 8-3 below.

Figure 8-3: Rocky Grassland vegetation community

8.1.1.3. Wetland Vegetation

According to the Digby Wells Wetland Report (Digby Wells Environmental, 2021), four Hydrogeomorphic (HGM) units were identified during the 2021 site assessment namely Channelled Valley Bottom (CVB), Unchannelled CVB, Seep and Pan wetlands. Majority of the watercourses (wetlands) have experienced disturbances from historic and current land use practises. The impacts include proliferation of AIPs, water quality, Acid Mine Drainage (AMD), connectivity to other wetlands and the general biodiversity (see Figure 8-4).

The vegetation associated with the wetlands include a number of facultative[3] species such as *Schoenoplectus corymbosus*, various sedges (Cyperaceae spp.) and moisture and clay loving graminoids such as *Berkheya* sp. and *Setaria sphacelata* (Golden Bristle Grass) can be observed. *Phragmites australis* (Common Reed) and *Typha capensis* (Common Bulrush) form dense stands in the riparian areas. The dominance of these two species indicates degraded river health as they are generally indicators of nitrification and sedimentation. This is thought to be the result of impacts from the surrounding mining activities. Majority of the wetlands are bordered by dense closed canopy stands of *Populus x canescens, Acacia mearnsii, Eucalyptus camaldulensis* and carpets of *Pennisetum clandestinum.* These species are NEM:BA Category listed and have severe impacts to the ecological functioning of wetlands. They are legislatively mandated to be eradicated, see Section 8.1.1.4.1 below.

Wetlands are important and sensitive habitats and are protected by the National Water Act (Act No. 36 of 1998) (NWA, 1998). The wetlands and their characteristics, including the classification and functionality, are discussed in detail in the Digby Wells Wetland Report 2021 (Digby Wells Environmental, 2021).

[3] Species that occur both in wetlands and uplands

Figure 8-4: Cyperaceae species within one of the channels of the HGM units, surrounded by numerous AIPs

8.1.1.4. Transformed

Majority of the site is transformed and large portions of natural vegetation have been replaced by alien vegetation, which comprises exotic tree stands, disturbed areas which have been colonised by alien invasive vegetation and (see Figure 8-5). Degraded landscapes and majority of the transformed areas are confined to the historical mine tailings, stockpiles and pits. The unrehabilitated landscape and soils has allowed the pioneering exotics to sprawl and proliferate throughout the identified vegetation communities and prevent natural vegetation from colonising. Declared weeds and invader plant species can have detrimental impacts on natural vegetation. These species can outcompete indigenous species, thereby transforming the structure, composition and function of natural ecosystems. Furthermore, legislation is in place which places responsibility of the landowner to eradicate and control certain invasive species. this is elaborated on below in Section 8.1.1.4.1.

8.1.1.4.1. Alien Invasive Plants

The historical and current land practices have completely altered majority of the Project Area's vegetation and habitat. Large stretches of facultative invasive tree, *Eucalyptus camaldulensis* (River Red Gum) and *Acacia mearnsii* (Black Wattle), were observed along the identified watercourses. In South Africa, these invasive species account for 16% of the 1,444 million cubic metres of water resources lost every year due to invasive plants (Maitre, Forsyth, Dzikiti, & Gush, 2016). The taxon with the greatest estimated impact on water resources in South Africa is the *Acacia* sp. (Wattles). This particular taxon was observed in abundance throughout the site.

The National Environmental Management: Biodiversity Act (NEM:BA) is the most recent legislation pertaining to AIPs. In August 2014 the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014). The Alien and Invasive Species Regulations was published in the Government Gazette No. 37886, 1 August 2014. The legislation calls for the removal and/or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within close proximity to a watercourse.

Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEM:BA):

- Category 1a: Species requiring compulsory control;
- Category 1b: Invasive species controlled by an invasive species management programme;
- Category 2: Invasive species controlled by area; and
- Category 3: Invasive species controlled by activity.

The table below (Table 8-2) lists the recorded AIPs and their respective NEM:BA category listing.

Table 8-2: Aline Invasive Plants Recorded on site

Scientific Names	***Common Names***	***Habitat***	***NEM:BA Category***
Acacia mearnsii	*Black Wattle*	*Tree*	*2*
Argemone ochroleuca	*Mexican Poppy*	*Herb*	*1b*
Arundo donax	*Spanish Reed*	*Grass*	*1b*
Canna indica	*Indian Shot*	*Herb*	*1b*
Cirsium vulgare	*Scotch Thistle*	*Herb*	*1b*
Cortaderia selloana	*Pampas Grass*	*Grass*	*1b*
Datura stramonium	*Common Thorn Apple*	*Herb*	*1b*

Eucalyptus camaldulensis	*River Red Gum*	*Tree*	*1b*
Gleditsia triacanthos	*Honey Locust*	*Tree*	*1b*
Melia azedarach	*Syringa*	*Tree*	*1b*
Morus alba	*White Mulberry*	*Tree*	*3*
Opuntia ficus-indica	*Sweet Prickly Pear*	*Tree*	*1b*
Pennisetum clandestinum	*Kikuyu Grass*	*Grass*	*1b*
Phytolacca octandra	*Forest Inkberry*	*Herb*	*1b*
Populus x canescens	*Grey Poplar*	*Tree*	*2*
Solanum mauritianum	*Bugweed*	*Tree*	*1b*
Solanum sisymbriifolium	*Dense-thorned Bitter Apple*	*Herb*	*1b*
Tamarix ramosissima	*Pink Tamarisk*	*Tree*	*1b*
Verbena bonariensis	*Wild Verbena*	*Herb*	*1b*
Verbena rigida	*Veined Verbena*	*Herb*	*1b*

Therefore, it is imperative that the invasive species are controlled and removed by means of an eradication and monitoring programme (see recommendation Section 9.3.1.2).

Figure 8-5: The sprawl of the AIPs encountered throughout all the vegetation units within the Project Area

8.2. Fauna

Fauna occurring in the Project Area include assemblages within terrestrial and wetland ecosystems: mammals, birds, reptiles, amphibians and invertebrates. Each of these assemblages occurs within unique habitats. The identified vegetation units and habitats in the Project Area include Grasslands, Wetlands, Rocky Grasslands and Transformed areas. Large portions of the terrestrial vegetation within the Project Area have been subjected to heavy modifications and have subsequently impacted the faunal species diversity and abundance. The findings of the faunal survey are used as a secondary reflection of the ecosystem health. During the September 2021 survey, recordings of mammals, reptiles, birds, amphibians and invertebrates within the Project area were very low.

8.2.1. Faunal Habitats

The various habitats identified correspond with the vegetation communities and provide niched refuge for many faunal species. They are particularity sensitive to disturbances and impacts from development.

8.2.1.1. Grassland Habitat

The variety of grasslands provide abundant food and shelter for numerous species. Small mammals, grassland birds and invertebrates seek sanctuary in these areas. The floral species provide ample sustenance attracting a number and diversity of species

8.2.1.2. Wetland Habitat

Wetlands are highly sensitive habitats due to their levels of biodiversity and sensitivity to disturbances. The overlay of aquatic and terrestrial habitat results in a varied habitat which attracts a high number of species. Invertebrate and amphibian diversity is most remarkably high with particular note of avifaunal activity, most notably the Grass Owl (*Tyto capensis*) (VU), and although not recorded during the survey, may occur in these areas.

Areas which have been transformed still provide habitat to numerous faunal species however due to the nature of terrestrial ecological modification much of the species which exist here are transitional or introduced. The alien vegetation in these areas provide habitat for a number of species which would not usually occur in the project area. Small mammal species and avifauna species benefit from these areas.

8.2.1.3. Rocky Habitat

Rocky outcrops and habitats in Gauteng are becoming increasingly rare due to urbanisation and transformation. Outcrops are usually embedded and function as part of surrounding grassland vegetation, which is also becoming scarce in its natural state. They are particularly suitable for providing refuge for biodiversity in an urbanised landscape as they function as islands within a natural landscape as they provide environmental isolation from developed landscapes. The rocky habitats provide refuge for rupiculous vertebrates. However, the rocky habitats in the Project area are entirely surrounded by roads and a plethora of structures and activities of civilization. As a result, it furthermore suffers from the zoogeographical "island effect" that inter alia implies that no (or very little) connectivity to other habitats exists. It is therefore assumed that ecological opportunists species with maximum reproductive capacity can persist.

8.2.2. Mammals

The survey conducted in September 2021 recorded very few mammals within the Project Area. The low count is primarily due to the modified nature and the on-going anthropogenic activities within the site. A total of five (5) mammal species were recorded within the Project Area, namely Cape Ground Squirrel (*Xerus inauris*), Yellow Mongoose (*Cynictis penicillata*), Scrub Hare (*Lepus saxatilis*), African Mole Rats (*Cryptomys hottentotus*) and Brown Rat (Rattus norvegicus).

No mammal SCC have been recorded from the surveys however as per minimum requirements from GDARD, the following mammal species were specifically searched for in the wetland habitat: Rough-haired Mole (*Chrysospalax villosus*) (VU), White-tailed Mongoose (*Mystromys albicaudatus*) (EN), African Clawless Otter (*Aonyx capensis*) (LC), Spotted-necked Otter (*Lutra maculicollis*) (NT), Highveld Golden Mole (*Amblysomus septentrionalis*) (NT) and African Marsh Rat (*Dasymys incomtus*) (LC) and none were confirmed. This does not necessarily infer that they do not occur in this region at all.

8.2.3. Birds

As mentioned above in Section 7.1.3.2, birds are viewed as good ecological indicators, as their presence or absence tends to represent conditions of a functioning ecosystem. The direct link between bird diversity and land cover portrays a direct indication of the habitats in the area of interest.

According to the SABAP2, 207 species of birds have been identified in the area (see Appendix D); the majority of these birds are comprised of grassland species. The infield assessment recorded twenty-one (21) species of birds with no record of listed or Red Data species within the Project Area. An unexpected sighting of a Peleartic migrant, the European Nightjar, was recorded adjacent to the Rocky Grassland near the Il10 tailings. This is not a listed species, however is known to migrate in the winter mainly in the south and east of Africa and therefore an unusual occurrence in the disturbed area.

Table 8-3: Birds recorded at site

Scientific Name	Common Name	Conservation Status
Acridotheres tristis	Common Myna	Least concern
Acrocephalus baeticatus	African Reed-Warbler	Least concern
Alopochen aegyptiacus	Egyptian Goose	Least concern
Anas erythrorhyncha	Red-billed Teal	Least concern

Scientific Name	Common Name	Conservation Status
Anas undulata	Yellow-billed Duck	Least concern
Apus affinis	Little Swift	Least concern
Apus caffer	White-rumped Swift	Least concern
Bubulcus ibis	Cattle Egret	Least concern
Charadrius tricollaris	Three-banded Plover	Least concern
Colius striatus	Speckled Mousebird	Least concern
Elanus caeruleus	Black-shouldered Kite	Least concern
Euplectes orix	Southern red Bishop	Least concern
Euplectes progne	Longtailed Widow	Least concern
Plocepasser mahli	White-browed sparrow-weaver	Least Concern
Ploceus velatus	Masked Weaver	Least concern
Saxicola torquatus	African Stonechat	Least concern
Streptopelia capicola	Cape Turtle Dove	Least concern
Streptopelia senegalensis	Laughing Dove	Least concern
Vanellus coronatus	Crowned Plover	Least concern
Vanellus lugubris	Lesser Blackwinged Plover	Least concern
Caprimugus europaeus	European Nightjar	Least concern

8.2.4. Herpetofauna

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupicolous (rock-dwelling) and wetland associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of global distribution ranges. Due to the presence of rupiculous habitat, two reptile species were encountered within this portion, a Common Girdled Lizard (*Cordylus vittifer*) (deceased one found, see Figure 8-6) and Southern Rock Agama (*Agama atra*). No amphibian species were recorded during the time of the survey, this may be due to the timing as it was not the optimal season and poor water quality of the watercourses not suitable for many amphibious species within the Project Area. The species assemblage was expectantly low as the few remaining terrestrial and aquatic habitats are fragmented and isolated due to the anthropogenic activities.

Figure 8-6: Deceased Common Girdled Lizard

9. Impact Assessment

The Fauna and Flora impacts were assessed for the three phases of the project life, including the construction, operational and decommissioning phases. The impacts were based on the impact's magnitude as well as the receiver's sensitivity, concluding an impact significance rating which identifies the most important impacts that require management.

The impacts that will potentially affect the fauna and flora of the Project Area are:

- Clearing the vegetation will result in loss of the vegetation communities, biodiversity, unique habitats and potential SCC. Loss of these components will degrade the overall habitat and ecosystem services they provide;
- Sensitive areas such as the Rocky Grassland, Grasslands, and Wetlands will be impacted. There is a risk of water contamination, loss of water quality and quantity and loss of unique habitats. Contaminated water will affect the surrounding areas, and decrease the overall functioning of the biodiversity and ecosystem; and
- Vegetation clearance and removal of topsoil will deplete the soil fertility and encourage AIP proliferation and erosion, further degrading the land and the services it provides.

This section rates the significance of the potential impacts pre-mitigation and post-mitigation. The impacts below are a result of the environment in which the activity takes place, as well as the activity itself. The impacts associated with the proposed project include the NEMA EIA Regulations, 2014 (as amended) Listed Activities, as well as the mining and associated activities to take place at the project area.

The methodology utilised to assess the significance of the potential impacts is described in Appendix H.

9.1. Construction Phase

Activities during the Construction Phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem functioning are listed in Table 9-1.

Table 9-1: Interactions and Impacts of Activity

Interaction	Impact
Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Removal of all vegetation within the development footprint, permits the loss of vegetation communities (including potential floral SCC), biodiversity and ecosystem services; and • Degradation to the topsoil impacting decreasing the arability for vegetation cover.
Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Removal of vegetation, AIP proliferation and faunal casualties; • Increased vehicle movement which may disturb the vegetation communities and spread AIPs; and • Increased dust, compaction and sedimentation.

9.1.1. Impact Description

Habitat loss refers to the removal of natural habitat and this occurs through the vegetation clearing and earth works during construction. Ancillary infrastructure such as pipelines, powerlines and pumps will be required for the proposed reclamation activities. The immediate impact is the destruction of flora and fauna occurring in the development footprint. Construction of the mining infrastructure will lead to the direct loss of the vegetation that has grown over the years on the selected mine tailings. The construction of the mining infrastructure will result in the loss of certain biodiversity aspects. General biodiversity will be affected (this includes individual species associated with vegetation).

Habitat modification occurs when natural habitat is degraded or disturbed to the extent that it is compositionally and structurally dissimilar to reference habitat conditions. In severe cases of habitat modification, the mix of functional species-types is altered and ecosystem functioning is impaired as a result. It is known that the Project Area has already been modified and shallow gold-bearing reefs were left unrehabilitated and unexploited by the extensive historic mining activities that have taken place in the area since 1888. Disturbance to existing vegetation coupled with earth works during construction, could lead to increase in soil erosion.

Eroded material could mobilise and lead to increases in sediment load in adjacent drainage features, choke plant species and close burrowing animal holes which serve as their habitat.

Since the area was unrehabilitated, additional contributor to loss of ecosystem function is the proliferation of alien and invasive species. Disturbance to the soil after vegetation clearing results in the establishment of alien species, that may form dense monospecific stands. Once the invasive species has formed a monodominant stand, it becomes extremely difficult to restore the area. This may hold true even after the exotic species has been eradicated, because the legacy of a monodominant stand often results in soil and other key structural alterations. Anticipated impacts include, fragmentation and edge effect, and alien vegetation colonisation.

9.1.1.1. Management Objectives

Management objective for the site clearance activity will include informing the mine where the location of the vegetation communities is, including the location of any protected fauna and flora, and how to limit impacts to these.

Due to the nature of the proposed TSF for reclamation, processing, deposition, reclamation and development, habitat loss is difficult to avoid or significantly mitigate. Steps however, can be taken to reduce the overall significance during all phases, but particularly during closure. With successful stabilisation and rehabilitation, impact magnitude can be reduced. The management objectives are to prevent the loss of important landscapes, species of plants and animals (Red Data and Nationally or Provincially listed species). This is achieved by avoiding destruction of areas where these species occur and preventing damage to surrounding fauna and flora species within the Project Area.

9.1.1.2. Management Actions

Areas that are not directly affected by mining activities should be conserved. This entails restricting access and controlling any alien invasives as well as keeping site clearing to a minimum. Vegetation clearing should be restricted to the proposed TSF footprints only, with no clearing permitted outside of this area. The footprint to be cleared should be clearly demarcated prior to construction to prevent unnecessary clearing outside of this area. Avoidance of identified areas of high fauna importance such as the Rocky Grasslands.

In the event that a threatened species (SCC) in encountered on site, these areas should be preserved, and mining should be restricted to areas outside of their immediate habitat. In the case where this is not possible, and all efforts to avoid these areas have been exhausted, permits may be applied for from the provincial authorities to translocate these species. It is imperative however, that the habitat in which these species are translocated to is as similar to the donor habitat as possible and is also within close proximity to the site. It must be noted, regardless of the potential relocation of SCC, if the original natural habitat in which these species occur is destroyed, the negative impact still exists.

Illegal waste dumping, including building waste and rubble, should be prohibited. Such illegal dumping sites are prone to alien vegetation recruitment. The environmental manager must ensure that after each building site is rehabilitated, there are no rubble piles remaining.

Cleared areas should be monitored for colonisation by alien species and a proactive approach should be undertaken to control alien species as soon as they are established. Monitoring and eradication of alien species is part of the mine's responsibility. An alien invasive species control programme specific to the TSF must be developed and/or incorporated in the mine's broader alien invasive species control programme. It should be implemented during all phases of the proposed project.

Rehabilitation of small areas disturbed during construction, and not needed for operation, should occur concurrently to mining activities. It is worthwhile investing in a nursery which will serve to propagate indigenous species in order that they can restore disturbed areas, immediately after activity has ceased. Removed topsoil should be stockpiled and used to rehabilitate the TSF. A suitable rehabilitation programme should be developed and implemented for all areas that were disturbed during construction, as well as the TSF.

9.1.1.3. Impact Ratings

Impacts associated with the construction phase are presented below in Table 9-2.

Table 9-2: Construction Phase Interactions, and Impacts of Activity Rating

1. Activity, and Interaction: Site/vegetation clearance			
Impact Description: • Loss of plant communities including potential floral SCC; • Loss of biodiversity; • Increased erosion; • Potential for AIP proliferation if not controlled; • Loss of faunal habitat including potential faunal SCC; and • Loss of vegetation types including grasslands, rocky habitats and wetland vegetation.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impact of the vegetation clearance will be long term yet can be reversed through management and mitigation.	Minor (negative) - 60
Extent	3	Vegetation removal will occur within the new processing plant facility and ancillary infrastructure	
Severity	3	Moderate loss of the vegetation communities (including grassland and wetlands) limiting ecosystem functioning	

Probability	6	Almost certain probability of vegetation clearing particularly in the pipeline route and infrastructure layout	
Nature	Negative		
Mitigation measures			
• Vegetation clearing should be restricted to the proposed TSF footprints only, with no clearing permitted outside of this area. • Avoidance of identified areas of high fauna importance such as Rocky Grassland; • Alien plant management strategy should be implemented; • Make use of existing roads to encourage minimal impacts/footprint; • The footprint of the mine should be as compact as possible from a design point of view			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	The impact will be medium term, specifically during the construction, and operational phases.	Minor (negative) - 40
Extent	2	Vegetation removal is limited only to the pipeline route and infrastructure layout.	
Intensity	3	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	5	There is a high probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
2. **Activity, and Interaction:** Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.			
Impact Description: • Removal of vegetation, AIP proliferation and faunal casualties; • Increased vehicle movement which may disturb the vegetation communities and spread AIPs; and • Increased dust, compaction and sedimentation of loosened soils stunting vegetation growth.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	5	The construction activities will remain during project life.	Minor (negative) - 72
Extent	3	Loss of fauna and flora will only occur within the impacted area and its near surroundings.	
Intensity	4	If not mitigated serious loss will occur to the moderately sensitive environment.	

Probability	6	Site clearance has to take place for construction of the access and haul roads, so vegetation removal is inevitable.	
Nature	Negative		
Mitigation measures			
• Keep site clearing to a minimum; • If any erosion occurs, corrective actions must be taken to minimise any further erosion from taking place at regular intervals or after high rainfall events; • Existing roads should be evaluated and where necessary, storm water drainage should be installed to avoid erosion gullies forming; • AIPs should be continuously monitored and controlled throughout the life of the mine and thereafter, with the establishment of an AIP Eradication Plan.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impacts will occur during the life of the project.	Minor (negative) - 45
Extent	2	Loss of fauna and flora is limited only to the site where the construction of the processing plant and ancillary infrastructure will occur.	
Intensity	3	Moderate loss, and/or effects to biological or physical resources or moderately sensitive environments, limiting ecosystem functioning.	
Probability	5	High probability that the impact will continue to occur.	
Nature	Negative		

9.2. Operational Phase

Activities during the Operational Phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem function are listed in Table 9-3.

Table 9-3: Operational Phases Interactions and Impacts

Interaction	Impact
Operation of pump stations during the operational phase.	• Risk of disturbances to the surrounding environment; • To limit surface water captured and stored within the TSF footprint according to best practices • Habitat disturbances and increased soil erosion, soil contamination and compaction; and • Altered quality of soil.

Interaction	Impact
Infilling of processed tailings material into the West Pits Pit and other potential pits.	• The sudden increase in activity may lead to the migration of sensitive species from the site to a more favourable habitat; • Continuous anthropogenic influence stemming from staff, residents and visitors that infiltrate the unexplored natural veld areas will damage and impact on species communities within certain areas. • Contamination of soil, water and surrounding areas / habitats (pan vegetation) from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels). • Increased vehicle movement in the area, increasing soil compaction, and runoff potential.
Surface tailings deposition within the West Wits Pit.	• The sudden increase in activity may lead to the migration of sensitive species from the site to a more favourable habitat; • Continuous anthropogenic influence stemming from staff, residents and visitors that infiltrate the unexplored natural veld areas will damage and impact on species communities within certain areas; • Contamination of soil, water and surrounding areas / habitats (wetland vegetation) from Hydrocarbon waste/spills (lubricants, oil, explosives, and fuels); • Increased vehicle movement in the area, increasing soil compaction, and runoff potential; and • Any leaks to undisturbed natural habits can impede the growth of plant species due to soil contamination.
Progressive rehabilitation of the new tailing's facility footprints (West Pits TSF and 1L23-1L25 TSF.	• Correct inspections of the TSF and equipment; and • Improvements from rehabilitation will be recognisable over time as the disturbed areas are undergo secondary succession – this will however not be the pre-mining natural habitat.

9.2.1. Impact Description

During the operational phase limited damage is anticipated on the vegetation. Major impacts on flora and their associated habitats as a result of the operational activities is considered to be less extensive because the areas will have already been cleared during construction phase. However, operational activities can cause soil instability due to increased erosion and loss of protective plant cover. There may be possible degradation of adjacent habitats due to potential contamination of underground water. An influx of vehicles and heavy equipment will continue to disturb vegetation habitats, spill diesel/fuel and can gather plants and soils which can spread invasive plant seeds. Some impacts on vegetation are expected in the tailings and dump areas.

Mobile or smaller faunal species will move off to avoid disturbances caused by construction activities. However, smaller and less mobile species may be trapped, injured and killed during earth works associated with the operational phase. Susceptible fauna includes amongst others, burrowing mammals (e.g., moles, rodents), nesting birds, reptiles and amphibians. Other common causes of fauna death or injury include vehicle collisions along access roads, trapping of fauna in fences, excavations and trenches. It is also possible that continuous anthropogenic influence stemming from staff, residents and visitors that infiltrate the unexplored natural veld areas will damage and impact on species communities within certain areas.

9.2.1.1. Management Objectives

Management objectives during the operational phase will concentrate on preventing the loss of vegetation and/or habitat and species that surround the operations. This can be accomplished by not allowing the condition of the vegetation and surrounds to deteriorate after the project activities have begun. Management objectives during the operational phase will concentrate on preventing the proliferation of AIPs, the loss of vegetation, or habitat that surrounds the TSF and pipeline routes. This could occur through windblown tailings being deposited on plants, which then affects their functioning.

9.2.1.2. Management Actions

As appropriate, fences should be erected to prevent fauna gaining access to construction and operational areas where they may be killed or injured. All vehicles should drive at low-speed limit (recommended 20-40 km/h) should be enforced on site to reduce wildlife collisions. No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped. The handling, poisoning and killing of on-site fauna by mine workers and contractors must be strictly prohibited; and employees and contractors should be made aware of the presence of, and rules regarding fauna through suitable induction training and on-site signage.

All hazardous materials should be stored in the appropriate manner to prevent contamination of the site and surrounding undisturbed areas. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.

It is essential to limit surface water captured and stored within the TSF footprint according to best practices and maintain water management infrastructure in such a manner as to reduce any possibility of dirty water entering the natural or clean water systems. Ensuring that the correct health and safety procedures are followed and that the correct inspections of the TSF and equipment are monitored to prevent dam failure.

All hydrocarbons must be stored in a manner which will prevent any harm to the environment. Any spillage must be capture, contain and managed immediately and ensure that any area which has been affected by a hydrocarbon spill is suitably rehabilitated and monitored until rehabilitation efforts have been successful.

9.2.1.3. Impact Ratings

The operational phase impacts are rated in Table 9-4.

Table 9-4: Operational Phase Interactions, and Impacts of Activity Rating

<table>
<tr><th colspan="4">1. Activity, and Interaction: Operation of pump stations during the operational phase.</th></tr>
<tr><td colspan="4">Impacts:
• Risk of disturbances to the surrounding environment;
• To limit surface water captured and stored within the TSF footprint according to best practices
• Habitat disturbances and increased soil erosion, soil contamination and compaction; and
• Altered quality of soil.</td></tr>
<tr><td colspan="4">Prior Mitigation</td></tr>
<tr><td>Dimension</td><td>Rating</td><td>Motivation</td><td>Significance</td></tr>
<tr><td>Duration</td><td>3</td><td>The impact will persist at a medium term (1-5 years) of the project, although reduced during the decommissioning phase.</td><td rowspan="5">Negligible (negative)
- 32</td></tr>
<tr><td>Extent</td><td>2</td><td>Majority of the impacts are limited to the pipeline route, TSFs and access roads.</td></tr>
<tr><td>Intensity</td><td>3</td><td>Soil compaction and erosion further degrading the habitat, increased vehicular activity and loss of vegetation due to increased runoff from compacted areas.</td></tr>
<tr><td>Probability</td><td>4</td><td>Movement of vehicles and heavy mine machinery will result in habitat degradation.</td></tr>
<tr><td>Nature</td><td>Negative</td><td></td></tr>
<tr><td colspan="4">Mitigation measures</td></tr>
</table>

- Avoid wasting water, all leaks from pipes must be fixed immediately;
- Alien invasive plants should be continuously monitored and controlled throughout the life of the mine and thereafter. It is recommended that AIP programme be established to control the spread; and
- Monitoring of the vegetation communities present must be completed every 2 years to document to impacts of the edge effect and fragmentation.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	3	The impact will occur on a medium-term basis	Negligible (negative) - 24
Extent	1	Habitat degradation is limited only to very limited areas, if mitigated correctly.	
Intensity	2	Minor loss, and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		

2. **Activity, and Interaction:** Maintenance of pipeline routes during the operational activities. Infilling of processed tailings material into the West Pits Pit and other potential pits. Surface tailings deposition within the West Wits Pit.

Impacts:

- Habitat disturbances and increased soil erosion, soil contamination and compaction. Continuous disturbances to plants species by vegetation removal;
- Increased vehicle activity;
- Vehicles and heavy equipment can gather plants and soils which can spread invasive plant seeds to the project area;
- Potential spillage of hydrocarbons (diesel/fuel) thus contaminating the soil and surrounding water;
- Decline in habitat quality for biodiversity and floral SCC;
- Increased faunal casualties (road kill);
- Increased erosion and sedimentation decreasing vegetation cover;
- Dust (contaminated) pollution due to the infilling of tailings material.

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	5	The impact will occur during the life of the project and result in permanent changes to the landscape and habitats.	Minor negative (-66)
Extent	3	Impacts will extend as far as the development site area.	

Intensity	3	Moderate loss to the environment. These activities will result in modification of the landscape and loss of fauna and flora.	
Probability	6	High probability	
Nature	Negative		
Mitigation measures			
• Monitoring of alien invasive sprawl during the operation is mandatory as there is a high chance of AIP sprawl due to the current density of invasives within the Project Area; • Keep sight clearing to a minimal, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands and rocky habitats. • Ensure maintenance of infrastructure to prevent any spillages thus preventing contamination of the soil. • Vegetate stockpiles to prevent soil loss, organic material loss, erosion, and sedimentation.			
Post-Mitigation			
Duration	4	The impact will occur on a long-term basis, specifically during the construction, and operational phases.	Minor negative (-40)
Extent	3	Removal of vegetation, soil stripping and stockpiling is limited only to current mine areas, provided that mitigation measures are implemented.	
Intensity	3	Moderate loss and damage to fauna and flora and habitats if mitigation measures are not adhered to.	
Probability	4	There is a probability that the impact will occur if mitigation measures are not implemented.	
Nature	Negative		
3. Activity, and Interaction: Progressive rehabilitation of the new tailing's facility footprints (West Pits TSF and 1L23-1L25 TSF.			
Impacts: • If managed correctly, the end result will be positive; • Increase in dust production; • AIP spread; and • Increased compaction, erosion, and consequently sedimentation potential.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	3	Medium term: 1 – 5 years and impact can be reversed with minimal management.	Minor (negative)

Extent	3	Majority of the impacts will occur pipeline route, TSFs and access roads.	- 50
Intensity	4	Soil compaction and erosion further degrading the habitat, increased vehicular activity and loss of vegetation due to increased runoff from compacted areas.	
Probability	5	The impact is likely to occur in not mitigated.	
Nature	Negative		
Mitigation measures			
• The footprint of the mine should be kept as small as possible with only necessary areas being cleared; • Existing roads should be used with no new roads constructed, if new roads need to be constructed, these should be done outside of the identified vegetation communities and as close as possible to the existing roads; • Access should be restricted to already impacted areas (haul roads, TSFs, pipelines and dumps) by rehabilitating these areas as soon as possible by removal of infrastructure and planting; • Alien invasive plants should be continuously monitored and controlled throughout the life of the mine and thereafter. It is recommended that AIP programme be established to control the spread; and • Monitoring of the vegetation communities present must be completed every 2 years to document to impacts of the edge effect and fragmentation.			
Post-Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Positive Impact 66
Extent	3	Local area will be affected.	
Intensity	2	Low positive impact.	
Probability	6	Almost certain with a high probability that the impact will occur.	
Nature	Positive		

9.3. Decommissioning Phase

Activities during the decommissioning phase that may have potential impacts on the vegetation communities, biodiversity and ecosystem function are listed in Table 9-5.

Table 9-5: Decommissioning Phase Interactions and Impacts

<table>
<tr><th>Interaction</th><th>Impact</th></tr>
<tr><td>Removal, decommissioning and rehabilitation of surface infrastructures such as pipelines, powerlines, pumps etc. footprints.</td><td rowspan="3">• Increased vehicle movement in the area, increasing soil erosion and habitat destruction;
• AIP proliferation;
• Unexpected changes in topography and landscape
• Exposure of soils, and subsequent compaction, erosion, and sedimentation decreasing vegetation cover;
• Increased runoff potential due to vehicle movement during rehabilitation programs;
• Loss of organic material, and vegetation cover; and
• Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of soil.</td></tr>
<tr><td>Removal, decommissioning and rehabilitation of the processing plant footprint.</td></tr>
<tr><td>Rehabilitation of the old Mintails Processing Plant, TSF footprints and the facility.</td></tr>
<tr><td>General rehabilitation of the surrounding area, including wetland rehabilitation.</td><td>• Minimal negative impacts on the environment if managed efficiently.</td></tr>
</table>

9.3.1. Impact Description

The demolition of the mine and associated infrastructure areas may have negative impacts similar to those of the construction activities due to the similarities of the actions. These areas will then need to be rehabilitated according to the updated rehabilitation and closure plans aligned with the regional strategic goal for the area.

The increased levels of noise, pollution, disturbance and human presence during decommissioning would have some negative impacts on fauna. Sensitive and shy fauna are likely to move away from the area during this period as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the decommissioning activities and might be killed. Vehicular traffic would be high and will pose a risk of collisions with susceptible fauna. Slower reptiles and amphibians would be most susceptible.

9.3.1.1. Management Objectives

Management objectives are to inform the Project where there are ecological interactions with the proposed activities during the decommissioning of the infrastructure. These objectives are to prevent/minimise the loss of or further damage to natural ecosystems and their buffer areas. This is important as the naturally occurring habitat and ecosystems play a major role in supporting a range of ecological processes and biodiversity in the region particularly as this currently is a tourism area.

9.3.1.2. Management Actions

This section provides measures that the mine Environmental Manager must undertake during the decommission phase. Site-specific management plans for the various infrastructure developments must be developed by the mine environmental manager. A detailed schedule should be drawn on how the management objectives will be achieved.

The EMP must be used as a guide to inform management actions. However, specific important management actions are briefly discussed below:

- Rehabilitate the area according to the updated rehabilitation and closure plans aligned with the regional strategic goal for the area; and
- Ensure biodiversity offsets for the disturbed habitats are identified and incorporated as part of the rehabilitation plans.

The removal and clearing of the site infrastructure would create some soil disturbance which would leave these areas vulnerable to erosion and AIP proliferation. The disturbed areas should be rehabilitated at decommissioning with indigenous vegetation suitable for soil stability and represent the remnant vegetation type (see Section 6.3).

Minimisation of long-term post-closure water quality impacts to prevent contamination of food source to fauna and nutrient for vegetation. Long-term stabilisation of the TSFs and minimise the environmental impacts. Removal of infrastructure must be done in a manner which has the smallest possible impact on the environment and limit all rehabilitation activities and the movement of people to within the disturbed area footprint.

All contaminated soils and material must be removed. Ensuring that all compacted areas have been ripped and disturbed areas are topsoiled and vegetated. The Environmental Officer (EO) must make sure that erosion of slopes, siltation of paddocks, berms, are attended to immediately and rehabilitated and vegetated.

There should be regular monitoring for erosion for at least 5 years after decommissioning by the applicant or appointed entity to ensure that no erosion problems develop as result of the disturbance, and if they do, to immediately implement erosion control measures. All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.

Congruently, as Category 1b invasive species have been identified in abundance throughout the Project Area, the EO must ensure competency in compliance with NEM:BA and ensure the AIPs are controlled via an eradication and monitoring programme. A systematic alien control programme will need to be deployed. This system theoretically involves three phases of control including: initial, follow-up and maintenance. The initial phase actively involves mechanical methods and in the case of heavy infestations, machinery. Follow-up procedures are instilled to prevent coppicing from tree stumps. Also, when large trees are removed, that shaded soil generally results in bulk germination of weedy species, which can easily be removed or sprayed as a young seedling. Lastly, maintenance control should prevent re-colonisation of AIPs or infestation of newly introduced species.

All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the facilities' decommissioning and recycling plan.

9.3.1.3. Impact Ratings

The decommissioning phase impacts are listed in Table 9-6 below.

Table 9-6: Decommissioning Phase Interactions, and Impacts of Activity Rating

1. Activity, and Interaction: Rehabilitation – Removal, decommissioning and rehabilitation of surface infrastructures such as pipelines, powerlines, pumps etc. footprints. Rehabilitation of the old Mintails Processing Plant, TSF footprints and the facility..			
Impact Description: • Exposure of soils, soil compaction, and increased runoff potential due to vehicle movement during rehabilitation programs; • AIP proliferation; • Loss of organic material and vegetation cover; and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the surrounding area.			
Prior Mitigation			
Dimension	**Rating**	**Motivation**	**Significance**
Duration	4	The impacts caused during the rehabilitation activities will have a long-lasting effect if not managed.	Minor negative (-65)
Extent	4	The impact could spread beyond the local development boundaries due to the ability of degraded landscape or alien invasive species impacting the area.	
Intensity	5	These impacts have serious implications to the revival of the disturbed areas.	
Probability	5	These are commonly observed impacts for the rehabilitation phase.	
Nature	Negative		
Mitigation measures			

- During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season to ensure adequate plant recruitment;
- Address eroded and compacted areas by deep ripping to loosen the soil, and revegetate the area as soon as possible;
- It is imperative that an AIP control and eradication programme be employed by the mine;
- Inventory of hazardous waste materials stored on-site should be compiled and complete removal arranged; and
- Only designated access routes are to be used to reduce any unnecessary compaction.

Post-Mitigation

Dimension	Rating	Motivation	Significance
Duration	6	The impact will be less than a year if rehabilitation measures are implemented correctly	Minor Positive (+66)
Extent	3	The impact will be limited to the site due to the implementation of mitigation measures	
Intensity	2	Minor effects on the biological or physical environment. Environmental damage can be rehabilitated internally with/ without the help of external consultants.	
Probability	6	The impact can occur	
Nature	Positive		

2. Activity, and Interaction: Post-closure monitoring and rehabilitation

Impact Description:

- Minimal negative impacts on the environment if effectively managed

Prior Mitigation

Dimension	Rating	Motivation	Significance
Duration	7	The impact will be permanent.	Minor Positive (+60)
Extent	1	Limited to isolated sections of the Project area.	
Intensity	4	Moderate loss, and/or effects to biological or physical resources or low sensitive environments, limiting ecosystem functioning.	
Probability	5	Likely: The impact may occur. <65% probability	
Nature	Positive		

Mitigation measures

- During the decommissioning phase, rehabilitation must start as soon as possible and preferably in the growing season to ensure adequate plant recruitment;
- Stockpiles, TSFs and dumps are to be rehabilitated;
- Ensure sufficient irrigation and fertilizing of newly planted vegetation to facilitate a rapid establishment; and
- Replant with species identified within each vegetation community.

Post-Mitigation

Dimension	**Rating**	**Motivation**	**Significance**
Duration	6	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Minor Positive (+66)
Extent	3	Local area will be affected.	
Intensity	2	Low positive impact.	
Probability	6	Almost certain with a high probability that the impact will occur.	
Nature	Positive		

9.4. Cumulative Impacts

It is necessary to consider the impacts that the development will have from a broad area perspective by considering land-use and transformation of natural habitat in areas surrounding the site. Cumulative impacts are assessed by considering past, present and anticipated changes to biodiversity. The Soweto Highveld Grasslands is assigned an Endangered status and is under threat due to expanding anthropogenic activities.

As already established, the vegetation and habitat present in the Project Area will be affected by the construction of new infrastructure which will necessitate the removal of vegetation. The loss of more habitat and vegetation types will have negative impacts during the construction phase. The primary impacts will be fragmentation and edge effects with a reduction in the movement of remaining naturally occurring, and isolation of pockets, of vegetation. Secondary cumulative impacts will include increased accessibility to the site and the resulting increase in development and resource dependence. Ideally, a strategic environmental plan for the area should be developed and adhered to. This should include the conservation of important areas as well as the provision of corridors for faunal movement

The cumulative impacts of these activities will mean that further viable natural habitat may be lost due to site clearance to allow construction of mine infrastructure. Site clearance, coupled with the alien invasive plant species that have already taken place, will have an additional negative impact on the existing habitats. If not controlled, the alien invasive plant species will colonise open and available areas and exclude natural species from re-colonisation this has a detrimental impact on the existing ecosystems that support the avifauna community as well as impacts on water sources (Maitre, Forsyth, Dzikiti, & Gush, 2016).

Impacts not originating from the Project activities include firewood collection, agriculture, housing and grazing. It is evident that local communities have caused several impacts on the Project site and the region as they are dependent on the natural ecosystem.

9.5. Unplanned and Low Risk Events

The activities taking place in the Mogale Cluster have the potential to result in unplanned events that may have significant impacts to the natural vegetation and habitat types of the area. These are described in Table 8 7 below.

Table 9-7: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
Leaking or spillage of hazardous substances from pipelines and waste storage	• If a spill occurs, it is to be cleaned up immediately (Drizit/Zupazorb type spill kits) and consequently reported to the authorities; • All infrastructure carrying or transporting such substances is to be checked frequently and maintained; and • Ensure all staff are adequately informed and safety measures are in place for such instances.
Hydrocarbon spillage from vehicles	• If leak occurs from vehicle, place drip trays below the leak; • All vehicles are to be serviced on concrete areas and off site; and • Machines must be parked upon hard parking surfaces and checked daily for leaks.
Tailings slurry spill due to a pipeline burst or during hydraulic reclamation of the TSF's.	• Monitoring of the pipeline and its pressure must be a continuous mitigation effort prevent a leak or burst or to identify a burst as soon as possible. • Should it occur, emergency valves need to be shut down to prevent spillage of hazardous material.
Excess dust pollution	• Excess dust in construction sites is mitigated via various methods and are site specific. The recommended methods for this site would be spraying of water, mulch from the removed vegetation and tackifiers and soil stabilisers that don't harden the soils.

10. Environmental Management Plan

The objective of an Environmental Management Plan (EMP) is to present mitigations (a) to manage undue or reasonably avoidable adverse impacts associated with the development of the Project and (b) to enhance potential positives.

Mitigation measures will sometimes be built into the base of a project and should be considered as part of the "pre-mitigation" scenario; additional mitigation must be recommended if the impact assessment indicates it is necessary.

The key objectives are EMPs are to give mitigation measures to:

- Identify the actual environmental, socio-economic and public health impacts of the project and check if the observed impacts are within the levels predicted in the EIA;
- Determine that mitigation measures or other conditions attached to project approval (e.g. by legislation) are properly implemented and work effectively;
- Adapt the measures and conditions attached to project approval in the light of new information or take action to manage unanticipated impacts if necessary; and
- Gauge if predicted benefits of the project are being achieved and maximized; and gain information for improving similar projects and ESIA practice in the future.

The EMP is described in Table 10-1 below.

Table 10-1: Environmental Management Plan

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Construction Phase	• Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc. • Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Removal of vegetation, basal cover, and thus increasing the potential of loss of topsoil, organic material, and increased erosion potential. • Removal of potential flora and fauna SCC and faunal habitat; • Removal of vegetation communities such as grasslands and unique rocky grasslands as well as sensitive wetlands; • AIP proliferation; • Increased runoff potential and consequently sedimentation and compaction of the soil; • Potential spillage of hydrocarbons such as oils, fuels (diesel), and grease, thus contamination of the soils and surrounding grounds; • Risk of fire during the dry season; and • Increased dust pollution.	• Keep site clearing to an absolute minimum by adhering to the Project layout only, and restrict vehicle movement outside of dedicated areas, specifically close to wetlands (pans) and ridges; • Red Data plants located in areas of development should be marked prior to commencement of construction. Necessary permits for relocations of protected species must be obtained from the relative government department. The relocation strategy must be approved by relevant authorities prior to relocation to a safe and ideal location; • Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Whilst the removal of vegetation is underway, key monitoring methods should be focussed on the prevention of AIP proliferation during the construction and operational phase. Measures must be in place to prevent the spread of AIPs; • Erosion prevention is key thus runoff must be controlled, and managed by use of proper stormwater management measures; • Management of dust may involve the spraying of water; • Vehicles should regularly be surveyed and checked that oils spill and other contaminants are not exposed to the soils; • Storage and re-fuelling of vehicles must take place on bunded impervious surfaces to prevent seepage of hydrocarbons into the soil; • Fuel, grease, and oil spills should be remediated using a commercially available emergency clean up kits. However, for major spills (>5L), if soils are contaminated, they must be stripped, and disposed of at a licensed waste disposal site; and • Fire management plan is recommended in case of uncontrolled fires during the dry season.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of remining operations	Life of Construction Phase

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Operational Phase	• Operation of pump stations during the operational phase. • Maintenance of pipeline routes during the operational activities. • Infilling of processed tailings material into the West Pits Pit and other potential pits. • Surface tailings deposition within the West Wits Pit • Progressive rehabilitation of the new tailing's facility footprints (West Pits TSF and 1L23-1L25 TSF.	• Increased vehicle movement in the area, Increasing the risk of faunal casualties due to road kill; • Increased risk of AIP proliferation without adequate control measures; • Increased dust pollution; • Increase risk of fire during dry season; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils and surrounding grounds.	• Make use of existing roads to encourage minimal impacts/footprint to the Project Area; • Monitor AIPs and ensure measures are in place to prevent spread and proliferation; • All bare patches of soil should be vegetated, preferably with pioneer species which will colonise open and disturbed patches quickly; • Adhere to the recommended protective buffer around the watercourses (refer to the Digby Wells Wetland Report, 2021); • It is recommended that a nursery for indigenous flora that represent the identified vegetation communities be developed as a community-based project; • Management of dust may involve the spraying of water; • Monitoring must be carried out during the operational phase to ensure no unnecessary impact to the remaining vegetation and associated habitats, and if so that a remediation plan is put in place as soon as possible; • In support of the Digby Wells Wetland Report 2021, a Storm Water Management Plan (SWMP) should already be implemented. This should consider all high land capability area, high potential erosion areas, wetlands, and other watercourses associated with the new developments/infrastructure which should divert stormwater away from the surface infrastructure, and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey stormwater to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses; • Fire management plan is recommended in case of uncontrolled fires during the dry season; • Hydrocarbons should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions; and • Re-fuelling of vehicles and machinery must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons in the surrounding area.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of remining operations	Life of Operational Phase

Activities		Potential Impacts	Mitigation Measure	Mitigation Type	The period for implementation
Decommissioning Phase	• Removal, decommissioning and rehabilitation of surface infrastructures such as pipelines, powerlines, pumps etc. footprints. • Removal, decommissioning and rehabilitation of the processing plant footprint. • Rehabilitation of the old Mintails Processing Plant, TSF footprints and the facility. • General rehabilitation of the surrounding area, including wetland rehabilitation.	• Increased vehicle movement in the area, Increasing the risk of faunal casualties due to roadkill; • Increased risk of AIP proliferation without adequate control measures; • Increased erosion, runoff and compaction of soil and consequently sedimentation potential; • Changes to the landscape with subsequent removal of faunal habitats and a decrease in biodiversity and loss of SCC (faunal and floral); and • Potential spillage of hydrocarbons such as oils, fuels, and grease, thus contamination of the soils and surrounding grounds.	• Address areas that have been impacted by erosion, compaction, sedimentation by loosening the soil, and revegetate the area as soon as possible; • Begin with the rehabilitation of the vegetation and replant with indigenous flora identified in vegetation communities, particularly pioneer species. • Ensure a AIP control and eradication programme is implemented for the entirety of this phase; • Ensure designated access routes and roads are used to reduce any unnecessary compaction and degradation; • Inventory of hazardous waste materials stored on-site should be compiled, and complete removal must be arranged; and • Rehabilitation and Monitoring Plan should be implemented.	***Modify, remedy, control, or stop*** Concurrent rehabilitation through the life of remining operations	Life of Decommissioning Phase

11. Monitoring Programme

A monitoring programme is essential as a management tool to detect negative impacts and variations as they arise and ensure that the necessary mitigation measures are implemented together with the effectiveness of the management measures in place. Table 11-1 describes the monitoring plan that is to be implemented from the construction phase through to monitoring after decommissioning. The program includes each element, frequency of monitoring and the person responsible thereof.

Monitoring should be done in terms of:

- Appendix 6 of the NEMA EIA Regulations, 2014, (as amended);
- National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA);
- National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) (NEM: WA);
- National Forest Act, 1998 (Act No. 84 of 1998) (NFA); and
- Gauteng Conservation Plan (C-Plan) v3.3.

Table 11-1: Monitoring Plan

Monitoring Element	Comment	Frequency	Responsibility
Alien Invasive Management	During the operational phase the presence if AIPs should be detected and monitored. An active programme of weed management, to control the presence and spread of invasive weeds, will need to be instituted so that encroaching weeds (from edge effects and fragmentation) are controlled by means appropriate to the species. This should run for the life of the mine and five years after rehabilitation.	Annually during the wet season for the first five years after rehabilitation.	Environmental Officer
Vegetation Cover Monitoring	The natural vegetation cover established on the disturbed areas needs to be monitored annually for the first five years after rehabilitation has been carried out, to ensure that the rehabilitation work has been successful in terms of stabilising the newly formed surfaces (preventing air and water erosion from affecting those surfaces), and that the newly established vegetation cover is trending towards convergence with the original vegetation cover found on the areas prior to disturbance (and on adjacent undisturbed	Annually during the wet season for the first five years after rehabilitation.	Botanist / Flora Specialist

Monitoring Element	Comment	Frequency	Responsibility
	areas). Parameters to be followed during monitoring: • Plant species present/absent; • Weed species composition; • Species density (number of individuals); • Species frequency (number of times species is recorded); • Basal cover; and • Biomass for ground cover.		
Red Data listed fauna and flora	All protected and Red Data plant and animal species must be marked prior to any construction taking place.	Monitored every 6 months from rehabilitation	Field Specialist
Fauna monitoring	This will be closely linked to the flora monitoring to enable scientific conclusions and comparisons. To successfully monitor faunal and floral biodiversity with a Savannah biome, a solid baseline (pre-construction) will be established through the first round of monitoring. This needs to be supplemented with regular repeats to compile a reasonable comparison between the pre-construction faunal communities present and faunal communities found in the same areas during various stages of construction and operation of the proposed project. It is recommended that this monitoring be carried out through the life of the mine and concurrently during rehabilitation.	Monitored every 6 months from rehabilitation	Field Specialist

12. Stakeholder Engagement Comments Received

Please refer to the Comments and Response Report, attached as Appendix C of the EIA Report for comments raised and responses provided.

13. Recommendations

The following actions are recommended to reduce adverse effects on the fauna and flora of the Project Area (Table 13-1).

Table 13-1: Possible impacts and recommendations

Possible Impacts	Recommendations	Person Responsible
Loss of Fauna species	• All identified faunal species must be located and relocated, if possible, before the construction phase.	Field specialist, and PM
Loss of Vegetation cover and Flora SCC	• As recommended in Section 9, replanting of indigenous flora during the rehabilitation phase as a means to re-vegetate the area after decommissioning the mining activities.	Field Specialist, and PM
Habitat and landscape fragmentation	• Restriction of vehicle movement over sensitive areas to reduce degradation of untouched areas. • Minimise unnecessary removal of the natural vegetation cover outside the development footprint. • After rehabilitation the area must be fenced, and animals (cattle) should be kept off the area until the vegetation is self-sustaining and established.	Field Specialist, Communal Nursery and PM

14. Reasoned Opinion Whether Project Should Proceed

Based on the baseline information, and impact assessment significance ratings, it is the opinion of the specialist that this Project can be approved from a faunal and floral perspective. The project will have an overall positive impact as rehabilitation, that was not done in previous years, will be undertaken. It is recommended that concurrent rehabilitation, management, and mitigation measures are correctly implemented to minimise all potential impacts.

15. Conclusion

The Project Area is severely modified from historical and current land use, most notably, mining. Despite current threats, the habitat found in the project area provides an ecological service to the plant and animal species encountered. The project activities with the most considerable impact on the vegetation and associated habitats is the construction of the new processing plant, ancillary infrastructure, and reclamation of the TSFs.

Loss of these components will result in minor loss of biodiversity for the area. The opportunity exists however, for the proposed project to contribute significantly to conservation of biodiversity within the Rocky Grassland and Wetland region.

Preservation of the natural land and creation of corridors as a linkage between other natural areas will aid in the conservation of the ecosystems and fauna and flora. If efforts are made to initiate conservation of these habitats, and conservation is maintained after the decommissioning of the TSF’s, the net impacts on biodiversity will be positive.

From a faunal perspective the most sensitive microhabitats are the wetland habitats and the rocky habitats. This habitat has potential to provide habitat for faunal SCC to inhabit and if rehabilitated and mitigated correctly, faunal species will make use of the variable habitats.

The habitats that are still relatively intact, i.e. the Rocky Grasslands and wetlands contribute to vital ecosystem services and should be protected. Furthermore, the delineation of sensitive landscapes such as rocky grasslands also form areas where infrastructure placement must be avoided. Lastly, in efforts to improve the biodiversity, it is imperative that Mogale employ, as soon as feasibly possible, an AIP control and eradication programme to achieve the attainable biodiversity positive impacts.

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Appendix A: Recorded Floral Species

Family	Species Name	Conservation statuts
Mimosaceae	*Acacia mearnsii**	2
Asphodelaceae	*Aloe greatheadii var. davyana*	LC
Pteridaceae	*Adiantum aethiopicum*	LC
Asparagaceae	*Agave americana**	Alien invasive
Liliaceae	*Albuca sp.*	LC
Aaphodelaceae	*Aloe greatheadii var. davyana*	SCC
Amaranthaceae	*Alternanthera pungens**	Alien invasive
Amaranthaceae	*Amaranthus viridis**	Alien invasive
Papaveracea	*Argemone ochroleuca*	Mexican Poppy
Poaceae	*Aristida junciformis**	Invasive
Poaceae	*Arundo donax**	1b
Asclepiadaceae	*Asclepias stellifera*	LC
Liliaceae	*Asparagus laricinus*	LC
Asteraceae	*Aster harveyanus*	LC
Lamiaceae	*Becium obovatum*	LC
Asteraceae	*Berkheya radula*	LC
Asteraceae	*Bidens pilosa**	Alien invasive
Cannaceae	*Canna indica**	1b
Euphorbiaceae	*Chamaesyce hirta**	Alien invasive
Amaranthaceae	*Chenopodium album**	Alien invasive
Asteraceae	*Cirsium vulgare**	1b
Asteraceae	*Conyza albida**	Alien invasive
Asteraceae	*Conyza bonariensis**	Alien invasive
Poaceae	*Cortaderia selloana**	1b
Poaceae	*Cynodon dactylon*	LC
Cyperaceae	*Cyperus esculentus*	LC
Solanaceae	*Datura ferox**	1b
Solanaceae	*Datura stramonium**	1b
Asteraceae	*Dianthus mooiensis*	LC
Poaceae	*Eragrostis echinochloidea*	LC
Myrtaceae	*Eucalyptus camaldulensis**	1b
Myrtaceae	*Eucalyptus sideroxylon**	Alien Invasive
Convolvulaceae	*Falckia oblonga*	LC
Asteraceae	*Felicia filifolia*	LC
Asteraceae	*Gazania krebsiana*	LC
Asteraceae	*Gerbera viridifolia*	LC
Fabaceae	*Gleditsia triacanthos**	1b
Apocynaceae	*Gomphocarpus physocarpus**	Alien Invasive
Amaranthaceae	*Gomphrena celosioides**	Alien Invasive
Asteraceae	*Haplocarpha scaposa*	LC
Poaceae	*Harpochloa falx*	LC
Asteraceae	*Helichrysum caespititium*	LC

Family	Species Name	Conservation statuts
Asteraceae	*Helichrysum coriaceum*	LC
Asteraceae	*Helichrysum setosum*	LC
Sterculiaceae	*Hermannia lancifolia*	LC
Solanaceae	*Hermannia transvaalensis*	LC
Asteraceae	*Hilliardiella oligocephala*	LC
Poaceae	*Hyparrhenia hirta*	LC
Hypericaceae	*Hypericum lalandii*	LC
Hypoxidaea	*Hypoxis rigidula*	LC
Fabaceae	*Indigofera comosa*	LC
Iridaceae	*Iris germanica**	Alien Invasive
Rubiaceae	*Kohautia amatymbica*	LC
Cyperaceae	*Kyallinga erecta*	LC
Thymelaeaceae	*Lasiosiphon capitatus*	LC
Thymelaeaceae	*Lasiosiphon kraussiana*	LC
Asteraceae	*Latuca inermis*	LC
Liliaceae	*Ledebouria ovatifolia*	LC
Lobeliaceae	*Lobelia flaccida*	LC
Asteraceae	*Lopholaena coriifolia*	LC
Poaceae	*Loudetia simplex*	LC
Marsielaceae	*Marsiella villosa*	LC
Meliaceae	*Melia azedarach**	1b
Poaceae	*Melinis repens*	LC
Moraceae	*Morus alba**	3
Scrophulariacea	*Nemesia fruitcans*	LC
Solanaceae	*Nicotiana glauca**	1b
Onagraceae	*Oethothera roasea**	LC
Cactaceae	*Opuntia ficus-indica**	1b
Polygonaceae	*Oxygonum dregeanum*	LC
Geraniaceae	*Pelargonium dolomiticum*	LC
Poaceae	*Pennisetum clandestinum**	1b
Poaceae	*Phragmites australis*	LC
Solanaceae	*Physalis viscosa**	Alien Invasive
Phytolaccaceae	*Phytolacca octandra**	1b
Pinaceae	*Pinus patula**	2
Poaceae	*Pogonarthria squarrosa*	LC
Salicaceae	*Populus x canescens**	2
Proteaceae	*Protea welwitchii*	LC
Molluginaceae	*Psammotropha myriantha*	LC
Asteraceae	*Pseudognaphalium luteo-album**	2
Rosaceae	*Pyracantha angustifolia**	1b
Rubiaceae	*Richardia brasiliensis**	Alien Invasive
Fabaceae	*Robinia pseudoacacia**	1b

Family	Species Name	Conservation statuts
Caprifoliaceae	*Scabiosa columbaria*	LC
Anacardiaceae	*Schinus molle**	Naturalised
Hyacinthaceae	*Schizocarphus nervosus*	LC
Asteraceae	*Schkuhria pinnata**	Weed
Cyperaceae	*Schoenoplectus muricinux*	LC
Cyperaceae	*Schoenoplectus brachyceras*	LC
Cyperaceae	*Schoenoplectus corymbosus*	LC
Anacardiaceae	*Searsia magalismontana*	LC
Asteraceae	*Senecio coronatus*	LC
Asteraceae	*Senecio ilicifolius**	Alien Invasive
Asteraceae	*Seriphium plumosum**	Alien Invasive
Solanaceae	*Solanum mauritianum**	1b
Solanaceae	*Solanum sisymbrifolium**	1b
Asteraceae	*Tagetes minuta**	Alien Invasive
Tamaricaceae	*Tamarix ramosissima**	1b
Fabaceae	*Tipuana tipu**	3
Fabaceae	*Trifolium pratense*	LC
Poaceae	*Typha capensis*	LC
Fabaceae	*Vachellia karoo*	LC
Verbenaceae	*Verbena bonariensis**	Alien Invasive
Verbenaceae	*Verbena rigida**	1b
Asteraceae	*Vernonia galpinii*	LC
Velloziaceae	*Xerophyta viscosa*	LC
Asparagaceae	*Yucca gloriosa**	Alien invasive
Poaceae	*Eragrostis curvula*	LC

*Denotes Alien Invasive Plants, LC= Least Concern

Appendix B: Expected Floral Species (NEWPOSA)

Family	Genus	Sp1	Sp2	Ecology
Oleaceae	*Olea*	*europaea*	*cuspidata*	Indigenous
Malvaceae	*Abutilon*	*sonneratianum*		Indigenous
Fabaceae	*Acacia*	*elata*		Not indigenous; Naturalised; Invasive
Fabaceae	*Acacia*	*baileyana*		Not indigenous; Naturalised; Invasive
Fabaceae	*Acacia*	*longifolia*		Not indigenous; Naturalised; Invasive
Euphorbiaceae	*Acalypha*	*glabrata*	*glabrata*	Indigenous
Euphorbiaceae	*Acalypha*	*caperonioides*	*caperonioides*	Indigenous
Asteraceae	*Acanthospermum*	*australe*		Not indigenous; Naturalised
Lamiaceae	*Acrotome*	*hispida*		Indigenous
Lamiaceae	*Acrotome*	*inflata*		Indigenous
Lamiaceae	*Aeollanthus*	*buchnerianus*		Indigenous
Amaranthaceae	*Aerva*	*leucura*		Indigenous
Loranthaceae	*Agelanthus*	*natalitius*	*zeyheri*	Indigenous
Simaroubaceae	*Ailanthus*	*altissima*		Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Albuca*	*setosa*		Indigenous
Poaceae	*Alloteropsis*	*semialata*	*eckloniana*	Indigenous
Asphodelaceae	***Aloe***	***davyana***		**Indigenous; Endemic**
Asphodelaceae	*Aloe*	*sp.*		
Amaranthaceae	*Alternanthera*	*pungens*		Not indigenous; Naturalised
Amaranthaceae	*Amaranthus*	*hybridus*		Not indigenous; Cultivated; Naturalised; Invasive
Amaranthaceae	*Amaranthus*	*hybridus*	*hybridus*	Not indigenous; Naturalised
Poaceae	*Anthephora*	*pubescens*		Indigenous
Rubiaceae	*Anthospermum*	*hispidulum*		Indigenous
Rubiaceae	*Anthospermum*	*rigidum*	*rigidum*	Indigenous

Family	Genus	Sp1	Sp2	Ecology
Apocynaceae	*Araujia*	*sericifera*		Not indigenous; Naturalised; Invasive
Fabaceae	*Argyrolobium*	*speciosum*		Indigenous
Poaceae	*Aristida*	*stipitata*	*graciliflora*	Indigenous
Poaceae	*Aristida*	*diffusa*	*burkei*	Indigenous
Asteraceae	*Artemisia*	*afra*	*afra*	Indigenous
Apocynaceae	*Asclepias*	*albens*		Indigenous
Asparagaceae	*Asparagus*	*africanus*		Indigenous
Asparagaceae	*Asparagus*	*buchananii*		Indigenous
Asparagaceae	*Asparagus*	*angusticladus*		Indigenous
Asparagaceae	*Asparagus*	*suaveolens*		Indigenous
Asparagaceae	*Asparagus*	*virgatus*		Indigenous
Asparagaceae	*Asparagus*	*laricinus*		Indigenous
Asparagaceae	*Asparagus*	*cooperi*		Indigenous
Asparagaceae	*Asparagus*	*flavicaulis*	*flavicaulis*	Indigenous
Asparagaceae	*Asparagus*	*asparagoides*		Indigenous
Apocynaceae	*Aspidoglossum*	*restioides*		Indigenous; Endemic
Asteraceae	*Athrixia*	*elata*		Indigenous
Iridaceae	*Babiana*	*bainesii*		Indigenous
Acanthaceae	*Barleria*	*macrostegia*		Indigenous
Acanthaceae	*Barleria*	*obtusa*		Indigenous
Apiaceae	*Berula*	*repanda*		Indigenous
Asteraceae	*Bidens*	*bipinnata*		Not indigenous; Naturalised
Amaryllidaceae	*Boophone*	*disticha*		Indigenous
Poaceae	*Brachiaria*	*nigropedata*		Indigenous
Malvaceae	*Brachychiton*	*populneus*		Not indigenous; Naturalised
Orchidaceae	*Brachycorythis*	*conica*	*transvaalensis*	Indigenous; Endemic
Apocynaceae	*Brachystelma*	*circinatum*		Indigenous
Rubiaceae	*Bridsonia*	*chamaedendrum*		Indigenous
Poaceae	*Bromus*	*leptoclados*		Indigenous
Bryaceae	*Bryum*	*argenteum*		Indigenous
Scrophulariaceae	*Buddleja*	*saligna*		Indigenous
Scrophulariaceae	*Buddleja*	*salviifolia*		Indigenous
Asphodelaceae	*Bulbine*	*capitata*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Asteraceae	*Campuloclinium*	*macrocephalum*		Not indigenous; Naturalised; Invasive
Cannabaceae	*Celtis*	*africana*		Indigenous
Dipsacaceae	*Cephalaria*	*zeyheriana*		Indigenous
Pedaliaceae	*Ceratotheca*	*triloba*		Indigenous
Apocynaceae	*Ceropegia*	*rendallii*		Indigenous
Solanaceae	*Cestrum*	*parqui*		Not indigenous; Naturalised; Invasive
Scrophulariaceae	*Chaenostoma*	*leve*		Indigenous
Fabaceae	*Chamaecrista*	*mimosoides*		Indigenous
Fabaceae	*Chamaecrista*	*biensis*		Indigenous
Verbenaceae	*Chascanum*	*hederaceum*	*hederaceum*	Indigenous
Pteridaceae	*Cheilanthes*	*involuta*	*obscura*	Indigenous
Pteridaceae	*Cheilanthes*	*viridis*	*glauca*	Indigenous
Agavaceae	*Chlorophytum*	*cooperi*		Indigenous
Agavaceae	*Chlorophytum*	*bowkeri*		Indigenous
Thelypteridaceae	*Christella*	*gueinziana*		Indigenous
Asteraceae	*Cineraria*	*aspera*		Indigenous
Asteraceae	*Cirsium*	*vulgare*		Not indigenous; Naturalised; Invasive
Ranunculaceae	*Clematis*	*brachiata*		Indigenous
Cleomaceae	*Cleome*	*monophylla*		Indigenous
Cleomaceae	*Cleome*	*maculata*		Indigenous
Cucurbitaceae	*Coccinia*	*adoensis*		Indigenous
Combretaceae	*Combretum*	*erythrophyllum*		Indigenous
Commelinaceae	*Commelina*	*africana*	*lancispatha*	Indigenous
Convolvulaceae	*Convolvulus*	*farinosus*		Indigenous
Convolvulaceae	*Convolvulus*	*ocellatus*	*ocellatus*	Indigenous
Convolvulaceae	*Convolvulus*	*thunbergii*		Indigenous
Convolvulaceae	*Convolvulus*	*sagittatus*		Indigenous
Asteraceae	*Conyza*	*podocephala*		Indigenous
Poaceae	*Cortaderia*	*selloana*		Not indigenous; Naturalised; Invasive
Asteraceae	*Cosmos*	*bipinnatus*		Not indigenous; Naturalised

Family	Genus	Sp1	Sp2	Ecology
Rosaceae	*Cotoneaster*	*pannosus*		Not indigenous; Cultivated; Naturalised; Invasive
Rosaceae	*Crataegus*	*lavalleei*		Not indigenous; Cultivated; Naturalised
Amaryllidaceae	***Crinum***	***graminicola***		**Indigenous**
Apocynaceae	*Cryptolepis*	*oblongifolia*		Indigenous
Apocynaceae	*Cryptolepis*	*cryptolepioides*		Indigenous
Convolvulaceae	*Cuscuta*	*campestris*		Not indigenous; Naturalised; Invasive
Araliaceae	*Cussonia*	*paniculata*	*sinuata*	Indigenous
Commelinaceae	*Cyanotis*	*speciosa*		Indigenous
Poaceae	*Cymbopogon*	*caesius*		Indigenous
Cyperaceae	*Cyperus*	*uitenhagensis*		Indigenous
Cyperaceae	*Cyperus*	*sp.*		
Cyperaceae	*Cyperus*	*austro-africanus*		Indigenous
Cyperaceae	*Cyperus*	*semitrifidus*		Indigenous
Cyperaceae	*Cyperus*	*eragrostis*		Not indigenous; Naturalised
Cyperaceae	*Cyperus*	*margaritaceus*	*margaritaceus*	Indigenous
Lobeliaceae	*Cyphia*	*persicifolia*		Indigenous; Endemic
Lobeliaceae	*Cyphia*	*stenopetala*		Indigenous
Solanaceae	*Datura*	*ferox*		Not indigenous; Naturalised; Invasive
Solanaceae	*Datura*	*stramonium*		Not indigenous; Naturalised; Invasive
Apiaceae	*Daucus*	*carota*		Not indigenous; Naturalised
Aizoaceae	*Delosperma*	*sp.*		
Aizoaceae	***Delosperma***	***leendertziae***		**NT**
Fabaceae	*Dichilus*	*pilosus*		Indigenous; Endemic
Poaceae	*Digitaria*	*eriantha*		Indigenous
Dioscoreaceae	*Dioscorea*	*dregeana*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Ebenaceae	*Diospyros*	*austroafricana*	*microphylla*	Indigenous
Ebenaceae	*Diospyros*	*lycioides*	*guerkei*	Indigenous
Hyacinthaceae	*Dipcadi*	*marlothii*		Indigenous
Orchidaceae	*Disperis*	*anthoceros*	*anthoceros*	Indigenous
Malvaceae	*Dombeya*	*rotundifolia*	*rotundifolia*	Indigenous
Salicaceae	*Dovyalis*	*zeyheri*		Indigenous
Hyacinthaceae	*Drimia*	*physodes*		Indigenous
Hyacinthaceae	*Drimia*	*intricata*		Indigenous
Amaranthaceae	*Dysphania*	*carinata*		Not indigenous; Naturalised; Invasive
Poaceae	*Ehrharta*	*erecta*	*natalensis*	Indigenous
Poaceae	*Eragrostis*	*barbinodis*		Indigenous
Poaceae	*Eragrostis*	*curvula*		Indigenous
Poaceae	*Eragrostis*	*sp.*		
Poaceae	*Eragrostis*	*chloromelas*		Indigenous
Fabaceae	*Eriosema*	*burkei*	*burkei*	Indigenous
Ruscaceae	*Eriospermum*	*flagelliforme*		Indigenous
Brassicaceae	*Erucastrum*	*austroafricanum*		Indigenous
Myrtaceae	*Eucalyptus*	*robusta*		Not indigenous; Cultivated; Naturalised
Myrtaceae	*Eucalyptus*	*camaldulensis*		Not indigenous; Cultivated; Naturalised; Invasive
Myrtaceae	*Eucalyptus*	*grandis*		Not indigenous; Cultivated; Naturalised; Invasive
Myrtaceae	*Eucalyptus*	*globulus*	*maidenii*	Not indigenous; Cultivated; Naturalised
Ebenaceae	*Euclea*	*crispa*	*crispa*	Indigenous
Hyacinthaceae	*Eucomis*	*pallidiflora*	*pallidiflora*	Indigenous
Orchidaceae	*Eulophia*	*hians*	*nutans*	Indigenous
Euphorbiaceae	*Euphorbia*	*spartaria*		Indigenous
Euphorbiaceae	*Euphorbia*	*inaequilatera*		Indigenous
Poaceae	*Eustachys*	*paspaloides*		Indigenous
Moraceae	*Ficus*	*salicifolia*		Indigenous

Family	**Genus**	**Sp1**	**Sp2**	**Ecology**
Moraceae	*Ficus*	*ingens*	*ingens*	Indigenous
Iridaceae	*Freesia*	*grandiflora*	*grandiflora*	Indigenous
Rubiaceae	*Galium*	*capense*	*garipense*	Indigenous
Asteraceae	*Geigeria*	*ornativa*	*ornativa*	Indigenous
Asteraceae	*Gerbera*	*viridifolia*		Indigenous
Iridaceae	*Gladiolus*	*crassifolius*		Indigenous
Iridaceae	*Gladiolus*	*papilio*		Indigenous
Verbenaceae	*Glandularia*	*aristigera*		Not indigenous; Naturalised; Invasive
Apocynaceae	*Gomphocarpus*	*glaucophyllus*		Indigenous
Malvaceae	*Grewia*	*occidentalis*	*occidentalis*	Indigenous
Celastraceae	*Gymnosporia*	*polyacantha*	*vaccinifolia*	Indigenous; Endemic
Orchidaceae	*Habenaria*	*epipactidea*		Indigenous
Orchidaceae	*Habenaria*	*schimperiana*		Indigenous
Orchidaceae	*Habenaria*	*nyikana*	*nyikana*	Indigenous
Asteraceae	*Helichrysum*	*harveyanum*		Indigenous
Asteraceae	*Helichrysum*	*rugulosum*		Indigenous
Asteraceae	*Helichrysum*	*cephaloideum*		Indigenous
Asteraceae	*Helichrysum*	*setosum*		Indigenous
Asteraceae	*Helichrysum*	*nudifolium*	*nudifolium*	Indigenous
Asteraceae	*Helichrysum*	*chionosphaerum*		Indigenous
Malvaceae	*Hermannia*	*floribunda*		Indigenous
Malvaceae	*Hermannia*	*cordata*		Indigenous; Endemic
Malvaceae	*Hermannia*	*depressa*		Indigenous
Apiaceae	*Heteromorpha*	*arborescens*	*abyssinica*	Indigenous
Poaceae	*Heteropogon*	*contortus*		Indigenous
Malvaceae	*Hibiscus*	*micranthus*	*micranthus*	Indigenous
Asteraceae	*Hilliardiella*	*aristata*		Indigenous
Asteraceae	*Hilliardiella*	*elaeagnoides*		Indigenous
Orchidaceae	***Holothrix***	***randii***		**NT**
Apocynaceae	*Huernia*	*transvaalensis*		Indigenous; Endemic
Poaceae	*Hyparrhenia*	*hirta*		Indigenous
Hypericaceae	*Hypericum*	*aethiopicum*	*aethiopicum*	Indigenous
Asteraceae	*Hypochaeris*	*brasiliensis*		Not indigenous; Naturalised
Acanthaceae	*Hypoestes*	*triflora*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Hypoxidaceae	*Hypoxis*	*galpinii*		Indigenous
Hypoxidaceae	*Hypoxis*	*oblonga*		Indigenous; Endemic
Hypoxidaceae	*Hypoxis*	*acuminata*		Indigenous
Aquifoliaceae	*Ilex*	*mitis*	*mitis*	Indigenous
Aquifoliaceae	*Ilex*	*mitis*		Indigenous
Fabaceae	*Indigastrum*	*burkeanum*		Indigenous
Fabaceae	*Indigofera*	*oxytropis*		Indigenous
Fabaceae	*Indigofera*	*spicata*	*spicata*	Indigenous
Fabaceae	*Indigofera*	*hedyantha*		Indigenous
Fabaceae	*Indigofera*	*sp.*		
Fabaceae	*Indigofera*	*comosa*		Indigenous
Fabaceae	*Indigofera*	*oxalidea*		Indigenous
Fabaceae	*Indigofera*	*melanadenia*		Indigenous
Convolvulaceae	*Ipomoea*	*purpurea*		Not indigenous; Naturalised; Invasive
Convolvulaceae	*Ipomoea*	*crassipes*	*crassipes*	Indigenous
Convolvulaceae	*Ipomoea*	*oblongata*		Indigenous
Scrophulariaceae	*Jamesbrittenia*	*burkeana*		Indigenous
Scrophulariaceae	*Jamesbrittenia*	*sp.*		
Acanthaceae	*Justicia*	*anagalloides*		Indigenous
Crassulaceae	*Kalanchoe*	*thyrsiflora*		Indigenous
Crassulaceae	*Kalanchoe*	*rotundifolia*		Indigenous
Cucurbitaceae	*Kedrostis*	*africana*		Indigenous
Aizoaceae	*Khadia*	*acutipetala*		Indigenous; Endemic
Aizoaceae	***Khadia***	***beswickii***		**VU**
Achariaceae	*Kiggelaria*	*africana*		Indigenous
Rubiaceae	*Kohautia*	*caespitosa*	*brachyloba*	Indigenous
Asteraceae	*Laggera*	*decurrens*		Indigenous
Asteraceae	*Laggera*	*crispata*		Indigenous
Anacardiaceae	*Lannea*	*discolor*		Indigenous
Verbenaceae	*Lantana*	*rugosa*		Indigenous
Verbenaceae	*Lantana*	*camara*		Not indigenous; Cultivated; Naturalised; Invasive
Thymelaeaceae	*Lasiosiphon*	*microcephalus*		Indigenous
Thymelaeaceae	*Lasiosiphon*	*caffer*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Thymelaeaceae	*Lasiosiphon*	*kraussianus*		Indigenous
Hyacinthaceae	*Ledebouria*	*marginata*		Indigenous
Hyacinthaceae	*Ledebouria*	*cooperi*		Indigenous
Poaceae	*Leersia*	*hexandra*		Indigenous
Fabaceae	*Leobordea*	*hirsuta*		Indigenous; Endemic
Fabaceae	*Leobordea*	*divaricata*		Indigenous
Lamiaceae	*Leonotis*	*nepetifolia*		Indigenous
Brassicaceae	*Lepidium*	*bonariense*		Not indigenous; Naturalised
Fabaceae	*Lespedeza*	*cuneata*		Not indigenous; Naturalised
Fabaceae	*Lessertia*	*phillipsiana*		Indigenous; Endemic
Fabaceae	*Lessertia*	*perennans*	*perennans*	Indigenous
Rosaceae	*Leucosidea*	*sericea*		Indigenous
Oleaceae	*Ligustrum*	*japonicum*		Not indigenous; Cultivated; Naturalised; Invasive
Oleaceae	*Ligustrum*	*sinense*		Not indigenous; Cultivated; Naturalised; Invasive
Asteraceae	*Lopholaena*	*coriifolia*		Indigenous
Fabaceae	*Lotononis*	*laxa*		Indigenous
Myrtaceae	*Melaleuca*	*quinquenervia*		Not indigenous; Cultivated; Naturalised; Invasive
Meliaceae	*Melia*	*azedarach*		Not indigenous; Naturalised; Invasive
Fabaceae	*Melilotus*	*albus*		Not indigenous; Naturalised; Invasive
Poaceae	*Melinis*	*repens*	*repens*	Indigenous
Poaceae	*Melinis*	*nerviglumis*		Indigenous
Fabaceae	***Melolobium***	***subspicatum***		**VU**

Family	Genus	Sp1	Sp2	Ecology
Malvaceae	*Modiola*	*caroliniana*		Not indigenous; Naturalised
Iridaceae	*Moraea*	*pallida*		Indigenous
Iridaceae	*Moraea*	*stricta*		Indigenous
Scrophulariaceae	*Nemesia*	*fruticans*		Indigenous
Fabaceae	*Neorautanenia*	*ficifolia*		Indigenous
Amaryllidaceae	*Nerine*	*angustifolia*		Indigenous
Solanaceae	*Nicotiana*	*glauca*		Not indigenous; Naturalised; Invasive
Asteraceae	*Nolletia*	*rarifolia*		Indigenous; Endemic
Onagraceae	*Oenothera*	*tetraptera*		Not indigenous; Naturalised; Invasive
Onagraceae	*Oenothera*	*laciniata*		Not indigenous; Naturalised; Invasive
Onagraceae	*Oenothera*	*indecora*		Not indigenous; Naturalised
Onagraceae	*Oenothera*	*lindheimeri*		Not indigenous; Naturalised; Invasive
Hyacinthaceae	*Ornithogalum*	*juncifolium*	*juncifolium*	Indigenous
Colchicaceae	*Ornithoglossum*	*vulgare*		Indigenous
Oxalidaceae	*Oxalis*	*corniculata*		Not indigenous; Naturalised; Invasive
Oxalidaceae	*Oxalis*	*depressa*		Indigenous
Anacardiaceae	*Ozoroa*	*paniculosa*	*paniculosa*	Indigenous
Papaveraceae	*Papaver*	*aculeatum*		Indigenous
Chrysobalanaceae	*Parinari*	*capensis*	*capensis*	Indigenous
Poaceae	*Paspalum*	*scrobiculatum*		Indigenous
Poaceae	*Paspalum*	*notatum*		Not indigenous; Naturalised; Invasive
Malvaceae	*Pavonia*	*columella*		Indigenous
Fabaceae	***Pearsonia***	***bracteata***		**NT**
Geraniaceae	*Pelargonium*	*minimum*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Geraniaceae	*Pelargonium*	*dolomiticum*		Indigenous
Geraniaceae	*Pelargonium*	*luridum*		Indigenous
Rubiaceae	*Pentanisia*	*angustifolia*		Indigenous
Polygonaceae	*Persicaria*	*lapathifolia*		Not indigenous; Naturalised; Invasive
Polygonaceae	*Persicaria*	*madagascariensis*		Indigenous
Poaceae	*Phalaris*	*sp.*		
Phyllanthaceae	*Phyllanthus*	*parvulus*	*parvulus*	Indigenous
Solanaceae	*Physalis*	*peruviana*		Not indigenous; Cultivated; Naturalised; Invasive
Apiaceae	*Pimpinella*	*transvaalensis*		Indigenous
Pittosporaceae	*Pittosporum*	*viridiflorum*		Indigenous
Aytoniaceae	*Plagiochasma*	*rupestre*	*volkii*	Indigenous
Plantaginaceae	*Plantago*	*lanceolata*		Indigenous
Lamiaceae	*Plectranthus*	*hereroensis*		Indigenous
Polytrichaceae	*Pogonatum*	*capense*		Indigenous
Caryophyllaceae	*Pollichia*	*campestris*		Indigenous
Asteraceae	*Polydora*	*angustifolia*		Indigenous
Polygalaceae	*Polygala*	*transvaalensis*	*transvaalensis*	Indigenous
Polytrichaceae	*Polytrichum*	*commune*		Indigenous
Porellaceae	*Porella*	*vallis-gratiae*		Indigenous
Portulacaceae	*Portulaca*	*quadrifida*		Indigenous
Verbenaceae	*Priva*	*flabelliformis*		Indigenous
Proteaceae	*Protea*	*caffra*	*caffra*	Indigenous
Proteaceae	*Protea*	*welwitschii*		Indigenous
Proteaceae	*Protea*	*roupelliae*		Indigenous
Rosaceae	*Prunus*	*salicifolia*		Not indigenous; Cultivated; Naturalised; Invasive
Pottiaceae	*Pseudocrossidium*	*crinitum*		Indigenous
Pteridaceae	*Pteris*	*cretica*		Indigenous
Amaranthaceae	*Pupalia*	*lappacea*	*lappacea*	Indigenous
Rubiaceae	*Pygmaeothamnus*	*zeyheri*	*zeyheri*	Indigenous
Brassicaceae	*Raphanus*	*raphanistrum*		Not indigenous; Naturalised; Invasive

Family	Genus	Sp1	Sp2	Ecology
Fabaceae	*Rhynchosia*	*totta*	*venulosa*	Indigenous
Fabaceae	*Rhynchosia*	*caribaea*		Indigenous
Fabaceae	*Robinia*	*pseudoacacia*		Not indigenous; Naturalised; Invasive
Brassicaceae	*Rorippa*	*nudiuscula*		Indigenous
Rosaceae	*Rubus*	*rigidus*		Indigenous
Polygonaceae	*Rumex*	*crispus*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Salsola*	*kali*		Not indigenous; Naturalised; Invasive
Lamiaceae	*Salvia*	*runcinata*		Indigenous
Lamiaceae	*Salvia*	*radula*		Indigenous
Lamiaceae	*Salvia*	*tiliifolia*		Not indigenous; Naturalised; Invasive
Lamiaceae	*Salvia*	*reflexa*		Not indigenous; Naturalised; Invasive
Orchidaceae	*Satyrium*	*hallackii*	*ocellatum*	Indigenous
Dipsacaceae	*Scabiosa*	*columbaria*		Indigenous
Amaryllidaceae	*Scadoxus*	*puniceus*		Indigenous
Asteraceae	*Schistostephium*	*crataegifolium*		Indigenous
Cyperaceae	*Scirpoides*	*burkei*		Indigenous
Lamiaceae	*Scutellaria*	*racemosa*		Not indigenous; Naturalised; Invasive
Anacardiaceae	*Searsia*	*pyroides*	*gracilis*	Indigenous
Anacardiaceae	*Searsia*	*rigida*	*margaretae*	Indigenous; Endemic
Anacardiaceae	*Searsia*	*dentata*		Indigenous
Anacardiaceae	*Searsia*	*pyroides*	*pyroides*	Indigenous
Anacardiaceae	*Searsia*	*magalismontana*	*magalismontana*	Indigenous
Scrophulariaceae	*Selago*	*sp.*		
Asteraceae	*Senecio*	*erubescens*	*crepidifolius*	Indigenous
Asteraceae	*Senecio*	*oxyriifolius*	*oxyriifolius*	Indigenous
Asteraceae	*Senecio*	*inaequidens*		Indigenous

Family	Genus	Sp1	Sp2	Ecology
Asteraceae	*Senecio*	*hieracioides*		Indigenous
Asteraceae	*Senecio*	*lydenburgensis*		Indigenous
Asteraceae	*Senecio*	*venosus*		Indigenous
Fabaceae	*Senna*	*corymbosa*		Not indigenous; Cultivated; Naturalised
Asteraceae	*Seriphium*	*plumosum*		Indigenous
Malvaceae	*Sida*	*dregei*		Indigenous
Malvaceae	*Sida*	*chrysantha*		Indigenous
Malvaceae	*Sida*	*ternata*		Indigenous
Malvaceae	*Sida*	*rhombifolia*	*rhombifolia*	Indigenous
Brassicaceae	*Sisymbrium*	*burchellii*	*burchellii*	Indigenous
Apocynaceae	*Sisyranthus*	*randii*		Indigenous
Solanaceae	*Solanum*	*chenopodioides*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum*	*mauritianum*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum*	*sisymbriifolium*		Not indigenous; Naturalised; Invasive
Asteraceae	*Sonchus*	*integrifolius*	*integrifolius*	Indigenous
Asteraceae	*Sonchus*	*dregeanus*		Indigenous
Poaceae	*Sorghum*	*halepense*		Not indigenous; Naturalised; Invasive
Fabaceae	*Sphenostylis*	*angustifolia*		Indigenous
Poaceae	*Sporobolus*	*discosporus*		Indigenous
Poaceae	*Stipa*	*dregeana*	*elongata*	Indigenous
Poaceae	*Stipagrostis*	*zeyheri*	*sericans*	Indigenous
Orobanchaceae	*Striga*	*asiatica*		Indigenous
Orobanchaceae	*Striga*	*elegans*		Indigenous
Asteraceae	*Tagetes*	*minuta*		Not indigenous; Naturalised; Invasive
Asteraceae	*Taraxacum*	*sp.*		
Bignoniaceae	*Tecoma*	*stans*	*stans*	Not indigenous; Cultivated;

Family	Genus	Sp1	Sp2	Ecology
				Naturalised; Invasive
Fabaceae	*Tephrosia*	*semiglabra*		Indigenous
Fabaceae	*Tephrosia*	*lupinifolia*		Indigenous
Lamiaceae	*Teucrium*	*trifidum*		Indigenous
Poaceae	*Themeda*	*triandra*		Indigenous
Santalaceae	*Thesium*	*goetzeanum*		Indigenous
Santalaceae	*Thesium*	*transvaalense*		Indigenous; Endemic
Santalaceae	*Thesium*	*utile*		Indigenous
Santalaceae	*Thesium*	*rasum*		Indigenous
Asteraceae	*Tithonia*	*diversifolia*		Not indigenous; Naturalised; Invasive
Asteraceae	*Tolpis*	*capensis*		Indigenous
Poaceae	*Tristachya*	*rehmannii*		Indigenous
Iridaceae	*Tritonia*	*nelsonii*		Indigenous
Cucurbitaceae	*Trochomeria*	*macrocarpa*	*macrocarpa*	Indigenous
Asteraceae	*Ursinia*	*nana*	*leptophylla*	Indigenous
Rubiaceae	*Vangueria*	*pygmaea*		Indigenous
Verbenaceae	*Verbena*	*bonariensis*		Not indigenous; Naturalised; Invasive
Verbenaceae	*Verbena*	*litoralis*		Not indigenous; Naturalised; Invasive
Fabaceae	*Vigna*	*unguiculata*	*unguiculata*	Indigenous
Fabaceae	*Vigna*	*vexillata*	*vexillata*	Indigenous
Campanulaceae	*Wahlenbergia*	*magaliesbergensis*		Indigenous; Endemic
Campanulaceae	*Wahlenbergia*	*undulata*		Indigenous
Solanaceae	*Withania*	*somnifera*		Indigenous
Apocynaceae	*Xysmalobium*	*undulatum*	*undulatum*	Indigenous
Scrophulariaceae	*Zaluzianskya*	*katharinae*		Indigenous; Endemic
Rhamnaceae	*Ziziphus*	*mucronata*	*mucronata*	Indigenous

Appendix C: Expected Mammal Species

Family	Species Name	Common name	Conservation Status
Bathyergidae	Cryptomys hottentotus	Southern African Mole-rat	LC
Bovidae	Aepyceros melampus	Impala	LC
Bovidae	Alcelaphus buselaphus caama	Red Hartebeest	LC
Bovidae	Antidorcas marsupialis	Springbok	LC
Bovidae	Cephalophus sp.	Forest Duikers	
Bovidae	Connochaetes gnou	Black Wildebeest	LC
Bovidae	Connochaetes taurinus	Blue Wildebeest	LC
Bovidae	Damaliscus pygargus phillipsi	Blesbok	LC
Bovidae	Kobus ellipsiprymnus	Waterbuck	LC
Bovidae	Oryx gazella	Gemsbok	LC
Bovidae	Raphicerus campestris	Steenbok	LC
Bovidae	Sylvicapra grimmia	Bush Duiker	LC
Bovidae	Taurotragus oryx	Common Eland	LC
Bovidae	Tragelaphus strepsiceros	Greater Kudu	LC
Canidae	Canis mesomelas	Black-backed Jackal	LC
Canidae	Otocyon megalotis	Bat-eared Fox	LC
Cercopithecidae	Chlorocebus pygerythrus	Vervet Monkey	LC
Cercopithecidae	Chlorocebus pygerythrus pygerythrus	Vervet Monkey (subspecies pygerythrus)	LC
Cercopithecidae	Papio ursinus	Chacma Baboon	LC
Cervidae	Dama dama	Fallow Deer	Introduced
Equidae	Equus quagga	Plains Zebra	LC
Erinaceidae	Atelerix frontalis	Southern African Hedgehog	NT
Felidae	Acinonyx jubatus	Cheetah	VU
Felidae	Caracal caracal	Caracal	LC
Felidae	Felis catus	Domestic Cat	Introduced
Felidae	Felis silvestris	Wildcat	LC
Felidae	Leptailurus serval	Serval	TN
Felidae	Panthera leo	Lion	LC
Felidae	Panthera pardus	Leopard	VU
Gliridae	Graphiurus (Graphiurus) platyops	Flat-headed African Dormouse	DD
Herpestidae	Atilax paludinosus	Marsh Mongoose	LC
Herpestidae	Cynictis penicillata	Yellow Mongoose	LC
Herpestidae	Herpestes sanguineus	Slender Mongoose	LC
Hippopotamidae	Hippopotamus amphibius	Common Hippopotamus	LC
Hipposideridae	Cloeotis percivali	Percival's Short-eared Trident Bat	EN

Family	Species Name	Common name	Conservation Status
Hystricidae	Hystrix africaeaustralis	Cape Porcupine	LC
Leporidae	Lepus saxatilis	Scrub Hare	LC
Macroscelididae	Elephantulus sp.	Elephant Shrews	
Macroscelididae	Elephantulus brachyrhynchus	Short-snouted Elephant Shrew	LC
Macroscelididae	Elephantulus myurus	Eastern Rock Elephant Shrew	LC
Molossidae	Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC
Muridae	Aethomys sp.	Veld rats	
Muridae	Aethomys namaquensis	Namaqua Rock Mouse	LC
Muridae	Gerbilliscus brantsii	Highveld Gerbil	LC
Muridae	Gerbilliscus leucogaster	Bushveld Gerbil	LC
Muridae	Lemniscomys sp.	Grass Mice	
Muridae	Lemniscomys rosalia	Single-Striped Lemniscomys	LC
Muridae	Mastomys sp.	Multimammate Mice	
Muridae	Mastomys natalensis	Natal Mastomys	LC
Muridae	Mus (Nannomys) minutoides	Southern African Pygmy Mouse	LC
Muridae	Mus musculus musculus		LC
Muridae	Otomys sp.	Vlei Rats	
Muridae	Otomys angoniensis	Angoni Vlei Rat	LC
Muridae	Otomys auratus	Southern African Vlei Rat (Grassland type)	NT
Muridae	Rattus rattus	Roof Rat	LC
Muridae	Rhabdomys pumilio	Xeric Four-striped Grass Rat	LC
Muridae	Tatera sp.		
Mustelidae	Aonyx capensis	African Clawless Otter	NT
Mustelidae	Hydrictis maculicollis	Spotted-necked Otter	LC
Mustelidae	Mellivora capensis	Honey Badger	LC
Mustelidae	Poecilogale albinucha	African Striped Weasel	NT
Nesomyidae	Dendromus melanotis	Gray African Climbing Mouse	LC
Nesomyidae	Dendromus mystacalis	Chestnut African Climbing Mouse	LC
Nesomyidae	Malacothrix typica	Large-eared African Desert Mouse	LC
Nesomyidae	Mystromys albicaudatus	African White-tailed Rat	VU
Nesomyidae	Steatomys sp.	Fat Mice	
Nesomyidae	Steatomys krebsii	Kreb's African Fat Mouse	LC
Nesomyidae	Steatomys pratensis	Common African Fat Mouse	LC
Nycteridae	Nycteris thebaica	Egyptian Slit-faced Bat	LC

Family	**Species Name**	**Common name**	**Conservation Status**
Procaviidae	Procavia capensis	Cape Rock Hyrax	LC
Rhinolophidae	Rhinolophus sp.	Horseshoe Bats	
Rhinolophidae	Rhinolophus blasii	Blasius's Horseshoe Bat	NT
Rhinolophidae	Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC
Rhinolophidae	Rhinolophus darlingi	Darling's Horseshoe Bat	LC
Rhinolophidae	Rhinolophus simulator	Bushveld Horseshoe Bat	LC
Sciuridae	Xerus inauris	South African Ground Squirrel	LC
Soricidae	-	Unidentified Soricidae (Shrew)	
Soricidae	Crocidura maquassiensis	Makwassie Musk Shrew	VU
Soricidae	Crocidura mariquensis	Swamp Musk Shrew	NT
Soricidae	Myosorex varius	Forest Shrew	LC
Soricidae	Suncus sp.	Dwarf Shrews	
Soricidae	Suncus infinitesimus	Least Dwarf Shrew	LC
Soricidae	Suncus varilla	Lesser Dwarf Shrew	LC
Suidae	Phacochoerus africanus	Common Warthog	LC
Vespertilionidae	Miniopterus sp.	Long-fingered Bats	
Vespertilionidae	Miniopterus fraterculus	Lesser Long-fingered Bat	LC
Vespertilionidae	Miniopterus natalensis	Natal Long-fingered Bat	LC
Vespertilionidae	Miniopterus schreibersii	Schreibers's Long-fingered Bat	NT
Vespertilionidae	Myotis tricolor	Temminck's Myotis	LC
Vespertilionidae	Neoromicia capensis	Cape Serotine	LC
Vespertilionidae	Pipistrellus (Pipistrellus) rusticus	Rusty Pipistrelle	NT
Vespertilionidae	Scotophilus dinganii	Yellow-bellied House Bat	LC
Viveridae	Genetta maculata	Common Large-spotted Genet	LC
Viverridae	Genetta sp.	Genets	LC
Viverridae	Genetta genetta	Common Genet	LC
Viverridae	Genetta tigrina	Cape Genet (Cape Large-spotted Genet)	LC

Appendix D: Expected Bird Species

Common Group	Common Species	Genus	Species	Conservation
-	Bokmakierie	Telophorus	zeylonus	LC
-	Hybrid Mallard	Anas	hybrid	LC
-	Neddicky	Cisticola	fulvicapilla	LC
-	Quailfinch	Ortygospiza	atricollis	LC
Apalis	Bar-throated	Apalis	thoracica	LC
Avocet	Pied	Recurvirostra	avosetta	LC
Babbler	Arrow-marked	Turdoides	jardineii	LC
Barbet	Acacia Pied	Tricholaema	leucomelas	LC
Barbet	Black-collared	Lybius	torquatus	LC
Barbet	Crested	Trachyphonus	vaillantii	LC
Batis	Chinspot	Batis	molitor	LC
Bee-eater	European	Merops	apiaster	LC
Bee-eater	Little	Merops	pusillus	LC
Bee-eater	White-fronted	Merops	bullockoides	LC
Bishop	Southern Red	Euplectes	orix	LC
Bishop	Yellow-crowned	Euplectes	afer	LC
Bittern	Little	Ixobrychus	minutus	LC
Boubou	Southern	Laniarius	ferrugineus	LC
Bulbul	Dark-capped	Pycnonotus	tricolor	LC
Bunting	Cinnamon-breasted	Emberiza	tahapisi	LC
Buzzard	Common	Buteo	buteo	LC
Buzzard	Jackal	Buteo	rufofuscus	LC

Common Group	Common Species	Genus	Species	Conservation
Canary	Black-throated	Crithagra	atrogularis	LC
Canary	Yellow-fronted	Crithagra	mozambica	LC
Chat	Ant-eating	Myrmecocichla	formicivora	LC
Chat	Familiar	Oenanthe	familiaris	LC
Cisticola	Cloud	Cisticola	textrix	LC
Cisticola	Desert	Cisticola	aridulus	LC
Cisticola	Lazy	Cisticola	aberrans	LC
Cisticola	Levaillant's	Cisticola	tinniens	LC
Cisticola	Rattling	Cisticola	chiniana	LC
Cisticola	Wailing	Cisticola	lais	LC
Cisticola	Wing-snapping	Cisticola	ayresii	LC
Cisticola	Zitting	Cisticola	juncidis	LC
Coot	Red-knobbed	Fulica	cristata	LC
Cormorant	Reed	Microcarbo	africanus	LC
Cormorant	White-breasted	Phalacrocorax	lucidus	LC
Coucal	Burchell's	Centropus	burchellii	LC
Crake	Black	Zapornia	flavirostra	LC
Crow	Pied	Corvus	albus	LC
Cuckoo	Black	Cuculus	clamosus	LC
Cuckoo	Diederik	Chrysococcyx	caprius	LC
Cuckoo	Red-chested	Cuculus	solitarius	LC
Cuckooshrike	Black	Campephaga	flava	LC
Dove	Cape Turtle	Streptopelia	capicola	LC
Dove	Laughing	Spilopelia	senegalensis	LC
Dove	Red-eyed	Streptopelia	semitorquata	LC

Common Group	Common Species	Genus	Species	Conservation
Dove	Rock	Columba	livia	LC
Drongo	Fork-tailed	Dicrurus	adsimilis	LC
Duck	African Black	Anas	sparsa	LC
Duck	White-faced Whistling	Dendrocygna	viduata	LC
Duck	Yellow-billed	Anas	undulata	LC
Eagle	Black-chested Snake	Circaetus	pectoralis	LC
Eagle	Brown Snake	Circaetus	cinereus	LC
Eagle	Verreaux's	Aquila	verreauxii	VU
Eagle-Owl	Spotted	Bubo	africanus	LC
Egret	Great	Ardea	alba	LC
Egret	Little	Egretta	garzetta	LC
Egret	Western Cattle	Bubulcus	ibis	LC
Falcon	Amur	Falco	amurensis	LC
Finch	Red-headed	Amadina	erythrocephala	LC
Firefinch	African	Lagonosticta	rubricata	LC
Firefinch	Jameson's	Lagonosticta	rhodopareia	LC
Firefinch	Red-billed	Lagonosticta	senegala	LC
Fiscal	Southern	Lanius	collaris	LC
Flufftail	Red-chested	Sarothrura	rufa	LC
Flycatcher	African Paradise	Terpsiphone	viridis	LC
Flycatcher	Fairy	Stenostira	scita	LC
Flycatcher	Fiscal	Melaenornis	silens	LC
Flycatcher	Spotted	Muscicapa	striata	LC

Common Group	Common Species	Genus	Species	Conservation
Francolin	Coqui	Peliperdix	coqui	LC
Francolin	Orange River	Scleroptila	gutturalis	LC
Francolin	Red-winged	Scleroptila	levaillantii	LC
Go-away-bird	Grey	Crinifer	concolor	LC
Goose	Egyptian	Alopochen	aegyptiaca	LC
Goose	Spur-winged	Plectropterus	gambensis	LC
Grassbird	Cape	Sphenoeacus	afer	LC
Grebe	Little	Tachybaptus	ruficollis	LC
Guineafowl	Helmeted	Numida	meleagris	LC
Gull	Grey-headed	Chroicocephalus	cirrocephalus	LC
Heron	Black-headed	Ardea	melanocephala	LC
Heron	Goliath	Ardea	goliath	LC
Heron	Grey	Ardea	cinerea	LC
Heron	Purple	Ardea	purpurea	LC
Honeybird	Brown-backed	Prodotiscus	regulus	LC
Honeyguide	Greater	Indicator	indicator	LC
Honeyguide	Lesser	Indicator	minor	LC
Hoopoe	African	Upupa	africana	LC
Hornbill	African Grey	Lophoceros	nasutus	LC
Ibis	African Sacred	Threskiornis	aethiopicus	LC
Ibis	Glossy	Plegadis	falcinellus	LC
Ibis	Hadada	Bostrychia	hagedash	LC
Kestrel	Greater	Falco	rupicoloides	LC
Kingfisher	Brown-hooded	Halcyon	albiventris	LC

Common Group	Common Species	Genus	Species	Conservation
Kingfisher	Malachite	Corythornis	cristatus	LC
Kingfisher	Pied	Ceryle	rudis	LC
Kite	Black-winged	Elanus	caeruleus	LC
Kite	Yellow-billed	Milvus	aegyptius	LC
Korhaan	Northern Black	Afrotis	afraoides	LC
Lapwing	African Wattled	Vanellus	senegallus	LC
Lapwing	Blacksmith	Vanellus	armatus	LC
Lapwing	Crowned	Vanellus	coronatus	LC
Lark	Eastern Clapper	Mirafra	fasciolata	LC
Lark	Eastern Long-billed	Certhilauda	semitorquata	LC
Lark	Melodious	Mirafra	cheniana	LC
Lark	Red-capped	Calandrella	cinerea	LC
Lark	Rufous-naped	Mirafra	africana	LC
Lark	Sabota	Calendulauda	sabota	LC
Lark	Spike-heeled	Chersomanes	albofasciata	LC
Longclaw	Cape	Macronyx	capensis	LC
Mannikin	Bronze	Spermestes	cucullata	LC
Martin	Banded	Riparia	cincta	LC
Martin	Brown-throated	Riparia	paludicola	LC
Martin	Rock	Ptyonoprogne	fuligula	LC
Moorhen	Common	Gallinula	chloropus	LC
Mousebird	Red-faced	Urocolius	indicus	LC

Common Group	Common Species	Genus	Species	Conservation
Mousebird	Speckled	Colius	striatus	LC
Myna	Common	Acridotheres	tristis	LC
Oriole	Black-headed	Oriolus	larvatus	LC
Ostrich	Common	Struthio	camelus	LC
Owl	Marsh	Asio	capensis	LC
Pigeon	African Olive	Columba	arquatrix	LC
Pigeon	Speckled	Columba	guinea	LC
Pipit	African	Anthus	cinnamomeus	LC
Pipit	Plain-backed	Anthus	leucophrys	LC
Pipit	Striped	Anthus	lineiventris	LC
Plover	Three-banded	Charadrius	tricollaris	LC
Pochard	Southern	Netta	erythrophthalma	LC
Prinia	Black-chested	Prinia	flavicans	LC
Prinia	Tawny-flanked	Prinia	subflava	LC
Puffback	Black-backed	Dryoscopus	cubla	LC
Quail	Common	Coturnix	coturnix	LC
Quelea	Red-billed	Quelea	quelea	LC
Rail	African	Rallus	caerulescens	LC
Robin-Chat	Cape	Cossypha	caffra	LC
Sandpiper	Wood	Tringa	glareola	LC
Scimitarbill	Common	Rhinopomastus	cyanomelas	LC
Scrub Robin	White-browed	Cercotrichas	leucophrys	LC
Seedeater	Streaky-headed	Crithagra	gularis	LC
Shelduck	South African	Tadorna	cana	LC

Common Group	Common Species	Genus	Species	Conservation
Shrike	Lesser Grey	Lanius	minor	LC
Shrike	Red-backed	Lanius	collurio	LC
Snipe	African	Gallinago	nigripennis	LC
Sparrow	Cape	Passer	melanurus	LC
Sparrow	House	Passer	domesticus	LC
Sparrow	Southern Grey-headed	Passer	diffusus	LC
Sparrow-Weaver	White-browed	Plocepasser	mahali	LC
Sparrowhawk	Black	Accipiter	melanoleucus	LC
Sparrowhawk	Ovambo	Accipiter	ovampensis	LC
Spurfowl	Swainson's	Pternistis	swainsonii	LC
Starling	Cape	Lamprotornis	nitens	LC
Starling	Pied	Lamprotornis	bicolor	LC
Starling	Red-winged	Onychognathus	morio	LC
Stilt	Black-winged	Himantopus	himantopus	LC
Stonechat	African	Saxicola	torquatus	LC
Sunbird	Amethyst	Chalcomitra	amethystina	LC
Sunbird	Greater Double-collared	Cinnyris	afer	LC
Sunbird	Marico	Cinnyris	mariquensis	LC
Sunbird	White-bellied	Cinnyris	talatala	LC
Swallow	Barn	Hirundo	rustica	LC
Swallow	Greater Striped	Cecropis	cucullata	LC

Common Group	Common Species	Genus	Species	Conservation
Swallow	Lesser Striped	Cecropis	abyssinica	LC
Swallow	Pearl-breasted	Hirundo	dimidiata	LC
Swallow	Red-breasted	Cecropis	semirufa	LC
Swallow	White-throated	Hirundo	albigularis	LC
Swamphen	African	Porphyrio	madagascariensis	LC
Swift	African Black	Apus	barbatus	LC
Swift	African Palm	Cypsiurus	parvus	LC
Swift	Horus	Apus	horus	LC
Swift	Little	Apus	affinis	LC
Swift	White-rumped	Apus	caffer	LC
Tchagra	Brown-crowned	Tchagra	australis	LC
Teal	Blue-billed	Spatula	hottentota	LC
Teal	Red-billed	Anas	erythrorhyncha	LC
Thick-knee	Spotted	Burhinus	capensis	LC
Thrush	Cape Rock	Monticola	rupestris	LC
Thrush	Groundscraper	Turdus	litsitsirupa	LC
Thrush	Karoo	Turdus	smithi	LC
Thrush	Kurrichane	Turdus	libonyana	LC
Vulture	Cape	Gyps	coprotheres	EN
Wagtail	Cape	Motacilla	capensis	LC
Warbler	African Reed	Acrocephalus	baeticatus	LC
Warbler	Great Reed	Acrocephalus	arundinaceus	LC
Warbler	Lesser Swamp	Acrocephalus	gracilirostris	LC
Warbler	Little Rush	Bradypterus	baboecala	LC

Common Group	Common Species	Genus	Species	Conservation
Warbler	Marsh	Acrocephalus	palustris	LC
Warbler	Willow	Phylloscopus	trochilus	LC
Waxbill	Blue	Uraeginthus	angolensis	LC
Waxbill	Common	Estrilda	astrild	LC
Waxbill	Orange-breasted	Amandava	subflava	LC
Weaver	Cape	Ploceus	capensis	LC
Weaver	Southern Masked	Ploceus	velatus	LC
Weaver	Thick-billed	Amblyospiza	albifrons	LC
Weaver	Village	Ploceus	cucullatus	LC
Wheatear	Capped	Oenanthe	pileata	LC
Wheatear	Mountain	Myrmecocichla	monticola	LC
White-eye	Cape	Zosterops	virens	LC
Whydah	Long-tailed Paradise	Vidua	paradisaea	LC
Whydah	Pin-tailed	Vidua	macroura	LC
Widowbird	Long-tailed	Euplectes	progne	LC
Widowbird	Red-collared	Euplectes	ardens	LC
Widowbird	White-winged	Euplectes	albonotatus	LC
Wood Hoopoe	Green	Phoeniculus	purpureus	LC
Woodpecker	Cardinal	Dendropicos	fuscescens	LC
Woodpecker	Golden-tailed	Campethera	abingoni	LC
Wryneck	Red-throated	Jynx	ruficollis	LC

Appendix E: Expected Reptile Species

Family	Species Name	Common Name	Conservation Status
Agamidae	*Agama aculeata distanti*	Distant's Ground Agama	LC (SARCA 2014)
Agamidae	*Agama atra*	Southern Rock Agama	LC (SARCA 2014)
Chamaeleonidae	*Chamaeleo dilepis*	Common Flap-neck Chameleon	LC (SARCA 2014)
Colubridae	*Crotaphopeltis hotamboeia*	Red-lipped Snake	LC (SARCA 2014)
Colubridae	*Dasypeltis scabra*	Rhombic Egg-eater	LC (SARCA 2014)
Colubridae	*Dispholidus typus viridis*	Northern Boomslang	Not evaluated
Colubridae	*Philothamnus semivariegatus*	Spotted Bush Snake	LC (SARCA 2014)
Cordylidae	*Chamaesaura aenea*	Coppery Grass Lizard	NT (SARCA 2014)
Cordylidae	*Cordylus vittifer*	Common Girdled Lizard	LC (SARCA 2014)
Cordylidae	*Smaug vandami*	Van Dam's Girdled Lizard	LC (SARCA 2014)
Crocodylidae	*Crocodylus niloticus*	Nile Crocodile	VU (SARCA 2014); LC (global, IUCN 2019)
Elapidae	*Elapsoidea sundevallii media*	Highveld Garter Snake	
Elapidae	*Hemachatus haemachatus*	Rinkhals	LC (SARCA 2014)
Elapidae	*Naja annulifera*	Snouted Cobra	LC (SARCA 2014)
Elapidae	*Naja mossambica*	Mozambique Spitting Cobra	LC (SARCA 2014)
Gekkonidae	*Hemidactylus mabouia*	Common Tropical House Gecko	LC (SARCA 2014)
Gekkonidae	*Lygodactylus capensis*	Common Dwarf Gecko	LC (SARCA 2014)
Gekkonidae	*Lygodactylus ocellatus*	Spotted Dwarf Gecko	LC (SARCA 2014)
Gekkonidae	*Pachydactylus sp.*		
Gekkonidae	*Pachydactylus affinis*	Transvaal Gecko	LC (SARCA 2014)
Gekkonidae	*Pachydactylus capensis*	Cape Gecko	LC (SARCA 2014)
Gerrhosauridae	*Gerrhosaurus flavigularis*	Yellow-throated Plated Lizard	LC (SARCA 2014)
Lacertidae	*Nucras holubi*	Holub's Sandveld Lizard	LC (SARCA 2014)
Lacertidae	*Nucras lalandii*	Delalande's Sandveld Lizard	LC (SARCA 2014)
Lacertidae	*Pedioplanis lineoocellata lineoocellata*	Spotted Sand Lizard	LC (SARCA 2014)
Lamprophiidae	*Aparallactus capensis*	Black-headed Centipede-eater	LC (SARCA 2014)
Lamprophiidae	*Atractaspis bibronii*	Bibron's Stiletto Snake	LC (SARCA 2014)
Lamprophiidae	*Boaedon capensis*	Brown House Snake	LC (SARCA 2014)

Family	Species Name	Common Name	Conservation Status
Lamprophiidae	*Homoroselaps lacteus*	Spotted Harlequin Snake	LC (SARCA 2014)
Lamprophiidae	*Lamprophis aurora*	Aurora House Snake	LC (SARCA 2014)
Lamprophiidae	*Lycodonomorphus inornatus*	Olive House Snake	LC (SARCA 2014)
Lamprophiidae	*Lycodonomorphus rufulus*	Brown Water Snake	LC (SARCA 2014)
Lamprophiidae	*Lycophidion capense capense*	Cape Wolf Snake	LC (SARCA 2014)
Lamprophiidae	*Prosymna sundevallii*	Sundevall's Shovel-snout	LC (SARCA 2014)
Lamprophiidae	*Psammophis brevirostris*	Short-snouted Grass Snake	LC (SARCA 2014)
Lamprophiidae	*Psammophis crucifer*	Cross-marked Grass Snake	LC (SARCA 2014)
Lamprophiidae	*Psammophis trinasalis*	Fork-marked Sand Snake	LC (SARCA 2014)
Lamprophiidae	*Psammophylax rhombeatus*	Spotted Grass Snake	LC (SARCA 2014)
Lamprophiidae	*Pseudaspis cana*	Mole Snake	LC (SARCA 2014)
Leptotyphlopidae	*Leptotyphlops distanti*	Distant's Thread Snake	LC (SARCA 2014)
Leptotyphlopidae	*Leptotyphlops scutifrons scutifrons*	Peters' Thread Snake	
Pelomedusidae	*Pelomedusa galeata*	South African Marsh Terrapin	Not evaluated
Pythonidae	*Python natalensis*	Southern African Python	LC (SARCA 2014)
Scincidae	*Panaspis wahlbergii*	Wahlberg's Snake-eyed Skink	LC (SARCA 2014)
Scincidae	*Trachylepis capensis*	Cape Skink	LC (SARCA 2014)
Scincidae	*Trachylepis punctatissima*	Speckled Rock Skink	LC (SARCA 2014)
Scincidae	*Trachylepis varia sensu lato*	Common Variable Skink Complex	LC (SARCA 2014)
Testudinidae	*Kinixys lobatsiana*	Lobatse Hinged Tortoise	LC (SARCA 2014)
Testudinidae	*Stigmochelys pardalis*	Leopard Tortoise	LC (SARCA 2014)
Typhlopidae	*Afrotyphlops bibronii*	Bibron's Blind Snake	LC (SARCA 2014)
Typhlopidae	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake	LC (SARCA 2014)
Viperidae	*Bitis arietans arietans*	Puff Adder	LC (SARCA 2014)
Viperidae	*Causus rhombeatus*	Rhombic Night Adder	LC (SARCA 2014)

Appendix F: Expected Amphibian Species

Family	Species Name	Common Name	Conservation Status
Bufonidae	*Schismaderma carens*	Red Toad	LC
Bufonidae	*Sclerophrys capensis*	Raucous Toad	LC
Bufonidae	*Sclerophrys gutturalis*	Guttural Toad	LC
Hyperoliidae	*Kassina senegalensis*	Bubbling Kassina	LC
Phrynobatrachidae	*Phrynobatrachus natalensis*	Snoring Puddle Frog	LC
Pipidae	*Xenopus laevis*	Common Platanna	LC
Ptychadenidae	*Ptychadena anchietae*	Plain Grass Frog	LC
Pyxicephalidae	*Amietia delalandii*	Delalande's River Frog	LC
Pyxicephalidae	*Amietia fuscigula*	Cape River Frog	LC
Pyxicephalidae	*Cacosternum boettgeri*	Common Caco	LC
Pyxicephalidae	*Pyxicephalus adspersus*	Giant Bull Frog	NT
Pyxicephalidae	*Strongylopus fasciatus*	Striped Stream Frog	LC
Pyxicephalidae	*Tomopterna cryptotis*	Tremelo Sand Frog	LC
Pyxicephalidae	*Tomopterna natalensis*	Natal Sand Frog	LC

Appendix G: Expected Lepidoptera Species

Family	*Species Name*	Common name	Conservation Status
Crambidae	*Agathodes musivalis*		Not listed
Crambidae	*Autocharis fessalis*		Not listed
Crambidae	*Bocchoris inspersalis*		Not listed
Crambidae	*Classeya sp.*		
Crambidae	*Diasemia sp.*		
Crambidae	*Diasemia monostigma*		Not listed
Crambidae	*Herpetogramma sp.*		
Crambidae	*Hydriris ornatalis*		Not listed
Crambidae	*Lamprophaia ablactalis*		Not listed
Crambidae	*Leucinodes sp.*		
Crambidae	*Loxostege venustalis*		Not listed
Crambidae	*Nausinoe geometralis*		Not listed
Crambidae	*Notarcha quaternalis*		Not listed
Crambidae	*Obtusipalpis pardalis*		Not listed
Crambidae	*Palpita elealis*		Not listed
Crambidae	*Pardomima sp.*		
Crambidae	*Poliobotys ablactalis*		
Crambidae	*Pyrausta phoenicealis*		Not listed
Crambidae	*Sameodes cancellalis*		Not listed
Crambidae	*Spoladea recurvalis*		Not listed
Crambidae	*Stemorrhages sericea*		Not listed
Crambidae	*Synclera traducalis*		Not listed
Crambidae	*Terastia sp.*		
Crambidae	*Terastia meticulosalis*		Not listed
Crambidae	*Trichophysetis whitei*		Not listed
Crambidae	*Udea ferrugalis*		Not listed
Crambidae	*Uresiphita gilvata*		Not listed
Elachistidae	*Ethmia circumdatella*		Not listed
Erebidae	*Achaea catella*		Not listed
Erebidae	*Achaea echo*		Not listed
Erebidae	*Achaea finita*		Not listed
Erebidae	*Anomis sp.*		
Erebidae	*Anomis sabulifera*		Not listed
Erebidae	*Asota speciosa*		Not listed
Erebidae	*Automolis sp.*		
Erebidae	*Bracharoa quadripunctata*		Not listed
Erebidae	*Cyligramma latona*		Not listed
Erebidae	*Dysgonia torrida*		Not listed
Erebidae	*Estigmene lemniscata*		Not listed

Family	*Species Name*	Common name	Conservation Status
Erebidae	*Eublemma sp.*		
Erebidae	*Eublemma anachoresis*		Not listed
Erebidae	*Eublemma rubripuncta*		Not listed
Erebidae	*Eudocima materna*		Not listed
Erebidae	*Euproctis aethiopica*		Not listed
Erebidae	*Grammodes sp.*		
Erebidae	*Grammodes exclusiva*		Not listed
Erebidae	*Grammodes stolida*		Not listed
Erebidae	*Hypena obaceralis*		Not listed
Erebidae	*Hypocala deflorata*		Not listed
Erebidae	*Mocis sp.*		
Erebidae	*Morasa modesta*		Not listed
Erebidae	*Ophiusa mejanesi*		Not listed
Erebidae	*Ophiusa tirhaca*		
Erebidae	*Pericyma atrifusa*		Not listed
Erebidae	*Phytometra sacraria*		Not listed
Erebidae	*Plecoptera annexa*		Not listed
Erebidae	*Plecoptera melalepis*		Not listed
Erebidae	*Polymona rufifemur*		Not listed
Erebidae	*Rhodogastria sp.*		
Erebidae	*Rhynchina sp.*		
Erebidae	*Saenura flava*		Not listed
Erebidae	*Siccia caffra*		Not listed
Erebidae	*Sphingomorpha chlorea*		Not listed
Erebidae	*Tathorhynchus plumbea*		Not listed
Erebidae	*Utetheisa pulchella*		Not listed
Erebidae	*Zekelita poecilopa*		
Eupterotidae		Unidentified EUPTEROTIDAE	
Euteliidae	*Eutelia adulatrix*		Not listed
Geometridae	*Chiasmia brongusaria brongusaria*		LC (SABCA 2013)
Geometridae	*Chiasmia multistrigata multistrigata*		LC (SABCA 2013)
Geometridae	*Chiasmia simplicilinea*	Oblique Peacock	LC (SABCA 2013)
Geometridae	*Chlorerythra rubriplaga*		LC (SABCA 2013)
Geometridae	*Chlorissa attenuata*		LC (SABCA 2013)
Geometridae	*Chloroclystis sp.*		LC (SABCA 2013)
Geometridae	*Conolophia aemula*		LC (SABCA 2013)
Geometridae	*Conolophia conscitaria*		LC (SABCA 2013)

Family	*Species Name*	Common name	Conservation Status
Geometridae	*Eupithecia infelix*		LC (SABCA 2013)
Geometridae	*Heterostegane rectistriga*		LC (SABCA 2013)
Geometridae	*Ligdia batesii*		LC (SABCA 2013)
Geometridae	*Menophra sp.*		LC (SABCA 2013)
Geometridae	*Mimoclystia pudicata pudicata*		LC (SABCA 2013)
Geometridae	*Pingasa distensaria*		LC (SABCA 2013)
Geometridae	*Prasinocyma oculata*		LC (SABCA 2013)
Geometridae	*Rhodometra sacraria*		LC (SABCA 2013)
Geometridae	*Scopula sp.*		LC (SABCA 2013)
Geometridae	*Scopula nigrinotata*		LC (SABCA 2013)
Geometridae	*Scopula spoliata*		LC (SABCA 2013)
Geometridae	*Scopula sublobata*		LC (SABCA 2013)
Geometridae	*Scotopteryx cryptocycla*		LC (SABCA 2013)
Geometridae	*Traminda ocellata*		LC (SABCA 2013)
Geometridae	*Xanthorhoe sp.*		LC (SABCA 2013)
Geometridae	*Xanthorhoe exorista*		LC (SABCA 2013)
Geometridae	*Zamarada sp.*		LC (SABCA 2013)
Geometridae	*Zamarada pulverosa*		LC (SABCA 2013)
Hepialidae	*Eudalaca ammon*		Not listed
Hepialidae	*Eudalaca leucophaea*		Not listed
Hepialidae	*Gorgopis libania*		Not listed
Hesperiidae	*Afrogegenes sp.*		
Hesperiidae	*Afrogegenes hottentota*	Masked Dodger	LC (SABCA 2013)
Hesperiidae	*Afrogegenes letterstedti*	Brown Dodger	LC (SABCA 2013)
Hesperiidae	*Afrogegenes ocra*	Yellow Dodger	
Hesperiidae	*Andronymus neander neander*	Nomad Dart	LC (SABCA 2013)
Hesperiidae	*Caprona pillaana*	Ragged Skipper	LC (SABCA 2013)
Hesperiidae	*Coeliades forestan forestan*	Striped Policeman	LC (SABCA 2013)
Hesperiidae	*Coeliades pisistratus*	Two-Pip Policeman	LC (SABCA 2013)
Hesperiidae	*Eretis djaelaelae*	Marbled Elf	LC (SABCA 2013)
Hesperiidae	*Eretis umbra umbra*	Small Marbled Elf	LC (SABCA 2013)
Hesperiidae	*Gegenes pumilio gambica*	Dark Dodger	LC (SABCA 2013)
Hesperiidae	*Gomalia elma elma*	Green-Marbled Skipper	LC (SABCA 2013)
Hesperiidae	*Kedestes barberae barberae*	Freckled Ranger	LC (SABCA 2013)
Hesperiidae	*Kedestes lepenula*	Chequered Ranger	LC (SABCA 2013)
Hesperiidae	*Kedestes mohozutza*	Fulvous Ranger	LC (SABCA 2013)
Hesperiidae	*Kedestes nerva nerva*	Magaliesberg Ranger	LC (SABCA 2013)
Hesperiidae	*Kedestes wallengrenii wallengrenii*	White-Streaked Ranger	LC (SABCA 2013)
Hesperiidae	*Larsenia gemella*	Twin Swift	LC (SABCA 2013)

Family	*Species Name*	Common name	Conservation Status
Hesperiidae	*Metisella malgacha malgacha*	Grassveld Sylph	LC (SABCA 2013)
Hesperiidae	*Metisella meninx*	Marsh Sylph	LC (SABCA 2013)
Hesperiidae	*Metisella willemi*	Netted Sylph	LC (SABCA 2013)
Hesperiidae	*Pelopidas mathias*	Black-Branded Swift	LC (SABCA 2013)
Hesperiidae	*Pelopidas thrax*	White-Branded Swift	LC (SABCA 2013)
Hesperiidae	*Platylesches ayresii*	Peppered Hopper	LC (SABCA 2013)
Hesperiidae	*Platylesches dolomitica*	Spring Hopper	LC (SABCA 2013)
Hesperiidae	*Platylesches neba*	Flower-Girl Hopper	LC (SABCA 2013)
Hesperiidae	*Sarangesa phidyle*	Small Elfin	LC (SABCA 2013)
Hesperiidae	*Spialia sp.*		
Hesperiidae	*Spialia asterodia*	Star Sandman	LC (SABCA 2013)
Hesperiidae	*Spialia delagoae*	Delagoa Sandman	LC (SABCA 2013)
Hesperiidae	*Spialia dromus*	Forest Sandman	LC (SABCA 2013)
Hesperiidae	*Spialia ferax*	Striped Sandman	LC (SABCA 2013)
Hesperiidae	*Spialia mafa mafa*	Mafa Sandman	LC (SABCA 2013)
Hesperiidae	*Spialia spio*	Mountain Sandman	LC (SABCA 2013)
Hesperiidae	*Tsitana tsita*	Dismal Sylph	LC (SABCA 2013)
Limacodidae	*Latoia vivida*		Not listed
Lycaenidae	*Actizera lucida*	Rayed Blue	LC (SABCA 2013)
Lycaenidae	*Alaena amazoula ochroma*	Yellow Zulu	LC (SABCA 2013)
Lycaenidae	*Aloeides aranda*	Yellow Russet	LC (SABCA 2013)
Lycaenidae	*Aloeides dentatis dentatis*	Roodepoort Toothed Russet	EN (SABCA 2013)
Lycaenidae	*Aloeides henningi*	Hillside Russet	LC (SABCA 2013)
Lycaenidae	*Aloeides molomo coalescens*	Mottled Russet	
Lycaenidae	*Aloeides molomo molomo*	Mottled Russet	LC (SABCA 2013)
Lycaenidae	*Aloeides taikosama*	Dusky Russet	LC (SABCA 2013)
Lycaenidae	*Aloeides trimeni trimeni*	Brown Russet	LC (SABCA 2013)
Lycaenidae	*Anthene amarah amarah*	Black-Striped Ciliate Blue	LC (SABCA 2013)
Lycaenidae	*Anthene definita definita*	Steel-Blue-Ciliate Blue	LC (SABCA 2013)
Lycaenidae	*Anthene livida livida*	Pale Ciliate Blue	LC (SABCA 2013)
Lycaenidae	*Anthene princeps*	Lebombo Ciliate Blue	LC (SABCA 2013)
Lycaenidae	*Axiocerses amanga amanga*	Bush Scarlet	LC (SABCA 2013)
Lycaenidae	*Axiocerses coalescens*	Black-Tipped Scarlet	LC (SABCA 2013)
Lycaenidae	*Axiocerses tjoane tjoane*	Eastern Scarlet	LC (SABCA 2013)
Lycaenidae	*Azanus jesous*	Topaz Babul Blue	LC (SABCA 2013)
Lycaenidae	*Azanus moriqua*	Black-Bordered Babul Blue	LC (SABCA 2013)
Lycaenidae	*Azanus natalensis*	Natal Babul Blue	LC (SABCA 2013)
Lycaenidae	*Azanus ubaldus*	Velvet-Spotted Babul Blue	LC (SABCA 2013)

Family	*Species Name*	Common name	Conservation Status
Lycaenidae	*Cacyreus fracta fracta*	Water Geranium Bronze	LC (SABCA 2013)
Lycaenidae	*Cacyreus lingeus*	Bush Bronze	LC (SABCA 2013)
Lycaenidae	*Cacyreus marshalli*	Common Geranium Bronze	LC (SABCA 2013)
Lycaenidae	*Cacyreus virilis*	Mocker Bronze	LC (SABCA 2013)
Lycaenidae	*Capys disjunctus*	Russet Protea	LC (SABCA 2013)
Lycaenidae	*Chilades trochylus*	Grass Jewel Blue	LC (SABCA 2013)
Lycaenidae	*Cigaritis ella*	Ella's Silverline	LC (SABCA 2013)
Lycaenidae	*Cigaritis mozambica*	Mozambique Silverline	LC (SABCA 2013)
Lycaenidae	*Cigaritis natalensis*	Natal Silverline	LC (SABCA 2013)
Lycaenidae	*Cigaritis phanes*	Silvery Silverline	LC (SABCA 2013)
Lycaenidae	*Crudaria leroma*	Silver-Spotted Grey	LC (SABCA 2013)
Lycaenidae	*Cupidopsis cissus cissus*	Meadow Blue	LC (SABCA 2013)
Lycaenidae	*Cupidopsis jobates jobates*	Tailed Meadow Blue	LC (SABCA 2013)
Lycaenidae	*Deudorix antalus*	Brown Playboy	LC (SABCA 2013)
Lycaenidae	*Eicochrysops messapus mahallakoaena*	Cupreous Ash Blue	LC (SABCA 2013)
Lycaenidae	*Euchrysops dolorosa*	Sabie Smoky Blue	LC (SABCA 2013)
Lycaenidae	*Euchrysops malathana*	Grey Smoky Blue	LC (SABCA 2013)
Lycaenidae	*Euchrysops subpallida*	Ashen Smoky Blue	LC (SABCA 2013)
Lycaenidae	*Hypolycaena philippus philippus*	Purple-Brown Hairstreak	LC (SABCA 2013)
Lycaenidae	*Iolaus mimosae rhodosense*	Mimosa Sapphire	LC (SABCA 2013)
Lycaenidae	*Iolaus trimeni*	Protea Sapphire	LC (SABCA 2013)
Lycaenidae	*Lachnocnema bibulus*	Common Woolly Legs	LC (SABCA 2013)
Lycaenidae	*Lachnocnema durbani*	Grassland Woolly Legs	LC (SABCA 2013)
Lycaenidae	*Lampides boeticus*	Pea Blue	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops glauca*	Silvery Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops ignota*	Zulu Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops ketsi ketsi*	Ketsi Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops ortygia*	Koppie Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops patricia*	Patrician Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops plebeia plebeia*	Twin-Spot Giant Cupid	LC (SABCA 2013)
Lycaenidae	*Lepidochrysops praeterita*	Highveld Giant Cupid	EN (SABCA 2013)
Lycaenidae	*Lepidochrysops ruthica*	Ruth's Giant Cupid	
Lycaenidae	*Leptomyrina henningi henningi*	Plain Black-Eye	LC (SABCA 2013)
Lycaenidae	*Leptotes sp.*		
Lycaenidae	*Leptotes brevidentatus*	Short-Toothed Zebra Blue	LC (SABCA 2013)
Lycaenidae	*Leptotes jeanneli*	Jeannel's Zebra Blue	LC (SABCA 2013)
Lycaenidae	*Leptotes pirithous pirithous*	Common Zebra Blue	LC (SABCA 2013)

Family	*Species Name*	Common name	Conservation Status
Lycaenidae	*Lycaena clarki*	Eastern Sorrel Copper	LC (SABCA 2013)
Lycaenidae	*Myrina dermaptera nyassae*	Lesser Fig Tree Blue	LC (SABCA 2013)
Lycaenidae	*Myrina silenus ficedula*	Common Fig Tree Blue	LC (SABCA 2013)
Lycaenidae	*Oraidium barberae*	Dwarf Blue	LC (SABCA 2013)
Lycaenidae	*Pseudonacaduba sichela sichela*	Dusky Line Blue	LC (SABCA 2013)
Lycaenidae	*Tarucus sybaris sybaris*	Dotted Pierrot	LC (SABCA 2013)
Lycaenidae	*Tuxentius melaena melaena*	Black Pie	LC (SABCA 2013)
Lycaenidae	*Uranothauma nubifer nubifer*	Black Heart	LC (SABCA 2013)
Lycaenidae	*Deudorix dinochares*	Apricot Playboy	LC (SABCA 2013)
Lycaenidae	*Zintha hintza hintza*	Hintza Pierrot	LC (SABCA 2013)
Lycaenidae	*Zizeeria knysna knysna*	African Grass Blue	LC (SABCA 2013)
Lycaenidae	*Zizina otis antanossa*	African Clover Blue	LC (SABCA 2013)
Lycaenidae	*Zizula hylax*	Tiny Grass Blue	LC (SABCA 2013)
Noctuidae	*Acrapex aenigma*		Not listed
Noctuidae	*Agrotis sp.*		
Noctuidae	*Brephos festiva festiva*		Not listed
Noctuidae	*Brithys crini*	Amaryllis Stalk Borer	Not listed
Noctuidae	*Chrysodeixis acuta*		Not listed
Noctuidae	*Chrysodeixis chalcites*		Not listed
Noctuidae	*Cucullia hutchinsoni*		Not listed
Noctuidae	*Cucullia pallidistria*		Not listed
Noctuidae	*Leucania melianoides*		Not listed
Noctuidae	*Mentaxya albifrons*		Not listed
Noctuidae	*Mentaxya ignicollis*		Not listed
Noctuidae	*Spodoptera littoralis*		Not listed
Noctuidae	*Thysanoplusia orichalcea*		
Noctuidae	*Trichoplusia orichalcea*		Not listed
Noctuidae	*Trichoplusia vittata*		Not listed
Noctuidae	*Vittaplusia vittata*		
Nolidae	*Earias biplaga*		Not listed
Nolidae	*Earias insulana*		Not listed
Nolidae	*Nola tineoides*		Not listed
Nymphalidae	*Acraea sp.*		
Nymphalidae	*Acraea aglaonice*	Clear-Spotted Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea anemosa*	Broad-Bordered Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea axina*	Little Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea horta*	Garden Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea lygus*	Lygus Acraea	LC (SABCA 2013)

Family	*Species Name*	Common name	Conservation Status
Nymphalidae	*Acraea natalica*	Black-Based Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea neobule neobule*	Wandering Donkey Acraea	LC (SABCA 2013)
Nymphalidae	*Acraea stenobea*	Suffused Acraea	LC (SABCA 2013)
Nymphalidae	*Aeropetes tulbaghia*	Table Mountain Beauty	LC (SABCA 2013)
Nymphalidae	*Amauris albimaculata albimaculata*	Layman	LC (SABCA 2013)
Nymphalidae	*Amauris niavius dominicanus*	Southern Friar	LC (SABCA 2013)
Nymphalidae	*Brakefieldia perspicua perspicua*	Marsh Patroller	LC (SABCA 2013)
Nymphalidae	*Byblia anvatara acheloia*	African Joker	LC (SABCA 2013)
Nymphalidae	*Byblia ilithyia*	Spotted Joker	LC (SABCA 2013)
Nymphalidae	*Catacroptera cloanthe cloanthe*	Pirate	LC (SABCA 2013)
Nymphalidae	*Charaxes brutus natalensis*	White-Barred Charaxes	LC (SABCA 2013)
Nymphalidae	*Charaxes candiope*	Green-Veined Charaxes	LC (SABCA 2013)
Nymphalidae	*Charaxes jahlusa rex*	Pearl-Spotted Charaxes	LC (SABCA 2013)
Nymphalidae	*Charaxes saturnus saturnus*	Foxy Charaxes	LC (SABCA 2013)
Nymphalidae	*Danaus chrysippus orientis*	African Plain Tiger	LC (SABCA 2013)
Nymphalidae	*Eurytela dryope angulata*	Golden Piper	LC (SABCA 2013)
Nymphalidae	*Hamanumida daedalus*	Guineafowl	LC (SABCA 2013)
Nymphalidae	*Hypolimnas misippus*	Common Diadem	LC (SABCA 2013)
Nymphalidae	*Junonia hierta cebrene*	Yellow Pansy	LC (SABCA 2013)
Nymphalidae	*Junonia oenone oenone*	Dark Blue Pansy	LC (SABCA 2013)
Nymphalidae	*Junonia orithya madagascariensis*	African Blue Pansy	LC (SABCA 2013)
Nymphalidae	*Junonia touhilimasa*	Naval Pansy	
Nymphalidae	*Melanitis leda*	Common Evening Brown	LC (SABCA 2013)
Nymphalidae	*Neptis saclava marpessa*	Spotted Sailer	LC (SABCA 2013)
Nymphalidae	*Paternympha narycia*	Spotted-Eye Small Ringlet	LC (SABCA 2013)
Nymphalidae	*Phalanta phalantha aethiopica*	African Leopard	LC (SABCA 2013)
Nymphalidae	*Precis antilope*	Darker Commodore	LC (SABCA 2013)
Nymphalidae	*Precis archesia archesia*	Garden Inspector	LC (SABCA 2013)
Nymphalidae	*Precis ceryne ceryne*	Marsh Commodore	LC (SABCA 2013)
Nymphalidae	*Precis octavia sesamus*	Southern Gaudy Commodore	LC (SABCA 2013)
Nymphalidae	*Stygionympha wichgrafi wichgrafi*	Wichgraf's Hillside Brown	LC (SABCA 2013)
Nymphalidae	*Telchinia anacreon*	Orange Telchinia	LC (SABCA 2013)
Nymphalidae	*Telchinia burni*	Pale-Yellow Telchinia	LC (SABCA 2013)
Nymphalidae	*Telchinia cabira*	Yellow-Banded Telchinia	LC (SABCA 2013)
Nymphalidae	*Telchinia encedon encedon*	White-Barred Telchinia	LC (SABCA 2013)
Nymphalidae	*Telchinia rahira rahira*	Marsh Telchinia	LC (SABCA 2013)

Family	***Species Name***	**Common name**	**Conservation Status**
Nymphalidae	*Telchinia serena*	Dancing Telchinia	LC (SABCA 2013)
Nymphalidae	*Vanessa cardui*	Painted Lady	LC (SABCA 2013)
Nymphalidae	*Ypthima asterope asterope*	African Three-Ring	LC (SABCA 2013)
Papilionidae	*Graphium antheus*	Large Striped Swordtail	LC (SABCA 2013)
Papilionidae	*Papilio demodocus demodocus*	Citrus Swallowtail	LC (SABCA 2013)
Papilionidae	*Papilio nireus lyaeus*	Narrow Green-Banded Swallowtail	LC (SABCA 2013)
Pieridae	*Belenois aurota*	Pioneer Caper White	LC (SABCA 2013)
Pieridae	*Belenois creona severina*	African Caper White	LC (SABCA 2013)
Pieridae	*Belenois zochalia zochalia*	Forest Caper White	LC (SABCA 2013)
Pieridae	*Catopsilia florella*	African Migrant	LC (SABCA 2013)
Pieridae	*Colias electo electo*	African Clouded Yellow	LC (SABCA 2013)
Pieridae	*Colotis annae annae*	Scarlet Tip	LC (SABCA 2013)
Pieridae	*Colotis euippe omphale*	Southern Round-Winged Orange Tip	LC (SABCA 2013)
Pieridae	*Colotis evagore antigone*	Small Orange Tip	LC (SABCA 2013)
Pieridae	*Colotis evenina evenina*	African Orange Tip	LC (SABCA 2013)
Pieridae	*Colotis pallene*	Bushveld Orange Tip	LC (SABCA 2013)
Pieridae	*Colotis regina*	Queen Purple Tip	LC (SABCA 2013)
Pieridae	*Colotis vesta argillaceus*	Southern Veined Arab	LC (SABCA 2013)
Pieridae	*Eurema brigitta brigitta*	Broad-Bordered Grass Yellow	LC (SABCA 2013)
Pieridae	*Mylothris sp.*		
Pieridae	*Mylothris agathina agathina*	Eastern Dotted Border	LC (SABCA 2013)
Pieridae	*Mylothris rueppellii haemus*	Twin Dotted Border	LC (SABCA 2013)
Pieridae	*Pinacopteryx eriphia eriphia*	Zebra White	LC (SABCA 2013)
Pieridae	*Pontia helice helice*	Southern Meadow White	LC (SABCA 2013)
Pieridae	*Teracolus agoye agoye*	Speckled Sulphur Tip	LC (SABCA 2013)
Pieridae	*Teracolus agoye bowkeri*	Speckled Sulphur Tip	LC (SABCA 2013)
Pieridae	*Teracolus eris eris*	Banded Gold Tip	LC (SABCA 2013)
Pieridae	*Teracolus subfasciatus*	Lemon Traveller	LC (SABCA 2013)
Plutellidae	*Plutella xylostella*		
Pyralidae	*Lamoria sp.*		
Pyralidae	*Loryma basalis*		
Saturniidae	*Bunaea alcinoe*		Not listed
Saturniidae	*Gonimbrasia belina*		
Sphingidae	*Acherontia atropos*		Not listed
Sphingidae	*Agrius convolvuli convolvuli*		Not listed
Sphingidae	*Basiothia medea*		Not listed
Sphingidae	*Daphnis nerii*		Not listed

Family	***Species Name***	Common name	Conservation Status
Sphingidae	*Hippotion celerio*		Not listed
Sphingidae	*Hippotion eson*		Not listed
Sphingidae	*Macroglossum trochilus*		Not listed
Sphingidae	*Nephele comma*		Not listed
Sphingidae	*Pseudoclanis postica*		Not listed
Sphingidae	*Sphingonaepiopsis nana*		Not listed

Appendix H: Impact Assessment

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	Irreplaceable loss or damage to biological or physical resources or highly sensitive environments. Irreplaceable damage to highly sensitive cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	Irreplaceable loss or damage to biological or physical resources or moderate to highly sensitive environments. Irreplaceable damage to cultural/social resources of moderate to highly sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond project life: The impact will remain for some time after the life of the project and is potentially irreversible even with management.	Almost certain / Highly probable: It is most likely that the impact will occur. <80% probability.
5	Serious loss and/or damage to physical or biological resources or highly sensitive environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/ Region Will affect the entire province or region.	Project Life (>15 years): The impact will cease after the operational life span of the project and can be reversed with sufficient management.	Likely: The impact may occur. <65% probability.
4	Serious loss and/or damage to physical or biological resources or moderately sensitive environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. <50% probability.

Rating	Intensity/Replaceability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
3	Moderate loss and/or damage to biological or physical resources of low to moderately sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local extending only as far as the development site area.	Medium term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the project, therefore there is a possibility that the impact will occur. <25% probability.
2	Minor loss and/or effects to biological or physical resources or low sensitive environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited to the site and its immediate surroundings.	Short term: Less than 1 year and is reversible.	Rare / improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. <10% probability.
1	Minimal to no loss and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and / or social benefits felt by a very small percentage of the baseline.	Very limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly unlikely / None: Expected never to happen. <1% probability.

	Significance																																					
Probability 7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Consequence	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the project. The impact may result in permanent positive change	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to the long-term effect on the natural and/or social environment	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short-term effects on the natural and/or social environment	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development from being approved. These impacts will result in negative medium to short-term effects on the natural and/or social environment	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to the long-term effect on the natural and/or social environment	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)

Appendix F: Wetland Environmental Impact Assessment

DIGBY WELLS ENVIRONMENTAL

Your Preferred Environmental and Social Solutions Partner

Providing innovative and sustainable solutions throughout the resources sector

Mogale Tailings Retreatment Operations Environmental Application Process

Wetland Environmental Impact Assessment

Prepared for:
Pan African Resources PLC (PAR)

Project Number:
PAR7273

June 2022

Digby Wells and Associates (South Africa) (Pty) Ltd
Company Registration: 2010/008577/07

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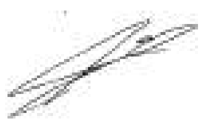
This document has been prepared by Digby Wells Environmental.

Report Type:	Wetland Environmental Impact Assessment
Project Name:	Mogale Tailings Retreatment Operations Environmental Application Process
Project Code:	PAR7273

Name	**Responsibility**	**Signature**	**Date**
Aamirah Dramat	Report Compiler		March 2022
Willnerie Janse van Rensburg	Report Compiler & Site Assessment		March 2022
Kathryn Terblanche	Report Compiler & Site Assessment		March 2022
Danie Otto	ExCo Reviewer		June 2022
Brett Coutts	Senior Review		June 2022

DETAILS AND DECLARATION OF THE SPECIALIST

Digby Wells and Associates (South Africa) (Pty) Ltd

Contact person: Kathryn Terblanche

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Full name:	Kathryn Terblanche
Title/ Position:	Manager: Rehabilitation and Soils
Qualification(s):	M.Sc. Restoration Ecology
Experience (years):	8
Registration(s):	

I, ___________________________________, 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 Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, 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; and

- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

	February 2022
Signature of the Specialist	*Date*

Findings, recommendations and conclusions provided in this report are based on the best available scientific methods and the author's professional knowledge and information at the time of compilation. Digby Wells employees involved in the compilation of this report, however, accepts no liability for any actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, and by the use of the information contained in this document.

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Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

EXECUTIVE SUMMARY

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

Mogale Tailings Retreatment (Pty) Ltd (MTR) a wholly owned subsidiary of Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation to be completed by 30th September 2022. The proposed transaction has now been concluded and was announced on the 6th October 2022.

PAR has closed the transaction to acquire the total share capital and claims of Mogale Gold and Mintails SA Soweto Cluster Proprietary Limited (MSC), (collectively, the Sale Transaction). Both Mogale Gold and MSC are 100% owned by Mintails Mining SA Proprietary Limited (Mintails SA), which was placed in provisional liquidation during 2018. Based on this PAR has now acquired the assets associated with MR 206, based on the conclusion of the transaction noted above.

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The wetland survey was conducted in October 2021 to delineate the wetlands within the Project Area and determine their Present Ecological State (PES), WET-EcoServices (EcoServices) and Ecological Importance and Sensitivity (EIS) values. The wetlands within the Project Area cover approximately 494.7 ha and were categorised into hydro-geomorphic (HGM) types, namely:

- Seasonal pan wetlands;
- Hillslope seepage wetlands;
- Valley bottom wetlands with a channel;

- Valley bottom wetlands without a channel; and
- Artificial wetlands.

The wetlands within the 500m zone of regulation of the proposed activities are currently impacted. The wetland PES scores were categorised as **Category E** (Seriously Modified) and **Category F** (Critically Modified) wetlands. The EcoServices of the delineated wetlands were rated as **Very Low to Moderately Low** while the EIS scores were found to range from **Low/Marginal** to **Moderate** due to the modified nature of the wetlands.

While the impacts of the proposed project have the potential to result in further degradation of the wetlands present, it is the opinion of the ecologist that the proposed project is likely to have an overall positive impact on the ecological integrity of the area in general, should the relevant mitigation and management measures outlined in this report be adhered to.

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ACRONYMS, ABBREVIATIONS AND DEFINITION

°C	Degree Celsius
AEL	Air Emission License
AIP	Alien Invasive Plant
ASM	Artisanal and Small-Scale Mining
C-Plan 3	Gauteng Conservation Plan Version 3
CARA	The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)
CBA	Critical Biodiversity Area
cm	Centimetre
CMA	Catchment Management Agencies
CSIR	Council for Scientific and Industrial Research
CVB	Channelled Valley Bottom
DEA	Department of Environmental Affairs
Digby Wells	Digby Wells Environmental
DMRE	Department of Mineral Resources and Energy
DWS	Department of Water and Sanitation
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIS	Ecological Importance and Sensitivity
EMP	Environmental Management Plan
EMPr	Environmental Management Program
EP	Environmental Practitioner
ESA	Ecological Support Area
FEPA	Freshwater Ecological Priority Area
ha	Hectare
HGM	Hydro-geomorphic
IUCN	International Union for Conservation of Nature
km	Kilometre
m	Metre
m.a.m.s.l.	Metres above mean sea level
MAP	Mean Annual Precipitation

MCLM	Mogale City Local Municipality
Mintails	Mintails SA Mining SA (Pty) Ltd
mm	Millimetre
MR	Mining Right
MRA	Mining Right Area
MTIS	Mineable tonnes in-situ
NBA	National Biodiversity Assessment
NBF	National Biodiversity Framework
NEM:BA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NFEPA	National Freshwater Ecological Priority Area
NWA	National Water Act, 1998 (Act No. 36 of 1998)
ONA	Other Natural Area
PA	Protected Area
PAR	Pam African Resources
PES	Present Ecological State
ROM	Run of Mine
SAIAB	South African Institute of Aquatic Biodiversity
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SFI	Soil Form Indicator
SWI	Soil Wetness Indicator
SWMP	Storm Water Management Plan
TSF	Tailings Storage Facility
TUI	Terrain Unit Indicator
UCVB	Unchannelled Valley Bottom
WET-EcoServices	Wetland Ecological Services
WET-Health	Wetland Ecological Health Assessment
WMA	Water Management Areas
WML	Water Management License

WRC	Water Research Commission
WRDM	West Rand District Municipality
WUL	Water Use License
WULA	Water Use License Application
WWF	Worldwide Fund for Nature
WWP	West Wits Pit

Legal Requirement		**Section in Report**
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of- (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Section 5
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page iii
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 and 2
cA	And indication of the quality and age of the base data used for the specialist report;	Appendix A
cB	A description of existing impacts on site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 2.2
(d)	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 8
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of the equipment and modelling used;	Section 6 and Appendix A
(f)	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure inclusive of a site plan identifying site alternatives;	Section 8
(g)	an identification of any areas to be avoided, including buffers;	Section 8
(h)	a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 8
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4

Legal Requirement		Section in Report
(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 8
(k)	any mitigation measures for inclusion in the Environmental Management Programme (EMPr);	Section 10
(l)	any conditions/aspects for inclusion in the environmental authorisation;	Section 10
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 12
(n)	a reasoned opinion (Environmental Impact Statement) -	Section 15
	whether the proposed activity, activities or portions thereof should be authorised; and	
	if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 11
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Section 13
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	
(q)	any other information requested by the competent authority.	N/A

1. Introduction

Digby Wells Environmental (hereinafter Digby Wells) has been appointed to undertake an Environmental Application Process and associated specialist studies for the Mogale Gold Mining Right with reference number: (GP) 30/5/1/2/2 (206) (MR) and, more specifically for the proposed construction of a Mogale Tailings Retreatment Operations.

Mogale Tailings Retreatment (Pty) Ltd (MTR) a wholly owned subsidiary of Pan African Resources PLC (PAR) has entered into a Sale and Purchase Agreement for the acquisition of the shares in and claims against Mogale Gold (Pty) Ltd (Mogale Gold). The agreement was entered into between PAR and the liquidators of Mintails Mining SA (Pty) Ltd (in liquidation) (MMSA). MMSA is the holding company of Mogale Gold. The intended transaction is subject to a due diligence investigation to be completed by 30th September 2022. The proposed transaction has now been concluded and was announced on the 6th October 2022.

PAR has closed the transaction to acquire the total share capital and claims of Mogale Gold and Mintails SA Soweto Cluster Proprietary Limited (MSC), (collectively, the Sale Transaction). Both Mogale Gold and MSC are 100% owned by Mintails Mining SA Proprietary Limited (Mintails SA), which was placed in provisional liquidation during 2018. Based on this PAR has now acquired the assets associated with MR 206, based on the conclusion of the transaction noted above.

The project entails the reclamation of historical unlined Tailings Storage Facilities (TSFs). The reprocessed tailings will be first discarded into West Wit Pit and possibly other nearby small pits. Any extra processed tailings will be stored on a ground TSF (West Wits Pit TSF and 1L23-1L25 TSF). It is proposed that the footprint of 1L23-1L25 footprint will be lined and the footprint of West Wits Pit TSF will not be lined.

Mogale Gold owns the right to extract and process gold from tailings recourses by reprocessing old gold mine slimes dams and sandy mine dumps left by the extensive historic mining activities that have taken place in the area since 1888. MTR (PAR) is only interested in the surface operations associated with Mining Right (MR) 206 (i.e., Tailings Storage Facilities (TSFs) for reclamation, processing and deposition), and therefore the focus of this application process.

The Project consists of 120 Mt of tailings to be reprocessed and firstly deposited into the West Wits Pit (current authorisation in place for in-pit deposition) and then undertake deposition of the footprint of 1L23-1L25 footprint (New Tailings Facility) once capacity has been reached within the West Wits Pit.

Alternatives are being considered for potential deposition of tailings material into the other pits in the area.

It must be noted that once the West Wits Pits reaches capacity the surface deposition will extend in a northern direction from the pit onto surface, expanding the deposition footprint associated with West Wits Pit.

There are six dumps being considered to be reprocessed, the largest of which amounts to 57.9 Mt, while the smallest contains 0.57 Mt. The primary location of processed tailings storage has been earmarked for deposition in the West Wits Pit.

2. Project Description

Mogale plan to undertake activities relating to reclamation associated with gold-bearing TSFs through hydraulic reclamation. Digby Wells were appointed as the Independent Environmental Consultant to undertake the Environmental Impact Assessment (EIA) Application process which comprises of an Air Emission Licence (AEL) and Water Use Licence (WUL) for the proposed gold-bearing TSFs.

The site is located in the West Rand, in Gauteng Province. The site comprises of existing infrastructure such as sand dumps, Lancaster Dam and an open pit that will be used for the deposition of tailings materials. A process plant, overland pumping and piping inclusive of associated water management infrastructure will form part of the proposed infrastructure that will require an authorisation. Once the open pit is filled to capacity, a new TSF will potentially be constructed on the footprint area of one of the reclaimed TSF sites (1L23-1L25) (Figure 2-2). The footprint of the area is 2 923.3 hectares (ha) which considers MR 206 and associated infrastructure.

Ancillary infrastructure such as pipelines, powerlines and pumps will be required for the proposed reclamation activities and will be included in support of the Environmental Application Process, which will be undertaken.

2.1. Project Locality

The Mining Right Area of the Mogale Cluster includes: G1, G2 plant; Cams, North Sand; South Sand; 1L23-1L25; 1L28; 1L13-1L15; 1L8, 1L9; 1L10; West Wits Pit (WWP) and Lancaster Dam. The mining right is located on Portions 66 and 99 of the farm Waterval 174 IQ and portions 136 and 209 of the farm Luipaardsvlei 246 IQ.

The Project is within the Mogale City Local Municipality (MCLM), which is located within the West Rand District Municipality (WRDM). MCLM is the regional services authority and the area falls under the jurisdiction of the Krugersdorp Magisterial District.

The site is located in the catchment of the Upper Wonderfonteinspruit, quaternary catchment C23D, which forms part of the Vaal River Water Management Area (WMA) within the Vaal Catchment Management Agency (CMA). The project is about 4 km south of Krugersdorp and north-east of Randfontein, approximately 10 kilometres (km) off the N14 National Road in the Gauteng Province, in an area that has been transformed by past gold mining activities.

The Project locality of the site is illustrated in Figure 2-1 and Figure 2-2.

Table 2-1: Summary of the PAR Project Location Details

Province	Gauteng
District Municipality	West Rand District Municipality
Local Municipality	Mogale Local Municipality
Nearest Town	Krugersdorp (4 km), Randfontein (4 km)
GPS Co-ordinates (relative centre point of study area)	26°07'45.54"S
	27°45'40.85"E

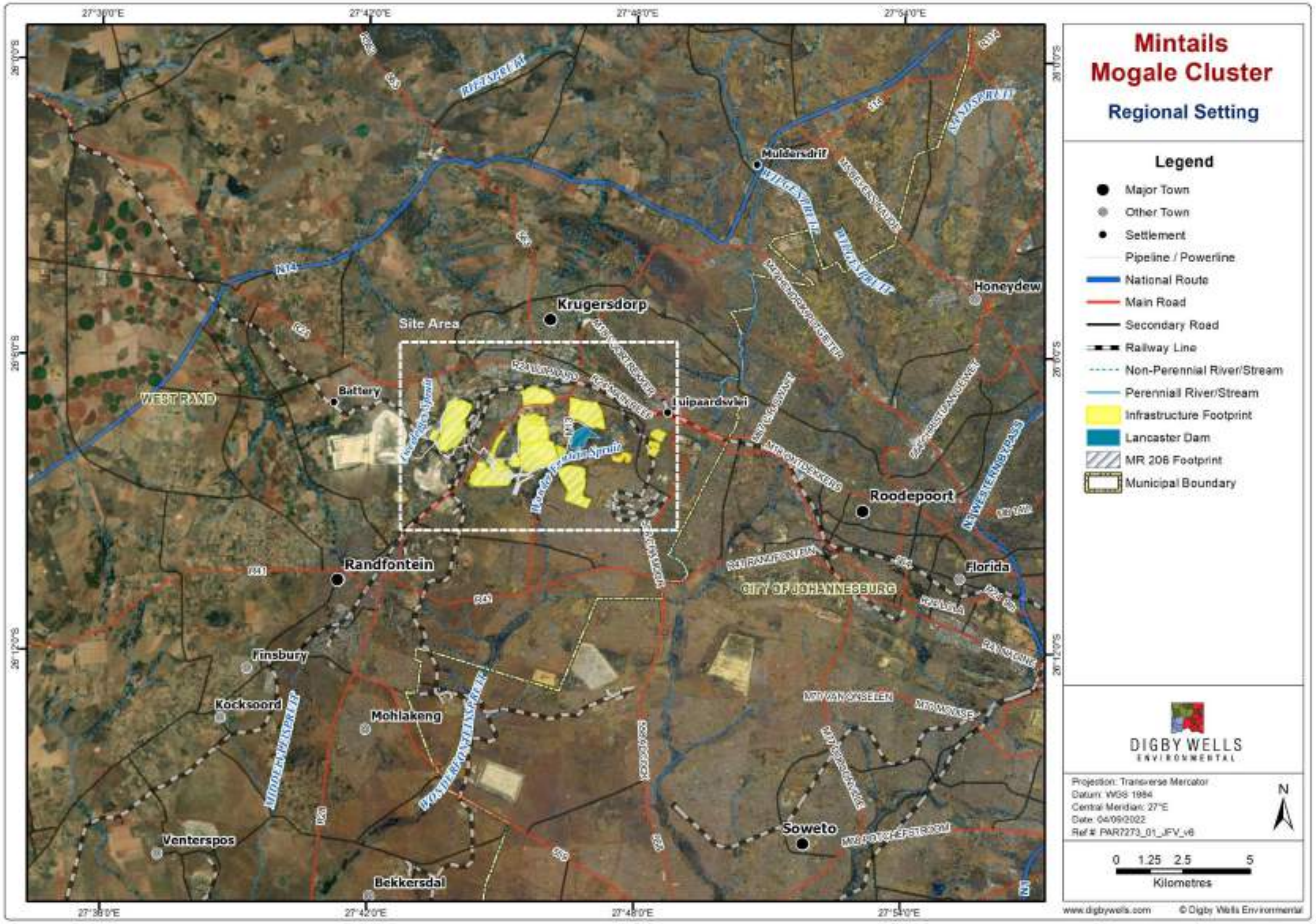


Figure 2-1: Regional Setting of the Project Area

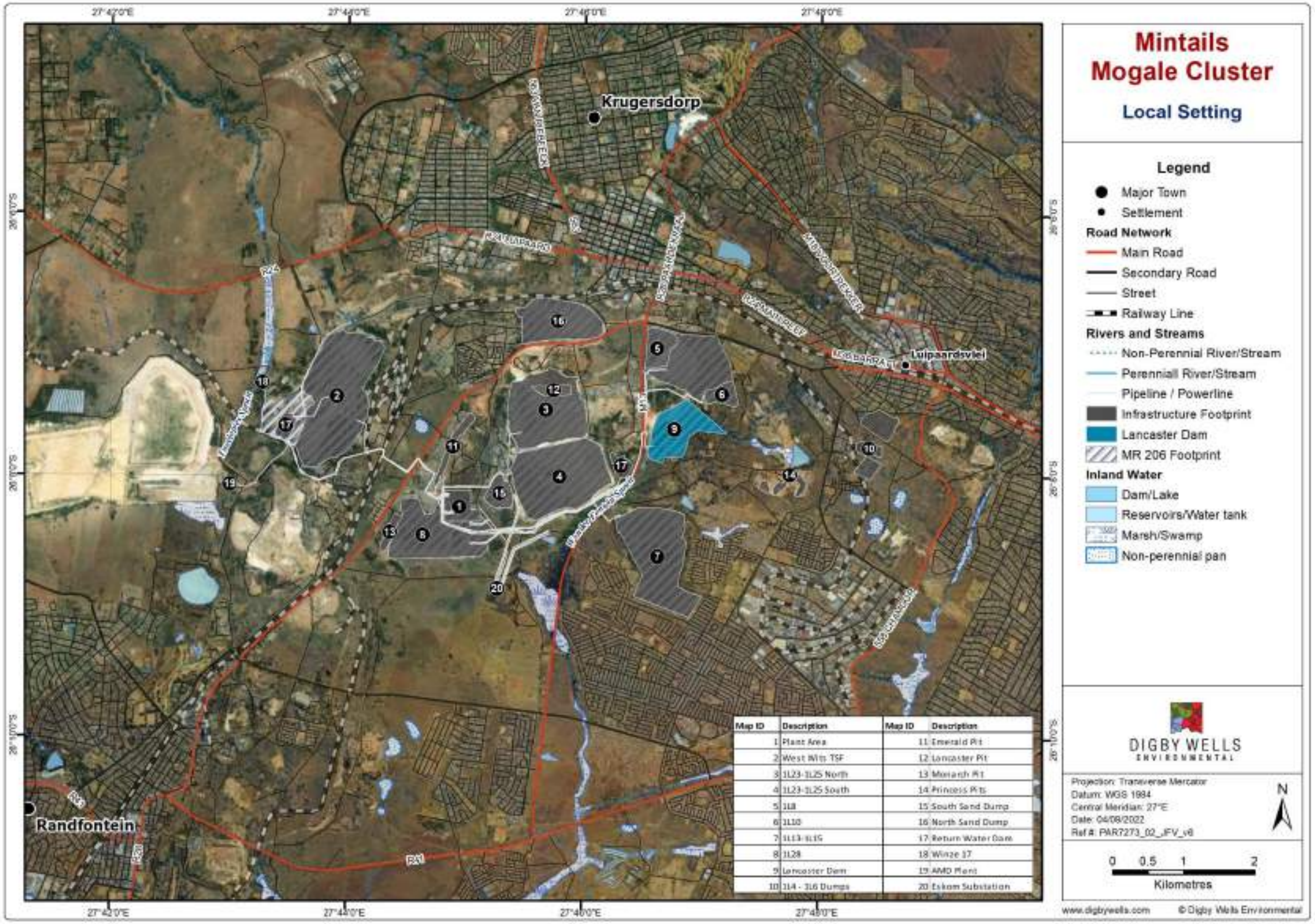


Figure 2-2: Local Setting of the Project Area

2.2. Proposed Infrastructure and Activities

The proposed infrastructure (Figure 2-3) and activities of the Project per phase are provided in Table 2-2 below.

Table 2-2: Project Phases and Associated Activities

Project Phase	Associated Activities
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.
	Operation of pump stations during the operational phase.
	Maintenance of pipeline routes during the operational activities.
	Infilling of processed tailings material into the West Pits Pit and other potential pits.
	Surface tailings deposition within the West Wits Pit.
	Tailings deposition onto the historic footprint of 1L23-1L25 (lined).
	Production of Gold.
	Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.
	Removal, decommissioning and rehabilitation of the processing plant footprint.
	Rehabilitation of the old TSF footprints.
	Rehabilitation of the old Mogale Processing Plant footprint.
	Final rehabilitation of the facility.
	General rehabilitation of the surrounding area, including wetland rehabilitation.

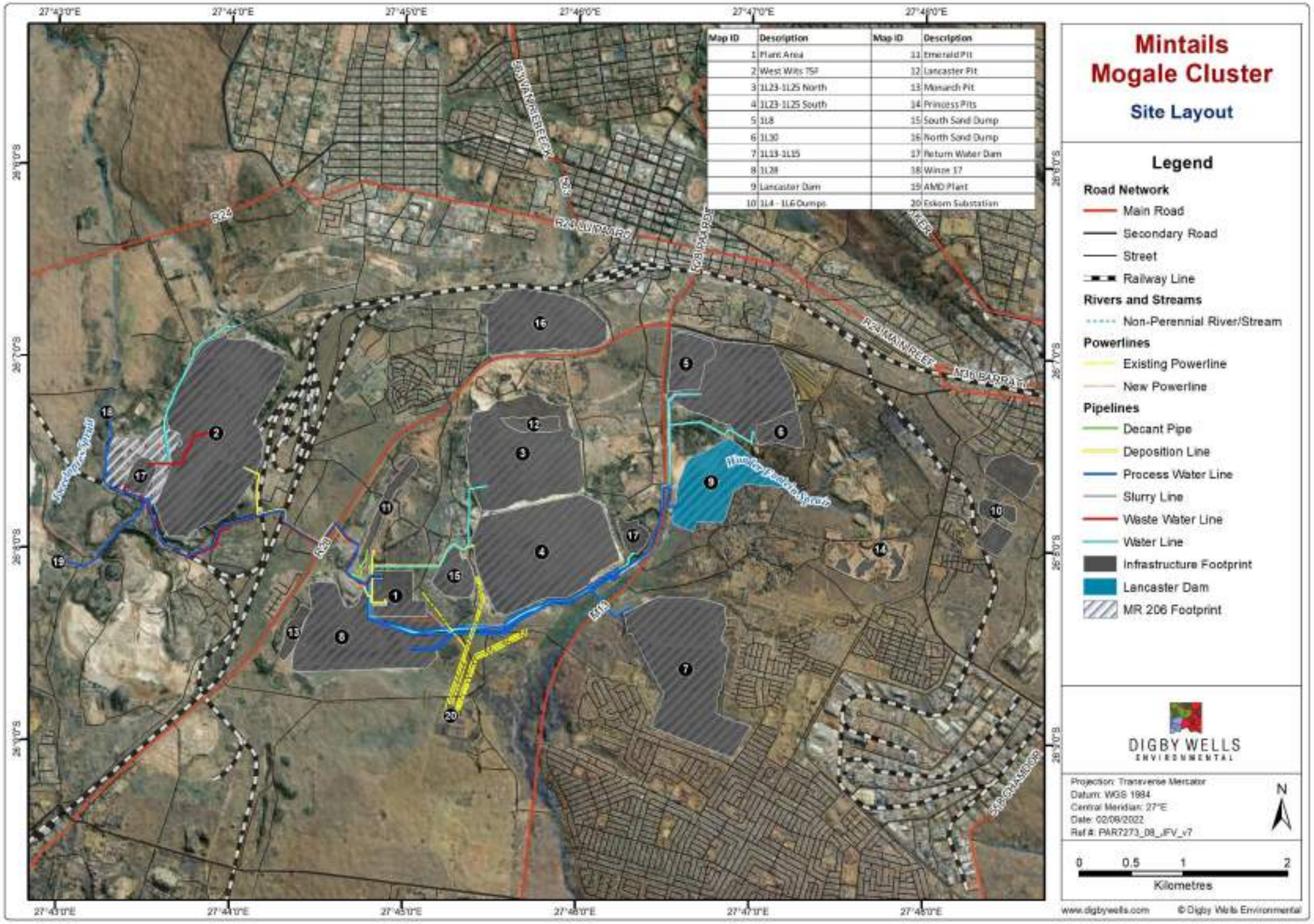


Figure 2-3: Proposed Site Layout of the Project Area

3. Relevant Legislation, Standards and Guidelines

The Project is required to comply with all the obligations in terms of the provisions of the National legislations, regulations, guidelines and by-laws. The guidelines directing the Wetland Environmental Impact Assessment are detailed in Table 3-1.

Table 3-1: Applicable Legislation, Regulations, Guidelines and By-Laws

Legislation, Regulation, Guideline or By-Law	Applicability
National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) (NEM:BA) The NEM:BA regulates the management and conservation of the biodiversity of South Africa within the framework provided under NEMA. This Act also regulates the protection of species and ecosystems that require national protection and also takes into account the management of alien and invasive species. The following regulations which have been promulgated in terms of the NEM:BA are also of relevance: • Alien and Invasive Species Lists, 2020 (terms of GNR 1003 in GG 43726 dated 18 September 2020 – effective from 18 October 2020); • Threatened and Protected Species Regulations; and • National list of Ecosystems Threatened and in need of protection under Section 52(1) (a) of the Biodiversity Act (GG 34809, GNR 1002, 9 December 2011).	• A Wetland Impact Assessment was undertaken as part of the EIA Phase; • The Project activities will be set out to abide by the guidelines set out in NEM:BA; • Areas of concern will be indicated and possible alternatives to avoid these areas; • Required mitigation measures will be included in the Environmental Management Plan (EMP) as part of the EIA Phase; and • Alien Invasive Plants (AIPs) of NEM:BA categories1a, 1b and 3 at the Project Area are required to be removed by law and therefore need to be considered.
Section 24 of the Constitution of the Republic of South Africa,1996 (Act No. 108 of 1996) Wetlands are protected under the Act that states that everyone has the right to an environment that is not harmful to their health or wellbeing. It also states that the environment must be protected for the benefit of present and future generations through responsible legislative measures. The Act: • Prevents pollution and ecological degradation; • Promote conservation and secure ecological sustainability; and • Promote justifiable economic and social development using natural resources.	• A Wetland Impact Assessment was undertaken as part of the EIA Phase; • Environmental Management Plan and Monitoring Program is included in the EIA Phase; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
The National Water Act, 1998 (Act No. 36 of 1998) (NWA) • Section 19 of the National Water Act (NWA), 1998 (Act 36 of 1998) that include the prevention and remediation of the effects of pollution; and • Section 21of the NWA (Act 36 of 1998) includes Water Uses.	• A Wetland Impact Assessment was undertaken as part of the EIA Phase. The EIA identified possible water usages, impacts, and possible preventions and remediation strategies; • Environmental Management Plan and Monitoring Program is included in the EIA Phase; and • Recommendations to prevent, avoid, and rehabilitate possible impacts were assessed.
National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA). NEMA (as amended) was set in place under Section 24 of the Constitution. Certain environmental principles under NEMA must be adhered to, to inform decision making for issues affecting the environment. Section 24 of NEMA states that:	• Activities that will influence the Wetlands of the proposed Project Area are listed in Section 2.2 and have been identified as Listed Activities in the Listing Notices (as amended) and therefore require environmental authorisation before being undertaken.

Legislation, Regulation, Guideline or By-Law	Applicability
The potential impact on the environment and socio-economic conditions of activities that require authorisation or permission by law and which may significantly affect the environment must be considered, investigated and assessed before their implementation and reported to the organ of state charged by law with authorizing, permitting, or otherwise allowing the implementation of an activity. The NEMA requires that pollution and degradation of the environment be avoided, or, where it cannot be avoided be minimised and treated.	
Department of Water and Forestry (DWAF) Guidelines for the Delineation of Wetlands (2005) To delineate any wetland the following criteria are used as in line with the Department of Water Affairs and Forestry (DWAF): A practical field procedure for identification and delineation of wetlands and riparian areas (2005). These criteria are: • Topographical location of the wetland in the landscape; • Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation (such as grey horizons, mottling streaks, hardpans, organic matter depositions, iron and manganese concretion resulting from prolonged saturation); • A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 centimetre (cm) of the soil; and • The presence, at least occasionally, of water-loving (hydrophilic) plants (i.e. hydrophytes).	• This guideline is a tool for wetland practitioners, at all levels, to improve procedures for mapping wetlands using a set of standards for data collection and storage, so that data feeds into national-level databases such as the National Wetland Inventory, and that informs national policy tools such as National Freshwater Ecosystem Priority Areas (NFEPA); and • It also includes tips on recognising, digitising, and classifying wetlands and human impacts on wetlands from desktop imagery and in the field.
Wetland Management Series (published by Water Research Commission (WRC, 2007) The WET-Management Series is a set of integrated tools that can be used to guide well-informed and effective wetland management and rehabilitation. The WET-Management tools are designed to be used at different spatial and institutional levels as needed, from national and provincial to the level of specific wetland sites involving individual landowners, to meet a range of wetland management and rehabilitation needs.	• Provides background information about wetlands and natural resource management as well as tools that can be used to guide decisions around wetland management.
National Freshwater Ecosystems Priority Areas (NFEPA, (Nel, et al., 2011)**)** The NFEPA project was a multi-partner project between the Council for Scientific and Industrial Research (CSIR), South African National Biodiversity Institute (SANBI), Water Research Commission (WRC), Department of Water and Sanitation (DWS) formerly known as the Department of Water Affairs and Forestry (DWAF)), Department of Environmental Affairs (DEA), Worldwide Fund for Nature (WWF), South African Institute for Aquatic Biodiversity (SAIAB) and South African National Parks (SANParks). The NFEPA project aimed to: • Identify Freshwater Ecosystem Priority Areas (hereafter referred to as 'FEPAs') to meet national biodiversity goals for freshwater ecosystems; and • Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers. The NFEPA study responded to the high levels of threat prevalent in a river, wetland, and estuary ecosystems of South Africa. It provides strategic spatial priorities for conserving the country's freshwater ecosystems and supporting the sustainable use of water resources. These strategic spatial priorities are known as Freshwater Ecosystem Priority Areas, or 'FEPAs'.	• Will help greatly to ensure that healthy freshwater ecosystems continue to form the cornerstone of the implementation of our water resource classification system and the development of catchment management strategies throughout the country. They also inform planning and decisions about land use and the expansion of the protected area network. By highlighting which ecosystems should remain in a healthy and well-functioning state, the maps provide a tool to guide our choices for the strategic development of water resources and to support sustainable development.
SANBI, in collaboration with the DWS report on "Wetland offsets: a Best-Practice Guideline for South Africa" (SANBI and DWS, 2016) This guideline serves as a practical tool to aid in the consistent application of wetland offsets in South Africa. The guideline is primarily aimed at wetland offsets required as part of water use authorisation processes (e.g. in an application for a Water Use Licence under the National Water Act) where compensatory actions are required to achieve water resources management and biodiversity conservation objectives. The guideline is equally relevant for use in EIA processes (e.g. as part of the environmental authorisation process in terms of the NEMA or an application for a mining license or development of an Environmental Management Programme under the Mineral and Petroleum Resources Development Act).	• The guideline provides practical guidance for determining the size and characteristics of a wetland offset and determining the requirements for its implementation, once a decision on the need for a wetland offset has been taken through the water use authorisation process by the DWS.

Legislation, Regulation, Guideline or By-Law	Applicability
Wetland offsets are enduring measurable conservation outcomes resulting from actions designed to compensate for significant residual adverse impacts on wetlands. They are implemented to address any anticipated significant residual impacts arising from development projects after appropriate avoidance, minimisation, and rehabilitation measures have been considered. The goals of wetland offsets are to achieve 'No Net Loss' and preferably a net gain concerning the full spectrum of functions and values provided by wetlands. These include: • Water resource and ecosystem service value, especially concerning regulating and supporting functions pertinent to water resource management and disaster risk reduction, such as flood control and water quality enhancement, but also including direct services such as food and water provisioning and cultural services such as spiritual, recreational, and cultural benefits that sustain communities; • Ecosystem conservation, especially in terms of meeting national, provincial and local objectives for habitat protection and avoiding a deterioration in ecosystem threat status; and • Species of conservation concern, to ensure that the status of threatened, rare or keystone wetland dependent species is maintained or improved.	

4. Assumptions, Limitations and Exclusions

The compilation of this Report is based on the following assumptions and limitations in Table 4-1.

Table 4-1: Limitations and Assumptions with Resultant Consequences

Assumptions and Limitations	Consequences
Wetlands situated within the 500 m zone of regulation were assessed mostly on a desktop level with very limited ground-truthing.	Some discrepancies within the zone may occur.
This wetland study forms part of a larger EIA and should be read in conjunction with the EIA and other related specialist studies.	This report does not include any other specialist studies other than the wetland assessment. The wetland report cannot be used as a stand-alone report in the application for a WUL.
The Wetland Assessment was conducted during spring, having some restrictions to vegetation diversity, identification and low flows in the systems.	Findings, recommendations, and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation.
No form of this report may be amended or extended without the prior written consent of the author and/or a relevant reference to the report by the inclusion of an appropriately detailed citation. Any recommendations, statements, or conclusions drawn from or based on this report must cite or reference this report. Whenever such recommendations, statements or conclusions form part of the main report relating to the current investigation, this report must be included in its entirety.	The wetland report cannot be used as a stand-alone report in the application for a WUL.

5. Details of the Specialist

The following is a list of Digby Wells' staff who were involved in the Wetland Environmental Impact Assessment:

- **Danie Otto** manages the South African Operations and Technical Services at Digby Wells. He holds an M.Sc. in Environmental Management with B.Sc. Hons (Limnology & Geomorphology, and GIS & Environmental Management) and B.Sc. (Botany and Geography & Environmental Management). He is a biogeomorphologist that specialises in ecology of wetlands and rehabilitation. He has been a registered Professional Natural Scientist since 2002. Danie has 25 years of experience in the mining industry in environmental and specialist assessments, management plans, audits, rehabilitation, and research. He has experience in 8 countries and his experience is in the environmental sector of coal, gold, platinum (PGMs), diamonds, asbestos, rock, clay & sand quarries, copper, phosphate, andalusite, base metals, heavy minerals (titanium), uranium, pyrophyllite, chrome, nickel etc. He has wetland and geomorphology working experience across Africa including specialist environmental input into various water resource related studies. These vary from studies of the wetlands of the Kruger National Park to swamp forests in central Africa to alpine systems in Lesotho.

- **Kathryn Terblanche** is the Rehabilitation and Soils Manager at Digby Wells. She received a Bachelor of Science in Ecology and Environmental Science and an Honours degree in Environmental Management from the University of Cape Town. She also has received her M.Sc. in Restoration Ecology through the University of KwaZulu-Natal. Kathryn is an ecologist with fields of interest in wetlands, flora, restoration and rehabilitation. In her 8 year career she has undertaken various wetland delineations and assessments, flora assessments, rehabilitation assessments and audits, as well as project management of various implementation projects. She has also worked extensively with alien invasive species removal programmes, ecological restoration projects and sustainable development programmes within the Government Sector. She has published a variety of environmental documents/articles and presented at various South African and international conferences.
- **Willnerie Janse van Rensburg** is a Soil Scientist in the Rehabilitation, Closure and Soils Division at Digby Wells. She received her Bachelor of Science in Environmental Geography as well as her Honours degree in Soil Science from the University of the Free State. She has 5 years' experience in the fields of Soil Science and Environmental Science. She has experience in completing soil surveys, land capability assessments, irrigation scheduling and provides recommendations on soil amelioration. Willnerie also completes wetland delineations and assessments. She has undertaken work in Lesotho, Botswana and throughout South Africa. Willnerie is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.
- **Aamirah Dramat** is a Junior Rehabilitation Consultant in the Rehabilitation, Closure and Soils Department at Digby Wells. She received her Bachelor of Science Degree in Applied Biology and Environmental and Geographical Science (EGS) as well as her Honours Degree in Biological Sciences from the University of Cape Town. She joined Digby Wells in 2020 as a Rehabilitation Intern and has since gained experience in the environmental services sector with specialised focus in Soils, Wetlands and Rehabilitation, both locally and internationally. She has been involved in the report compilation and undertaking of Baseline Assessments, Environmental Impact Assessments (EIAs), Rehabilitation and Closure Plans (RCPs), Rehabilitation Strategy and Implementation Plans (RSIPs), Alien Invasive Plant (AIP) Assessments, Re-vegetation Trial Studies and Monitoring Assessments. Aamirah is registered as a Candidate Natural Scientist with the South African Council for Natural Scientific Professionals.

6. Methodology

This section provides the methodology used in the compilation of the Wetland Impact Assessment. A detailed methodology is described in Appendix A and is summarized in Figure 6-1 below.

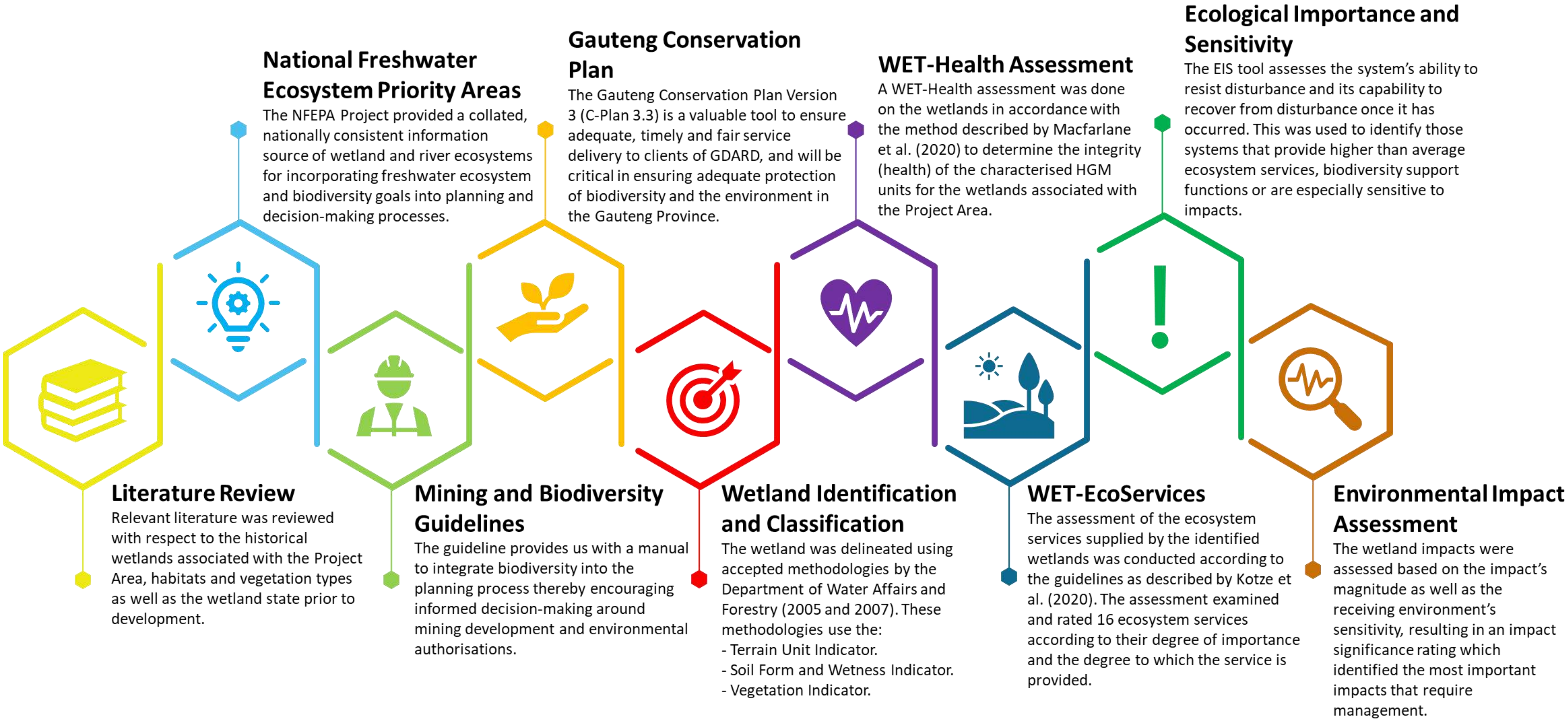


Figure 6-1: Wetland Assessment Methodology

7. Regional Baseline Environment and Desktop Review

Relevant literature was reviewed prior to the field assessment concerning the historical wetlands associated with the Project Area. This includes the habitats and vegetation types as well as the wetland states. Baseline and background information was researched and used to understand the Project Area prior to undertaking the fieldwork component and is described in Table 7-1 below.

Table 7-1: Baseline Environment of the Project Area

Bioregional Context (Kleynhans, Thirion, & Moolman, 2005; Darwall, Smith, Tweddle, & Skelton, 2009; Climate-data.org, n.d.)		**Plant Species Characteristic of the Soweto Highveld Grasslands** (Mucina & Rutherford, 2012) **(Figure 7-1)**	
Ecoregion	Highveld	Graminoid Species	*Andropogon appendiculatus, Brachiaria serrata, Cymbopogon pospischilii, Cynodon dactylon, Elionurus muticus, Eragrostis capensis, E. chloromelas, E. curvula, E. plana, E. planiculmis, E. racemosa, Heteropogon contortus, Hyparrhenia hirta, Setaria nigrirostris, S. sphacelata, Themeda triandra, Tristachya leucothrix, Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis subsp. galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra, Paspalum dilatatum.*
Altitude (m.a.m.s.l.) (modifying)	1667	Herb Species	*Hermannia depressa, Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera var. aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium var. nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala, Wahlenbergia undulata.*
Mean Annual Precipitation (MAP) (mm)	784	Geophytic Herb Species	*Haemanthus humilis subsp. hirsutus, H. montanus.*
Rainfall Seasonality	Early to late summer	Herbaceous Climber Species	*Rhynchosia totta.*
Mean Annual Temp. (°C)	15.9	Low Shrub Species	*Anthospermum hispidulum, A. rigidum subsp. pumilum, Berkheya annectens, Felicia muricata, Ziziphus zeyheriana.*
WMA	Upper Vaal and Crocodile West and Marico	Status	Endangered.
Quaternary Catchment (Figure 7-2)	C23D and A21D	**Gauteng Conservation Plan** (GDARD, 2011; GDARD, 2014) **(Figure 7-3)**	
Watercourse	Wonderfonteinspruit, Tweelopiespruit, Mooi River, Vaal River, Crocodile River and Bloubankspruit	The area surrounding the eastern RWD, Preferred Plant Location and the Wonderfonteinspruit, is classified as an **Ecological Support Area (ESA)**. Minor northern areas of the West Wits TSF are classified as **Critical Biodiversity Areas (CBAs)** and **ESAs** with areas surrounding the pit also classified as ESAs and CBAs. Outside of the Project Area, a large area adjacent to South Sand Dump and IL23-IL25 South is classified as a CBA. Two areas classified as ESAs are located adjacent to North Sand Dump.	

Mining and Biodiversity Guideline Category, DEA (2013) **(Figure 7-4)**	**NFEPA Wetland Classification** (Nel, et al., 2011) **(Figure 7-5 and Figure 7-6)**	
Most of the Project Area is classified as **High Biodiversity Importance – High Risk for Mining** with the remaining area classified as **Moderate Biodiversity Importance – Moderate Risk for Mining** and a section of IL4 – IL6 classified as **Highest Biodiversity Importance – Highest Risk for Mining**. A large area near South Sand Dump is classified as Highest Biodiversity Importance – Highest Risk for Mining. To the north of the Project Area is a large area classified as Legally Protected – Mining Prohibited.	NFEPA Wetlands	A large **Depression (Rank 6) NFEPA Wetland** is located near North Sand Dump. The Project Area also comprises small NFEPA Wetlands with a **Flat (Rank 6), Seep (Rank 6)** and **Depression (Rank 4 and 5)** located near the Emerald Pit and IL4-IL6. Small **Flat (Rank 6)** and **Seep (Rank 6)** wetlands are present near West Wits TSF and the western RWD. Near the Preferred Plant Location and eastern RWD is a large **Seep (Rank 6)** NFEPA Wetland.
	River FEPA	The Project Area is defined as an **Upstream Management Area**, which is a sub-quaternary catchment in which human activities need to be managed to prevent degradation of downstream river FEPAs and Fish Support Areas.

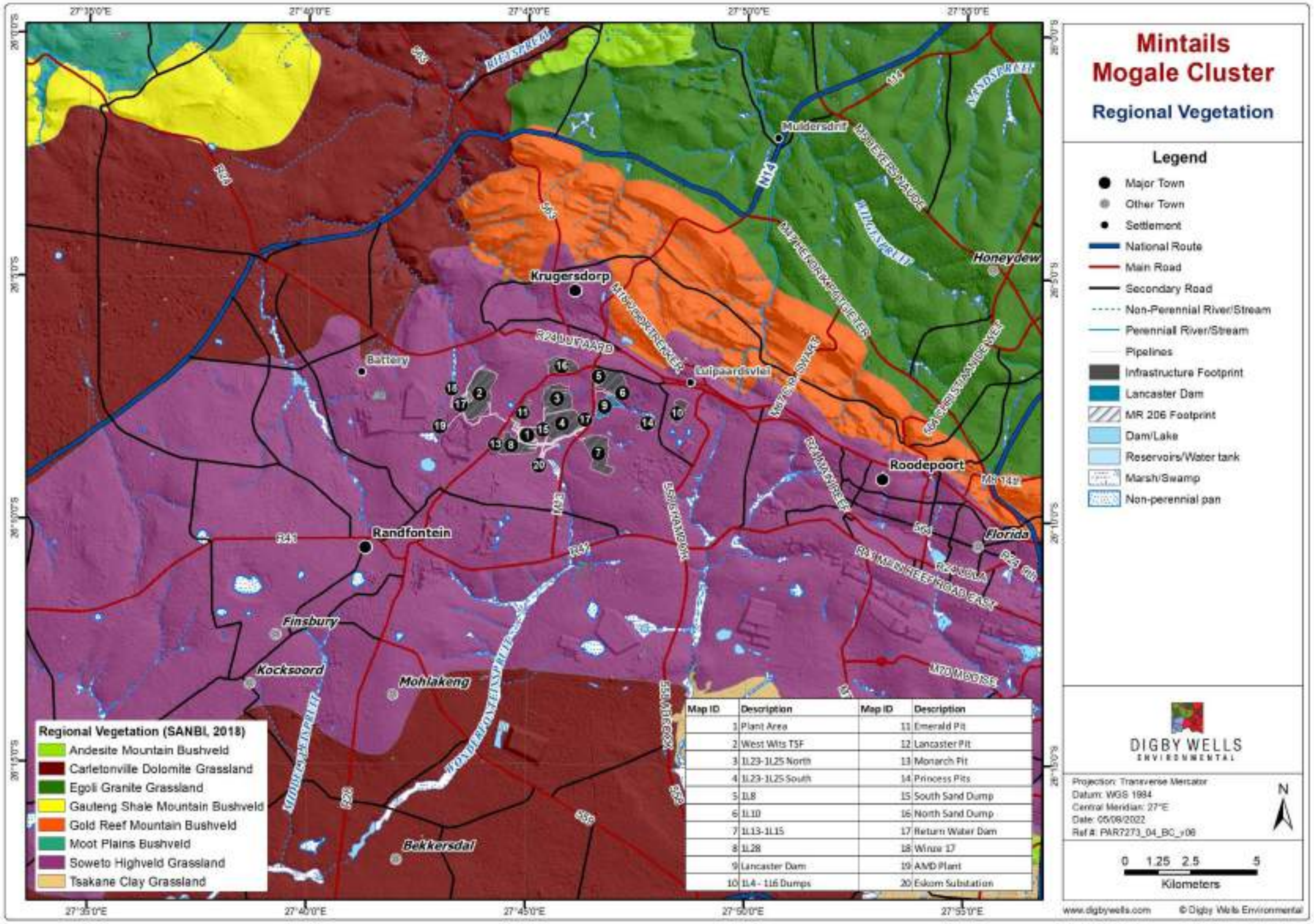


Figure 7-1: Regional Vegetation of the Project Area

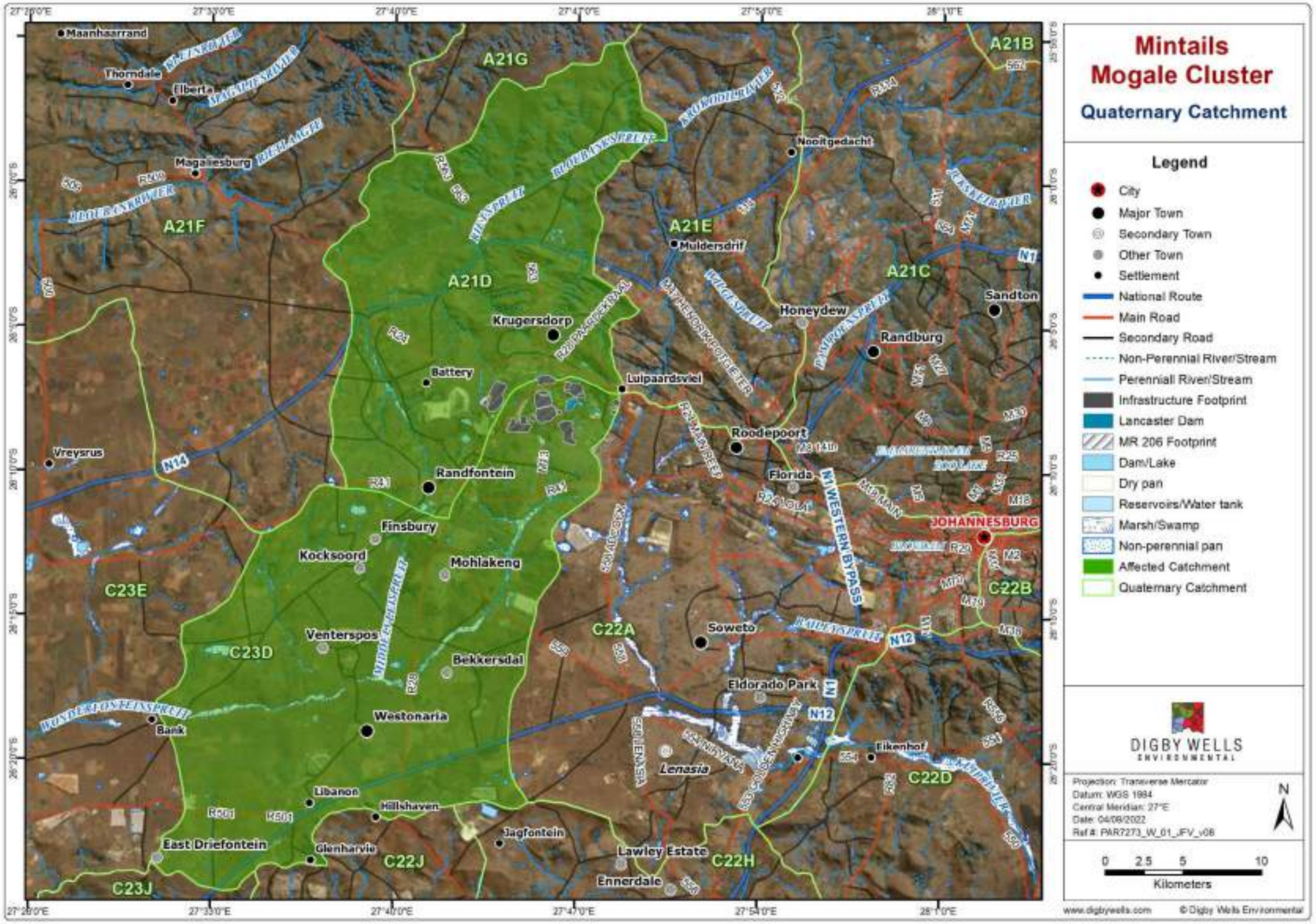
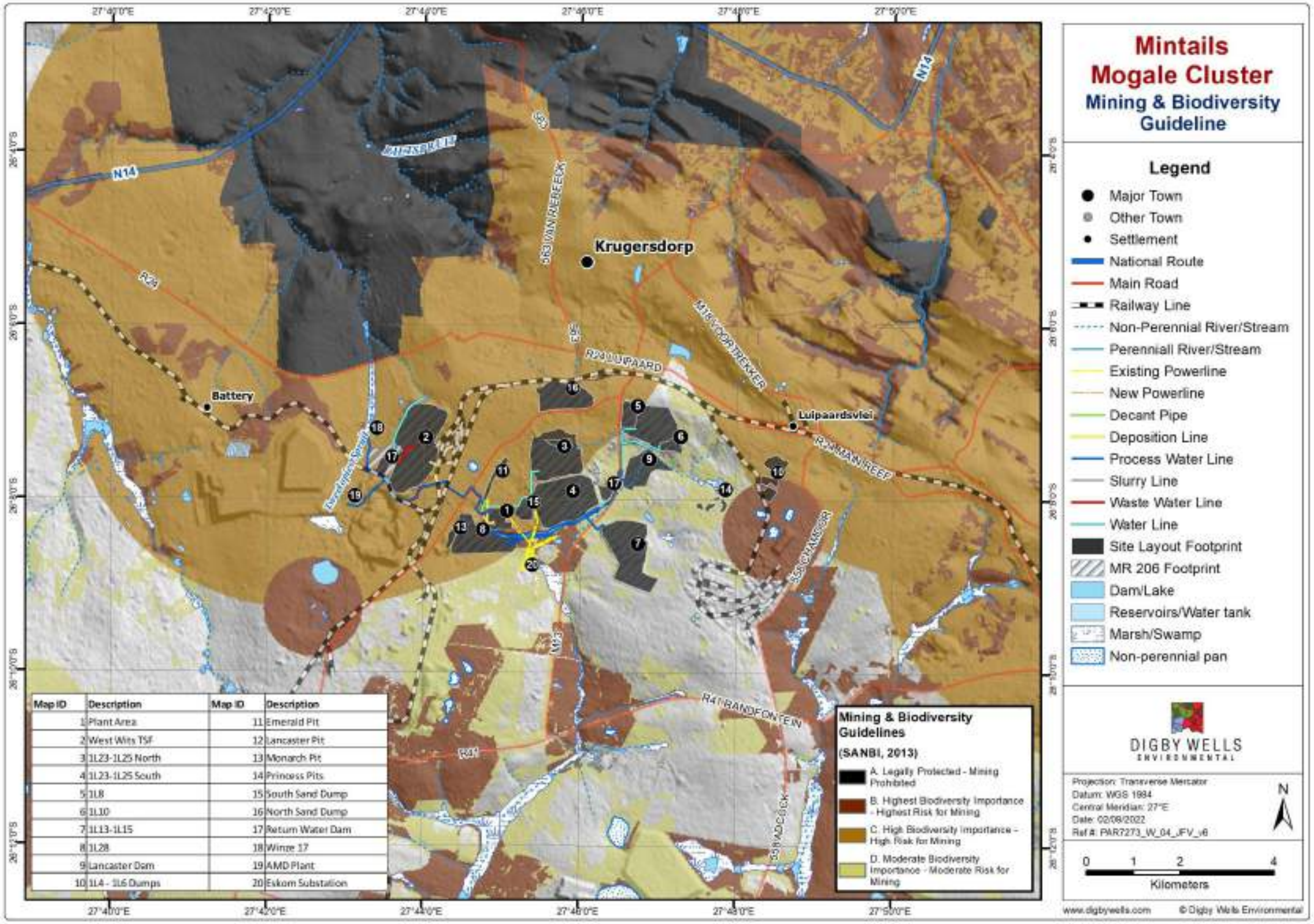


Figure 7-2: Quaternary Catchment of the Project Area

Figure 7-3: Gauteng Conservation Plan of the Project Area



Map ID	Description	Map ID	Description
1	Plant Area	11	Emerald Pit
2	West Wits TSF	12	Lancaster Pit
3	1L23-1L25 North	13	Monarch Pit
4	1L23-1L25 South	14	Princess Pits
5	1L8	15	South Sand Dump
6	1L10	16	North Sand Dump
7	1L13-1L15	17	Return Water Dam
8	1L28	18	Winze 17
9	Lancaster Dam	19	AMD Plant
10	1L4 - 1L6 Dumps	20	Eskom Substation

Figure 7-4: Mining and Biodiversity Guideline of the Project Area

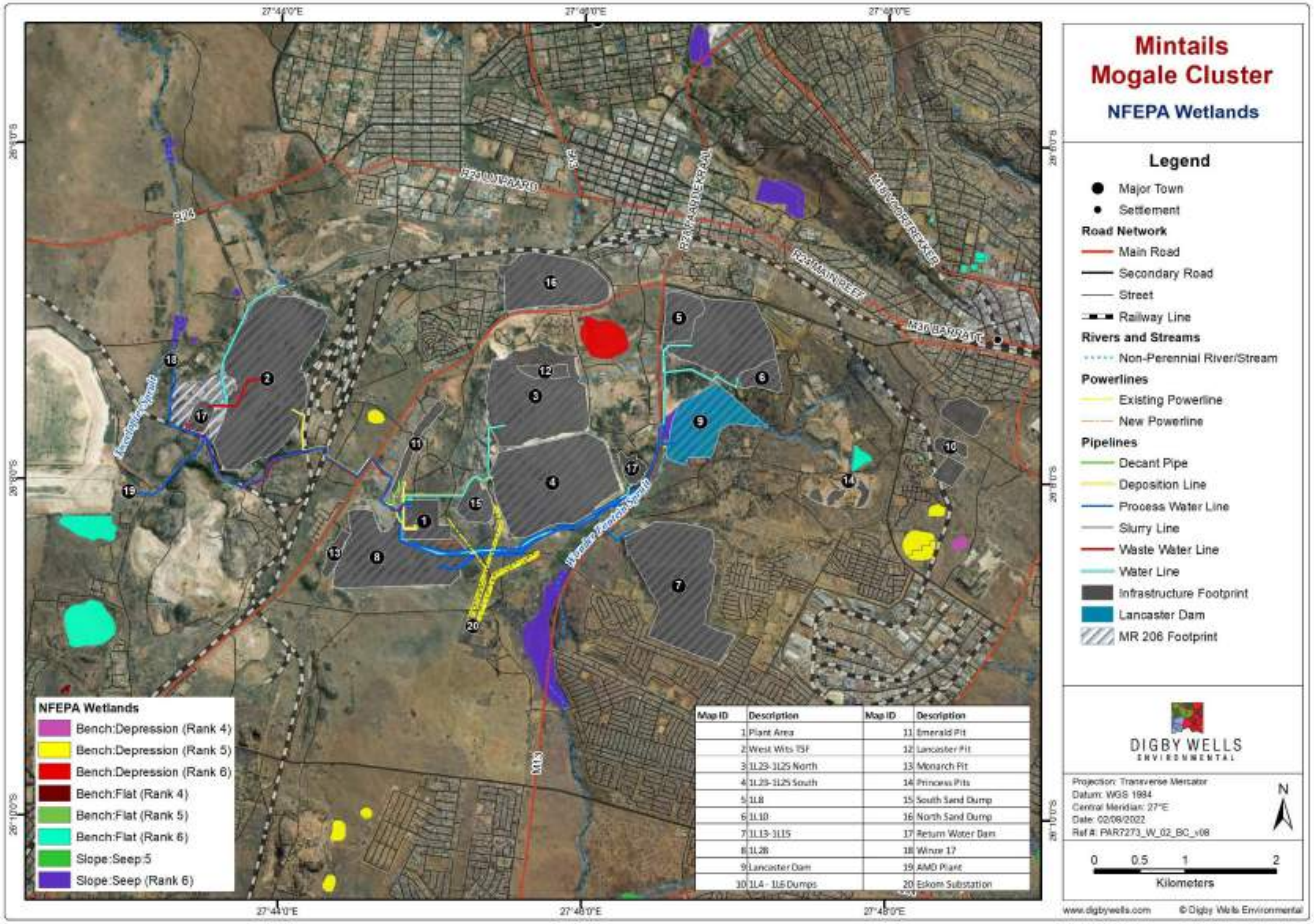


Figure 7-5: NFEPA Wetlands of the Project Area

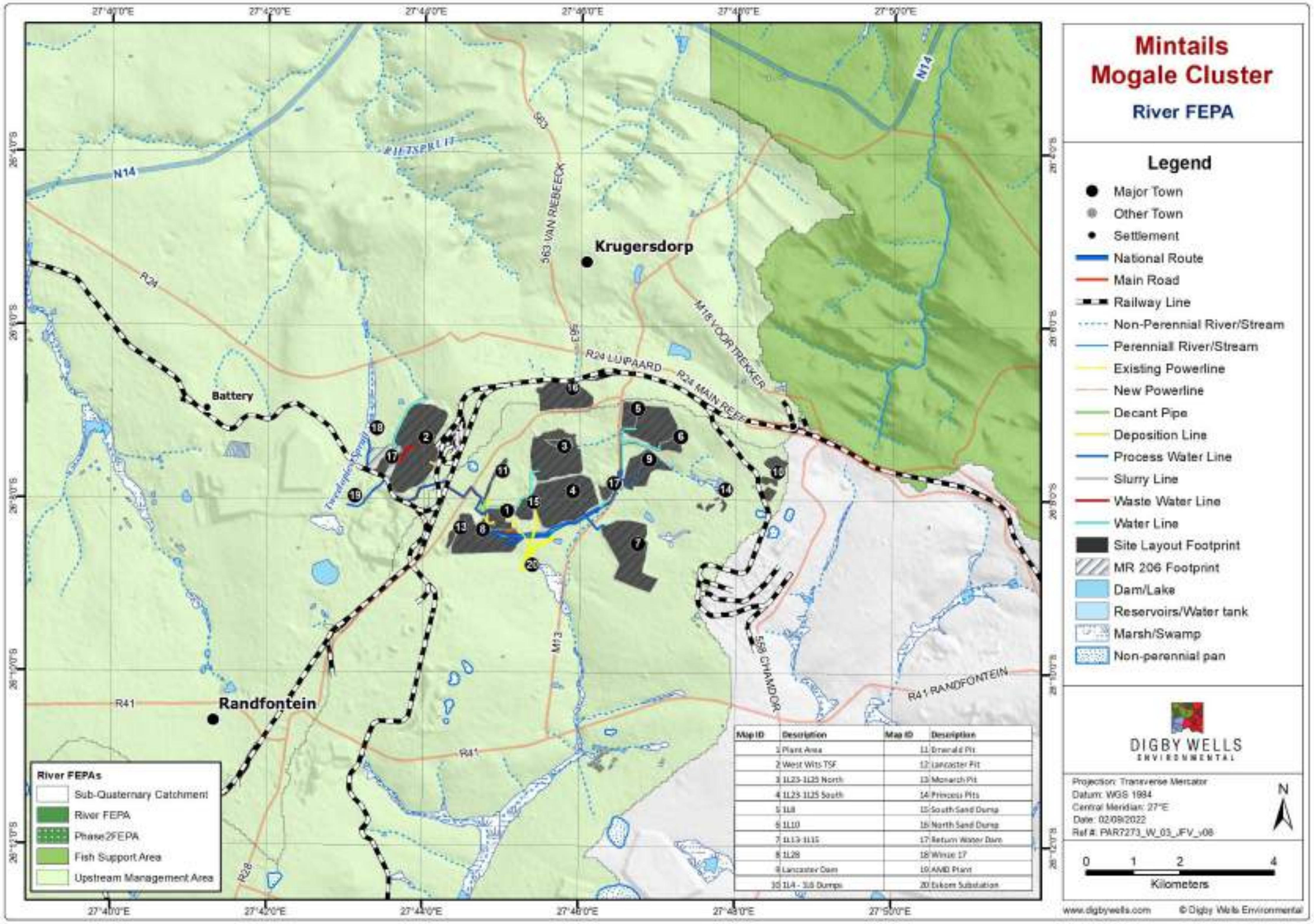


Figure 7-6: River FEPA of the Project Area

8. Findings and Discussion

The wetlands associated with the Project Area were desktop delineated and confirmed during a rapid site survey. The site survey was conducted in October 2021 to delineate the wetlands within the Project Area and determine their Present Ecological State (PES), WET-EcoServices (EcoServices) and Ecological Importance and Sensitivity (EIS) values. The wetlands were categorised into hydro-geomorphic (HGM) types, namely:

- Seasonal pan wetlands;
- Hillslope seepage wetlands;
- Valley bottom wetlands with a channel;
- Valley bottom wetlands without a channel; and
- Artificial wetlands.

The PES, WET-EcoServices and EIS were calculated accordingly. This report includes a consolidation of the aforementioned assessments, along with the potential impacts the Project will have on the wetland systems of the area.

Field verification focused on the wetlands located within the Project Area. Wetlands that will be impacted to a lesser extent, such as wetlands located within the 500 m Zone of Regulation were only verified at a desktop level.

8.1. Wetland Delineation and HGM Unit Identification

The wetlands within the Project Area cover approximately 494.7 ha. The breakdown of the wetland types area is detailed in Table 8-1. Figure 8-6 illustrates the wetland delineations for the Project Area.

Table 8-1: Wetland HGM Units of the Project Area

HGM Unit No.	HGM Unit	Area (ha)
1	Channelled Valley Bottom (CVB)	50,87
2	Channelled Valley Bottom (CVB)	21,13
3	Channelled Valley Bottom (CVB)	200,86
4	Channelled Valley Bottom (CVB)	38,51
5	Channelled Valley Bottom (CVB)	20,94
6	Unchannelled Valley Bottom (UCVB)	13,75
7	Unchannelled Valley Bottom (UCVB)	21,28
8	Unchannelled Valley Bottom (UCVB)	4,18
9	Unchannelled Valley Bottom (UCVB)	10,59

HGM Unit No.	HGM Unit	Area (ha)
10	Pan	8,71
11	Pan	21,10
12	Pan	10,21
13	Pan	2,85
14	Pan	3,63
15	Pan	1,88
16	Seep	44,00
17	Seep	8,84
18	Seep	11,36
Total Wetlands (ha)		**494.7**

Each wetland that was verified on site was delineated and the HGM unit type identified using the wetland indicators as discussed in the sections that follow.

8.2. Wetland Indicators

The wetland delineation was completed according to a combination of the accepted methodologies from the Department of Water and Sanitation 'A practical field procedure for identification and delineation of wetlands and riparian areas' (Department of Water Affairs and Forestry, 2005) and the "Updated manual for identification and delineation of wetlands and riparian areas" (Department of Water Affairs and Forestry, 2008). The methodology includes four wetland indicators; Soil Wetness Indicator (SWI), Soil Form Indicator (SFI), Vegetation and Terrain and are discussed in the subsections below.

Figure 8-1: Wetland Indicators of the Project Area

(Top: Typical topography of a valley bottom wetland; Left: *Phragmites australis*, an obligate wetland species; Right: Mottling indicating soil wetness)

8.2.1. Terrain Unit Indicators

Terrain indicators help to identify areas in the landscape where wetlands are more likely to occur. The topography is typically the physical characteristics of an area with a variation of soils against the slope, each with its own characteristics because of its relative position in the landscape and terrain.

Detailed imagery and contours, coupled with field verifications, allows the geomorphic setting of the wetland and catchments to be understood and the HGM unit to be determined. Terrain indicators are important for understanding the hydrological and specific functionality of the wetland and determining the potential risks from anthropological activities on the wetland.

The topography of the Study Area is typical of the Highveld Lower Ecoregion with gentle, rolling grassland slopes and many valley systems and depressions scattered across the landscape. Typical terrain indicators identified in the Project Area can be seen in Figure 8-1.

8.2.2. Soil Indicators

Soil indicators, including soil forms (i.e., Katspruit, Kroonstad and Rensburg) and soil wetness (i.e., mottling, gleying and leaching) were used, where possible, to identify and confirm wetland delineations. SWI were mostly used to delineate the wetlands as the mottling and leaching indicators were prominent in most cases. Where soil mixing and disturbances had taken place (Witbank soils), focus was given to the topography and vegetation indicators to assist in the delineations.

8.2.3. Vegetation Indicators

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas. The vegetation species were identified and classified according to their indicative response in accordance to their occurrence across aquatic and terrestrial habitats such as: Obligated Wetland Species (OW), Facultative Wetland Species (FW), Facultative Species (F) and Facultative Dry-land Species (FD). This approach was used to delineate wetlands based on the dominant plants per plant community. The dominant wetland and non-wetland vegetation indicators identified across the Project Area are detailed in Table 8-2 below.

Table 8-2: Vegetation Indicators

Scientific Name	Common Name	Classification of Plant Species According to Occurrence in Wetlands
Grasses		
*Arundo donax***	Spanish Reed	Facultative Wetland Species
*Bromus catharticus**	Rescue Grass	Facultative Wetland Species
*Cortaderia selloana***	Pampas Grass	Facultative Species
Cynodon dactylon	Couch Grass	Facultative Species
Eragrostis curvula	Weeping Love Grass	Facultative Species
Eragrostis gummiflua	Gum Grass	Facultative Wetland Species
Harpochloa falx	Caterpillar Grass	Facultative Species
Imperata cylindrica	Cotton Wool Grass	Facultative Wetland Species
*Polypogon monspeliensis**	Annual Beard-Grass	Facultative Wetland Species
*Paspalum dilatatum**	Dallis Grass	Facultative Species
*Pennisetum clandestinum***	Kikuyu Grass	Facultative Species
Sporobolus africanus	Rat's Tail Dropseed	Facultative Wetland Species
Herbs and Shrubs		
Albuca setosa	Soldier-in-the-box	Facultative Dry-land Species

Scientific Name	Common Name	Classification of Plant Species According to Occurrence in Wetlands
Aloe greatheadii var. *davyana*	Spotted Aloe	Facultative Dry-land Species
*Amaranthus hybridus**	Green Pigweed	Facultative Species
*Araujia sericifera***	Moth Catcher	Facultative Species
*Argemone ochroleuca***	Mexican Poppy	Facultative Species
Berkheya radula	Sun Daisy	Facultative Species
*Canna indica***	Indian Shot	Facultative Species
*Conyza bonariensis**	Leaf Fleabane	Facultative Species
*Datura stramonium***	Common Thorn Apple	Facultative Species
Helichrysum aureonitens	Golden Everlasting	Facultative Wetland Species
Ledebouria cooperi	Cooper's African Hyacinth	Facultative Species
*Mirabilis jalapa***	Four-O'clock	Facultative Species
*Persicaria Spp**	Knotweed	Obligate Species
*Phytolacca octandra***	Forest Inkberry	Facultative Species
*Plantago lanceolata**	Ribwort Plantain	Facultative Species
Rumex lanceolata	Common Dock	Facultative Wetland Species
*Schkuhria pinnata**	Dwarf Mexican Marigold	Facultative Species
*Solanum sisymbriifolium***	Dense-thorned Bitter Apple	Facultative Species
*Tagetes minuta**	Khaki Bush	Facultative Dry-land Species
*Taraxacum officinale**	Common Dandelion	Facultative Species
Trichodesma physaloides	Chocolate Bells	Facultative Dry-land Species
*Verbena bonariensis***	Wild Verbena	Facultative Species
*Verbena rigida***	Veined Verbena	Facultative Species
Withania somnifera	Winter Cherry	Facultative Dry-land Species
Sedges and Reeds		
Cyperus obtusifolius	-	Facultative Wetland Species
Phragmites australis	Common Reed	Obligate Species
Schoenoplectus brachyceras	-	Obligate Species
Schoenoplectus corymbosus	Common Sedge Basket Grass	Obligate Species
Schoenoplectus muricinux	-	Obligate Species

Scientific Name	Common Name	Classification of Plant Species According to Occurrence in Wetlands
Typha capensis	Common Bulrush	Obligate Species
Trees		
*Acacia mearnsii***	Black Wattle	Facultative Species
*Eucalyptus camaldulensis***	River Red Gum	Facultative Wetland Species
*Gleditsia triacanthos***	Honey Locust	Facultative Species
*Melia azedarach***	Syringa	Facultative Species
*Morus alba***	White Mulberry	Facultative Species
*Opuntia ficus-indica***	Sweet Prickly Pear	Facultative Species
*Populus x canescens***	Grey Poplar	Obligate Species
*Robinia pseudoacacia***	Black Locust	Facultative Wetland Species
*Schinus molle**	Peruvian Pepper	Facultative Wetland Species
*Solanum mauritianum***	Bugweed	Facultative Species
*Tamarix ramosissima***	Pink Tamarisk	Facultative Wetland Species
**Exotic Species* ***Category 1b Listed Invasive Species according to the NEM:BA Alien and Invasive Species Regulations 2020 (GNR 1003 in GG 43726 dated 18 September 2020 – effective from 18 October 2020)*		

Figure 8-2: Channelled Valley Bottom Wetlands Observed on Site

Figure 8-3: Unchannelled Valley Bottom Wetland Observed on Site

Figure 8-4: Pans Observed on Site

Figure 8-5: Seeps Observed on Site

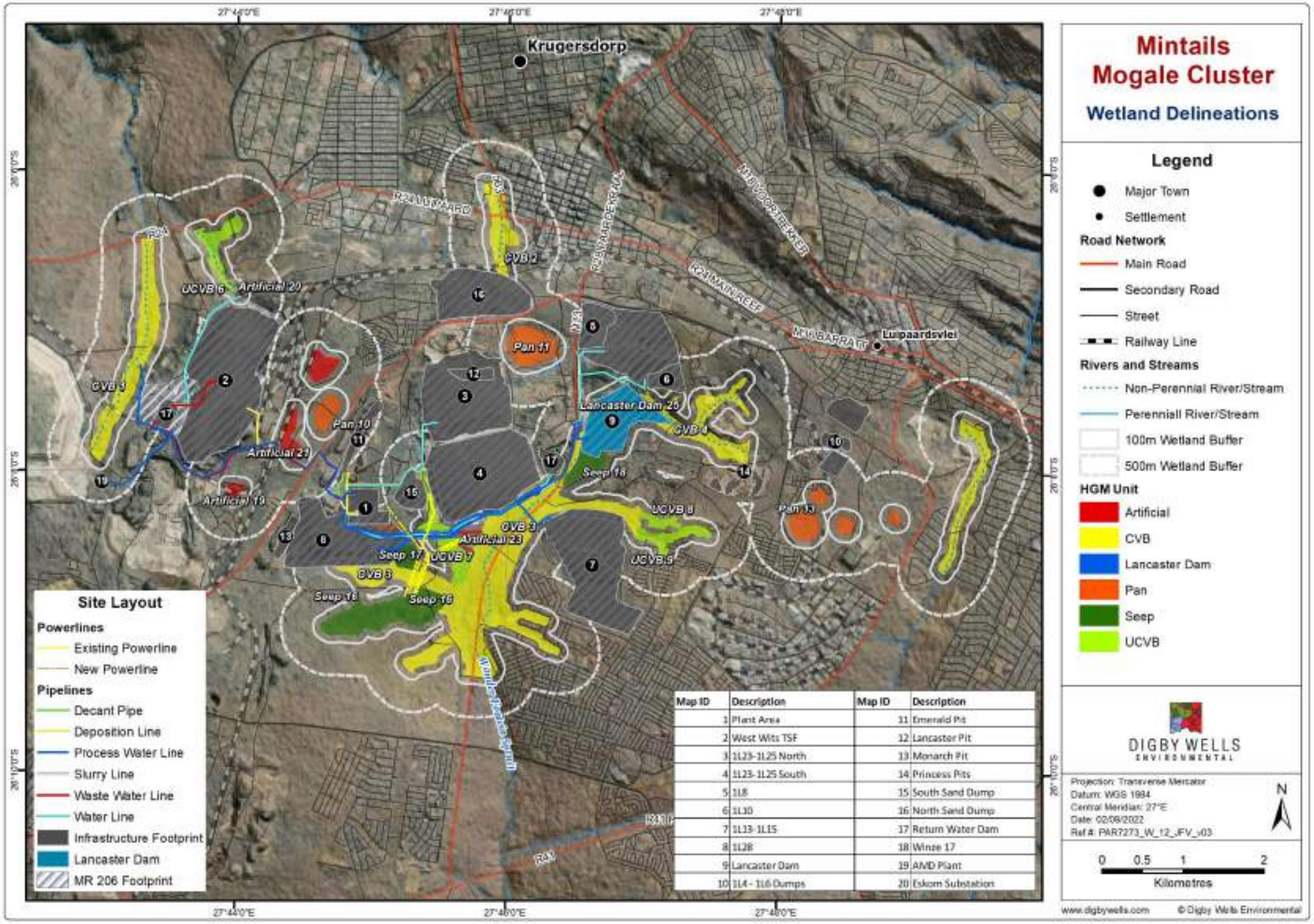


Figure 8-6: Wetland Delineation of the Project Area

8.3. Wetland Assessment

The wetland PES, EcoServices and EIS were calculated accordingly.

8.3.1. Wetland Ecological Health Assessment (WET-Health)

Guidance Note:

According to Macfarlane, Kotze, & Ellery (2009), the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A level 2 WET-Health assessment was done on the wetlands in accordance with the method described by Macfarlane et al. (2020) to determine the integrity (health) of the characterised HGM units for the Project Area.

A PES analysis was conducted to establish baseline integrity (health) for the associated wetlands. The PES assessment attempts to evaluate the hydrological, geomorphological and vegetation health in three separate modules to attempt to estimate similarity to or deviation from natural conditions.

The wetlands were categorised as **Category E and F Wetlands**. According to the integrity (health) method described by Macfarlane et al. (2009; 2020), a **Category E** Wetland is **Seriously Modified**. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable. Whereas a **Category F** wetland is **Critically Modified** as modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.

Mining and industry are prevalent in the catchment The current impacts on the wetlands have resulted in severely impacted systems:

- Wind and water erosion has resulted in tailings sedimentation within the wetland systems. The tailings has smothered vegetation, altered flow patterns, impacted water quality and reduced the quality of habitat for flora and fauna. Furthermore, human life is impacted through reduction of habitat quality for watering of livestock and domestic water use;
- Artisanal mining is rife and has resulted in diggings in various wetland. This alters the hydrological and geomorphological aspects of the wetland systems. Water quality is also impacted through the chemical utilised in the Artisanal and Small-Scale Mining (ASM) processes;
- Mining infrastructure has resulted in a complete loss of some wetlands. Construction of infrastructure results in cleared vegetation, altered flow patterns, impacted water quality and reduced the quality of habitat for flora and fauna;
- Construction and vegetation clearing have resulted in bare soil, the formation of preferential flow paths and the sedimentation of some wetland systems. The systems

provide habitat for floral species that favour this environment and these then proliferate, reducing species diversity;

- Removal of indigenous species and clearing resulting in bare soil, which allows for colonisation by AIPs;
- Fragmentation due to linear infrastructure such as roads, pipelines and powerlines crossing wetlands, resulting in damming effects upstream and desiccation and head cut erosion downstream;
- Trenches have been dug in wetlands to desiccate and divert the water, altering the water retention patterns as well as the geomorphology;
- Water quality impacts due to oil spills, domestic use and stormwater runoff etc.;
- Dams; and
- Discharge of mine/industry/sewage affected water into the various systems has altered water quality and quantity. This has impacted the system in the following ways:
  - Erosion and deep incision due to increased flow;
  - Sedimentation downstream;
  - Increased toxicants in the water; and
  - Head cut erosion upstream.

Table 8-3: Wetland Ecological Health Assessment Scores

HGM Unit No.	HGM Unit	Hydrological PES Score	Geomorphological PES Score	Water Quality PES Score	Vegetation PES Score	Final PES	PES Category
1	Channelled Valley Bottom (CVB)	26%	47%	11%	16%	**25%**	**E**
2	Channelled Valley Bottom (CVB)	21%	32%	5%	13%	**19%**	**F**
3	Channelled Valley Bottom (CVB)	25%	43%	4%	17%	**23%**	**E**
4	Channelled Valley Bottom (CVB)	27%	38%	5%	12%	**23%**	**E**
5	Channelled Valley Bottom (CVB)	25%	48%	5%	16%	**24%**	**E**
6	Unchannelled Valley Bottom (UCVB)	23%	44%	6%	15%	**22%**	**E**
7	Unchannelled Valley Bottom (UCVB)	26%	47%	12%	15%	**25%**	**E**
8	Unchannelled Valley Bottom (UCVB)	13%	53%	16%	8%	**19%**	**F**
9	Unchannelled Valley Bottom (UCVB)	17%	31%	15%	8%	**18%**	**F**
10	Pan						**F**
11	Pan						**F**
12	Pan	3%	42%	4%	14%	**12%**	**F**
13	Pan	18%	34%	13%	8%	**18%**	**F**
14	Pan	4%	27%	10%	14%	**10%**	**F**
15	Pan	7%	38%	13%	23%	**16%**	**F**
16	Seep	7%	74%	27%	13%	**23%**	**E**
17	Seep	9%	71%	27%	16%	**23%**	**E**
18	Seep	12%	70%	27%	19%	**25%**	**E**

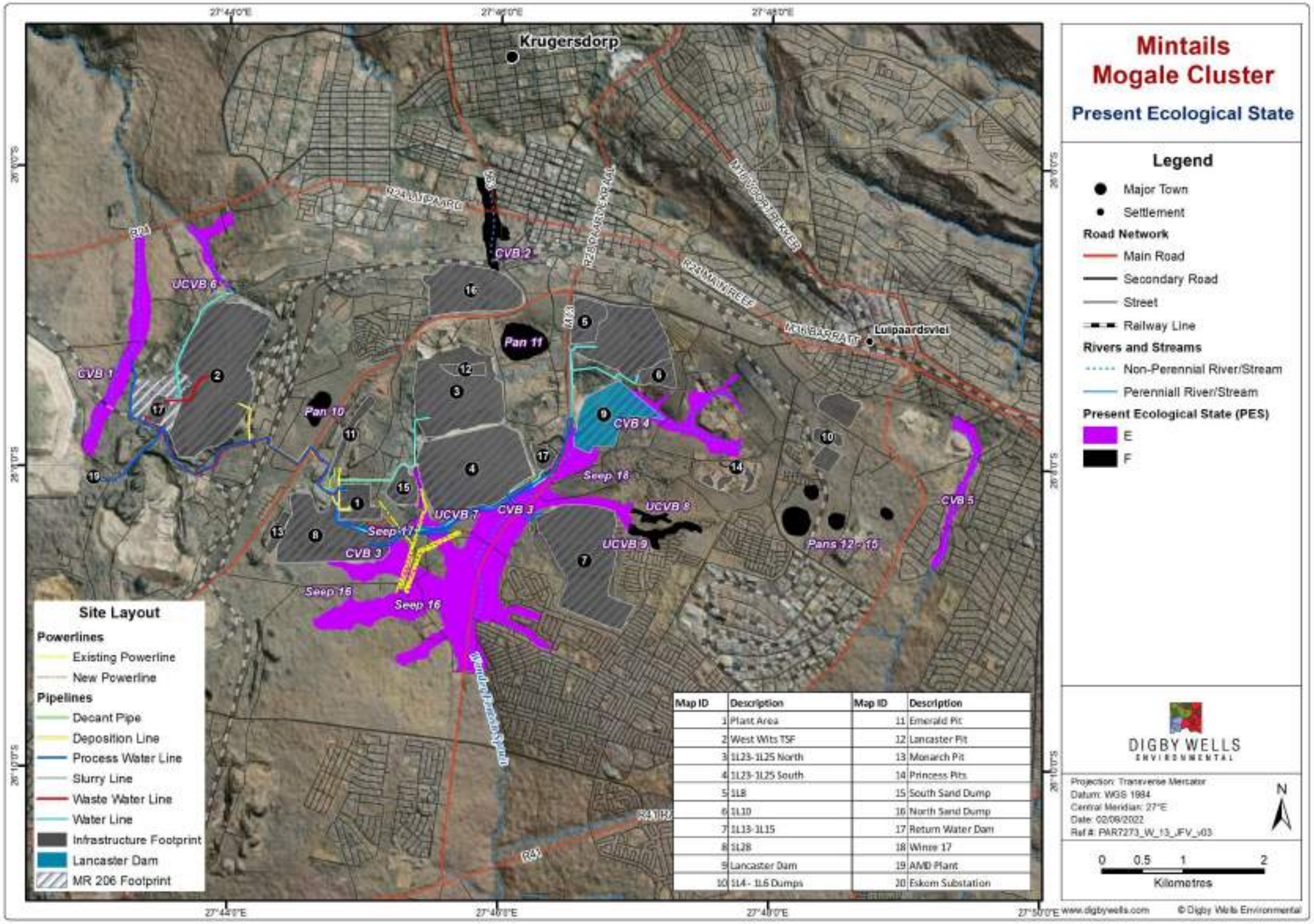


Figure 8-7: Wetland Present Ecological State Categories

Figure 8-8: Wetland Impacts Observed on Site

Figure 8-9: AIP Species Observed on Site

8.3.2. Wetland Ecological Services (WET-EcoServices)

Guidance Note:

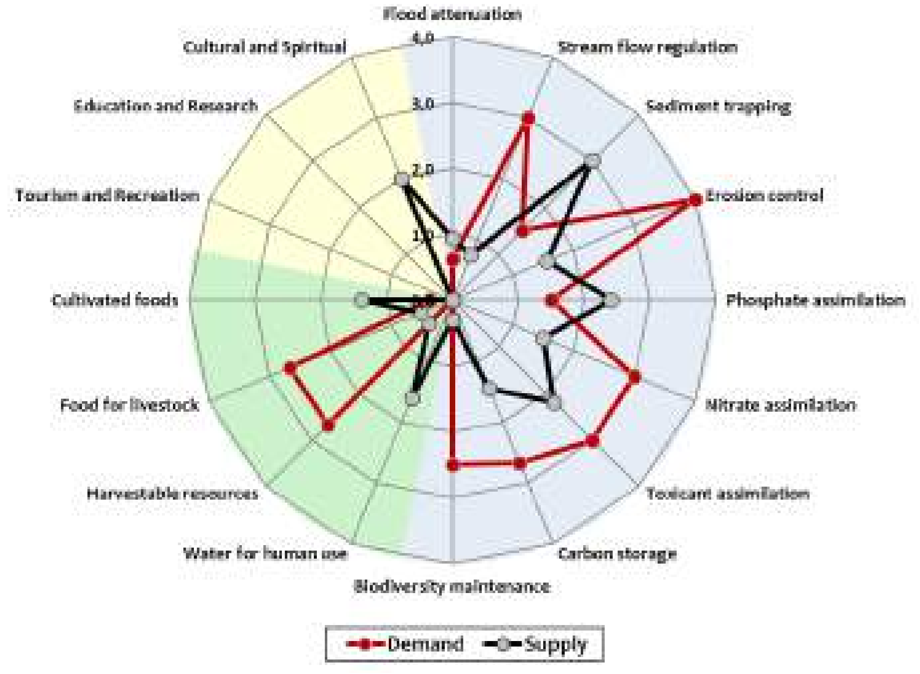
The importance of a water resource in ecological, social or economic terms, acts as a modifying or motivating determinant in the selection of the management class' (South African Department of Water Affairs and Forestry, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines described by Kotze et al. (2020). 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.

The characteristics were used to quantitatively determine the value and, by extension, the 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.

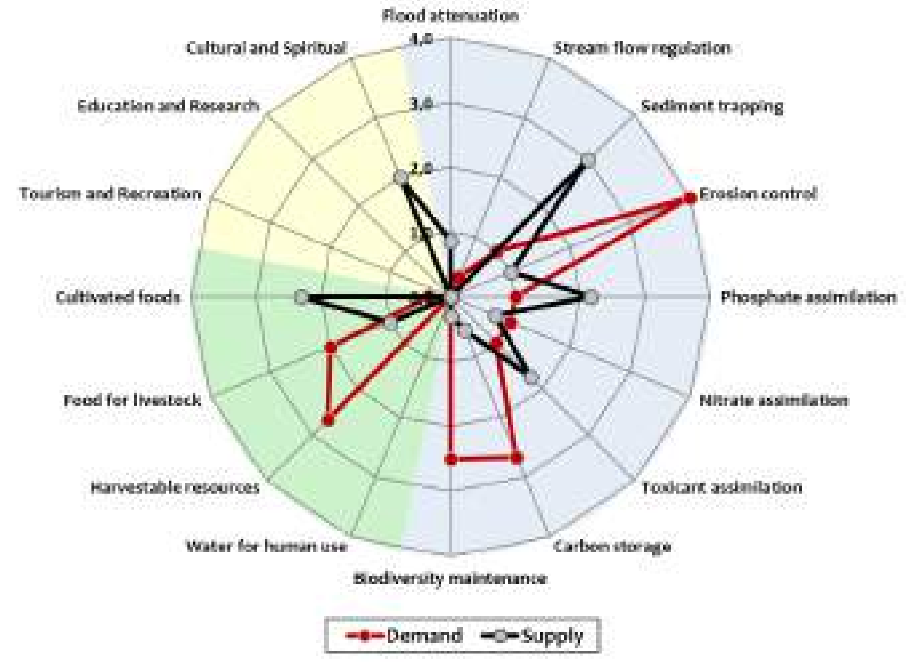
The EcoServices of the HGM units were rated as **Very Low to Moderately Low**. Figure 8-10 represents radial plots showing the relative importance of each ecosystem service and Table 8-4 lists the summary of the scores obtained.

Some of the predominant functions provided by the wetlands include aspects related to the input of tailings material, sewage and chemicals from artisanal mining. Thus the wetlands provide sediment trapping, assimilation of various nutrients and toxicants. Where cattle grazing is prevalent, those wetlands are providing food for livestock

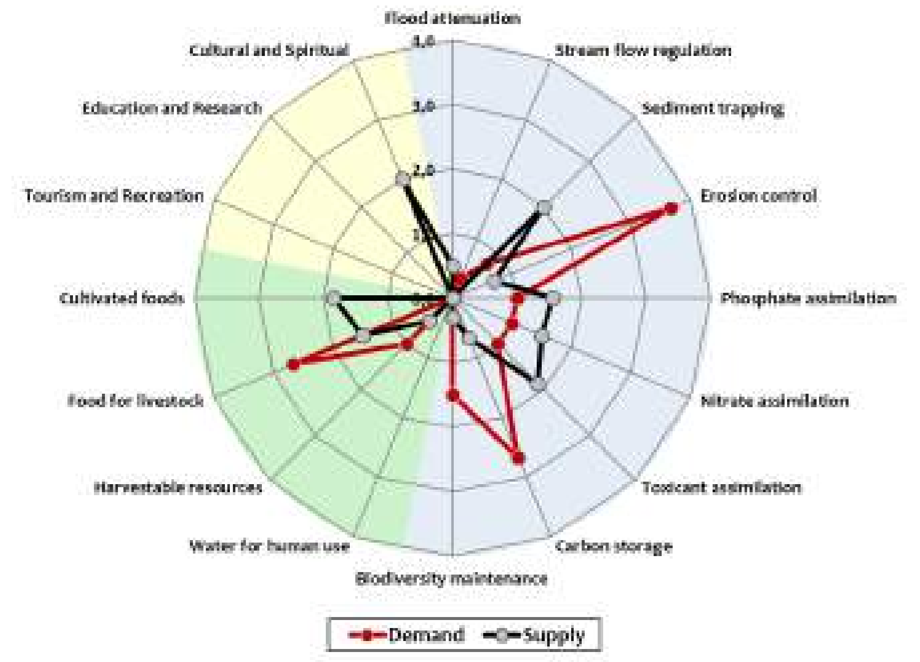
CVB 1, 3, 4 and 5



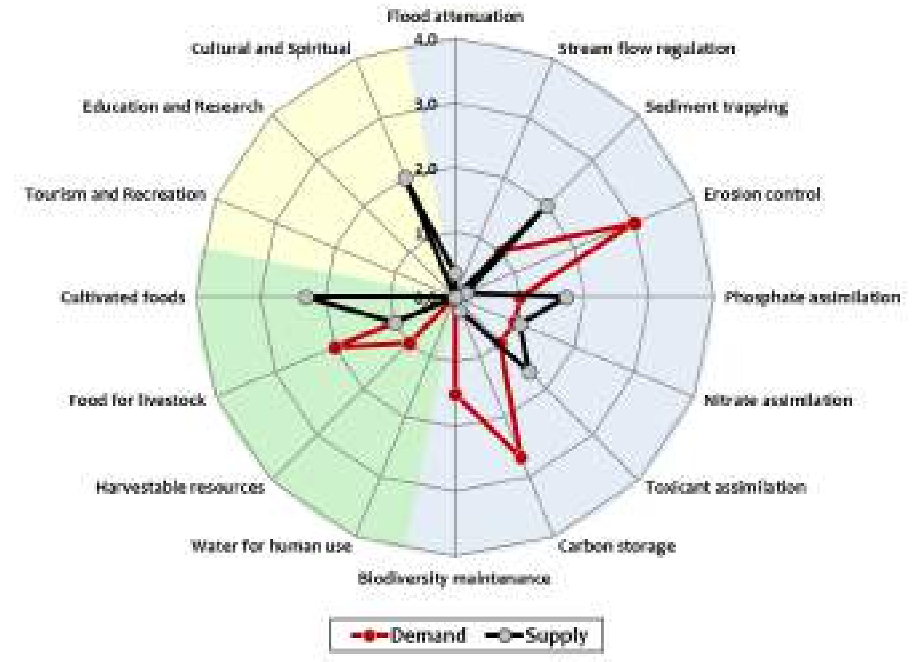
CVB 2



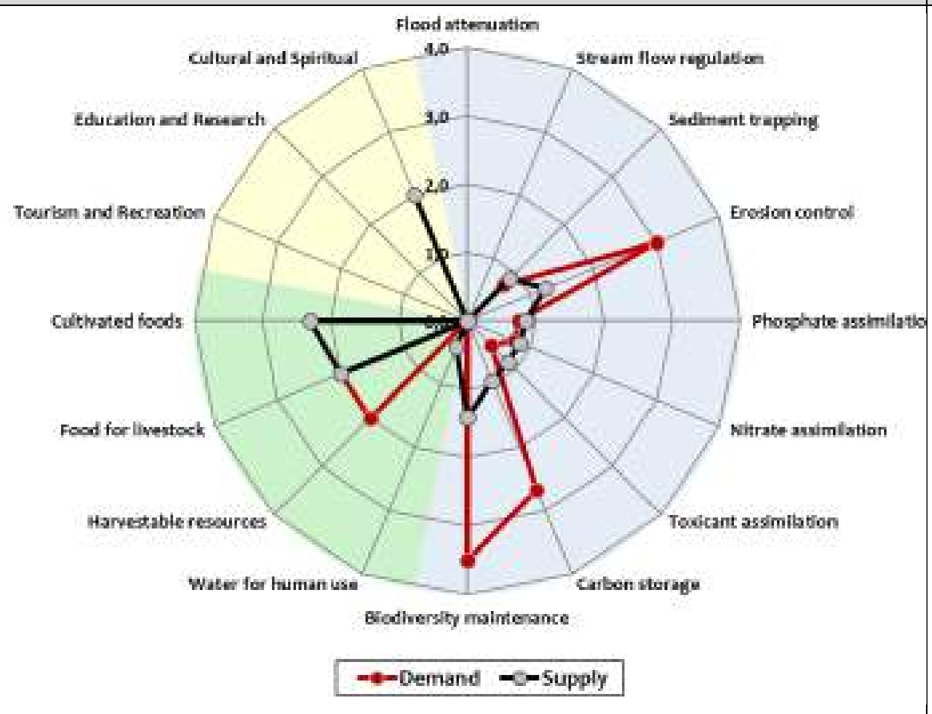
UCVB 6 and 7



UCVB 8 and 9



Pan 10 – 15



Seep 16 – 18

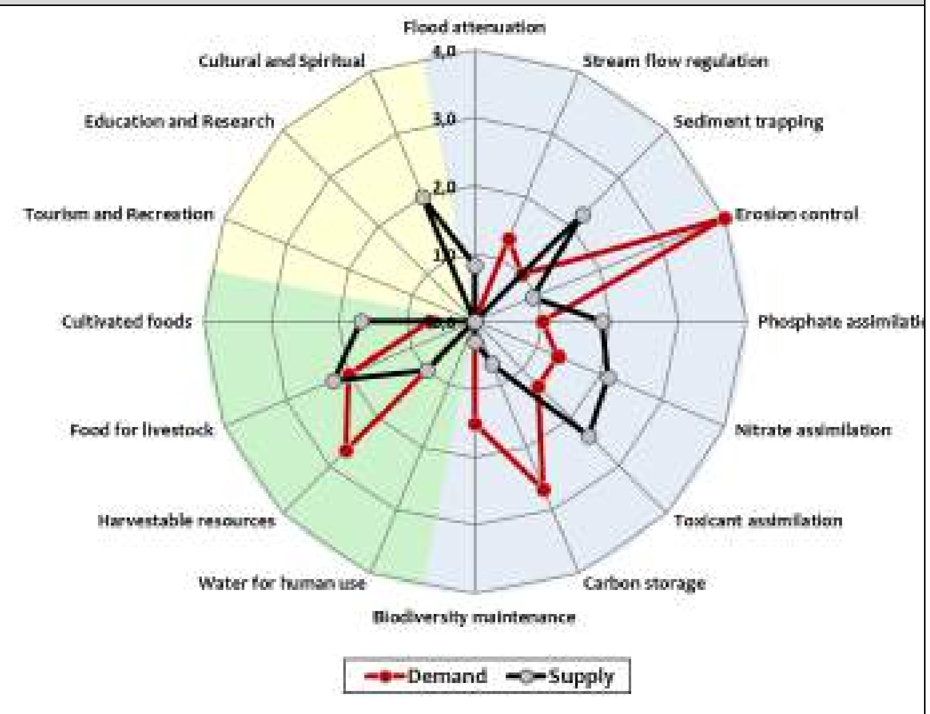


Figure 8-10: Wetland Ecosystem Services Radial Graphs

Table 8-4: Wetland Ecosystem Services Scores

		CVB 1. 3. 4 and 5		CVB 2		UCV 6 and 7		UCVB 8 and 9		Pan 10 – 15		Seep 16 – 18	
ECOSYSTEM SERVICE		Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance	Importance Score	Importance
REGULATING AND SUPPORTING SERVICES	Flood attenuation	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low
	Stream flow regulation	0.8	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low
	Sediment trapping	2.3	Moderate	2.0	Moderate	0.9	Low	1.0	Low	0.0	Very Low	1.3	Low
	Erosion control	2.1	Moderate	1.5	Moderately Low	1.0	Low	0.2	Very Low	1.3	Low	1.4	Moderately Low
	Phosphate assimilation	1.7	Moderately Low	1.2	Low	0.6	Very Low	0.7	Very Low	0.0	Very Low	0.9	Low
	Nitrate assimilation	1.5	Moderately Low	0.0	Very Low	0.5	Very Low	0.1	Very Low	0.0	Very Low	1.3	Low
	Toxicant assimilation	2.2	Moderate	0.8	Very Low	0.9	Low	0.6	Very Low	0.0	Very Low	1.5	Moderately Low
	Carbon storage	1.3	Low	0.4	Very Low	0.5	Very Low	0.1	Very Low	0.8	Very Low	0.5	Very Low
	Biodiversity maintenance	0.1	Very Low	0.1	Very Low	0.0	Very Low	0.0	Very Low	1.7	Moderately Low	0.0	Very Low
PROVISIONING SERVICES	Water for human use	0.1	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low
	Harvestable resources	0.3	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.8	Low
	Food for livestock	0.3	Very Low	0.5	Very Low	1.3	Moderately Low	0.5	Very Low	1.5	Moderately Low	1.8	Moderate
	Cultivated foods	0.0	Very Low	1.0	Low	0.3	Very Low	0.8	Very Low	0.8	Very Low	0.5	Very Low
CULTURAL SERVICES	Tourism and Recreation	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low
	Education and Research	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low	0.0	Very Low
	Cultural and Spiritual	0.5	Very Low	0.5	Very Low	0.5	Very Low	0.5	Very Low	0.5	Very Low	0.5	Very Low
Average Ecological Service Provision		1.46	Moderately Low	0.5	Very Low	0.4	Very Low	0.3	Very Low	0.4	Very Low	0.65	Very Low

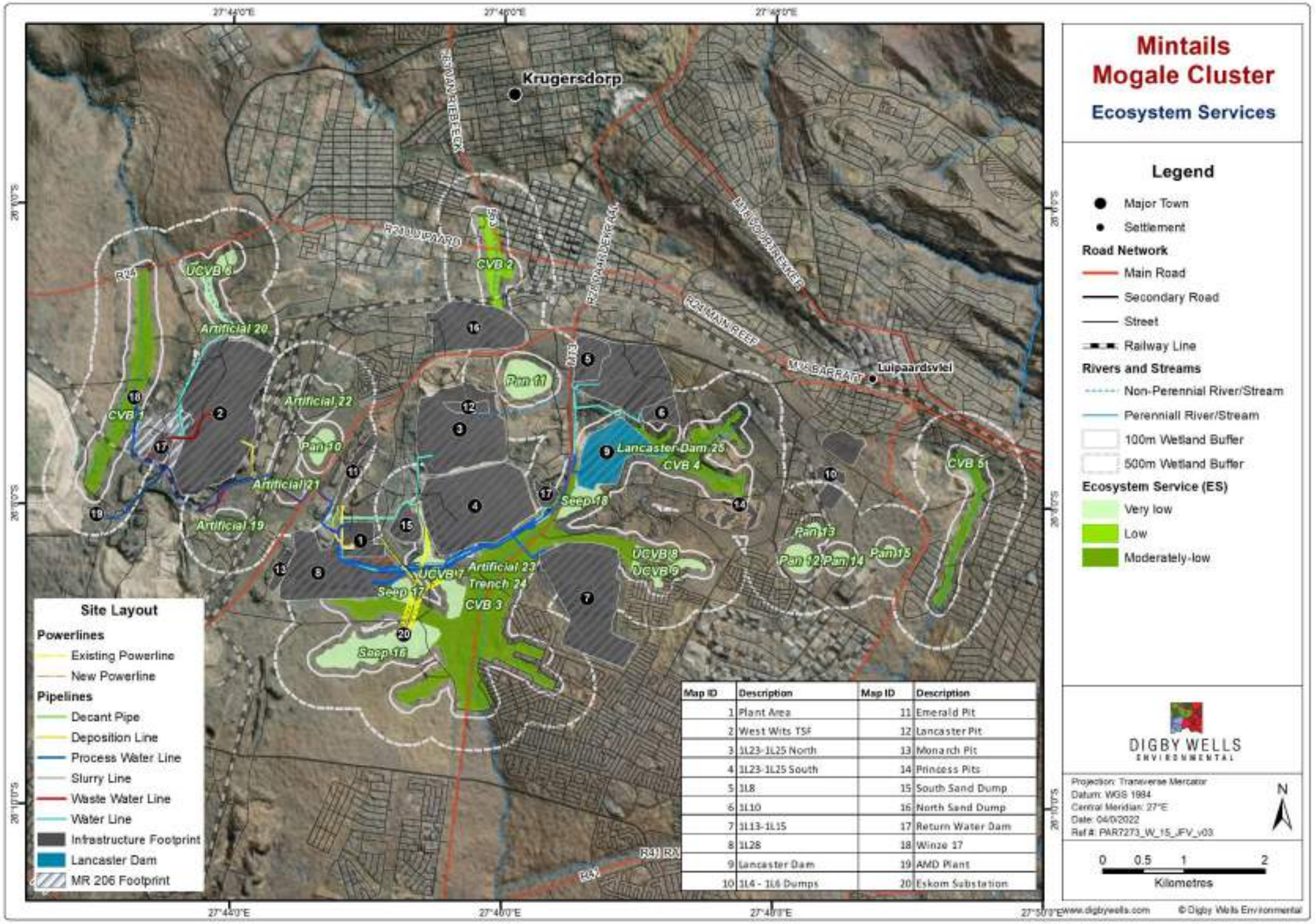


Figure 8-11: Wetland Ecosystem Service Provision

8.3.3. Ecological Importance and Sensitivity (EIS)

Guidance Note:

The ecological importance of a wetland is an expression of its importance to the maintenance of ecological diversity and functioning on a local and wider scale. Additionally, ecological sensitivity refers to the wetland's ability to resist disturbance and capability to recover from disturbance that has occurred (Department of Water Affairs and Forestry, 1999). It is important to note that the EIS score is a combination of the Ecological Importance & Sensitivity, Hydrological/Functional Importance, and the Direct Human Benefits.

The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. This study utilised the methodology outlined by DWAF (1999) and updated in Kotze and Rountree (Kotze, Ellery, Macfarlane, & Jewitt, 2012; Rountree, Malan, & Weston, 2013).

The EIS scores for the delineated wetlands were found to range from **Low/Marginal to Moderate** as shown in Table 8-5 below.

Table 8-5: Wetland Ecological Importance and Sensitivity Scores

HGM Unit No.	HGM Unit	Ecological Importance & Sensitivity	Hydrological/ Functional Importance	Direct Human Benefits	Final EIS	EIS Category
1 – 5	CVB	0.1	0.7	0.7	0.7	Low/Marginal
6 – 9	UCVB	0	0.5	0.7	0.7	Low/Marginal
10 – 15	Pan	1.7	0.3	0.8	1.7	Moderate
16 – 18	Seep	0	0.9	0.8	0.9	Low/Marginal

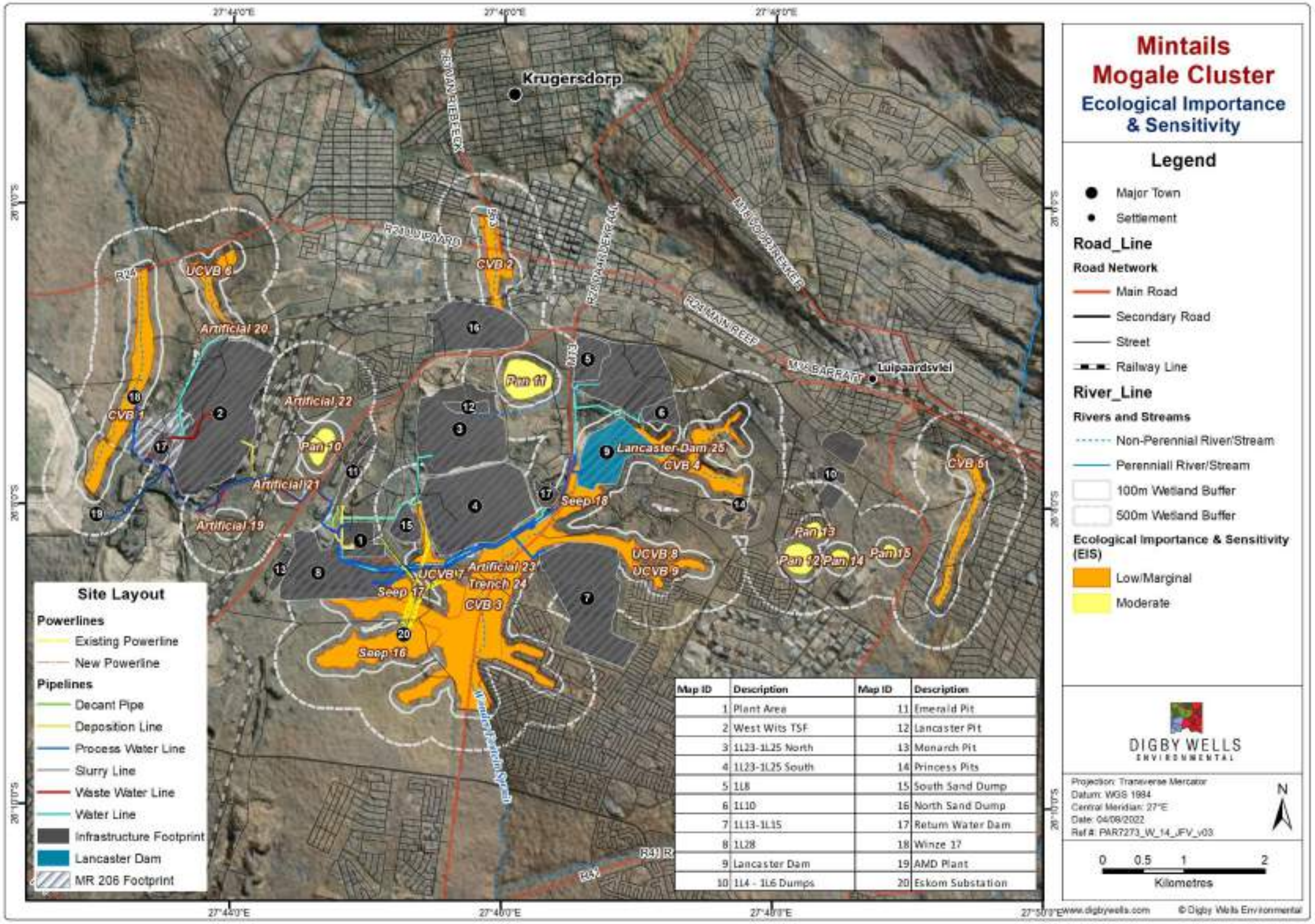


Figure 8-12: Wetland Ecological Importance and Sensitivity

9. Mitigation Hierarchy

Guidance note:

The aim of the Impact Assessment is to strive to avoid damage to, or loss of, ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate.

Based on previous studies and similar projects within the Mpumalanga Province, it is inevitable that the proposed activities will impact on the wetlands. Even when wetlands are avoided, impacts to the wetlands may still arise from other mining activities in the area. Mining particularly affects surface and subsurface water flow in a catchment and consequently affects recharge and discharge of water and the hydrological expression in wetlands.

However, it is not always possible to avoid or prevent impacts and therefore, minimisation of impacts and future rehabilitation should be considered. If this is not possible or feasible, wetland offsetting should be implemented where rehabilitation may be included as part of the Offset Plan.

The mitigation hierarchy for the wetlands within the Study Area are described in Table 9-1 below.

Table 9-1: Mitigation Hierarchy

Mitigation Step	Actions
Avoid or prevent	*Consider options to avoid impacts on biodiversity, ecosystem services and people (e.g., project location, siting, scale, layout, technology and project phase). This is the best option, however not always possible. Where the social and environmental impacts are too high, mining should not take place as it would be unlikely to rely on the taller steps to prove effective remedy for impacts.*
	• Avoid mining and infrastructure within all delineated wetlands; and • Establishment of a 500 m buffer zone to protect wetlands from infrastructure and mining. This would require that development occur further than 500 m from a delineated wetland area. This will require avoidance of the entire Project Area.
Minimize	*Consider alternatives to minimise impacts on biodiversity and ecosystem services (e.g., project location, scale, technology and layout). In areas where the environmental and social constraints are not too high, minimising should still be taking place.*
	• Avoid mining and infrastructure within wetlands with a High and Medium Sensitivity that could lead to impacts (e.g., subsidence, dewatering, decanting and contamination); • Establish at least a 100 m buffer around the wetlands to protect wetland areas from infrastructure and mining within the Project Area. This would

<table>
<tr><th>Mitigation Step</th><th>Actions</th></tr>
<tr><td></td><td>require that development occur further than 100 m from a delineated wetland;
Select wetlands on-site to avoid (High Sensitivity) and rehabilitate to minimize the impacts on wetlands within the catchment and Project Area; and
Consider moving infrastructure outside wetlands and the 100 m buffer zone.
This will require moving the proposed infrastructure areas outside delineated wetlands.</td></tr>
<tr><td rowspan="2">Rehabilitate</td><td>Rehabilitate areas where impacts were unavoidable. Measures must be taken to return impacted areas to conditions ecologically similar to their 'pre-mining natural state' or an agreed land use after mine closure. Rehabilitation is important and necessary, however even with significant resources and effort, rehabilitation is limited and almost always falls short of replicating the biodiversity and complexity of a natural system.</td></tr>
<tr><td>Rehabilitate selected wetlands within the Project Area (impacted by surface infrastructure and potential underground mining impacts);
Recreate wetlands on-site after mining and rehabilitation;
Monitor and mitigate wetlands affected by decanting, subsidence, contamination and dewatering of wetlands; and
Ensure concurrent rehabilitation with special attention to reshaping the areas, re-vegetating and mitigation of decanting and contamination.
Not all wetlands will be restored to pre-mining conditions, therefore wetland offsetting will still have to be considered.</td></tr>
<tr><td rowspan="2">Offset</td><td>Compensating for remaining and residual (unavoidable) negative impacts on the biodiversity. Offset should be implemented when every effort has been made to minimise and rehabilitate remaining impacts to a degree of 'no net loss' of biodiversity against biodiversity targets.</td></tr>
<tr><td>Develop and implement a Wetland (biodiversity) Offset Strategy and Rehabilitation Plan for the wetlands in the Project Area that will be unavoidable; and
Monitor and mitigate subsidence, dewatering, decanting and contamination of wetlands.
This is a costly activity and requires selecting wetlands outside the impacted area to rehabilitate. This could lead to cost implications and often entails selecting wetlands located outside the current catchment. However, due to the size of the MRA, wetlands within the MRA could be selected to implement offsetting.</td></tr>
</table>

10. Wetland Impact Assessment

Guidance Note:

This section aims to rate the significance of the identified potential impacts pre-mitigation and post-mitigation. The potential impacts identified in this section are a result of both the environment in which the proposed project activities take place, as well as the actual activities. The potential impacts are discussed per aspect and per each phase of the Project, i.e., the Construction Phase, Operational and Rehabilitation/Closure Phases where applicable.

Mitigation measures in this section are provided to avoid, minimise and rehabilitate wetlands within the Project Area. However, due to the loss of wetlands, it is recommended to develop and implement a Wetland Offset Strategy to compensate for the wetlands lost.

The mitigation hierarchy includes firstly the avoidance of an impact. When it is not possible to avoid an impact, such as in the case of during the Construction and Operational Phases, the next step is or to minimise the impact and thereafter rectify or reduced the impact. When it is not possible to rectify or reduce the impact, offsets need to be implemented.

Activities during the Construction, Operational and Rehabilitation Phases that may have potential impacts on the wetlands are described below. Wetlands directly impacted by the proposed surface infrastructure, needs to be avoided and minimised as far as possible, when it is not possible to avoid impacts, the wetlands need to be rehabilitated and or offset implemented (Figure 10-1).

Wetlands impacted by underground mining activities, such as subsidence, groundwater contamination, dewatering and decanting must be rehabilitated. A wetland Offset Calculation must be done to determine the residual impacts to the wetlands. Offsetting must be implemented to compensate for the hectare equivalent lost (“like-for-like”).

The following are discussed below:

- Table 10-1: Interactions and Impacts of Activity;
- Table 10-2: Pre-mitigation Impact Ratings;
- Table 10-3: Mitigation Measures; and
- Table 10-4: Post-mitigation Rating.

Figure 10-1: Wetland Sensitivity

Table 10-1: Interactions and Impacts of Activity

Project Phase	Associated Activities	Impact	Description
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Loss of vegetation and biodiversity. • Fragmentation and degradation of freshwater ecosystems. • Loss of water supply and catchment yield. • Increased runoff and creation of preferential flow paths. • Increased erosion. • Sedimentation and increased sediment loads into freshwater ecosystems. • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems.	• The site clearance, removal of vegetation, soil stripping and stockpiling will result in the complete loss of wetlands within the vicinity of the proposed infrastructure. This will alter the hydrological regime and flow of water to adjacent and downstream wetlands and watercourses. This could contribute to further loss of wetlands adjacent and downstream of the infrastructure area, referred to as indirect loss. • Construction of infrastructure (i.e., linear infrastructure, PCD, STP, shaft, workshops etc.) will result in complete and or partial loss of wetlands within the proposed infrastructure area. Construction may possibly lead to soil compaction, increased surface runoff and increased risk of erosion, contamination and sedimentation of the wetlands. • Among the impacts associated with the proposed decommissioning project are potential impacts to soil and water quality as a result of the ingress of hydrocarbons and mechanical spills associated with moving machinery required for the decommissioning activities. The contamination of water resources will result in the deterioration of water quality which will result in impacts to the aquatic faunal species, terrestrial faunal species and vegetation. • Larger impacts include compaction of soils, potential loss of natural vegetation and the increased potential for erosion and sedimentation in the decommissioned areas and resulting in impacts further downstream. • With unregulated use of existing dirt roads across wetlands and indiscriminate driving and movement of heavy machinery across wetland areas, vegetation establishment will be hindered and erosion will be promoted. These impacts have the potential to increase sediment loads being deposited, which in turn may result in the establishment and further spread of invasive hydrophytic plants and loss of stream flow and natural refuge areas in the aquatic systems further downstream. • Removal of vegetation and disturbance of soils in the vicinity of the decommissioning footprint is likely to give rise to an increased potential for encroachment by robust pioneer species and alien invasive vegetation species, further altering the natural vegetation profiles of the wetlands encountered in the vicinity of the decommissioning footprint. • Increased flow velocity from hardened surfaces and concentrated flow may increase the erosion risk and sedimentation of water resources. Stockpiles and dumps might erode and cause sedimentation of downstream and adjacent wetlands and water courses as well as lead to soil and water contamination. • loss of stream connectivity, loss of refuge areas, alterations to the terrain profiles of the areas and the creation of preferential flow paths, which may result in sedimentation, alterations to the vegetation structure of the area, encourage alien vegetation encroachment and result in increased erosion and sedimentation potentials.
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.		

Project Phase	Associated Activities	Impact	Description
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps. Operation of pump stations during the operational phase. Maintenance of pipeline routes during the operational activities. Infilling of processed tailings material into the West Pits Pit and other potential pits. Surface tailings deposition within the West Wits Pit. Tailings deposition onto the historic footprint of 1L23-1L25. Production of gold. Progressive rehabilitation of the new tailings facility footprints (West Pits TSF and 1L23-1L25 TSF.	Negative impacts: • Increased vehicle movement in the area, increasing soil compaction and runoff potential. • Potential spillage of hydrocarbons or material thus contamination of the freshwater ecosystems. • Sedimentation and increased sediment loads into wetlands. • Water quality impairment through seepage/ groundwater contamination of the deposition into unlined facility. Positive impacts: • Removal of contaminant source. • Removal of sedimentation source.	• Various unplanned and residual impacts to the wetlands may occur due to the surface infrastructure. This could potentially lead to water and soil contamination, leading to contamination of the low-lying areas such as wetlands. Contamination of the environment will lead to deterioration and loss of biodiversity, habitat, clean water and have various social constrains. • The disturbance of areas may potentially exacerbate the spread of Alien invasive plant species. • The reclamation will result in exposed surfaces for prolonged periods and the generation of loose contaminated material which may be washed to downstream wetlands and water courses that may lead to sedimentation and contamination. The exposed surfaces will have no ability to slow water flow and as such may cause an altered or elevated water flow to the wetland areas which may prompt the onset of erosion in wetland areas. • However, due to the nature of the activities to be undertaken (mining of historical gold tailings material), impacts from the operational and decommissioning phases may be positive. Reclamation of the tailings material will reduce the quantity of tailings that could potentially wash into downstream wetland systems thereby reducing contamination and sedimentation.
Decommissioning Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints. Removal, decommissioning and rehabilitation of the processing plant footprint. Rehabilitation of the old TSF footprints. Rehabilitation of the old Mogale Processing Plant footprint. Final rehabilitation of the facility. General rehabilitation of the surrounding area, including wetland rehabilitation.	Negative impacts: • Sedimentation and increased sediment loads into freshwater ecosystems. • Fragmentation and degradation of freshwater ecosystems. • Increased erosion. • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems. • Increased AIPs due to soil disturbance. Positive impacts: • Increase basal cover thereby reducing sedimentation and contamination.	• During the decommissioning and rehabilitation activities, the soils could potentially be compacted, leading to increased erosion, loss of effective rooting depth, water and root penetration, water holding capacity and soil fertility. The movement of heavy machinery on the soil surface causes compaction, which reduces the vegetation’s ability to grow and as a result erosion. Soils might be lost due to erosion from unprotected surfaces. • Rehabilitation activities will cover the extent of the infrastructure footprint areas and will include ripping, spreading of overburden and topsoil and establishment of vegetation. The first phase of the rehabilitation plan (demolishing of infrastructure) will have a negative effect on the soil, land use and land capability, however when rehabilitation of these areas commence, the land capability status will increase, being an positive effect. It would be the optimal to rehabilitate the Project Area to at least cattle grazing and wildlife. • The activities will reduce the current impacted area significantly as well as focus on rehabilitating the area. This will have significant positive impacts on the soils, land use, land capability, environment, water and overall functionality of the area.

10.1. Impact Ratings

Table 10-2 and Table 10-4 present the impact ratings associated with the Project for all the phases prior to and post-mitigation, whereas Table 10-3 presents the mitigation measures to be implemented to avoid, reduce, and rehabilitate impacts.

Table 10-2: Pre-mitigation Impact Ratings

Pre-Mitigation Rating								
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Loss of vegetation and biodiversity. • Fragmentation and degradation of freshwater ecosystems. • Loss of water supply and catchment yield. • Increased runoff and creation of preferential flow paths. • Increased erosion. • Sedimentation and increased sediment loads into freshwater ecosystems. • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems.	Permanent (7)	Municipal (4)	High (-5)	Definite (7)	Negative	Major (-112)
	Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.		Permanent (7)	Local (3)	Moderately High (-4)	Definite (7)	Negative	Moderate (-98)
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps.	• Increased vehicle movement in the area, increasing soil compaction and runoff potential. • Potential spillage of hydrocarbons or material thus contamination of the freshwater ecosystems. • Sedimentation and increased sediment loads into wetlands. • Water quality impairment through seepage/ groundwater contamination of the deposition into unlined facilities.	Project Life (5)	Limited (2)	Moderately High (-4)	Definite (7)	Negative	Moderate (-77)
	Operation of pump stations during the operational phase.		Project Life (5)	Limited (2)	Moderate (-3)	Likely (5)	Negative	Minor (-50)
	Maintenance of pipeline routes during the operational activities.		Project Life (5)	Very Limited (1)	Moderate (-3)	Likely (5)	Negative	Minor (-45)
	Infilling of processed tailings material into the West Pits Pit and other potential pits.		Permanent (7)	Local (3)	Serious (4)	Almost likely (6)	Negative	Moderate (-84)
	Surface tailings deposition within the West Wits Pit.		Permanent (7)	Local (3)	Serious (4)	Almost likely (6)	Negative	Moderate (-84)
Rehabilitation Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.	• Sedimentation and increased sediment loads into freshwater ecosystems. • Fragmentation and degradation of freshwater ecosystems. • Increased erosion. • Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems.	Long Term (4)	Limited (2)	Moderate (-3)	Definite (7)	Negative	Minor (-63)
	Removal, decommissioning and rehabilitation of the processing plant footprint.		Long Term (4)	Limited (2)	Moderately High (-4)	Definite (7)	Negative	Minor (-70)
	Rehabilitation of the old TSF footprints.		Medium Term (3)	Local (3)	Moderately High (-4)	Highly Probable (6)	Negative	Minor (-60)
	Rehabilitation of the old Mogale Processing Plant footprint.		Medium Term (3)	Local (3)	Moderately High (-4)	Highly Probable (6)	Negative	Minor (-60)

Pre-Mitigation Rating								
Project Phase	Project Activity	Impact	Duration/ Reversibility	Extent	Intensity/ Replicability	Probability	Nature	Significance
	Final rehabilitation of the facility.	• Increased AIPs due to soil disturbance.	Medium Term (3)	Local (3)	Moderate (-3)	Highly Probable (6)	Negative	Minor (-54)
	General rehabilitation of the surrounding area, including wetland rehabilitation.		Medium Term (3)	Limited (2)	Moderately High (-4)	Highly Probable (6)	Negative	Minor (-54)

Table 10-3: Mitigation Measures

Project Phase	Mitigation Measures
Construction Phase	• Environmental Practitioner to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area. • Limit vegetation removal activities to the infrastructure footprint area only, where removed or damaged vegetation areas should be revegetated as soon as possible with a suitable mix of plant species as determined by a qualified botanist. • No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas. All vehicles must remain on demarcated roads and within the rehabilitation footprint and access roads. • Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing. • Ensure a soil management programme is implemented and maintained to minimize erosion and sedimentation. • Locate stockpiles outside wetlands and at least a 100 m buffer. • Stripped topsoil stockpiles and bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel. • Implement the Storm Water Management Plan (SWMP). • Implement concurrent rehabilitation to prevent and minimise impacts to the freshwater systems.

Project Phase	Mitigation Measures

Operational Phase	• Ensure that sound environmental management is in place during the proposed operational phase.
	• Ensure that as far as possible all operational activities take place outside of wetland/riparian areas and their associated 100 m zone of regulation.
	• Limit the footprint area of the operational activities to what is absolutely essential in order to minimise impacts as a result of vegetation clearing and compaction of soils.
	• Ensure that no incision and canalisation of the wetland features present takes place as a result of the proposed operational activities.
	• All erosion noted within and in the vicinity of the area footprint should be remedied immediately and included as part of the ongoing rehabilitation plan.
	• All soils compacted as a result of operational activities should be ripped and profiled.
	• A suitable alien-vegetation control programme must be put in place so as to prevent further encroachment as a result of disturbance to the surrounding terrestrial zones.
	• Permit only essential personnel within the 100 m buffer for all wetland features identified.
	• All areas of increased ecological sensitivity should be designated as “No-Go” areas and be off limits to all unauthorised vehicles and personnel.
	• No crossing of the wetland features and their associated buffers should take place and the substrate conditions of the wetlands and downstream stream connectivity must be maintained.
	• No material may be dumped or stockpiled within any wetland areas in the vicinity of the proposed decommissioning footprint.
	• No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zone of regulation. All vehicles must remain on demarcated roads and within the Project area footprint.
	• All vehicles must be regularly inspected for leaks and re-fuelling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil.
	• All spills should be immediately cleaned up and treated accordingly.
	• Water quality with special mention of pH, dissolved salts and specific problem substances like pyrites need to be managed, and monitored in order to ensure that reasonable water quality occurs downstream of the mined areas to allow for the on-going survival of wetland and aquatic communities of some diversity and reasonable sensitivity.
	• Appropriate sanitary facilities must be provided for the duration of the operational activities and all waste must be removed to an appropriate waste facility.
	• During the operational phase, erosion berms should be installed on roadways and in the vicinity of disturbed soils and cleared vegetation soils as well as in areas where tailings or contaminated soils are reclaimed or removed to prevent gully formation and siltation of the wetland areas. The following points should serve to guide the placement of erosion berms:
	    • Where the track has slope of less than 2%, berms every 50 m should be installed.
	    • Where the track slopes between 2% and 10%, berms every 25 m should be installed.
	    • Where the track slopes between 10%-15%, berms every 20 m should be installed.
	    • Where the track has slope greater than 15%, berms every 10 m should be installed.

Project Phase	Mitigation Measures
Decommissioning Phase	• Wetland monitoring must be carried out during both the decommissioning and rehabilitation phases to ensure no unnecessary impact to wetlands takes place. Monitoring should take place on an annual basis during the summer/wet season and carried out by an independent consultant for the duration of the decommissioning phase. Monitoring should continue to take place every two years until the systems are considered stable. • Ongoing wetland rehabilitation is necessary both within and in the vicinity of the proposed decommissioning footprint and appropriate wetland monitoring techniques must take place on an annual basis during the summer/wet season in order to identify any emerging issues, trends or improvements in the receiving environment. • Wetlands and their associated 100 m zone of regulation, to be clearly demarcated and avoided. • An AIP management plan to be implemented and managed for the life of the proposed decommissioning, rehabilitation, closure and post-closure phases of the proposed decommissioning and rehabilitation project. • As much vegetation growth as possible should be promoted within the proposed development area during all phases. In order to protect soils and vegetation, clearance should be kept to a minimum as the biomass in the area is not very high and so therefore plants will not grow quickly. • All areas where active erosion is observed should be ripped, re-profiled and seeded with indigenous grasses. • Preventative measures such as hessian sheeting should be used in steep re-seeded areas where high erosion potentials exist. • The use of indigenous phyto-remediation specific grass, forb and tree species is encouraged. • No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas and their associated zones of regulation. All vehicles must remain on demarcated roads and within the project area footprint. • Compacted soils should be ripped, re-profiled and re-seeded. • All vehicles must be regularly inspected for leaks and re-fueling must take place on a sealed surface area to prevent ingress of hydrocarbons into topsoil. • All existing litter, debris should be removed from the wetland areas and littering should be prohibited on an ongoing basis. • All spills should be immediately cleaned up and treated accordingly. • Appropriate sanitary facilities must be provided for the duration of the rehabilitation activities and all waste must be removed to an appropriate waste facility.

DIGBY WELLS ENVIRONMENTAL

Table 10-4: Post-mitigation Rating

<table>
<tr><th colspan="10">Post-Mitigation Rating</th></tr>
<tr><th>Project Phase</th><th>Project Activity</th><th>Impact</th><th>Duration/ Reversibility</th><th>Extent</th><th>Intensity/ Replicability</th><th>Probability</th><th>Nature</th><th>Significance</th></tr>
<tr><td rowspan="2">Construction Phase</td><td>Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.</td><td rowspan="2">• Loss of vegetation and biodiversity.
• Fragmentation and degradation of freshwater ecosystems.
• Loss of water supply and catchment yield.
• Increased runoff and creation of preferential flow paths.
• Increased erosion.
• Sedimentation and increased sediment loads into freshwater ecosystems.
• Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems.</td><td>Permanent (7)</td><td>Limited (2)</td><td>Moderately High (-4)</td><td>Highly Probable (6)</td><td>Negative</td><td>Moderate (-78)</td></tr>
<tr><td>Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.</td><td>Permanent (7)</td><td>Limited (2)</td><td>Moderate (-3)</td><td>Highly Probable (6)</td><td>Negative</td><td>Minor (-72)</td></tr>
<tr><td rowspan="5">Operational Phase</td><td>Hydraulic reclamation of the associated historic tailings facilities and sand dumps.</td><td rowspan="5">• Increased vehicle movement in the area, increasing soil compaction and runoff potential.
• Potential spillage of hydrocarbons or material thus contamination of the freshwater ecosystems.
• Sedimentation and increased sediment loads into wetlands.
• Water quality impairment through seepage/ groundwater contamination of the deposition into unlined facilities – Refer to groundwater report for further information..</td><td>Project Life (5)</td><td>Limited (2)</td><td>Low (-2)</td><td>Likely (5)</td><td>Negative</td><td>Minor (-45)</td></tr>
<tr><td>Operation of pump stations during the operational phase.</td><td>Project Life (5)</td><td>Very Limited (1)</td><td>Low (-2)</td><td>Probable (4)</td><td>Negative</td><td>Negligible (-32)</td></tr>
<tr><td>Maintenance of pipeline routes during the operational activities.</td><td>Project Life (5)</td><td>Very Limited (1)</td><td>Low (-2)</td><td>Probable (4)</td><td>Negative</td><td>Negligible (-32)</td></tr>
<tr><td>Infilling of processed tailings material into the West Pits Pit and other potential pits.</td><td>Permanent (7)</td><td>Local (3)</td><td>Moderate (-3)</td><td>Highly Probable (5)</td><td>Negative</td><td>Minor (-65)</td></tr>
<tr><td>Surface tailings deposition within the West Wits Pit.</td><td>Permanent (7)</td><td>Local (3)</td><td>Moderate (-3)</td><td>Highly Probable (5)</td><td>Negative</td><td>Minor (-65)</td></tr>
<tr><td rowspan="4">Rehabilitation Phase</td><td>Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints.</td><td rowspan="4">Negative impacts:
• Sedimentation and increased sediment loads into freshwater ecosystems.
• Fragmentation and degradation of freshwater ecosystems.
• Increased erosion.
• Potential spillage of hydrocarbons such as oils, fuels and grease, thus contamination of the freshwater ecosystems.
• Increased AIPs due to soil disturbance.</td><td>Medium Term (3)</td><td>Limited (2)</td><td>Low (-2)</td><td>Highly Probable (6)</td><td>Negative</td><td>Minor (-42)</td></tr>
<tr><td>Removal, decommissioning and rehabilitation of the processing plant footprint.</td><td>Medium Term (3)</td><td>Limited (2)</td><td>Low (-2)</td><td>Highly Probable (6)</td><td>Negative</td><td>Minor (-42)</td></tr>
<tr><td>Rehabilitation of the old TSF footprints.</td><td>Permanent (7)</td><td>Local (3)</td><td>Moderate (3)</td><td>Likely (5)</td><td>Positive</td><td>Minor (65)</td></tr>
<tr><td>Rehabilitation of the old Mogale Processing Plant footprint.</td><td>Permanent (7)</td><td>Local (3)</td><td>Moderate (3)</td><td>Probable (4)</td><td>Positive</td><td>Minor (52)</td></tr>
</table>

Post-Mitigation Rating								
Project Phase	**Project Activity**	**Impact**	**Duration/ Reversibility**	**Extent**	**Intensity/ Replicability**	**Probability**	**Nature**	**Significance**
	Final rehabilitation of the facility.	Positive impacts: • Removal of contaminant source. • Removal of sedimentation source. • Progressive rehabilitation may increase basal cover thereby reducing sedimentation and contamination.	Permanent (7)	Local (3)	Moderate (3)	Likely (5)	Positive	Minor (65)
	General rehabilitation of the surrounding area, including wetland rehabilitation.		Permanent (7)	Limited (2)	Moderately High (4)	Likely (5)	Positive	Minor (65)

10.2. Cumulative Impacts

The freshwater resources in this area are currently heavily impacted as a result of various cumulative impacts as a result of extensive mining activities in the area (both historical and artisanal). In addition, other impacts to the freshwater resources present in the vicinity of the proposed project include agricultural cultivation and grazing activities and impacts from increasing urbanisation and other anthropogenic activities.

It is the opinion of the ecologist that should this decommissioning and rehabilitation project be allowed to proceed and the recommended management and mitigation measures supplied in this report are adhered to, the ecological integrity and functioning of the wetland ecosystems present are likely to improve.

10.3. Unplanned and Low Risk Events

There is a risk that wetland areas associated with the mining operations/infrastructure throughout the life of the proposed Project might be affected by the entry of hazardous substances, such as hydrocarbons, in the event of a spillage or unseen seepage from storage facilities; and

Accidents or deterioration of structures along the roadways and river/wetland crossings, including pipelines, may result in impacts to the habitat and water quality.

Table 10-5 outlines mitigation measures that must be adopted in the event of unplanned impacts throughout the life of the proposed Project.

Table 10-5: Unplanned Events and Associated Mitigation Measures

Unplanned Risk	Mitigation Measures
• Chemical and (or) contaminant spills from mining operation, infrastructure and associated activities.	• Ensure correct storage of all chemicals at operations as per each chemical's specific storage requirements (e.g. sealed containers for hydrocarbons). • Ensure staff involved at the proposed Project have been trained to correctly work with chemicals at the sites. • Ensure spill kits (e.g. Drizit) are readily available at areas where chemicals are known to be used. Staff must also receive appropriate training in the event of a spill, especially near wetlands, watercourses and/or drainage lines.
• Unplanned structural deterioration or accidents along the roadways and pipelines in the vicinity of wetlands.	• Install safety valves and emergency switches that can be used to seal off leakages from pipelines when noticed or triggered. • Ensure that spill kits and trained staff capable of using the kits are available on site in case of accidental spillages.

Unplanned Risk	Mitigation Measures
	• Maintenance of roadways, river crossings and pipelines should be considered an ongoing process where leakages or issues with the pipe should be reporting to acting Environmental Control Officer (ECO) of the Project immediately after notice.

11. Environmental Management Plan

The EMP is described in Table 11-1 below.

Table 11-1: Environmental Management Plan

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
Construction Phase	Site clearing for the construction of the new processing plant facility and ancillary infrastructure such as pipelines, pump stations, electrical supply etc. Construction of the new processing plant and ancillary infrastructure such as pipelines, pump stations, electrical supply etc.	• Direct loss of wetlands. • Loss of habitat and biodiversity. • Erosions and sedimentation of adjacent wetlands and water courses. • Water quality contamination and deterioration. • Increased runoff from hardened surfaces. • Increased or decreased water supply to the wetlands systems. • Change in habitat and potential change in species composition.	• Control. if the destruction of wetlands is unavoidable disturbance must be minimised and suitably rehabilitated. • Control. At areas where road crossings have been designed, these roads should cross wetland or river features at the narrowest point and a 90-degree angle with suitable drainage designed into the relevant bridge/culvert crossing. • Control. Environmental Practitioner and botanist to be present during vegetation clearing to prevent unnecessary clearing of extensive areas not part of the direct footprint area. • Control and Remedy. Bare land surfaces must be vegetated to limit erosion from surface runoff associated with infrastructure areas. Revegetate disturbed areas immediately after construction. • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems. • Control and Remedy. If spills have occurred, it should be cleaned up immediately. • Control and Remedy. Run Of Mine (ROM) must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater. • Control and Remedy. ROM stockpiles must be located outside wetlands and at least a 100 m Zone of Regulation.	Concurrent rehabilitation through the life of mine	Life of Construction Phase
Operational Phase	Hydraulic reclamation of the associated historic tailings facilities and sand dumps. Operation of pump stations during the operational phase.	• Impacts to downstream and adjacent wetlands and watercourses: • Loss of habitat and biodiversity. • Erosions and sedimentation. • Water and soil quality contamination	• Remedy. If it is unavoidable that any of the wetlands adjacent and downstream will be affected, the disturbance must be minimised and suitably rehabilitated. • Control. All vehicle maintenance must occur within designated areas. • Control. All vehicles must be regularly inspected for leaks. • Control and Remedy. All spills must be cleaned up immediately to prevent contaminants to enter the wetlands. • Control. Re-fuelling and maintenance must take place on a sealed surface area away from wetlands to prevent the ingress of hydrocarbons into topsoil. • Control and Stop. All areas of increased ecological sensitivity adjacent of the Project Area should be designated as “No-Go” areas and be off-limits to all unauthorised vehicles and personnel. • Control and Stop. No material is to be dumped or stockpiled within any rivers, tributaries or drainage lines. • Control and Remedy. Culverts, roads and river crossings must be maintained, cleared and monitored.	Concurrent rehabilitation through the life of mine	Life of Operational Phase

Phase	Project Activity	Potential Impacts	Mitigation Measures	Mitigation Type	Period for Implementation
	Maintenance of pipeline routes during the operational activities. Infilling of processed tailings material into the West Pits Pit and other potential pits. Surface tailings deposition within the West Wits Pit.	and deterioration. • Increased runoff and flow from hardened surfaces. • Increased or decreased water supply. • Dewatering of wetland adjacent and downstream to the Project Area. • Change in habitat and potential change in species composition.	• Control and Stop. No vehicles or heavy machinery may be allowed to drive indiscriminately within any wetland areas or their Zone of Regulation areas. All vehicles must remain on demarcated roads and within the operational footprint. • Control and Remedy. Stockpiles should be monitored to ensure no runoff, erosion and sedimentation into the adjacent areas, especially the wetlands and freshwater systems. • Control and Remedy. Stockpiles must be allocated to specific areas and stockpiled on hardened surfaces to prevent leaching of contaminants into the soil and groundwater. • Control and Stop. Stockpiles must be located outside wetlands and at least a 100 m Zone of Regulation. • Control and Remedy. A Storm Water Management Plan (SWMP) should already be implemented. This should consider all wetlands and other watercourses adjacent and downstream of the new developments/infrastructure which should divert stormwater and wastewater away from the surface infrastructure and back into natural watercourses to maintain catchment yield as far as possible. The SWMP should also convey contaminated water to silt traps to limit erosion and the subsequent increase of suspended solids in downstream watercourses. • Control and Remedy. Freshwater resource monitoring must be carried out during the operational phase by a wetland specialist to ensure no unnecessary impact to the freshwater resources present, and if so that a remedy is put in place as soon as possible. • Control and Remedy. Care must be taken to ensure that contamination of the receiving environment as a result of mining activities is minimised as far as possible. • Control and Stop. Chemicals, such as paints and hydrocarbons, should be used in an environmentally safe manner with correct storage as per each chemical's specific storage descriptions.		
Rehabilitation Phase	Removal, decommissioning and rehabilitation of surface infrastructure such as pipelines, powerlines, pumps etc. footprints. Removal, decommissioning and rehabilitation of the processing plant footprint. Rehabilitation of the old TSF footprints. Rehabilitation of the old Mogale Processing Plant footprint. Final rehabilitation of the facility. General rehabilitation of the surrounding area, including wetland rehabilitation.	• Impacts to downstream and adjacent wetlands and watercourses: • Erosions and sedimentation. • Increased AIPs. • Change in habitat and potential change in species composition.	• Control and Stop. Rehabilitation should occur in the dry season to avoid high rainfall events that could lead to increased runoff, erosion, contamination and sedimentation of the wetlands. • Control and Remedy. Stormwater must be diverted from or equally spread over newly rehabilitated areas. • Control and Stop. Stored mine-affected water should be treated before reintroduced into the environment. • Modify, Control and Remedy. Actively landscape and re-vegetate disturbed areas as soon as possible to avoid loss of soil, organic material, and sedimentation into wetland areas. • Modify, Control and Remedy. Implement and maintain a Wetland and AIPs Plan for the duration of the rehabilitation phase and into closure. • Control and Stop. No material should be dumped/stockpiled within any wetlands or watercourses. • Control and Stop. No vehicles or heavy machinery should be allowed to drive indiscriminately within any wetland areas or their Zone of Regulation areas. All vehicles must remain on demarcated roads. • Control and Remedy. Wetland monitoring must be carried out during the Rehabilitation phase into mine closure to ensure no unnecessary impact to wetlands takes place. • Modify, Control and Remedy. Rehabilitation must be done as soon as any impacts are observed. • Modify, Control and Remedy. Monitor the decant of Acid Mine Drainage (AMD) and implement management measures which include in-situ passive treatment or neutralisation and electrolytic treatment using a WTP to get purified water for discharge to the natural environment or other beneficial uses. • Modify, Control and Remedy. Newly shaped and topsoiled areas must be revegetated as soon as possible to prevent sedimentation and erosion. • Modify, Control and Remedy. Implement a Wetland Offset Strategy to compensate for the wetlands lost.	Concurrent rehabilitation through the life of mine and after mine	Life of Rehabilitation Phase

12. Monitoring Programme

Guidance Note:

A monitoring programme is essential as a management tool to detect negative impacts as they arise and to ensure that the necessary mitigation measures are implemented together with ensuring effectiveness of the management measures in place.

Monitoring should be done in terms of:

- EIA Regulations, 2014 promulgated under the NEMA;
- NEMA;
- NEM: WA; and
- The CARA.

The Mine Manager and the Environmental Practitioner are responsible to report on results of the monitoring program. Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 12-1 describes the monitoring plan which should be followed from the Operational Phase through to the Rehabilitation and Monitoring phase. The table below includes each aspect of monitoring together with the frequency of monitoring and person responsible thereof.

The monitoring programme are based on the following points:

- Undertake monitoring on the adjacent and downstream wetlands to detect and rectify any secondary impacts caused by the Project;
- Commence with monitoring prior to the Construction Phase to collect baseline information regarding adjacent and downstream wetlands, soils and vegetation and to monitor any changes due to the proposed activities;
- Undertake bi-annual (twice a year) monitoring throughout the Construction Phase, for wetlands, soils and vegetation, preferably one survey after the rainy season (January to March) and one after the dry season (July to September);
- Undertake annual wetland monitoring throughout the Operational and Rehabilitation Phases, preferably one survey after the rainy season (January to March);
- Upon closure and rehabilitation, undertake annual monitoring for another three years to ensure there are no emerging impacts identified, which may need to be addressed;
- Update the monitoring programme once a wetland offset plan has been developed and offsetting has been implemented; and
- Internal monitoring reports should be required, reporting on the progress of the state of the monitoring and rehabilitation programme. This should be completed after each external monitoring report.

Table 12-1: Monitoring Plan

Monitoring Element	Comment	Requirement	Frequency	Phase	Responsibility	Duration
Wetland health (PES, EcoServices, EIS)	Implementation of intervention measures.	Wetland update report and recommendations for impact mitigation, if any.	Quarterly	Construction	Environmental Officer	3 years after Rehabilitation
			Once every year	Operational		
				Rehabilitation		
Wetland physical attributes (vegetation, erosion, habitat, open water extent)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take photos of adjacent and downstream wetland areas and record any impacts seen.	Quarterly and after storm events	Construction	Mine Environmental Manager.	Up to Rehabilitation
				Operational		
			Once every year	Rehabilitation		
Surface water and soil contamination assessment (incl. decant points)	Report any irregularities to the Environmental Officer for assessment and mitigation measures.	Take water and soil samples for laboratory analysis, measuring heavy metals and potential harmful elements.	Only after a spill has occurred	Construction	Environmental Officer	3 months thereafter (monthly) the spill has occurred
				Operational		
				Rehabilitation		

13. Stakeholder Engagement Comments Received

The consultation process affords Interested and Affected Parties (I&APs) opportunities to engage in the EIA process. The objectives of the Stakeholder Engagement Process (SEP) include the following:

- To ensure that I&APs are informed about the Project;
- To provide I&APs with an opportunity to engage and provide comment on the Project;
- To draw on local knowledge by identifying environmental and social concerns associated with the Project;
- To involve I&APs in identifying methods in which concerns can be addressed;
- To verify that stakeholder comments have been accurately recorded; and
- To comply with the legal requirements.

Please refer to the Comments and Response Report, attached as Appendix C of the EIA Report for comments raised and responses provided.

14. Recommendations

The following actions are recommended to reduce adverse effects on the wetland resources of the Project Area (Table 14-1):

Table 14-1: Possible Impacts and Recommendations

Possible Impacts	Recommendations	Person Responsible
Soil disturbance, and decreasing biodiversity resulting in increased sedimentation and increased erosion.	Improved vegetation cover and establish hydrophytic plants and facultative hydrophytes that are native to the area. Reduced risk of erosion and sedimentation.	Wetland ecologist, Botanist and Soil Scientist.
Linear infrastructures resulting in fragmentation of wetlands, the creation of preferential flow paths, and the onset of erosion.	Reduced risk of erosion, compaction, and the creation of preferential flow paths. Maintain linear infrastructure.	Wetland ecologist.
The presence of dams/weirs in wetland areas promote flooding and prevent natural diffuse flow.	Natural diffuse flow through the wetland and reduced the occurrence of channelization.	Wetland ecologist and Botanist.
Erosion/Sedimentation.	Reduced risk of erosion and sedimentation of downstream wetland areas by re-vegetation.	Wetland ecologist.

Possible Impacts	Recommendations	Person Responsible
Increased run-off and sedimentation, the input of pesticides and fertilisers and reduced buffer capacity of wetlands due to crop farming and AIPs.	Employment of a protective vegetated buffer strip around the wetland.	Wetland ecologist and Botanist.
Water quality impacts.	Improved water quality and prevention of pollution.	Wetland ecologist and Aquatic ecologist.

15. Reasoned Opinion Whether the Project Should Proceed

While the above-mentioned impacts have the potential to result in further degradation of the wetlands present, it is the opinion of the ecologist that the proposed project is likely to have an overall positive impact on the ecological integrity of the area in general, should the relevant mitigation and management measures outlined in this report be adhered to.

16. Conclusion

The wetlands associated with the Project Area were desktop delineated and confirmed during a rapid site survey in October 2021. The wetlands cover an area of approximately 494.7 ha consisting of Seasonal pan, Hillslope seepage, CVB, UCVB and artificial wetlands. The catchment and wetland buffer are dominated by mining activities, residential and commercial land and agropastoral activities. The current impacts on the wetlands, which have resulted in severely impacted systems, are:

- Wind and water erosion has resulted in tailings sedimentation within the wetland systems. The tailings has smothered vegetation, altered flow patterns, impacted water quality and reduced the quality of habitat for flora and fauna. Furthermore, human life is impacted through reduction of habitat quality for watering of livestock and domestic water use;
- Artisanal mining is rife and has resulted in diggings in various wetland. This alters the hydrological and geomorphological aspects of the wetland systems. Water quality is also impacted through the chemical utilised in the Artisanal and Small-Scale Mining (ASM) processes;
- Mining infrastructure has resulted in a complete loss of some wetlands. Construction of infrastructure results in cleared vegetation, altered flow patterns, impacted water quality and reduced the quality of habitat for flora and fauna;
- Construction and vegetation clearing have resulted in bare soil, the formation of preferential flow paths and the sedimentation of some wetland systems. The systems

provide habitat for floral species that favour this environment and these then proliferate, reducing species diversity;

- Removal of indigenous species and clearing resulting in bare soil, which allows for colonisation by AIPs;
- Fragmentation due to linear infrastructure such as roads, pipelines and powerlines crossing wetlands, resulting in damming effects upstream and desiccation and head cut erosion downstream;
- Trenches have been dug in wetlands to desiccate and divert the water, altering the water retention patterns as well as the geomorphology;
- Water quality impacts due to oil spills, domestic use and stormwater runoff etc.;
- Dams; and
- Discharge of mine/industry/sewage affected water into the various systems has altered water quality and quantity. This has impacted the system in the following ways:
  - Erosion and deep incision due to increased flow;
  - Sedimentation downstream;
  - Increased toxicants in the water; and
  - Head cut erosion upstream.

The PES, EcoServices and EIS were assessed for the natural wetlands only. The PES of the HGM Systems ranges from **Seriously Modified (E)** to **Critically Modified (F).** The EcoServices of the delineated wetlands were rated as **Very Low to Moderately Low** while the EIS scores were found to range from **Low/Marginal** to **Moderate** due to the modified nature of the wetlands.

While the above-mentioned impacts have the potential to result in further degradation of the wetlands present, it is the opinion of the ecologist that the proposed project is likely to have an overall positive impact on the ecological integrity of the area in general, should the relevant mitigation and management measures outlined in this report be adhered to.

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Appendix A: Methodology

Literature Review and Desktop Assessment

Relevant literature was reviewed with respect to the historical wetlands associated with the Project Area, habitats and vegetation types as well as the wetland state prior to development. This was completed to obtain relevant information on the wetland ecology of the Project Area and its vicinity to acquire enough information to compile a Wetland Environmental Impact Assessment Report.

For the purpose of this assessment, wetland areas were identified, and preliminary wetland boundaries were delineated at the desktop level using detailed aerial imagery and wetland signatures, along with 5 m contours. Baseline and background information were researched and used to understand the area on a desktop level prior to fieldwork confirmation. This included but was not limited to:

- A practical field procedure for the identification and delineation of wetlands and riparian areas (Department of Water Affairs and Forestry, 2005);
- WET-RoadMap: A Guide to the Wetland Management Series (WRC, 2007);
- National Freshwater Ecological Priority Areas (NFEPA) (Driver, et al., 2011; Nel, et al., 2011);
- Vegetation types of South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2012);
- Mining and Biodiversity Guidelines, DEA et al. (2013);
- Gauteng Conservation Plan (GDARD, 2011; GDARD, 2014);
- Amendment of Approved EMP dated 02 September 2002 for Mining Right (GP) 30/5/1/2/3/2/1/(133) EM (Golder Associates Africa (Pty) Ltd, 2014);
- Amendment of Approved EMP dated 26 June 2013 for Mining Right (GP) 30/5/1/2/3/2/1/(132) MR (Golder Associates Africa (Pty) Ltd, 2014a);
- Wetland Offsets: A Best Practice Guideline for South Africa (SANBI and DWS, 2016);
- Mintails Pipeline WULA Wetland Assessment (Rossouw Associates, 2016);
- External Water Use License Audit Report (Golder Associates Africa (Pty) Ltd, 2017); and
- Updates Integrated Water and Waste Management Plan for 2017 (Golder Associates Africa (Pty) Ltd, 2017).

National Freshwater Ecosystem Priority Areas

The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011). The spatial layers (FEPAs) include the nationally delineated wetland areas that are classified into Hydro-geomorphic (HGM) units and ranked in terms of their biodiversity importance. These layers were assessed to evaluate the importance of the wetlands.

The NFEPA Project represents a multi-partner Project between the CSIR, SANBI, WRC, DWS, DEA, WWF, SAIAB and SANParks. The NFEPA Project provides a collated, nationally consistent information source of wetland and river ecosystems for incorporating freshwater ecosystem and biodiversity goals into planning and decision-making processes (Nel, et al., 2011).

More specifically, the NFEPA Project aims to:

1. Identify FEPAs to meet national biodiversity goals for freshwater ecosystems; and
2. Develop a basis for enabling effective implementation of measures to protect FEPAs, including free-flowing rivers.

The first aim uses systematic biodiversity planning to identify priorities for conserving South Africa's freshwater biodiversity within the context of equitable social and economic development. The second aim is comprised of two separate components: the (i) national component aimed to align DWS and DEA policy mechanisms and tools for managing and conserving freshwater ecosystems, while the (ii) sub-national component is aimed to use three case studies to demonstrate how NFEPA products should be implemented to influence land and water resource decision-making processes. The Project further aimed to maximize synergies and alignment with other national level initiatives, including the National Biodiversity Assessment (NBA) and the Cross-Sector Policy Objectives for Inland Water Conservation (Driver, et al., 2011).

Based on a desktop-based modelled wetland condition and a combination of special features, including expert knowledge (e.g. intact peat wetlands, presence of rare plants and animals, etc.) and available spatial data on the occurrence of threatened frogs and wetland-dependent birds, each of the wetlands within the inventory were ranked in terms of their biodiversity importance and as such, Wetland FEPAs were identified in an effort to achieve biodiversity targets (Driver, et al., 2011). Table 1 below indicates the criteria that were considered for the ranking of each of these wetland areas. Whilst being a valuable tool, it is important to note that the FEPAs were delineated and studied at a desktop and relatively low-resolution level. Thus, the wetlands delineated via the desktop delineations and ground-truthing work done through this study may differ from the NFEPA data layers. The NFEPA assessment does, however, hold significance from a national perspective.

Table 1: NFEPA Wetland Classification Ranking Criteria (Nel et al., 2011)

Criteria	Rank
Wetlands that intersect with a Ramsar site.	1
• Wetlands within 500 m of an International Union for Conservation of Nature (IUCN) threatened frog point locality; • Wetlands within 500 m of a threatened water-bird point locality; • Wetlands (excluding dams) with most of their area within a sub-quaternary catchment that has sightings or breeding areas for threatened Wattled Cranes, Grey Crowned Cranes and Blue Cranes; • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of exceptional Biodiversity importance, with valid reasons documented; and • Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands that are good, intact examples from which to choose.	2
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing wetlands of biodiversity importance, but with no valid reasons documented.	3
Wetlands (excluding dams) in A or B condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion); and Wetlands in C condition AND associated with more than three other wetlands (both riverine and non-riverine wetlands were assessed for this criterion).	4
Wetlands (excluding dams) within a sub-quaternary catchment identified by experts at the regional review workshops as containing Impacted Working for Wetland sites.	5
Any other wetland (excluding dams).	6

Mining and Biodiversity Guideline

The Mining and Biodiversity Guideline was developed collaboratively by SANBI, the DEA, the Department of Mineral Resources (DMR), the Chamber of Mines and the South African Mining and Biodiversity Forum (2013). The purpose of the guideline was to provide the mining sector with a manual to integrate biodiversity into the planning process thereby encouraging informed decision-making around mining development and environmental authorisations. The aim of the guideline is to explain the value for mining companies to consider biodiversity management throughout the planning process. The guideline highlights the importance of biodiversity in managing the social, economic and environmental risk of the proposed mining Project. The country has been mapped into biodiversity priority areas including the four categories each with associated risks and implications (Department of Environmental Affairs, Department of

Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013) (Table 2).

Table 2: Mining and Biodiversity Guideline Categories (DEA et al., 2013)

Category	Risk and Implications for Mining
Legally Protected	Mining prohibited; unless authorised by ministers of both the DEA and DMR.
Highest Biodiversity Importance	Highest Risk for Mining: the EIA process must confirm significance of the biodiversity features that may be a fatal flaw to the proposed Project. Specialists must provide site-specific recommendations for the application of the mitigation hierarchy that informs the decision-making processes of mining licences, water use licences and environmental authorisations. If granted, authorisations should set limits on allowed activities and specify biodiversity related management outcomes.
High Biodiversity Importance	High Risk for Mining: the EIA process must confirm the significance of the biodiversity features for the conservation of biodiversity priority areas. Significance of impacts must be discussed as mining options are possible but must be limited. Authorisations may set limits and specify biodiversity related management outcomes.
Moderate Biodiversity Importance	Moderate Risk for Mining: the EIA process must confirm the significance of the biodiversity features and the potential impacts as mining options must be limited but are possible. Authorisations may set limits and specify biodiversity related management outcomes.

Gauteng Conservation Plan

Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (GDARD), produced the Gauteng Conservation Plan Version 3 (C-Plan 3) in December 2010. The latest version is C-Plan 3.3 which became available in October 2011 (GDARD, 2011), with a technical report being released in March 2014 **Invalid source specified.**. The Plan is based on the systematic conservation protocol developed by Margules and Pressey (2000) of the principles of complementarity, efficiency, defensibility and flexibility, irreplaceability, retention, persistence and accountability. C-Plan 3.3 is a valuable tool to ensure adequate, timely and fair service delivery to clients of GDARD, and will be critical in ensuring adequate protection of biodiversity and the environment in the Gauteng Province.

The main purposes of the C-Plan 3.3 are:

- To serve as the primary decision support tool for the biodiversity component of the EIA process;

- To inform protected area expansion and biodiversity stewardship programmes in the province; and
- To serve as a basis for development of Bioregional Plans in municipalities within the province.

Review of the C-Plan provided an understanding of the conservation priority of the Project area. The publication includes terrestrial and freshwater biodiversity areas that are mapped and classified in Protected Areas (PAs), Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Table 3).

Table 3: Gauteng Conservation Plan Categories

Map Category	Definition	Desired Management Objectives
PA	Those areas that are proclaimed as Provincial Nature Reserves, Municipal Nature Reserves, other state owned protected area, Private Nature Reserves and Natural Heritage Sites with management plans that have biodiversity conservation as the primary objective.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
CBAs	Any natural or near-natural terrestrial or aquatic area required to meet targets for biodiversity pattern and/or ecological processes. Divided into Irreplaceable Areas and Important Areas.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
ESAs	Natural, near-natural or degraded areas required to be maintained in an ecologically functional state to support Critical Biodiversity Areas and/or Protected Areas. Areas with no natural habitat remaining, but which retain potential importance for supporting ecological processes.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorization process that ensures the underlying biodiversity objectives are not compromised.

Wetland Identification, Delineation and Classification

The total Project Area is 494.7 ha and encompasses large wetland areas. Due to the size of the Project Area, a detailed desktop delineation was done prior the field assessment for budget and time purposes. The site survey was therefore done for ground truthing purposes to verify the desktop delineations as well as compiling data and information to assess the wetland health, ecological state and importance and sensitivity.

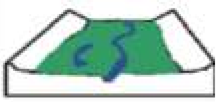
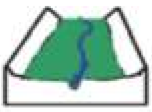
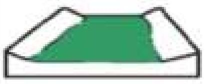
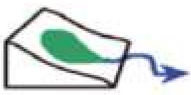
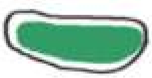
The wetland delineations were verified according to the accepted methodology from the Department of Water and Sanitation 'A practical field procedure for identification and delineation of wetlands and riparian areas' (Department of Water Affairs and Forestry, 2005) as well as the "Updated manual for identification and delineation of wetlands and riparian areas" (Department of Water Affairs and Forestry, 2008). These methodologies use the:

- **Terrain Unit Indicator**: Identifies those parts of the landscape where wetlands are more likely to occur;
- **Soil Form Indicator**: Identifies the soil forms, which are associated with prolonged and frequent saturation;
- **Soil Wetness Indicator**: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation; and
- **Vegetation Indicator**: Identifies hydrophilic vegetation associated with frequently saturated soils.

Terrain Unit Indicator

Terrain Unit Indicator (TUI) areas include depressions and channels where water would be most likely to accumulate. These areas are determined with the aid of topographical maps, contour data, aerial photographs and engineering and town planning diagrams (Department of Water Affairs and Forestry, 2005). In accordance with the guidelines provided by the DWS (Department of Water Affairs and Forestry, 2005) wetlands are identified and classified into various HGM units based on their individual characteristics and setting within the landscape. The HGM unit classification system focuses on the hydro-geomorphic setting/position of wetlands in a landscape which incorporates geomorphology; water movement into, through and out of the wetland. The HGM unit is dependent on various aspects, including whether the drainage is open or close, water is dominating the system or is sub-surface water, how the water flows from and into the wetlands and how water is contained within the wetland. Once wetlands have been identified, they are categorised into HGM units as shown in Table 4.

Table 4: Description of the Various HGM Units for Wetland Classification

Hydromorphic Wetland Type	Diagram	Description
Floodplain		Valley bottom areas with a well-defined stream channel stream channel, gently sloped and characterised by floodplain features such as oxbow depression and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom with a channel		Valley bottom areas with a well-defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterised by the net loss of sediment. Water inputs from the main channel (when channel banks overspill) and from adjacent slopes.
Valley bottom without a channel		Valley bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from the channel entering the wetland and also from adjacent slopes.
Hillslope seepage linked to a stream channel		Slopes on hillsides, which are characterised by colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well-defined stream channel connecting the area directly to a stream channel.
Isolated hillslope seepage		Slopes on hillsides that are characterised by colluvial transport (transported by gravity) movement of materials. Water inputs are from sub-surface flow and outflow either very limited or through diffuse sub-surface flow but with no direct link to a surface water channel.
Pan/Depression		A basin-shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. It is inward draining). It may also receive subsurface water. An outlet is usually absent and so this type of wetland is usually isolated from the stream network.

Soil Indicators

Soil Form Indicators

Hydromorphic soils are characterized as soils that has undergone redox reactions because of the fluctuation of water and oxygen within the soil profile, creating segregations of iron (Fe) and manganese (Mn) particles. This fluctuation of water and oxygen in the soils can be attributed to the fluctuating ground water table, creating seasonal, temporary and permanent wet zones. Hydromorphic soils are thus Soil Form Indicators (SFI) which will display unique characteristics resulting from prolonged and repeated water saturation (Department of Water Affairs and Forestry, 2005). The permanent, as well as occasional saturation of soil results in anaerobic conditions of the soils causing a chemical, physical and biological change to the soil.

Hydromorphic soils are often identified by the colours of various soil components. The frequency and duration of the soil saturation periods strongly influences the colours of these components. Grey colours become more prominent in the soil matrix the higher the duration and frequency of saturation in a soil profile (Department of Water Affairs and Forestry, 2005). A feature of hydromorphic soils are coloured mottles (iron and manganese accumulation) which are usually absent in permanently saturated soils and are most prominent in seasonally saturated soils and are less abundant in temporarily saturated soils (Department of Water Affairs and Forestry, 2005). The hydromorphic soils must display signs of wetness within 50 cm of the soil surface, as this is necessary to support hydrophytic vegetation.

Soils that are commonly associated with wetlands are: Champagne, Rensburg, Arcadia, Katspruit, Kroonstad, Longlands, Fernwood and Westley soil forms. These soil forms are associated with high clay content and accumulation of clay, promoting water logging and creating low drainage, thus water logging conditions. These soils are commonly associated with low-laying landscapes such as valley bottoms, foot-slopes and mid-slopes.

Soil Wetness Indicators

In practice, the Soil Wetness Indictor (SWI) is used as the primary indicator (Department of Water Affairs and Forestry, 2005). Iron and manganese accumulation in a soil profile, termed mottles, are some of the recognized 'wet-indicators'. These two elements are insoluble under aerobic (unsaturated) conditions and become soluble when the soil becomes anaerobic (saturated). The fluctuating water table creates these conditions by increasing and reducing the oxygen levels in the soil profile by increased and reduced water levels. Iron is one of the most abundant elements in soils and is responsible for the red and brown chroma of many soils.

During anaerobic (saturated) conditions, the iron and manganese in the soils are mobile and thus begin to leach out of the soil profile. Where oxidation takes place around for example roots, aggregate surfaces and pores, relatively insoluble ferric oxides is deposited leading to formation of red/green mottles and concretions. These soil profiles are commonly known as leached soils, gleysol, E-horizons or Albic horizons. Resulting from the prolonged anaerobic conditions, the soil matrix is left a grey, greenish or bluish colour, and is said to be “gleyed”. Recurrence of the cycle of wetting and drying over many decades concentrates these insoluble iron compounds. Thus, soil that is gleyed and has mottles within the first 0.5 m of the surface are indicating a zone that is seasonally or temporarily saturated, interpreted and classified as a wetland (Department of Water Affairs and Forestry, 2005).

Vegetation Indicator

Plant communities undergo distinct changes in species composition along the wetness gradient from the centre of the wetland to the edge, and into adjacent terrestrial areas. Valuable information for determining the wetland boundary and wetness zone is derived from the change in species composition. A supplementary method for employing vegetation as an indicator is to use the broad classification of the wetland plants according to their occurrence in the wetlands and wetness zones (Kotze & Marneweck, Guidelines for delineating the wetland boundary and zones within a wetland under the South African Water Act, 1999; Department of Water Affairs and Forestry, 2005). This is summarised in Table 5 below.

When using vegetation indicators for delineation, emphasis is placed on the group of species that dominate the plant community, rather than on individual indicator species (Department of Water Affairs and Forestry, 2005). Areas where soils are a poor indicator (black clay, vertic soils), vegetation (as well as topographical setting) is relied on to a greater extent and the use of the wetland species classification as per Table 5 becomes more important. If vegetation was to be used as a primary indicator, undisturbed conditions and expert knowledge are required (Department of Water Affairs and Forestry, 2005). Due to this uncertainty, greater emphasis is often placed on the SWI to delineate wetland areas.

Table 5: Classification of Plant Species According to Occurrence in Wetlands

Type	Description
Obligate Wetland Species (OW)	Almost always grow in wetlands: > 99% of occurrences.
Facultative Wetland Species (FW)	Usually grow in wetlands but occasionally are found in non-wetland areas: 67-99% of occurrences.
Facultative Species (F)	Are equally likely to grow in wetlands and non-wetland areas: 34-66% of occurrences.
Facultative Dry-land Species (FD)	Usually grow in non-wetland areas but sometimes grow in wetlands: 1-34% of occurrences.

(Source: (Department of Water Affairs and Forestry, 2005))

Wetland Ecological Health Assessment (WET-Health)

According to Macfarlane et al. (2009; 2020), the health of a wetland can be defined as a measure of the deviation of wetland structure and function from the wetland's natural reference condition. A level 2 WET-Health assessment was done on the wetlands in accordance with the method described by Macfarlane et al. (2020) to determine the integrity (health) of the characterised HGM units for the wetlands associated with the Project Area. A Present Ecological State (PES) analysis was conducted to establish baseline integrity (health) for the associated wetlands. The health assessment attempts to evaluate the hydrological, geomorphological, vegetation and water quality health in four separate modules to attempt to estimate similarity to or deviation from natural conditions. The overall health score of the wetland was then calculated.

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 above.

The overall approach is to quantify the impacts on wetland health and then to convert the impact scores to a PES 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 PES categories are provided in Table 6 (Macfarlane, Kotze, & Ellery, 2009; Macfarlane, Ollis, & Kotze, WET-Health (Version 2.0): A Refined Suite of Tools for Assessing the Present Ecological State of Wetland Systems, 2020).

Table 6: Impact Scores and Present Ecological State Categories (WET-Health; Macfarlane et al., 2009 and 2020)

Impact Category	Description	Combined Impact Score	PES Score (%)	PES Category
None	Unmodified, natural.	0-0.9	90-00	A
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota has taken place.	1-1.9	80-89	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	60-79	C

Impact Category	Description	Combined Impact Score	PES Score (%)	PES Category
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	40-59	D
Serious	Seriously modified. The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	20-39	E
Critical	Critically modified. Modifications have reached a critical level and ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	0-19	F

As is the case with the PES, future threats to the state of the wetland may arise from activities in the catchment upstream of the unit, within the wetland itself or from processes downstream of the wetland. In each of the individual sections for hydrology, geomorphology, vegetation and water quality, five potential situations exist depending upon the direction and likely extent of change (Table 7) (Macfarlane, Kotze, & Ellery, 2009).

Table 7: Trajectory of Change Classes and Scores Used to Evaluate Likely Future Changes to the Present State of the Wetland

Change Class	Description	HGM Change Score	Symbol
Substantial Improvement	State is likely to improve substantially over the next 5 years.	2	↑↑
Slight Improvement	State is likely to improve slightly over the next 5 years.	1	↑
Remain Stable	State is likely to remain stable over the next 5 years.	0	→
Slight Deterioration	State is likely to deteriorate slightly over the next 5 years.	-1	↓
Substantial Deterioration	State is expected to deteriorate substantially over the next 5 years.	-2	↓↓

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

Wetland Ecological Services (WET-EcoServices)

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 (Department of Water Affairs and Forestry, 1999). The assessment of the ecosystem services supplied by the identified wetlands was conducted according to the guidelines as described Kotze et al. (2020). 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 (Table 8).

Table 8: Ecosystem Services

Regulating and Supporting Services	Provisioning Services	Cultural Services
Flood Attenuation	Provision of Water for Human Use	Cultural and Spiritual Experience
Streamflow Regulation	Provision of Harvestable Resources	Tourism and Recreation
Sediment Trapping	Food for Livestock	Education and Research
Phosphate Assimilation	Provision of Cultivated Foods	
Nitrate Assimilation		
Toxicant Assimilation		
Erosion Control		
Carbon Storage		
Biodiversity Maintenance		

The characteristics were used to quantitatively determine the value and, by extension, sensitivity of the wetlands. Each characteristic was scored to reflect the importance of the wetland in providing the service relative to other wetlands and riparian areas (Table 9).

Table 9: Categories Used for Reporting the Overall Importance of Ecosystem Services

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

Ecological Importance and Sensitivity

The Ecological Importance and Sensitivity (EIS) tool was derived to assess the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred. The purpose of assessing importance and sensitivity of water resources is to be able to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. Water resources with higher ecological importance may require managing such water resources in a better condition than the present to ensure the continued provision of ecosystem benefits in the long term. The methodology outlined by DWAF (1999) and updated in Kotze and Rountree (Kotze, Ellery, Macfarlane, & Jewitt, 2012; Rountree, Malan, & Weston, 2013), was used for this study.

In this method there are three suites of importance criteria; namely:

- **Ecological Importance and Sensitivity:** incorporating the traditionally examined criteria used in EIS assessments of other water resources by DWS and thus enabling consistent assessment approaches across water resource types;
- **Hydro-functional Importance:** which considers water quality, flood attenuation and sediment trapping ecosystem services that the wetland may provide; and
- **Importance in Terms of Basic Human Benefits:** this suite of criteria considers the subsistence uses and cultural benefits of the wetland system.

These determinants are assessed for the wetlands on a scale of 0 to 4, where 0 indicates no importance and 4 indicates very high importance. It is recommended that the highest of these three suites of scores be used to determine the overall Importance and Sensitivity category of the wetland system, as defined in Table 10.

Table 10: Interpretation of Overall EIS Scores for Biotic and Habitat Determinants

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very High Systems that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these systems is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
High Systems that are considered to be ecologically important and sensitive. The biodiversity of these systems may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Systems that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these systems is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/Marginal Systems that are not ecologically important and sensitive at any scale. The biodiversity of these systems is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

Impact Assessment

The wetland impacts were assessed based on the impact's magnitude as well as the receiving environment's sensitivity, resulting in an impact significance rating which identified the most important impacts that require management. Based on international guidelines and legislation, the following criteria were taken into consideration when potentially significant impacts were examined relating to wetlands:

- Nature of impacts (direct/indirect and positive/negative);
- Duration (short/medium/long-term; permanent (irreversible)/temporary (reversible) and frequent/seldom);

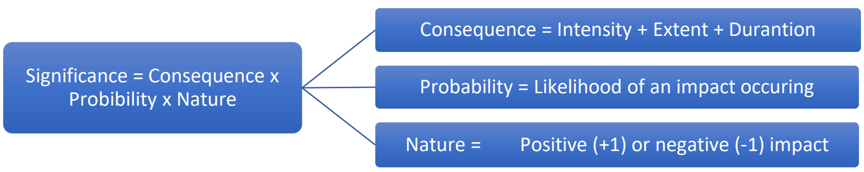
- Extent (geographical area and size of affected population/species);
- Intensity (minimal, severe, replaceable/irreplaceable);
- Probability (high/medium/low probability); and
- Measures to mitigate avoid or offset significant adverse impacts.

Significance Rating

Impacts and risks have been identified based on the description of the activities to be undertaken. Once the impacts were identified, a numerical environmental significance rating process was undertaken that utilises the probability of an event occurring and the severity of the impact as factors to determine the significance of a specific environmental impact.

The severity of an impact was determined by taking the spatial extent, the duration and the severity of the impacts into consideration. The probability of an impact was then determined by the frequency at which the activity takes place or is likely to take place and by how often the type of impact in question has taken place in similar circumstances.

Following the identification and significance ratings of potential impacts, mitigation and management measures were incorporated into the EMP. Details of the impact assessment methodology used to determine the significance of physical, bio-physical and socio-economic impacts are provided below. The significance rating process follows the established impact/risk assessment formula:



Note: In the formula for calculating consequence, the type of impact is multiplied by +1 for positive impacts and -1 for negative impacts.

The matrix calculated the rating out of 147, whereby intensity, extent, duration and probability were each rated out of seven as indicated in Table 13. The weight assigned to the various parameters was then multiplied by +1 for positive and -1 for negative impacts.

Parameter Rating

Impacts are rated prior to mitigation and again after consideration of the mitigation proposed in this report. The significance of an impact is then determined and categorised into one of seven categories, as indicated in Table 12, which is extracted from Table 13. The description of the significance ratings is discussed in Table 14.

It is important to note that the pre-mitigation rating takes into consideration the activity as proposed, i.e. there may already be certain types of mitigation measures included in the design (for example due to legal requirements). If the potential impact is still considered too high, additional mitigation measures are proposed.

Mitigation Hierarchy

The aim of the Impact Assessment is to strive to avoid damage to or loss of ecosystems and services that they provide, and where they cannot be avoided, to reduce and mitigate these impacts (Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum, & South African National Biodiversity Institute, 2013). Offsets to compensate for loss of habitat are regarded as a last resort, after all efforts have been made to avoid, reduce and mitigate. The mitigation hierarchy is represented in Table 11.

Table 11: Mitigation Hierarchy

↓	**Avoid or Prevent**	Refers to considering options in project location, sitting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services and people. This is the best option but is not always possible. Where environmental and social factors give rise to unacceptable negative impacts, mining should not take place. In such cases, it is unlikely to be possible or appropriate to rely on the other steps in the mitigation.
	Minimize	Refers to considering alternatives in the Project location, sitting, scale, layout, technology and phasing that would minimize impacts on biodiversity, associated ecosystem services. In cases where there are environmental constraints, every effort should be made to minimize impacts.
	Rehabilitate	Refers to rehabilitation of areas where impacts are unavoidable, and measures are provided to return impacted areas to near natural state or an agreed land use after mine closure. Rehabilitation can, however, fall short of replicating the diversity and complexity of natural systems.
	Offset	Refers to measures over and above rehabilitation to compensate for the residual negative impacts on biodiversity after every effort has been made to minimize and then rehabilitate the impacts. Biodiversity offsets can provide a mechanism to compensate for significant residual impacts on biodiversity.

Table 12: Impact Assessment Parameter Ratings

Rating	Intensity/Replicability		Extent	Duration/Reversibility	Probability
	Negative Impacts (Nature = -1)	**Positive Impacts (Nature = +1)**			
7	**Irreplaceable loss** or damage to biological or physical resources or **highly sensitive** environments. Irreplaceable damage to **highly sensitive** cultural/social resources.	Noticeable, on-going natural and/or social benefits which have improved the overall conditions of the baseline.	International The effect will occur across international borders.	Permanent: The impact is irreversible, even with management, and will remain after the life of the Project.	Definite: There are sound scientific reasons to expect that the impact will definitely occur. >80% probability.
6	**Irreplaceable loss** or damage to biological or physical resources or **moderate to highly** sensitive environments. Irreplaceable damage to cultural/social resources of **moderate to highly** sensitivity.	Great improvement to the overall conditions of a large percentage of the baseline.	National Will affect the entire country.	Beyond Project Life: The impact will remain for some time after the life of the Project and is potentially irreversible even with management.	Almost Certain/Highly Probable: It is most likely that the impact will occur. > 65 but < 80% probability.
5	**Serious loss** and/or damage to physical or biological resources or **highly sensitive** environments, limiting ecosystem function. Very serious widespread social impacts. Irreparable damage to highly valued items.	On-going and widespread benefits to local communities and natural features of the landscape.	Province/Region Will affect the entire province or region.	Project Life (> 15 years): The impact will cease after the operational life span of the Project and can be reversed with sufficient management.	Likely: The impact may occur. < 65% probability.
4	**Serious loss** and/or damage to physical or biological resources or **moderately sensitive** environments, limiting ecosystem function. On-going serious social issues. Significant damage to structures/items of cultural significance.	Average to intense natural and/or social benefits to some elements of the baseline.	Municipal Area Will affect the whole municipal area.	Long Term: 6-15 years and impact can be reversed with management.	Probable: Has occurred here or elsewhere and could therefore occur. < 50% probability.
3	**Moderate loss** and/or damage to biological or physical resources of **low to moderately** sensitive environments and, limiting ecosystem function. On-going social issues. Damage to items of cultural significance.	Average, on-going positive benefits, not widespread but felt by some elements of the baseline.	Local Local including the site and its immediate surrounding area.	Medium Term: 1-5 years and impact can be reversed with minimal management.	Unlikely: Has not happened yet but could happen once in the lifetime of the Project, therefore there is a possibility that the impact will occur. < 25% probability.
2	**Minor loss and/or effects** to biological or physical resources or **low sensitive** environments, not affecting ecosystem functioning. Minor medium-term social impacts on local population. Mostly repairable. Cultural functions and processes not affected.	Low positive impacts experience by a small percentage of the baseline.	Limited Limited extending only as far as the development site area.	Short Term: Less than 1 year and is reversible.	Rare/Improbable: Conceivable, but only in extreme circumstances. The possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures. < 10% probability.
1	**Minimal to no loss** and/or effect to biological or physical resources, not affecting ecosystem functioning. Minimal social impacts, low-level repairable damage to commonplace structures.	Some low-level natural and/or social benefits felt by a very small percentage of the baseline.	Very Limited/Isolated Limited to specific isolated parts of the site.	Immediate: Less than 1 month and is completely reversible without management.	Highly Unlikely/None: Expected never to happen. < 1% probability.

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Table 13: Probability/Consequence Matrix

Probability	Significance																																					
7	-147	-140	-133	-126	-119	-112	-105	-98	-91	-84	-77	-70	-63	-56	-49	-42	-35	-28	-21	21	28	35	42	49	56	63	70	77	84	91	98	105	112	119	126	133	140	147
6	-126	-120	-114	-108	-102	-96	-90	-84	-78	-72	-66	-60	-54	-48	-42	-36	-30	-24	-18	18	24	30	36	42	48	54	60	66	72	78	84	90	96	102	108	114	120	126
5	-105	-100	-95	-90	-85	-80	-75	-70	-65	-60	-55	-50	-45	-40	-35	-30	-25	-20	-15	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100	105
4	-84	-80	-76	-72	-68	-64	-60	-56	-52	-48	-44	-40	-36	-32	-28	-24	-20	-16	-12	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72	76	80	84
3	-63	-60	-57	-54	-51	-48	-45	-42	-39	-36	-33	-30	-27	-24	-21	-18	-15	-12	-9	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60	63
2	-42	-40	-38	-36	-34	-32	-30	-28	-26	-24	-22	-20	-18	-16	-14	-12	-10	-8	-6	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42
1	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
	-21	-20	-19	-18	-17	-16	-15	-14	-13	-12	-11	-10	-9	-8	-7	-6	-5	-4	-3	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21

Consequence

Table 14: Significance Rating Description

Score	Description	Rating
109 to 147	A very beneficial impact that may be sufficient by itself to justify implementation of the Project. The impact may result in permanent positive change.	Major (positive) (+)
73 to 108	A beneficial impact which may help to justify the implementation of the Project. These impacts would be considered by society as constituting a major and usually a long-term positive change to the (natural and/or social) environment.	Moderate (positive) (+)
36 to 72	A positive impact. These impacts will usually result in positive medium to long-term effect on the natural and/or social environment.	Minor (positive) (+)
3 to 35	A small positive impact. The impact will result in medium to short term effects on the natural and/or social environment.	Negligible (positive) (+)
-3 to -35	An acceptable negative impact for which mitigation is desirable. The impact by itself is insufficient even in combination with other low impacts to prevent the development being approved. These impacts will result in negative medium to short term effects on the natural and/or social environment.	Negligible (negative) (-)
-36 to -72	A minor negative impact requires mitigation. The impact is insufficient by itself to prevent the implementation of the Project but which in conjunction with other impacts may prevent its implementation. These impacts will usually result in negative medium to long-term effect on the natural and/or social environment.	Minor (negative) (-)
-73 to -108	A moderate negative impact may prevent the implementation of the Project. These impacts would be considered as constituting a major and usually a long-term change to the (natural and/or social) environment and result in severe changes.	Moderate (negative) (-)
-109 to -147	A major negative impact may be sufficient by itself to prevent implementation of the Project. The impact may result in permanent change. Very often these impacts are immitigable and usually result in very severe effects. The impacts are likely to be irreversible and/or irreplaceable.	Major (negative) (-)