mineral resources

Department:
Mineral Resources
REPUBLIC OF SOUTH AFRICA

CONSULTATION SCOPING REPORT FOR THE ALEXANDER MINING PROJECT

FOR LISTED ACTIVITIES ASSOCIATED WITH MINING RIGHT ACTIVITIES

SUBMITTED FOR ENVIRONMENTAL AUTHORIZATIONS IN TERMS OF THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 AND THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT, 2008 IN RESPECT OF LISTED ACTIVITIES THAT HAVE BEEN TRIGGERED BY APPLICATIONS IN TERMS OF THE MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT, 2002 (MPRDA) (AS AMENDED).

NAME OF APPLICANT: Sasol Mining (Pty) Ltd

TEL NO: +27 (0)17 614 5427

FAX NO: +27 (0)17 614 5382

POSTAL ADDRESS: Private Bag X1015, Secunda, 2302

PHYSICAL ADDRESS: 50 Katherine Street, Sasol Place, Sandton, 2194

FILE REFERENCE NUMBER SAMRAD: TBC

IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a prospecting or mining right if among others the mining "will not result in unacceptable pollution, ecological degradation or damage to the environment".

Unless an Environmental Authorisation can be granted following the evaluation of an Environmental Impact Assessment and an Environmental Management Programme report in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA), it cannot be concluded that the said activities will not result in unacceptable pollution, ecological degradation or damage to the environment.

In terms of section 16(3) (b) of the EIA Regulations, 2014, any report submitted as part of an application must be prepared in a format that may be determined by the Competent Authority and in terms of section 17 (1) (c) the competent Authority must check whether the application has taken into account any minimum requirements applicable or instructions or guidance provided by the competent authority to the submission of applications.

It is therefore an instruction that the prescribed reports required in respect of applications for an environmental authorisation for listed activities triggered by an application for a right or permit are submitted in the exact format of, and provide all the information required in terms of, this template. Furthermore please be advised that failure to submit the information required in the format provided in this template will be regarded as a failure to meet the requirements of the Regulation and will lead to the Environmental Authorisation being refused.

It is furthermore an instruction that the Environmental Assessment Practitioner must process and interpret his/her research and analysis and use the findings thereof to compile the information required herein. (Unprocessed supporting information may be attached as appendices). The EAP must ensure that the information required is placed correctly in the relevant sections of the Report, in the order, and under the provided headings as set out below, and ensure that the report is not cluttered with un-interpreted information and that it unambiguously represents the interpretation of the applicant.

OBJECTIVE OF THE SCOPING PROCESS

1) The objective of the scoping process is to, through a consultative process—

(a) identify the relevant policies and legislation relevant to the activity;

(b) motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;

(c) identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking process;

(d) identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;

(e) identify the key issues to be addressed in the assessment phase;

(f) agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and

(g) identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

Report No.: JW269/18/G292 - Rev 0
February 2022

DOCUMENT APPROVAL RECORD

ACTION	FUNCTION	NAME	DATE	SIGNATURE
Prepared	Environmental Scientist	Nosipho Makaya	March 2021	Cannot sign, no longer employed by J&W
Revised (new mine plan)	Environmental Scientist	Jessica Badenhorst	October 2021	Cannot sign, no longer employed by J&W
Finalised	Environmental Scientist	Daniella Kristensen	August 2022	
Reviewed	Environmental Scientist	Gina Martin	August 2022	
Approved	Project Director	Jacqui Hex	August 2022	

RECORD OF REVISIONS AND ISSUES REGISTER

Date	Revision	Description	Issued to	Issue Format	No. Copies
24/02/2022	A	Internal review	G Martin	Electronic	N/A
07/03/2022	B	Review comments	J Badenhorst	Electronic	N/A
07/03/2022	0	Client review	B Mndawe	Electronic	N/A
24/08/2011	1	Authority and public review	Competent and commenting authorities; public	Hard copies and electronic copies	Multiple

SYNOPSIS

Background

Sasol Mining (Pty) Ltd (hereafter referred to as Sasol Mining) operates several underground coal mines near Secunda, Mpumalanga Province. To ensure an uninterrupted coal supply to the Sasol Operations (SO) in Secunda, Sasol Mining has acquired new reserves and in future will deploy its mining activities into these new areas. These areas are the Alexander Block 2, 3 and 4, herein referred as the "Alexander Mining Project".

The Alexander Mining Project is situated approximately 12 km northwest of Bethal and directly to the south and south-east of Kriel in the Mpumalanga Province. The target mineral resource lies between the R547 provincial road to the west and the R35 provincial road to the east.

The Alexander mining right, with Department of Mineral Resources and Energy (DMRE) reference number MP 30/5/1/2/2/ 10125MR, was transferred from Anglo American Inyosi Coal (Pty) Ltd (AAIC)[1] to Sasol Mining on 29/04/2018.

The Alexander coal reserves are required to replace coal currently purchased from the Isibonelo Colliery, when the Isibonelo operations cease. A combination of Sasol Mining operations is scheduled to supply coal to SO.

The proposed Alexander Mining Project is a greenfields project that will include opencast mining operations, to extract coal from the No.4 and No.5 Coal Seams of Block 2.

Sasol Mining has indicated that they may decide to mine additional areas of the remaining reserves at Alexander in future via underground mining, however this is not currently in the project plan and has not been assessed as part of this study. A new environmental application and licensing process would be required for additional mining, should Sasol Mining decide to mine these areas in future.

The Alexander Mining Project also includes the development of the following surface infrastructure at Block 2:

- Mine complex (including offices, parking, change houses, workshops, substation, haul roads, Run of Mine (ROM) tip, temporary coal stockpile, Pollution Control Dam (PCD), canals, contaminated and topsoil stockpiles, a Sewage Treatment Plant, etc);
- Overland conveyor;
- Access roads;
- Powerlines; and
- Potable and dirty water pipelines

The opencast mining activities at Alexander are envisaged to continue for thirteen (13) years.

Jones & Wagener (Pty) Ltd Engineering & Environmental Consultants (J&W) has been appointed as an independent Environmental Assessment Practitioner (EAP) to undertake an Integrated Regulatory Process (IRP) for the required environmental applications and licences for the proposed Alexander Mining Project.

Environmental Authorisation and Licensing Processes

This document serves as the Consultation Scoping Report (CSR) to be lodged with the DFFE in terms of the National Environmental Management Act, Act 107 of 1998 (NEMA)

[1] Now Thungela Resources Limited following a demerger.

and Government Notice (GN) Regulations 324 to 327 (7 April 2017, as amended), for the proposed Alexander Project.

In terms of the Environmental Impact Assessment (EIA) regulations of 2014 (as amended), the following listed activities are included in the application for environmental authorisation in terms of Listing Notice 1, 2 and 3. The waste management activities in terms of NEM:WA (GN 921 (2013) as amended have also been included in the below table.

NAME OF ACTIVITY	APPLICABLE LISTING NOTICE
Dirty water pipelines, including pipelines from the pit to the PCD, pipelines from the office complex to the Sewage Treatment Plant (STP), pipeline from the Riversdale underground compartment to the service water reservoir, and dirty stormwater management infrastructure	Activity 10 of Listing Notice 1 (GNR 327)
Development of opencast mining pits, reservoir, conveyors, roads, pipelines, powerlines, mine complex, topsoil stockpiles, contaminated stockpiles, and associated infrastructure within watercourses and within 32m of a watercourse.	Activity 12 of Listing Notice 1 (GNR 327)
Storage of chemicals within the Explosives magazine Storage of fuel and chemicals within the mine complex workshops	Activity 14 of Listing Notice 1 (GNR 327)
The stripping and excavation of soil in proximity to a watercourse for the development of infrastructure or mining	Activity 19 of Listing Notice 1 (GNR 327)
The mining right Ref MP 30/5/1/2/2/ 10125MR is being amended by Sasol in terms of Section 102 of the MPRDA, following their acquisition of this mining right.	Activity 21D of Listing Notice 1 (GNR 327, amended in GN517 of June 2021)
Construction of gravel roads with a reserve of 25 m (including the temporary access toad from the D618) and new sections of the D450 and D620 (which will have a road reserve of 40 m). Construction of internal mine roads with a reserve of 12.5 m Upgrade of an intersection of a provincial road and upgrade and diversion of a district road.	Activity 24 of Listing Notice 1 (GNR 327)
Construction and operation of a sewage treatment plant at the mine complex	Activity 25 of Listing Notice 1 (GNR 327)
Upgrading of the existing D620 road and potential lengthening by diversion. Upgraded public roads have a 40 m road reserve. Widening of existing D618, D450, and D620 road by more than 6 m.	Activity 56 of Listing Notice 1 (GNR 327)
Activities requiring a water use licence: • ROM stockpile • Dust suppression using mine impacted water • PCD • Sumps within mine complex • Overburden stockpiles • Dirty water channels, sumps, and pipelines • Overburden stockpiles • STP and drying beds Infrastructure and mining pits within 500m of a watercourse	Activity 6 of Listing Notice 2 (GNR 325)
Clearing of vegetation for infrastructure, mining complex, stockpile areas, mining pits	Activity 15 of Listing Notice 2 (GNR 325)
Opencast mining pits and related activities	Activity 17 of Listing Notice 2 (GNR 325,

NAME OF ACTIVITY	APPLICABLE LISTING NOTICE
	amended in GN517 of June 2021)
Clearing of vegetation for infrastructure, mining complex, stockpile areas, mining pits, within a CBA.	Activity 12 of Listing Notice 3 (GNR 324)
Development of opencast mining pits, reservoir, conveyors, roads, pipelines, powerlines, and associated infrastructure within watercourses and within 32m of a watercourse. Development of a post-closure stormwater management dam within a watercourse.	Activity 14 of Listing Notice 3 (GNR 324)
The D450 road will be lengthened by ~1 km within CBAs.	Activity 18 of Listing Notice 3 (GNR 324)
Construction of overburden stockpiles, associated liners and water management infrastructure	Category B, Activity 10
ROM stockpiles Overburden stockpiles	Category B, Activity 11
Storage of general or hazardous waste at the mine complex (waste stockpiles, yards etc.)	Category C, Activities 1 and 2

As this project consists of an integrated process, an Integrated Water Use Licence Application will also be prepared in terms of the National Water Act, Act 36 of 1998 (NWA) for the proposed Alexander project.

Specialist Investigations

The following specialist impact studies will be undertaken as part of the Environmental Impact Reporting phase.

SPECIALIST STUDIES	
Soils, land use and land capability	Visual
Surface water	Noise
Wetlands	Air Quality
Groundwater	Climate Change
Aquatic Ecosystems	Heritage and Palaeontology
Terrestrial Biodiversity	Blasting and Vibrations
Socio-economic	Traffic

Way forward

The CSR is being submitted to the Department of Mineral Resources and Energy (DMRE) and commenting authorities and is available for public review and comment from 24 August 2022 to 23 September 2022 and can be accessed at the following locations.

Location
Bethal Public Library: Danie Nortje Street, Bethal Kriel Public Library: Cnr Quinton and Heinrich str, Kriel

Contact person	Electronic copies	Tel
Ms Anelle Lotter (public participation office)	(www.jaws.co.za) under public documents.	011 519 0200 or email anelle@jaws.co.za

Stakeholder comments received during the review of the Consultation document will be considered in refining and updating of the Final Scoping Report. The Final document will be made available for stakeholder review and notification of availability will be provided so that comments can be directly submitted to the DMRE with a copy thereof to the public participation office.

Stakeholders will be notified of the outcome of the DMRE decision with regards to the application for an Environmental Authorisation. This will be done in accordance with the NEMA requirements and the notification received from the DMRE.

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Abbreviations used in the report:

Abbreviation / Acronym	Meaning
AAIC	Anglo American Inyosi Coal
ABET	Adult Basic Education and Training
AIS	Alien and Invasive Species
AMD	Acid Mine Drainage
BID	Background Information Document
BMC	Blast Management & Consulting
CBA	Critical Biodiversity Area
CCRA	Climate Change Reference Atlas
CCS	Carbon Capture and Storage
CSI	Corporate Social Investments
CSR	Consultation Scoping Report
dBA	Decibels (A-weighted measurements)
DEA	Department of Environmental Affairs (now DFFE)
DFFE	Department of Forestry, Fisheries and Environment
DMR	Department of Mineral Resources (now DMRE)
DMRE	Department of Mineral Resources and Energy
DTM	Digital Terrain Model
DWA	Department of Water Affairs (Now DWS)
DWAF	Department of Water Affairs and Forestry (Now DWS)
DWF	Dry Weather Flow
DWS	Department of Water & Sanitation
EAP	Environmental Assessment Practitioner
EC	Electrical conductivity
ECA	Environmental Conservation Act
EE	Employment Equity
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Reports
EIR	Environmental Impact Report
EHS	Environmental, Health and Safety
ELM	Emalahleni Local Municipality
EMPr	Environmental Management Programme (NEMA)
ESA	Ecological Support Areas

Abbreviation / Acronym	Meaning
ETS	Ecosystem Threat Status
FEPA	Freshwater Ecosystem Priority Areas
FOLU	Forestry and Other Land Use
FSR	Final Scoping Report
GCMs	Global Climate Change Models
GDT	Groundwater Decision Tool
GHGs	Greenhouse gases
GHGIP	National Greenhouse Gas Improvement Programme
GMLM	Govan Mbeki Local Municipality
GN	Government Notice
GNR	Government Notice Regulation
GSDM	Gert Sibande District Municipality
GQMI	Groundwater Quality Management Index
GWP	Global warming potential
HDPE	High Density Polyethylene
HGM	Hydrogeomorphic
HMA	Heavily Modified Areas
HME	Heavy Mining Equipment
HPA	Highveld Airshed Priority Area
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Parties
IBR	Inverted Box Rib
IDP	Integrated Development Plan
IFC	International Finance Corporation
IHIA	Intermediate Habitat Integrity Assessment
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Regulatory Process
IUA	Integrated Unit of Analysis
IUCN	International Union for the Conservation of Nature
IWULA	Integrated Water Use Licence Application
IWWMP	Integrated Water and Waste Management Plan
J&W	Jones & Wagener (Pty) Ltd Engineering and Environmental Consultants
JMA	Jasper Müller Associates

Abbreviation / Acronym	Meaning
LDV	Light Duty Vehicle
LED	Local Economic Development
LHD	Load, Haul, Dump Machine
LOC	Life of Coal
LOM	Life-of-Mine
MAE	Mean Annual Evaporation
mamsl	Meters Above Mean Sea Level
MAP	Mean Annual Precipitation
MAR	Mean Annual Runoff
MBSP	Mpumalanga Biodiversity Sector Plan
MHGG	Mesic Highveld Grasslands Group
MIRAI	Macro-Invertebrate Response Assessment Index
MMA	Moderately Modified Areas
MPHG	Mpumalanga Highveld Grasslands
MPRDA	Mineral and Petroleum Resources Development Act
MTPA	Mpumalanga Tourism and Parks Agency
NAAQS	National Ambient Air Quality Standards
NAEIS	National Atmospheric Emission Inventory System
NDC	Nationally Determined Contribution
NDM	Nkangala District Municipality
NEMA	National Environmental Management Act
NEM:BA	National Environmental Management: Biodiversity Act
NEM:WA	National Environmental Management: Waste Act
NEM:PAA	National Environmental Management: Protected Areas Act
NFEPA	National Freshwater Ecosystem Priority Areas
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
ONA	Other Natural Area
PCD	Pollution Control Dam
PES	Present Ecological State
PFS	Pre-Feasibility Study

Abbreviation / Acronym	Meaning
PLC	Programmable Logic Controller
POI	Point of Interest
PSM	Process Safety Management
RCPs	Representative Concentration Pathways
REIPPP	Renewable Energy Independent Power Producer Procurement Programme
ROM	Run of Mine
RQO	Resource Quality Objectives
RWQO	Resource Water Quality Objectives
S&EIR	Scoping & Environmental Impact Reporting
SAAELIP	South African Atmospheric Emission Licensing and Inventory Portal
SAGERS	South African Greenhouse Gas Emission Reporting System
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African Biodiversity Institute
SANS	South African National Standards
Sasol Mining	Sasol Mining (Pty) Ltd
SASS5	South African Scoring System Version 5
SAWS	South African Weather Services
SBR	Sequencing Batch Reactor
SCS	Sasol Coal Supply
SEM	Standard Error Mean
SLP	Social and Labour Plan
SO	Sasol Operations
STP	Sewage Treatment Plant
TBC	The Biodiversity Company
ToR	Terms of Reference
TWQR	Target Water Quality Range
UNFCCC	United Nations Framework Convention on Climate Change
WCS	Wetland Consulting Services
WMA	Water Management Area
WMLA	Waste Management Licence Application
WUL	Water Use Licence

NATIONAL ENVIRONMENTAL MANAGEMENT ACT – SCOPING REPORT CHECKLIST

Regulations	Description	Reference in Report
NEMA EIA Regulations, 2014 (as amended) – Contents of a Scoping Report		
28 (1) a	Details of the EAP and relevant expertise	Section 2
28 (1) b	Description of the proposed activity	Section 4.2
28 (1) c	Description of alternatives	Section 8.1
28 (1) d	Description of the property on which the activity is to be undertaken and location of the activity	Section 8.1.1
28 (1) e	Description of the environment that may be affected and the manner in which the activity may affect the environment	Section 10.1
28 (1) f	All legislation and guidelines that have been considered in preparing the scoping report	Section 5
28 (1) g	Description of environmental issues and potential impacts, cumulative impacts that have been identified	Section 11
28 (1) h	Public participation process	Section 9
28 (1) h (i)	Steps taken to notify I&APs	Section 9
28 (1) h (ii)	Proof of notice boards, advertisements and notices notifying potential IA's of the application	Appendix 6
28 (1) h (iii)	Stakeholder database	Appendix 6
28 (1) h (iv)	Issues and Response Report	Appendix 6
28 (1) i	Description of the need and desirability of the proposed activity	Section 6
28 (1) j	Description of the alternatives and the advantages and disadvantages that the proposed alternatives may have on the environment	Section 8.1 and 11
28 (1) k	Copies of comments from stakeholders	Appendix 6
28 (1) l	Minutes from I&AP meetings	Appendix 6
28 (1) m	Issues and Response Reports	Appendix 6
28 (1) n	Plan of Study for EIR	Section 18
28 (1) n (i)	Description of the tasks proposed for the EIR phase, including specialist studies and the manner in which specialist studies will be undertaken	Section 18
28 (1) n (ii)	Indication of the stages at which the competent authority will be consulted	Section 9
28 (1) n (iii)	Description of the methodology to be used for assessing environmental issues and alternatives including the option of not processing with the activity	Section 12

Regulations	Description	Reference in Report
NEMA EIA Regulations, 2014 (as amended) – Contents of a Scoping Report		
28 (1) n (iv)	Description of the public participation process to be conducted during the impact assessment phase	Section 9
28 (o)	Any specific information required by the competent authority	Not yet applicable
28 (p)	Any other matters required in terms of Sections 24 (4)(a) and (b) of NEMA	Section 20.3

NATIONAL ENVIRONMENTAL MANAGEMENT: WASTE MANAGEMENT ACT

CHECKLIST FOR COMPLIANCE WITH THE INFORMATION REQUIREMENTS LISTED IN THE WASTE MANAGEMENT LICENCE APPLICATION FORM

Appendix A1 Information needed when applying for scheduled activities listed under Category B of the list of waste management activities in terms of NEM:WA		Section in this Report
	Scoping and Environmental Impact Assessment Report which should include:	
1	• Description of the environment that may be affected by the proposed activity and the manner in which the geographical, physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed activity	Section 10
2	• Description of significant environmental impacts, including cumulative impacts, that may occur as a result of the undertaking of the activity	Section 11
3	• Conducting public participation as outlined in EIA Regulations	Section 9
4	• Waste disposal facility designs	To be included in EIR
5	• Closure plan (report)	To be included in EIR
6	• Operational plan	To be included in EIR
7	• All applicable legislation, policies and/or guidelines	Section 5
8	• End-use plan (only apply to site closure)	N/A
9	• Closure/Remedial designs (only apply to site closure)	N/A (GNR1147 reporting to be undertaken as project progresses)
10	• Latest external audit report (only apply to permit amendment)	N/A
11	• Application and report documents (four hard copies for all applications)	This report
12	• A3 size layout plans (four hard copies for all applications)	Appendix 4
13	• Landfill conceptual designs	N/A
14	• Geo-hydrological report (only apply to landfill sites, storage and treatment of waste)	To be included in EIR
15	• Consideration of alternatives	Section 8.1
16	• Description of mitigation measures and risk assessment	To be included in EIR
17	• Any inputs made by specialists to the extent that may be necessary	To be included in EIR
18	• Any specific information as may be required by the competent authority	Not yet applicable
19	Plan of study for environmental impact assessment which must among others include: • Description of the tasks to be undertaken as part of the environmental impact	

Appendix A1 Information needed when applying for scheduled activities listed under Category B of the list of waste management activities in terms of NEM:WA		Section in this Report
	assessment process, including specialist report or specialized processes, and a manner in which such tasks will be undertaken • An indication of stages of stages at which the competent authority will be consulted • Description of methods for assessing issues and alternatives, including the no-go alternative • Particulars of participation process that will be conducted during the EIA process	Section 18 Section 9 Section 8.1 Section 18.7
20	NB: Compilation of EIA report must be based on tasks outlined in the Plan of Study for EIA, and the below listed reports must also be attached. • Draft environmental management plan (only apply to EIA reports. No draft EMP should be included in the scoping report) • Copies of any specialist reports and specialized processes (only apply to EIA reports. No copies of specialist studies and specialized processes should be included in the scoping report)	To be included in EIR

Appendix B1 Required piece of information		Section in this Report
1	Extremely clear Google Earth colour picture of the site (dated not more than a month from the date of the application)	Appendix 7
2	1:50 000 topography /topo-cadastral map of the area showing	Appendix 3
	2.1 the site and 5km radius	
	2.2 Existing residential and industrial areas	
	2.3 Possible future development (indicate the type of development)	
	2.4 Other waste handling sites (existing or closed) in the area	
	2.5 Existing and possible future residential areas.	
	2.6 Sites which are listed as national monuments or archaeological, paleontological and cultural historical sites or objects worthy of conservation;	Figure 10-65
3	Security and access aspects of the site	Section 4.2.3.21
4	The site plan drawn to scale showing the site's boundary showing:	
	4.1 Activities or development existing on all 4 directions of the site.	Appendix 4
	4.2 Waste receipt, storage and handling areas	To be included in EIR
	4.3 Impermeable surfaces	
	4.4 Sealed drainage systems	
	4.5 Drainage system for the site including sumps and discharge points	
	4.6 Road names and access from all major roads in the area	Appendix 4
	4.7 Land Owner's consent (letter with signature)	Appendix 6

Appendix B1 Required piece of information		Section in this Report
5	Waste hierarchy implementation plan	N/A
6	Emergency preparedness plan	To be included in EIR

MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT – SCOPING REPORT CHECKLIST

Regulation	Description	Reference in report
MPRDA Regulations – Contents of a Scoping Report		
Section 49 (1)	A scoping report, in relation to a proposed mining operation, must:	
a.	Describe the methodology applied to conduct scoping;	Section 18.8
b.	Describe the existing status of the environment prior to the mining operation;	Section 10
c.	Identify and describe the anticipated environmental, social and cultural impacts, including cumulative effects, where applicable;	Section 11
d.	Identify and describe reasonable land use or development alternatives to the proposed operation, alternative means of carrying out the operation and the consequences of not proceeding with the proposed operation;	Section 8.1
e.	Describe the most appropriate procedure to plan and develop the proposed mining operation;	Section 8.1
f.	Describe the process of engagement of identified interested and affected persons, including their view and concerns; and	Section 9
g.	Describe the nature and extent of further investigations required in the environmental impact assessment report.	Section 18

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SASOL MINING (PTY) LTD

ALEXANDER MINING PROJECT
CONSULTATION SCOPING REPORT

REPORT NO: JW269/18/G292

1. INTRODUCTION

Sasol Mining (Pty) Ltd (hereafter referred to as Sasol Mining) operates several underground coal mines near Secunda, Mpumalanga Province. To ensure an uninterrupted coal supply to the Sasol Operations (SO) in Secunda, Sasol Mining has acquired new reserves and in future will deploy its mining activities into these new areas. These areas are the Alexander Block 2, 3 and 4, herein referred as the "Alexander Mining Project".

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Sasol Mining has indicated that they may decide to mine additional areas of the remaining reserves at Alexander in future via underground mining, however this is not currently in the project plan and has not been assessed as part of this study. A new environmental application and licensing process would be required for additional mining, should Sasol Mining decide to mine these areas in future.

The Alexander Mining Project also includes the development of the following surface infrastructure at Block 2:

- Mine complex (including offices, parking, change houses, workshops, substation, haul roads, Run of Mine (ROM) tip, temporary coal stockpile, Pollution Control Dam (PCD), canals, contaminated and topsoil stockpiles, a Sewage Treatment Plant, etc);
- Overland conveyor;

[2] Now Thungela Resources Limited following a demerger.

- Access roads;
- Powerlines; and
- Potable and dirty water pipelines

The opencast mining activities at Alexander are envisaged to be completed within a thirteen (13) year period.

Jones & Wagener (Pty) Ltd Engineering & Environmental Consultants (J&W) has been appointed as an independent Environmental Assessment Practitioner (EAP) to undertake an Integrated Regulatory Process (IRP) for the required environmental applications and licences for the proposed Alexander Mining Project.

2. CONTACT PERSON AND CORRESPONDENCE ADDRESS

2.1 Details of the EAP who prepared the report

Table 2-1: Details of the Environmental Assessment Practitioners.

Name	Organisation	Highest Qualifications	Experience	Professional Registrations
Ms Jacqui Hex (Project Director)	Jones & Wagener	MSc Environmental Management	15+ years	Pr. Sci. Nat EAPASA Registered EAP
Ms Gina Martin (Environmental Scientist)	Jones & Wagener	BSc Honours Geography (Env. Sci)	9 years	Pr. Sci. Nat EAPASA Registered EAP
Ms Jessica Badenhorst (Environmental Scientist)	Jones & Wagener	MSc. Entomology	4 years	Pr. Sci. Nat EAPASA Candidate EAP
Ms Anelle Lötter (Public Participation Practitioner)	Jones & Wagener	National Diploma in Journalism	20+ years	Member of the International Association of Public Participation (IAP2)

2.2 Expertise of the EAP

2.2.1 The qualifications of the EAP

Refer to **Table 2-1** and **Appendix 1**.

2.2.2 Summary of the EAP's experience

Refer to **Table 2-1** and **Appendix 1**.

3. DESCRIPTION OF THE PROPERTY

Table 3-1: Property details

Farm Name:	Please refer to Table 3-2

Application area (Ha)	Approximately 10 700ha
Magisterial district:	Emalahleni Local Municipality within the Nkangala District Municipality Govan Mbeki Local Municipality within the Gert Sibande District Municipality
Distance and direction from nearest town	12 km north-west of Bethal Directly south of Kriel
21-digit surveyor General Code for each farm portion	Please refer to Table 3-2

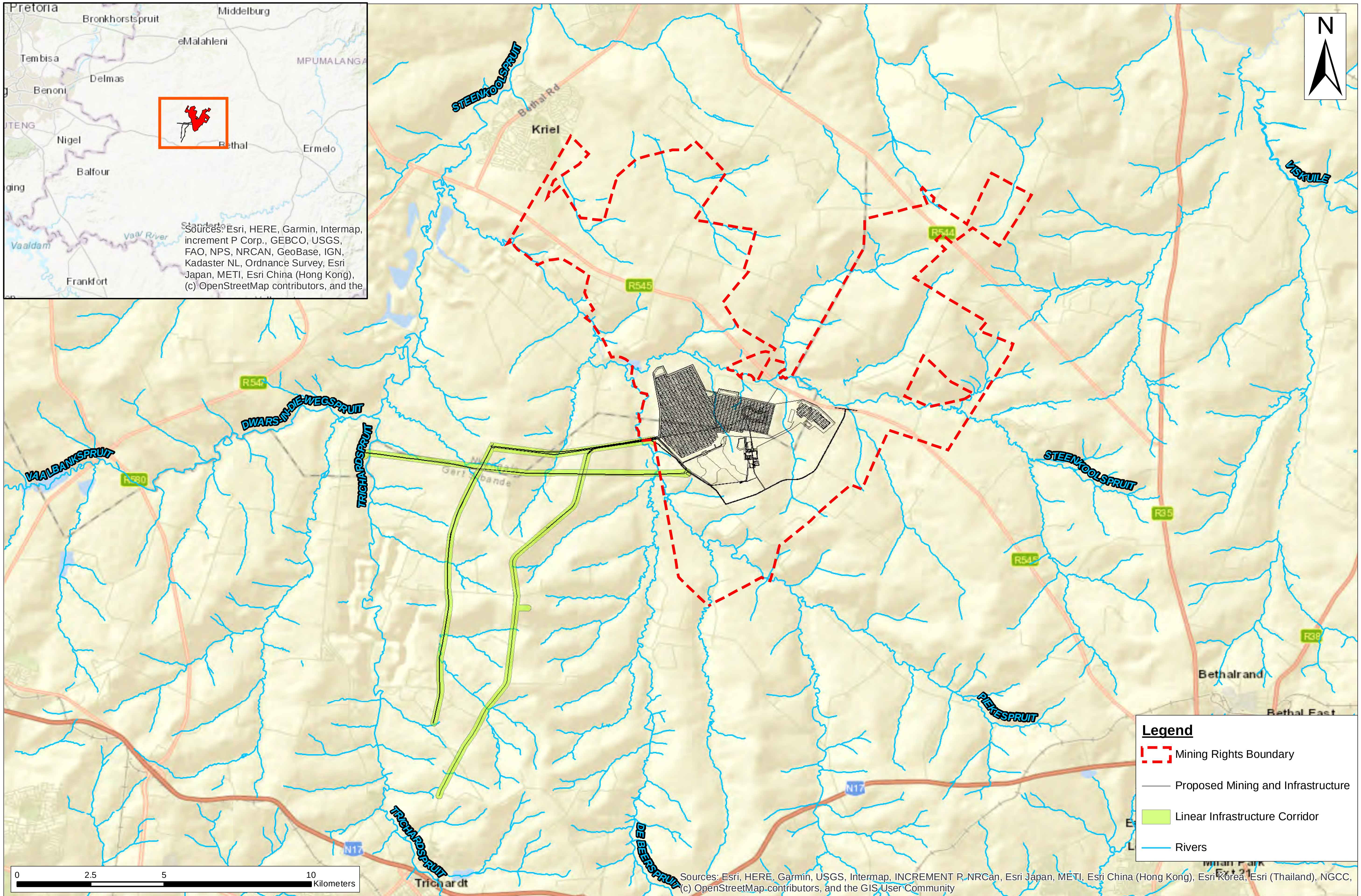
3.1 Locality map

Alexander is located approximately 12 km north-west and directly south of Kriel, within the Emalahleni Local Municipality of the Nkangala District Municipality and Govan Mbeki Local Municipality of the Gert Sibande District Municipality.

A locality map is provided in **Figure 3-1**, with a large-scale map provided in **Appendix 3**.

3.2 Property and property ownership

Detail of the properties affected by the proposed development is provided in **Table 3-2**, and illustrated in **Figure 3-2**.



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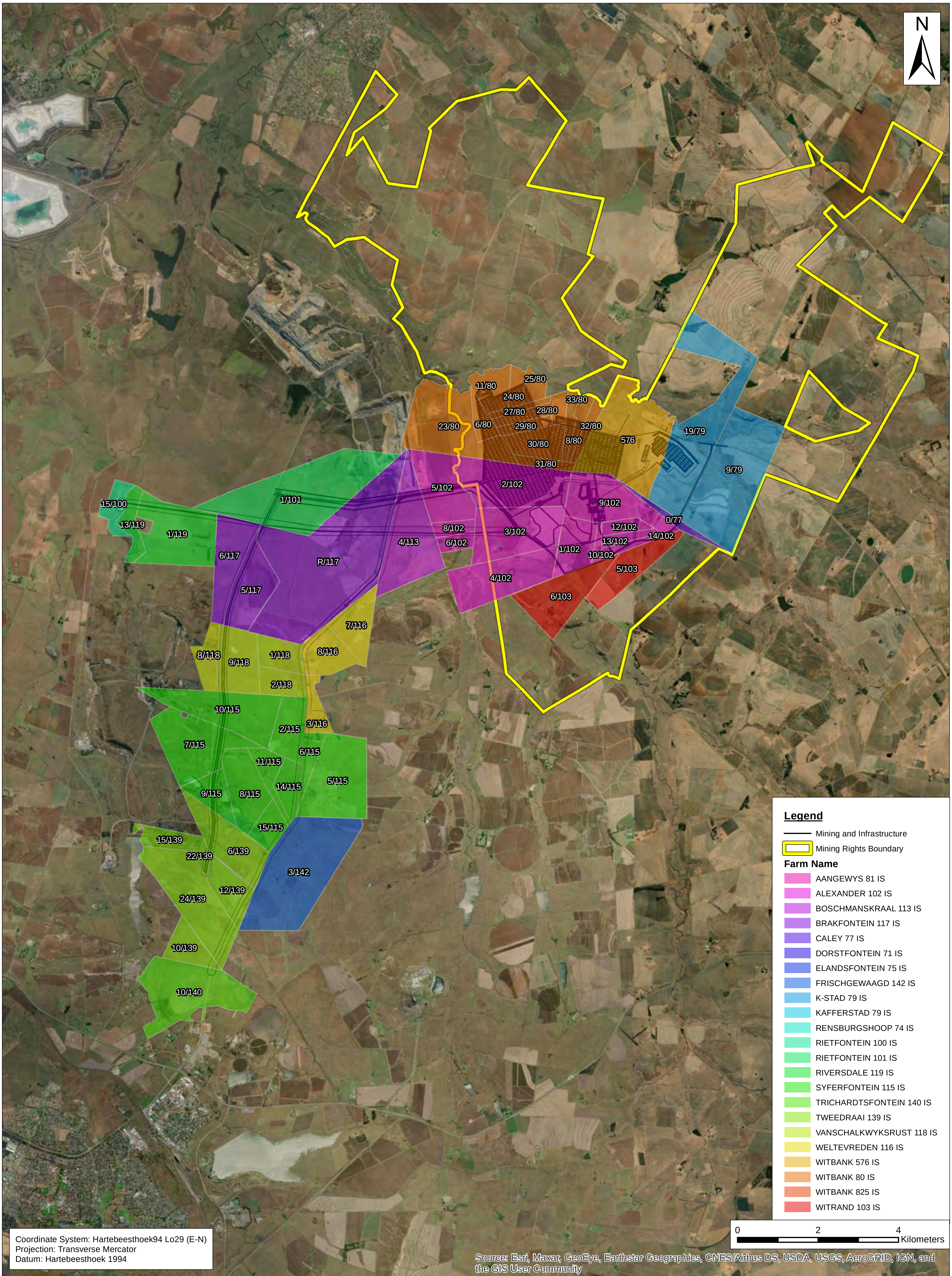
Sasol Mining (Pty) Ltd
Alexander Mining Project IRP
Locality map

Job No G292-55

Figure 3-1



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Sasol Mining (Pty) Ltd

Alexander Mining Project

Map showing property ownership of project area and surrounding areas

Job No: G292-55

Figure 3-2

Table 3-2: Details of properties affected by the proposed development

Farm name	Portion	S21-digit number	Property Owner	Title deed
RIETFONTEIN 101 IS	1/101	T0IS00000000010100001	ANGLO OPERATIONS PTY LTD	T5508/2003
RIETFONTEIN 100 IS	15/100	T0IS00000000010100015	REPUBLIC OF SOUTH AFRICA (MPUMALANGA)	T11707/1978
ALEXANDER 102 IS	3/102	T0IS00000000010200003	SASOL MINING (PTY) LTD	T1063/2020
	12/102	T0IS00000000010200012	H J PIETERSE VLAKFONTEIN TWEEHONDERD PTY LTD	T21787/1999
	14/102	T0IS00000000010200014		
	1/102	T0IS00000000010200001	NICI JANSE VAN RENSBURG	T9783/201
	9/102	T0IS00000000010200009	LATTER RAIN MISSION INTERNATIONAL	T50133/1997
	5/102	T0IS00000000010200005	H J PIETERSE KAALPLAATS DRIEHONDERD CC	T14414/2018
	4/102	T0IS00000000010200004	LATTER RAIN MISSION INTERNATIONAL	T50133/1997
	13/102	T0IS00000000010200013	H J PIETERSE VLAKFONTEIN TWEEHONDERD PTY LTD	T21787/1999
	10/102	T0IS00000000010200010	NICI JANSE VAN RENSBURG	T9783/201
	2/102	T0IS00000000010200002	HENRY BROWN DUNN	T56399/1992
	8/102	T0IS00000000010200008	H J PIETERSE KAALPLAATS DRIEHONDERD CC	T15710/2018
	6/102	T0IS00000000010200006	VENTER JOHANNA DORETHEA PETRONELLA	T36465/1980
BOSCHMANSKRAAL 113 IS	4/113	T0IS00000000011300004	NIEVAN TRUST	T16944/2018
BRAKFONTEIN 117 IS	0/117	T0IS000000000117000004	ANGLO OPERATIONS PTY LTD	T14728/2010
	1/117	T0IS000000000117000001		T10801/2011
	2/117	T0IS000000000117000002	KLIPKRAAL TRUST	T8918/2014
	5/117	T0IS00000000011700005	KLIPKRAAL TRUST	T8918/2014
	6/117	T0IS00000000011700006	ANGLO OPERATIONS (PTY) LTD	T14728/2010
RIVERSDALE 119 IS	RE1/119	T0IS000000000119000001	SASOL MINING (PTY) LTD	T13259/1994
	13/119	T0IS00000000011900013	REPUBLIC OF SOUTH AFRICA (MPUMALANGA)	T5204/1979
SYFERFONTEIN 115 IS	9/115	T0IS00000000011500009	SASOL MINING (PTY) LTD	T73925/1990
	10/115	T0IS00000000011500015		
	15/115	T0IS00000000011500015	SASOL MINING (PTY) LTD	T35748/1990
	2/115	T0IS00000000011500002	MEN SURVEY & DRILLING (PTY) LTD	T3554/2014
	5/115	T0IS00000000011500005	NIEVAN TRUST	T16943/2018
	6/115	T0IS00000000011500006	NIEVAN TRUST	T16943/2018
	7/115	T0IS00000000011500007	SASOL MINING (PTY) LTD	T73925/1990
	11/115	T0IS00000000011500011		T22602/1989
	14/115	T0IS00000000011500014	COLORADO PARK PTY LTD	T1681/1991
K-STAD 79 IS	19/79	T0IS00000000007900019	PIETER HENDRIK SCHALK VAN DE MERWE	T8278/2011

Farm name	Portion	S21-digit number	Property Owner	Title deed
	9/79	T0IS00000000007900009	VOSBREET BOERDERY PTY LTD	T8683/2019
WITBANK 576 IS	0/576	T0IS00000000057600000	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	TT7254/2011
WITBANK 80 IS	24/80	T0IS00000000008000024	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	T21782/1999
	27/80	T0IS00000000008000027		
	29/80	T0IS00000000008000029	H B DUNN BOERDERY (PTY) LTD	T1450/2017
	30/80	T0IS00000000008000030		
	31/80	T0IS00000000008000031	HENRY BROWN DUNN	T96084/1997
	6/80	T0IS00000000008000006	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	T21782/1999
	8/80	T0IS00000000008000008	SANDRIENA JOHANNA VENTER	T336029/2007
	11/80	T0IS00000000008000011	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	T21782/1999
	23/80	T0IS00000000008000023	HENRY & MARLENE DUNN WITBANK TRUST	T1351/2021
	25/80	T0IS00000000008000025	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	T21782/1999
	33/80	T0IS00000000008000033		
	28/80	T0IS00000000008000028	SANDRIENA JOHANNA VENTER	T336029/2007
	32/80	T0IS00000000008000032	H B DUNN BOERDERY (PTY) LTD	T1450/2017
WITRAND 103 IS	6/103	T0IS00000000010300006	LATTER RAIN MISSION INTERNATIONAL	T103805/1996
	5/103	T0IS00000000010300005	H J PIETERSE (VLAAKFONTEIN TWEEHONDERD) CC	T21787/1999
CALEY 77 IS	00R/77	T0IS00000000007700000	LATTER RAIN MISSION INTERNATIONAL	T12594/2011
VANSCHALKWYKSRUST 118 IS	1/118	T0IS00000000011800001	BRAKFONTEIN TRUST	T14724/2010
	2/118	T0IS00000000011800002		
	9/118	T0IS00000000011800009	KLIPKRAAL TRUST	T14682/2014
	RE8/118	T0IS00000000011800008	SASOL MYNBOU PTY LTD	T14681/2014
WELTEVREDEN 116 IS	3/116	T0IS00000000011600003	NIEUWENHUIZEN CHRISTINA MAGDALENA JANSEN VAN	T107453/2004
	7/116	T0IS00000000011600007		
	8/116	T0IS00000000011600008		
TWEEDRAAI 139 IS	6/139	T0IS00000000013900006	SASOL MINING PTY LTD	T35748/1990
	10/139	T0IS00000000013900010	WET GABRIEL FRANCOIS DE	T1228/1990
	12/139	T0IS00000000013900012	SASOL MINING PTY LTD	T51413/1990
	15/139	T0IS00000000013900015		T37581/1990
	22/139	T0IS00000000013900022		T81457/1992
	24/139	T0IS00000000013900024	WET GABRIEL FRANCOIS DE	T41812/1994
TRICHARDTSFONTEIN 140 IS	RE10/140	T0IS00000000014000010	SASOL MINING PTY LTD	T16607/2015
FRISCHGEWAAGD 142 IS	3/142	T0IS00000000014200003	WET JOHANNA JACOBA DE	T16330/2001

4. DESCRIPTION OF THE SCOPE OF THE PROPOSED OVERALL ACTIVITY

4.1 Listed and specified activities

Provide a plan drawn to a scale acceptable to the competent authority but not less than 1: 10 000 that shows the location, and area (hectares) of all the aforesaid main and listed activities, and infrastructure to be placed on site and attach as Appendix 4

A list of activities to be undertaken as part of the proposed project is provided in **Table 4-1**. A large-scale map is provided in **Appendix 4**.

Table 4-1: Listed and specified activities

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
Listed activities in terms of NEMA EIA Regulations 2014, as amended				
The development and related operation of infrastructure exceeding 1 000 metres in length for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes – (i) with an internal diameter of 0,36 metres or more; or (ii) with a peak throughput of 120 litres per second or more; excluding where— ~~(a) such infrastructure is for the bulk transportation of sewage, effluent, process water, waste water, return water, industrial discharge or slimes inside a road reserve or railway line reserve; or~~ ~~(b) where such development will occur within an urban area.~~	Dirty water pipelines, including pipelines from the pit to the PCD, pipelines from the office complex to the Sewage Treatment Plant (STP), pipeline from the Riversdale underground compartment to the service water reservoir, and dirty stormwater management infrastructure	~5 200 m	X	Activity 10 of Listing Notice 1 (GNR 327)
The development of— (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs— (a) within a watercourse; ~~(b) in front of a development setback; or~~ (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse; — excluding— ~~(aa) the development of infrastructure or~~	Development of opencast mining pits, reservoir, conveyors, roads, pipelines, powerlines, mine complex, topsoil stockpiles, contaminated stockpiles, and associated infrastructure within watercourses and within 32m of a watercourse.	Opencast pits: 636.4 ha Conveyors & service roads: ~27 300 m Roads: ~17 600 m Haul roads: ~2 800 m in length Contaminated dump: ~95 ha Softs: ~5 ha	X	Activity 12 of Listing Notice 1 (GNR 327)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~structures within existing ports or harbours that will not increase the development footprint of the port or harbour;~~ ~~(bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies;~~ ~~(cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies;~~ ~~(dd) where such development occurs within an urban area;~~ ~~(ee) where such development occurs within existing roads, road reserves or railway line reserves; or~~ ~~(ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.~~				
The development and related operation of facilities or infrastructure, for the storage, or for the storage and handling, of a dangerous good, where such storage occurs in containers with a combined capacity of 80 cubic metres or more but not exceeding 500 cubic metres.	Storage of chemicals within the Explosives magazine Storage of fuel and chemicals within the mine complex workshops	Explosive magazine: ~0.005 ha Bulk fuel and lube bay: ~0.06 ha	X	Activity 14 of Listing Notice 1 (GNR 327)
The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving— ~~(a) will occur behind a development setback;~~	The stripping and excavation of soil in proximity to a watercourse for the development of infrastructure or mining	-	X	Activity 19 of Listing Notice 1 (GNR 327)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~(b) is for maintenance purposes undertaken in accordance with a maintenance management plan;~~ ~~(c) falls within the ambit of activity 21 in this Notice, in which case that activity applies;~~ ~~(d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or~~ ~~where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.~~				
Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required for the exercising of such exempted activity.	The mining right Ref MP 30/5/1/2/2/ 10125MR is being amended by Sasol in terms of Section 102 of the MPRDA, following their acquisition of this mining right.	Mine boundary: ~10 700 ha	X	Activity 21D of Listing Notice 1 (GNR 327, amended in GN517 of June 2021)
The development of a road— ~~(i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or~~ (ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres ~~but excluding a road—~~ ~~(a) which is identified and included in activity 27 in Listing Notice 2 of 2014;~~ ~~(b) where the entire road falls within an urban area;~~	Construction of gravel roads with a reserve of 25 m (including the temporary access toad from the D618) and new sections of the D450 and D620 (which will have a road reserve of 40 m). Construction of internal mine roads with a reserve of 12.5 m Upgrade of an intersection of a provincial road and upgrade and diversion of a district road.	New sections of D450: ~1 000 m in length New section of D620 (gravel): ~1 200 m in length Temporary access road: ~1km	X	Activity 24 of Listing Notice 1 (GNR 327)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~or~~ ~~(c) which is 1 kilometre or shorter.~~				
The development and related operation of facilities or infrastructure for the treatment of effluent, wastewater or sewage with a daily throughput capacity of more than 2 000 cubic metres but less than 15 000 cubic metres.	Construction and operation of a sewage treatment plant at the mine complex	STP: ~0.5 ha	X	Activity 25 of Listing Notice 1 (GNR 327)
The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre— (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres; excluding where widening or lengthening occur inside urban areas.	Upgrading of the existing D620 road and potential lengthening by diversion. Upgraded public roads have a 40 m road reserve. Widening of existing D618, D450, and D620 road by more than 6 m.	Upgrade of existing road: ~80 000 m^2 Upgrade of D618: ~1 700 m in length Upgrade of D450: ~2 250 m in length	X	Activity 56 of Listing Notice 1 (GNR 327)
The development of facilities or infrastructure for any process or activity which requires a permit or licence or an amended permit or licence in terms of national or provincial legislation governing the generation or release of emissions, pollution or effluent, excluding — ~~(i) activities which are identified and included in Listing Notice 1 of 2014;~~ ~~activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies~~	Activities requiring a water use licence: • ROM stockpile • Dust suppression using mine impacted water • PCD • Sumps within mine complex • Overburden stockpiles • Dirty water channels, sumps, and pipelines • Overburden stockpiles • STP and drying beds Infrastructure and mining pits within 500m of a watercourse	ROM tip: ~1.5 ha PCD: 5.8 ha Conveyors & service roads: ~27 300 m Roads: ~17 600 m Haul roads: ~2 800 m Mine complex: ~25 ha STP: ~0.5 ha Topsoil stockpiles: ~12.5 ha Softs: ~5 ha Contaminated dump: ~95 ha	X	Activity 6 of Listing Notice 2 (GNR 325)
The clearance of an area of 20 hectares or more of indigenous vegetation excluding where such clearance of indigenous vegetation is required for—	Clearing of vegetation for infrastructure, mining complex, stockpile areas, mining pits	~850 ha	X	Activity 15 of Listing Notice 2 (GNR 325)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~(i) the undertaking of a linear activity; or~~ ~~maintenance purposes undertaken in accordance with a maintenance management plan.~~				
Any activity including the operation of that activity, which requires a mining right in terms of section 22 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice, in Listing Notice 1 of 2014 or Listing Notice 3 of 2014, required to exercise the mining right	Opencast mining pits and related activities	~636.4 ha	X	Activity 17 of Listing Notice 2 (GNR 325, amended in GN517 of June 2021)
The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan. Mpumalanga ~~i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;~~ ii. Within critical biodiversity areas identified in bioregional plans; or ~~iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning or proclamation in terms of NEMPAA.~~	Clearing of vegetation for infrastructure, mining complex, stockpile areas, mining pits, within a CBA.	~200 ha	X	Activity 12 of Listing Notice 3 (GNR 324)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
The development of— iv. dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or v. infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs— (a) within a watercourse; ~~(b) in front of a development setback; or~~ (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; Mpumalanga i. i. Outside urban areas: ~~(aa) A protected area identified in terms of NEMPAA, excluding conservancies;~~ ~~(bb) National Protected Area Expansion Strategy Focus areas;~~ ~~(cc) World Heritage Sites;~~ ~~(dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;~~ ~~(ee) Sites or areas identified in terms of an international convention;~~ (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; ~~(gg) Core areas in biosphere reserves; or~~ ~~(hh) Areas within 10 kilometres from national parks~~	Development of opencast mining pits, reservoir, conveyors, roads, pipelines, powerlines, and associated infrastructure within watercourses and within 32m of a watercourse. Development of a post-closure stormwater management dam within a watercourse.	Opencast pits: 636.4 ha (of which ~18 ha is within CBAs) Conveyors & service roads: ~27 300 m (of which ~4 800 m is within CBAs) Roads: ~17 600 m (of which ~2 300 m is within CBAs) Softs: ~5 ha (of which 0.8 ha is within CBAs) Powerlines: ~3 500 m within CBAs Clean water pipeline: ~5 900 m within CBAs Dirty water pipeline: ~1 050 m within CBAs	X	Activity 14 of Listing Notice 3 (GNR 324)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or~~ ~~ii. Inside urban areas:~~ ~~(aa) Areas zoned for use as public open space; or~~ ~~(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose.~~				
The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre Mpumalanga i. Outside urban areas: ~~(aa) A protected area identified in terms of NEMPAA, excluding conservancies;~~ ~~(bb) National Protected Area Expansion Strategy Focus areas;~~ ~~(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;~~ ~~(dd) Sites or areas identified in terms of an international convention;~~ (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; ~~(ff) Core areas in biosphere reserves; or~~ ~~(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of~~	The D450 road will be lengthened by ~1 km within CBAs.	D450 road within CBAs: ~1 000 m	X	Activity 18 of Listing Notice 3 (GNR 324)

DESCRIPTION OF ACTIVITY AS PER REGULATIONS	NAME OF ACTIVITY	AERIAL EXTENT OF ACTIVITY	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
~~NEMPAA or from the core area of a biosphere reserve, where such areas comprise indigenous vegetation; or~~ ~~ii. Inside urban areas:~~ ~~(aa) Areas zoned for use as public open space; or~~ ~~(bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.~~				
Waste management activities in terms of NEM:WA (GN 921 (2013) as amended in GN 332 (2014), GN 633 (2015), GN 242 (2017) and GN 1094 (2017))				
The construction of a facility for a waste management activity listed in Category B of this Schedule (not in isolation to associated waste management activity).	Construction of overburden stockpiles, associated liners and water management infrastructure	Contaminated dump: ~95 ha PCD: 5.8 ha	X	Category B, Activity 10
The establishment or reclamation of a residue stockpile or residue deposit resulting from activities which require a prospecting right or mining permit, in terms of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).	ROM stockpiles Overburden stockpiles	ROM tip: ~1.5 ha Contaminated dump: ~95 ha	X	Category B, Activity 11
Activity 1: The storage of general waste at a facility that has the capacity to store in excess of 100m3 of general waste at any one time, excluding the storage of waste in lagoons or temporary storage of such waste. Activity 2: The storage of hazardous waste at a facility that has the capacity to store in excess of 80m3 of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such waste	Storage of general or hazardous waste at the mine complex (waste stockpiles, yards etc.)	ISO bin yard: 0.16 ha	X	Category C, Activities 1 and 2

4.2 Description of the activities to be undertaken

4.2.1 Mining methods

The proposed Alexander Mining Project is a greenfields project that will include opencast mining operations to extract coal from the No.4 and No.5 Coal Seams of Block 2, located on the southern side of the Steenkoolspruit. 47 Mt of in situ coal is available for mining at Block 2. This resource will be mined across three (3) separate pits namely Pit 1, 2 and 3, using truck and shovel with doze over mining method. The extent of the opencast pits is indicated in **Appendix 4** and the mine plan is shown in **Figure 4-1** below.

The 47 Mt of available coal to be mined in Block 2 comprise the C5L Seam (6 Mt) and the C4L Seam (41 Mt). The mining of Block 2 reserves will be undertaken over a period of thirteen (13) years.

Pit 2 will be mined first by virtue of its lowest strip ratio and Pit 1 will follow shortly thereafter (within two years) to achieve the build-up to steady-state production.

Pit 2 is located to the east of Pit 1. Another smaller and deeper area that can be mined by truck and shovel has been identified to the east of Pit 2, namely Pit 3.

The Block 2 reserve is considered to be the preferred mining area with better coal qualities and fewer geological intrusions.

Sasol Mining has indicated that they may decide to mine additional areas of the remaining reserves at Alexander in future via underground mining, however this is not currently in the project plan and has not been assessed as part of this study. A new environmental application and licensing process would be required for additional mining, should Sasol Mining decide to mine additional areas in future.

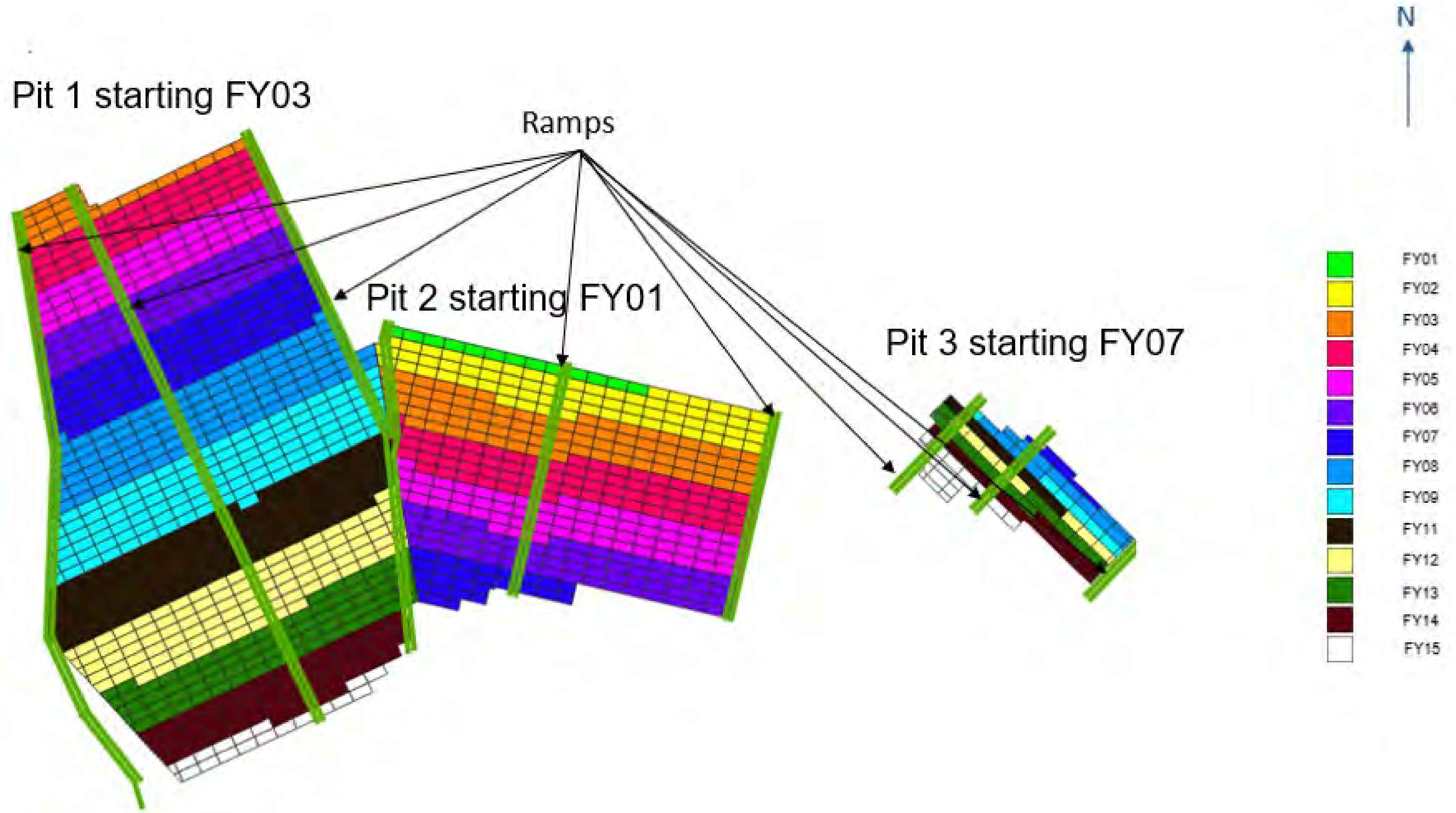


Figure 4-1: Opencast mine plan (Phoenix Mine Planning, as at 20 November 2020).

4.2.2 Mining facilities

The mining facilities and support infrastructure discussed in the following sections have been informed by the Design Report compiled by GIBB (2021) and are illustrated in the map provided in **Appendix 4**.

4.2.2.1. Pollution Control Dam (PCD)

The PCD will be double lined with High Density Polyethylene (HDPE) lining and will be designed for a recurrence of 1:100 years with an emergency spillway, inlet and outlet structures as well as an emergency outflow channel. Sub-surface drains will be incorporated into the PCD layer works and a minimum of 800 mm freeboard has been provided in the design. The PCD will comply with the latest Dam Safety regulations and due to its capacity, the PCD will need to be registered with the Dam Safety Office.

4.2.2.2. Stockpiles

Overburden (hards and contaminated)

A large, contaminated stockpile area was identified outside the mining areas for the initial boxcut. A second clean stockpile area was identified next to the contaminated stockpile area. Once sufficient backfilling has taken place, contaminated and clean material will be stored on top of the backfilled area in the mining area.

The contaminated stockpile area outside the opencast pit area will be constructed with a suitably classified liner system with sub-surface drains, stormwater catchment drains around the stockpile that channel the contaminated water into the PCD dam.

Topsoil and Softs

Provision has been made to separate topsoil storage with protection berms to minimise the erosion of the topsoil. These stockpiles will be well managed and vegetated to prevent erosion. Topsoil stripping must be kept to the absolute minimum (stockpile footprint).

4.2.2.3. Haul roads & Haul Road Bridge

The haul roads will have a servitude of 40 m. They will be gravel surfaced roads consisting of two lanes, each 13.285 m wide with a camber of 2%, separated by an earth berm at selected high-risk areas.

The proposed bridge structure crossing a watercourse withing the project area is 30 m long x 39.43 m wide (roadway between parapets lines). The superstructure consists of a solid rectangular deck section. Outer spans are 8.5 m each and the internal span is 13 m long. The substructure is supported on augured piles, that is both the abutments and the piers.

4.2.2.4. ROM tip

Opencast coal will be mined using a truck and shovel operation whereby the coal will be delivered by haul trucks to a ROM tip. The ROM tip grizzly screen on top of the ROM bin has an aperture size of 1 000 mm x 1 000 mm. Oversize material that does not pass through the grizzly screen will be broken down with a rock breaker.

4.2.2.5. Crusher

The coal from the ROM Tip will be extracted from the tip via an apron feeder and fed into a primary crushing circuit. The ROM tip conveyor will transport the coal from underneath the primary crusher at the ROM tip up into the screening and secondary crushing facility.

The secondary crushing circuit will comprise out of a vibrating screen and a rotary breaker. Discard from the rotary breaker will be stored in a 300 t discard bin. The discard will be discarded responsibly into the opencast area via haul trucks. The coal from the surface surge bunker will be extracted from the bunker via a reclaim conveyor and onto the overland feed conveyor.

The coal from the overland feed conveyor will be transported via an overland conveyor system from where it will tie into the current Syferfontein conveyor system.

4.2.2.6. Bunker

The surface surge bunker is a reinforced concrete bunker structure consisting of 7 bays with a total storage capacity of 10 000 t. Additional emergency capacity is allowed for by creating a throw-out facility by extending the discharge end of the tripper conveyors beyond the end limit of the bunker.

The surface surge bunker structure extends over a total length of approximately 140 m, consisting of an in-feed structure section of approximately 30 m in length. The concrete surface bunker section is approximately 70 m in length and the throw-out stockpile/head section approximately 40 m in length. The bunker structure is approximately 37 m in overall height. The bunker will be equipped with an overhead crane to assist with the maintenance and repairs of the mechanical equipment.

4.2.2.7. Throw-out stockpile

The bunker lift conveyor and the ROM tip conveyor both feed the tripper conveyor. The design capacity was selected to accommodate the feed from the ROM Tip. The ROM tip conveyor receives coal from the primary crusher and feeds directly onto the tripper conveyor. The tripper conveyor is equipped with a travelling tripper car that can be positioned to discharge in any location within the surface surge bunker or redirect the coal to discharge onto the throw-out stockpile area located beyond the surface surge bunker. The tripper conveyor drive is located at the head pulley of the tripper conveyor on top of the surface surge bunker structure. The final drive position needs to be optimised to ensure ease of maintenance and based on the final layout of the throw-out facility.

4.2.2.8. Sampling plant

A sampling plant will be installed on the reclaim conveyor. The sampling plant will measure moisture content, ash content and percentage fines taken from samples on the overland feed conveyor at 15-minute intervals. The sampling plant will be equipped to crush the sample taken to ~10 mm and store 1 kg of the sample in a container for further analysis.

4.2.2.9. Explosives off-loading magazine

An explosive magazine facility is provided to the southwestern side of the infrastructure complex. This facility was placed a minimum of 500 m from any infrastructure to ensure a safe region. The explosive magazine will be constructed with gravel protection berms around an open area. The purpose of the explosive magazine is to offload any explosive arriving on the mine.

4.2.3 Support infrastructure

The infrastructure to support the surface mining operations over the full 13-year Life of Mine (LOM) has been engineered to accommodate the initial surface mining requirements.

4.2.3.1. Conveyor

Overland Conveyor

The overland conveyor and service road will be contained within a 25 m servitude. The single conveyor line and service road will be within a width of 9.5 m (between shoulder breakpoints). The conveyor service road will be a gravel surface road.

The overland conveyor system transports material to the Syferfontein complex area, where it will be fed into the existing Sasol Coal Supply (SCS) conveyor system. The system comprises of two flights of 1 200 mm wide conveyors with a design capacity of 2 400 tph at 5.8 m/s. The flight lengths are 9 km and 5.3 km respectively with both conveyors having both straight and horizontally curved alignment.

Both the overland conveyors will have belt turnovers to reduce the risk of spillage and duff generation from the return strand on the conveyors. Overland conveyor 1 will cross two wetland areas in an environmental enclosed bridge structure. The structure will prevent rain onto the conveyor over the wetlands, prevent any spillage landing in the wetlands and prevent dust deliberation from the conveyor due to high winds.

Overland Conveyor Bridge

Isibonelo Overland Conveyor Bridge. The proposed bridge structure is 205 m long x 3.3 m wide, consisting of a seven span simply supported lattice steel girder supporting the overland conveyor. The two outer spans are 27.5 m long each and the internal five spans are each 30 m long. The substructure consists of two solid wall abutments and six circular column type piers supported on augured piles. A 1: 100 flood recurrence interval bridge design was also undertaken.

Debeerspruit Overland Conveyor Bridge. The proposed bridge structure is 190 m long x 3.3 m wide, consisting of a seven span simply supported lattice steel girders supporting the overland conveyor. The two outer spans are 20 m long each and the internal five spans are each 30 m long. The substructure consists of two solid wall abutments and six circular column type piers supported on augured piles. A 1: 100 bridge size was also calculated.

4.2.3.2. Powerlines

There will be 2 x 22 kV overhead powerlines supplying the Alexander Mine. These lines will run from Eskom Rietfontein substation, located approximately 12 km from the Alexander mine complex, and provide firm power to the mine. Rietfontein is currently an 88 kV substation however Eskom is in the process of upgrading it to a 132 kV substation. Sasol Mining will apply to Eskom to add additional bays to Rietfontein to step the voltage down to 22 kV. The load requirements of the project have been submitted to Eskom and it has been confirmed by Eskom that Rietfontein will be able to supply the power requirements of the mine within time, in terms of the draft Execution Schedule.

The following safety and environmental considerations were taken into consideration when planning the line servitudes:

- Care was taken to avoid sensitive wetland areas as far as possible
- Existing farmhouses were avoided;
- Crossings of infrastructure such as roads and other powerlines was limited;
- Running parallel to conveyors in proximity was avoided to limit voltages being induced onto the metal structures of the conveyor;
- The shortest distance from the point of supply to the mine; and
- Accessibility to the lines from existing roads.

Power will be distributed at 22 kV throughout the Alexander Mine complex where it will be stepped down the relevant operating voltage at the major load centres.

22 kV lines will run from the Alexander Mine complex to power the overland conveyor and the Riversdale pump station.

A 22 kV overhead powerline will also be run from the surface infrastructure substation to the proposed dewatering well fields.

4.2.3.3. Substations

There will be 5 basic typical types of substation layouts. These will cater for all the substations envisaged for the mine, as listed below. The substations will house all the relevant electrical equipment such as transformers, switchgear and cabling as required by the electrical engineers. Local minisubs will provide power to offices, buildings, and area lighting. Metering points will be installed for power feeders to sub-contractor facilities. Each minisub will be mounted on a concrete plinth with a surrounding spillage bund. Cable entry will be from the bottom.

There will be several substations located across the expanse of the mine and all of them will be interconnected with 22 kV overhead powerlines.

The substations to be provided on-site are as follows:

- Alexander Main Substation
- Bunker/Tripper Substation
- Surface Infrastructure Substation
- Bunker/Reclaim/ Crushing and Screening Substation
- Overland Feeder Conveyor Substation
- OLC 1 Substation
- OLC 2 Substation

The main substations are discussed in more detail below.

Alexander 22 kV Main Substation

The Alexander Main 22 kV Substation will distribute power at 22 kV to other distribution substations located around the Alexander complex. The substation will consist of an elevated brick building housing; a 23-panel switchboard with a separate room to house the Programmable Logic Controller (PLC), Communications, control, and battery tripping equipment.

4.2.3.4. *Pipelines*

Potable water

A 90 mm diameter HDPE pipeline of approximately 19.5 km in length will be installed from the Rand Water Weltevreden pump station to provide the proposed Alexander mine with potable water. The potable water network will be equipped with water flow meters throughout to facilitate to ensure proper recording of water usage.

Dirty water

During initial start-up of the operations service water will be obtained from an underground compartment at Riversdale. The pipe will be a HDPE PE100 Class PN 16 with a nominal diameter of 560 mm.

During later stages of operation, surplus water from the mine will be pumped back to the Riversdale underground mining compartment.

4.2.3.5. *Potable water tank*

From the prefeasibility investigation, it was determined that there is adequate pressure to supply the proposed mine site with bulk potable water from the Rand Water Weltevreden pump station. The pump station is located southwest of the proposed Alexander mine. The potable water will be delivered into a 380 kl capacity elevated storage tank. The potable water will be distributed from this storage tank for potable and fire water distribution to the mine main infrastructure area. The capacity of the storage tank will provide storage to supply all the potable water demands for 24 hours via a ring main pipeline.

4.2.3.6. *Service water tank*

The initial supply of the service water during the establishing years of the proposed Alexander mine will be sourced from the Riversdale underground compartment located approximately 7 km from the mine.

The water from the PCD will be pumped into a ground reservoir where after it will be distributed as service water throughout the proposed mining operations. The PCD will be fed via stormwater runoff from the main mine complex dirty areas, water pumped from the opencast mine pit pumps and the contaminated stockpile area.

The PCD will be operated with a low level allowing for a service water demand of 15 days. Any excess water will be pumped back to the underground water compartment at Riversdale.

4.2.3.7. *Sewage Treatment Plant*

The sewer system will collect all sewer from buildings and convey it via gravity to a designated point where a sewage treatment plant will be located. The treatment plant proposed is called a Sequencing Batch Reactor (SBR) and has the advantage of requiring a small installation area due to all the phases of the treatment process occurring sequentially within the same tank. All Class I and II ('light') and Class III ('dark') greywater arising from the change house, laundry, wash hand basins and tea-kitchen facilities within the Alexander Mine complex, will be harvested and directed to the sewage plant for treatment. All sewage arising from toilets will report separately to the sewage treatment plant. The sewage treatment plant will only discharge treated water that complies to the minimum discharge water standards and the approved Water Use

Licence (WUL) conditions. Such treated water will be directed to wetlands and/or the river systems.

The domestic sewage from the toilet facilities at the ROM Tip workshop, SCS workshop and overland conveyor 1 workshop will be treated at the different working in a modular self-contained sewerage plant. Sludge from these smaller sewerage systems will be collected by a licensed waste disposal company on a regular basis. Black and grey water will not be managed separately. All water will be considered as black water and report to a sewage treatment plant located in the main infrastructure complex of the mine.

All treated solid waste will be directed to drying beds for removal by mechanical means.

4.2.3.8. Workshops

General workshop

The general workshop will provide sufficient floor space for the following services:

- Minor boiler making, fabrication and repairs (excluding large earth moving buckets)
- Instrumentation
- Electrical repairs
- General fitting
- General repairs

The workshop will have the following general facilities:

- Office and seating for relevant personnel
- Kitchens
- Ablutions

Diesel workshop

The diesel workshop will provide floorspace to heavy duty and light duty vehicles that require servicing/repairs. It is envisaged to house three designated areas namely the Truck workshop the Boiler workshop and the Light Duty Vehicle (LDV) workshop. The facility will also be catered for a centrally fed oil supply system to cater for the oil distribution and supply needs of the facility/equipment.

The facility will include the following:

- Area for boilermaker activities
- LDV, tractor and truck haul bays
- Offices (upper level included)
- Kitchen
- Storeroom
- Ablutions
- Plant room/transformer room
- Compressor room
- Gas storage room

- Oil storage room
- Several access bays with electrically operated roller shutter doors

Tyre pressure workshop

The tyre pressure workshop will be located near the tyre changing slab. The workshop will house equipment for the repair and maintenance works to the heavy haul truck tyres. It will typically house tyre pressurisation cages, a compressor, and other relevant tools. This will not act as a tyre store. The tyre storage function will be taken up by the Process Safety Management (PSM) Warehouse facility.

PSM Warehouse

The PSM Warehouse design was the responsibility of an independent consultant appointed by Sasol. There will only be a space allocation made for this facility.

4.2.3.9. Office block

Production offices

The facility will comprise of offices for the staff involved in the daily operations of the mine. This will typically include general administration, service personnel, environmental, planners and engineering.

The facility will include the following:

- Reception areas including reception desk, and waiting areas
- Designated offices for specific personnel
- Office area ablution facilities sized to suit for a male to female ratio of 60:40 in the administrative areas
- Paraplegic ablution facilities
- Ancillary office areas such as conference/board rooms, meeting rooms, storerooms and IT/communication rooms as required
- Kitchenette and lunch facilities
- The facility will be laid out to provide easy access to all staff and to minimise travelling distances
- Open Courtyards (minimised)

Management offices

The facility will cater for management, clerks, financial and human resource staff.

The facility will include the following:

- Reception areas including reception desk, and waiting areas
- Designated offices for specific personnel
- Safes
- Access secure areas
- Office area ablution facilities sized to suit for a male to female ratio of 60:40 in the administrative areas

- Paraplegic ablution facilities
- Ancillary office areas such as conference/board rooms, meeting rooms, storerooms and IT/communication rooms as required
- Local Area Network Room
- Kitchenette and lunch facilities
- Open courtyards
- The facility will be laid out to provide easy access to all staff and to minimise travelling distances.

4.2.3.10. Tyre fitment slab

A concrete slab will be provided adjacent to the tyre workshop allowing Heavy Mining Equipment (HME) to be lifted for the replace of tyres and allowing a tyre handler to manoeuvre around the HME. The slab will be designed to carry the weight of a heavy vehicle while being supported on trestles.

4.2.3.11. Refuelling bay

The haul truck refuelling bay is to be an open-ended Inverted Box Rib (IBR) covered steel structure. The side covering on the structure will end 2.7 m above the ground level to assist the staff operating in that area from being exposed to rain etc. while refuelling the equipment.

The fuel dispensing pumps are allocated on raised concrete platforms to assist in reaching the truck refuelling points. The bays are laid out to be side by side rather than one behind the other. This is done to avoid the possibility where the front unit might have to wait, causing the rear unit having to wait accordingly. With the side-by-side approach this possible occurrence is negated. The floor of the refuelling facility will be sloped to ensure all spillage collected in the contaminated drain system. The collected contaminated fluid will drain to the oil separator for further treatment.

4.2.3.12. Bulk fuel and lube area

The bulk fuel and lubricant storage facility will be provided by an approved independent fuel/lubricant supplier. The operational intent of the latter bulk storage facility will be to provide fuel and lubrication storage for approximately one week for all mine vehicles and light vehicles.

The facility will be designed to incorporate the following:

- Area for self-bunded storage tanks which are non-reactive to its contents
- Area where off-loading and decanting can occur
- Areas for dispensing
- Bowsers for all mine service vehicles and light vehicles
- Containment and treatment of spillages
- Services reticulation and connection within the Fuel/lubricant Storage Facility bounds
- Only local high mast area lighting will be provided

4.2.3.13. Materials handling contractor terrace

This facility will be equipped with a small workshop and offices to accommodate the maintenance staff as well as the control room operators. The facilities will consist of the following:

- Male and female change rooms
- Open plan workspace
- Oil store
- Compressor room
- Office
- Kitchen
- Storeroom

4.2.3.14. Construction offices and laydown area

A construction office and laydown area will be provided in the north of the planned infrastructure area. The prepared terrace will allow for temporary construction offices to be erected, material to be stored and construction vehicles to be parked on the terrace. This construction terrace is included in the contaminated water management system to ensure that any possible contamination from this area is directed to the PCD.

4.2.3.15. Oil-water separator

Run-off water from the LDV wash bay will be guided to a silt trap/sump, where solids will settle out. The silt trap will be sized to allow settlement of medium silt. The width of the slit trap will be sized to accommodate clean out on a regular basis using a Front-end loader or Bobcat. The silt trap will be provided with steel tracks to minimise the damage to the silt trap by the Front-end loader during cleaning. The sump will be compartmentalised to separate clean and oil contaminated water.

The sump overflow water will be reticulated to the dirty water drainage system for return to the PCD. The oil contaminated water will be processed via an oil separation system that will consist of a floating oil skimmer, coalescing plate oil separator and 1.5 KL horizontal steel waste oil tank. Water discharged from the oil separator will be directed to the PCD.

4.2.3.16. ISO bin facility

The facility will essentially be the central refuse point on-site. The entrances will be sized to ensure that a truck and skip can manoeuvre with ease for collection. Sub-division of the premises will ensure that no cross-contamination occurs upon disposal and that materials could be transported for recycling. The sub-division of refuse rooms will be as indicated:

- Scrap metal
- Scrap wood
- Oil refuse
- Hazardous chemicals refuse
- Household products refuse

- Paper
- Fluorescent bay
- Fire extinguishers
- Plastic
- Rubber and tyres
- Cable refuse

4.2.3.17. Service yards

A central area was allowed to act as a service yards. This site ensures that there are controlled spaces where work activities and/or storage can be undertaken. The following potential storage commodities are envisaged to be stored in this area:

- Pipe yard
- Cable yard
- General items

4.2.3.18. Washbays

LDV washbay

The facility will provide space and facilities to wash all roadworthy vehicles before either entering a workshop or being dispatched for servicing. The LDV wash facility will have two flat ground level bays with one steel structure raised bay. All the bays will be able to accommodate Load, Haul, Dump Machine (LHD) equipment which will come into use later during the mine's life cycle.

Typical vehicle allocations:

- LDV and Sports Utility Vehicle
- Microbus 12-seater
- 22-seater busses
- LHD Equipment

Haul truck washbay

The haul truck drive-through wash bay will provide sufficient space to wash all heavy-duty vehicles and heavy maintenance equipment before driving to the relevant workshops for both scheduled and incidental maintenance.

All heavy-duty vehicles and heavy maintenance equipment traffic will be directed through this facility prior to entering the workshops. The heavy vehicle wash facility will be designed to cater for the following typical equipment including:

- CAT 789 (or similar) size Haul truck, and,
- CAT D11 bulldozer (or similar).

4.2.3.19. Heavy mining equipment parking hardstand

The HME hardstand is a design gravel terrace in front of the diesel workshop. The design is of such that all storm water is drained into the dirty water system. The hardstand will be designed with a V-shape trough allowing the HME to be parked with one of the axles in the trough. This will allow the HME vehicles to be parked without the risk of running away in the event that the park brakes are not functional

4.2.3.20. Change house complex

The main change house facility will be provided for operators and maintenance personnel for use as a personal protective equipment change area, shower, and ablution facility. The central facilities will be provided for the following personnel:

- Management
- Operators
- Maintenance staff
- Contract staff
- Visitors

4.2.3.21. Security building

The security facility will be designed with the sole purpose of controlling and monitoring all access onto the mine. Site access will be governed by personnel designation of either visitor or employee. All visitor inductions will be conducted at the security office prior to entry to the mine facility. All employees will be required to pass through a turnstile facility linked to an automated access control system with time and attendance clocking via a biometric system.

The security office will be manned 24 (twenty-four) hours per day 365 days per annum. CCTV cameras will be installed throughout the site in designated areas. CCTV monitors will also be installed in this security facility to ensure all abnormal activity is logged and mitigated.

4.2.3.22. Tetra Tower

The location of the Tetra Tower was chosen to be on the perimeter of the main parking area located at the main mine entrance. The area required by the Tetra tower is a 12 m x 12 m area. The power requirements for the tower have been indicated to be 60A.

The Tetra Tower can be utilised by contractors to establish their own site communications networks and therefore Sasol have indicated that the erection of the Tetra tower would be one of the first tasks which must be completed during the execution phase. Sasol also indicated that they would be undertaking the installation of the Tetra Tower as part of their scope but that they would require the process to be managed on their behalf. The requisite Technical Pack will need to be prepared in the next phase for procurement purposes.

4.2.3.23. Access roads

Access to the mine will be provided from the provincial road R545 (P52/3) via the district road D620. Access to the mine from Secunda/Trichardt can also be obtained from the gravel district roads D618/D450.

Due to the proposed footprint of the Alexander Mine, district road D618 will need to be closed from the regional road R545 up to the intersection with district road D450.

District road D450 will also be closed for a section and re-routed in order to accommodate the footprint of the mine.

For road safety purposes, the district road D620 will be closed at the position where the D620 is re-routed along the new alignment.

The road servitude for the upgraded district road D620 will be 40m wide and for all the gravel roads will be 25 m.

The planned upgrades to the mine access roads are as follows:

- The intersection of provincial road R545 and district road D620 will be upgraded to accommodate the future traffic generated by the mine and to provide safe access to and from the mine.
- District road D620 will be upgraded from gravel to bituminous surfaced road up to the entrance of the mine. The rest of the new alignment of district road D620 from the mine towards the intersection with district road D450 will be a new gravel road.
- As mentioned above district road D450 will be re-routed, and it will also be upgraded gravel road to accommodate the expected traffic generated and provide safe access to the mine.

Access to the new mine will be required for:

- Mine personnel from Bethal, Kriel and Trichardt/Secunda
- Maintenance service providers
- Visitors to the mine
- Private service providers who supply spares and equipment to the mine
- Private service providers who supply fuels, oils, and lubricants to the mine

4.2.3.24. Bus shelter

The bus shelter is a brick & mortar design along the length of the taxi/bus staging area located in front of the security facility at the mine entrance. Segregated ablution facilities are allowed for staff while waiting to be transported. The bus-shelter will have IBR roofing supported by a cantilevered steel structure along the length of the shelter.

4.2.4 Project phases

The project phases associated with the proposed Alexander Mining Project and associated infrastructure, are described below.

Item	Year
Construction commences: Once authorisation has been received	From 2023 onwards
Construction: Once authorisation has been received	30 months
Operations / Life of Mine (LOM)	Commencing 2025, for 13 years
Decommissioning (dependent on potential future additional mining plans)	Post operations

4.2.4.1. Construction Phase (anticipated to be from 2023 onwards)

Once the relevant authorisations have been received, construction activities will commence. This involves the establishment of the facilities and infrastructure as specified in **Table 4-1** and listed in **Section 4.2.2** and **Section 4.2.3**. Activities to be undertaken that may impact the baseline environment include general construction activities such as civil works, movement of materials and equipment, and servicing of construction vehicles and equipment.

Rehabilitation of any surrounding areas impacted by the construction of infrastructure components must occur immediately after the construction thereof.

4.2.4.2. Operational Phase (2025 + 13 years)

The infrastructure will be utilised during this phase when opencast mining commences. Topsoil stripping will be conducted, and topsoil stockpiles will be placed separately for use during rehabilitation. Overburden/contaminated softs and hards dumps will be established and stockpiled following blasting. Coal will be extracted and transported to the ROM tip. Mine-affected water will be collected and managed as described in **Section 4.2**.

The operational phase ends when the last reserves have been extracted.

4.2.4.3. Decommissioning Phase (Post operations)

The period directly after cessation of operational activities (i.e. when the last mineral reserves have been extracted). It includes the removal of all operation-related equipment that has no beneficial re-use potential, as well as reclamation, rehabilitation and/or restoration of any final remaining areas (e.g. backfilling of final ramps and voids, landform shaping, topsoiling and seeding).

Sasol Mining has indicated that they may decide to mine additional areas of the remaining reserves at Alexander in future via underground mining, however this is not currently in the project plan and has not been assessed as part of this study. A new environmental application and licensing process would be required for additional mining, should Sasol Mining decide to mine these areas in future.

4.2.4.4. Closure Phase

The point in time when all decommissioning and rehabilitation activities have ceased, monitoring has been completed and the mine applies for a closure certificate. The closure phase will include activities such as decant management, erosion monitoring, etc. These aspects will be discussed in more detail in the EIR.

5. POLICY AND LEGISLATIVE CONTEXT

Environmental legislation in South Africa was promulgated with the aim of, at the very least, minimising and at the most preventing environmental degradation. The following Acts and Regulations are applicable to the proposed project.

The environmental applications foreseen for the Alexander Mining Project include:

- Application for Environmental Authorisation through a Scoping and Environmental Impact Reporting (S&EIR) process and the compilation of an Environmental

Management Programme (EMPr) in terms of the National Environmental Management Act, 1998 (Act 107 of 1998; NEMA) and its Regulations;

- Waste Management Licence Application (WMLA) in terms of the National Environmental Management: Waste Act, 2008 (Act 59 of 2008; NEM:WA); and
- Integrated Water Use Licence Application (IWULA) in terms of the National Water Act, 1998 (Act 36 of 1998; NWA), including an Integrated Water and Waste Management Plan (IWWMP).

The first two requirements outlined above, will be addressed in an Integrated Environmental Authorisation as allowed for in Section 24L of NEMA and Section 25(3) of GNR 326.

A Phase 1 Heritage Impact Assessment in terms of the National Heritage Resources Act, 1999 (Act 25 of 1999, NHRA) is being undertaken.

5.1 Applicable legislation

5.1.1 The Constitution of the Republic of South Africa (Act 108 of 1996)

Section 24 of the Constitution states that: Everyone has the right to:

- An environment that is not harmful to their health or well-being; and
- Have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-
  - Prevent pollution and ecological degradation;
  - Promote conservation; and
  - Secure ecologically sustainable development and use of natural resources, while promoting justifiable economic and social development.

The current environmental laws in South Africa concentrate on protecting, promoting, and fulfilling the nation’s social-, economic- and environmental rights; while encouraging public participation, implementing cultural and traditional knowledge, and benefiting previously disadvantaged communities.

5.1.2 National Environmental Management Act (Act 107 of 1998)

The overarching environmental legislation for the management of the environment in South Africa is the NEMA. It provides a framework for environmental law reform and covers three areas, namely:

- Land, planning and development;
- Natural and cultural resources, use and conservation; and
- Pollution control and waste management.

The law is based on the concept of sustainable development. The objective of the NEMA is to provide for co-operative environmental governance through a series of principles relating to:

- The procedures for state decision-making on the environment; and
- The institutions of state, which make those decisions.

The NEMA principles serve as:

- A general framework for environmental planning;
- Guidelines according to which the state must exercise its environmental functions; and
- A guide to the interpretation of NEMA itself and of any other law relating to the environment.

Some of the most important principles contained in NEMA are that:

- Environmental management must put people and their needs first;
- Development must be socially, environmentally and economically sustainable;
- There should be equal access to environmental resources, benefits and services to meet basic human needs;
- Government should promote public participation when making decisions about the environment;
- Communities must be given environmental education;
- Workers have the right to refuse to do work that is harmful to their health or to the environment;
- Decisions must be taken in an open and transparent manner and there must be access to information;
- The role of youth and women in environmental management must be recognised;
- The person or company who pollutes the environment must pay to clean it up;
- The environment is held in trust by the state for the benefit of all South Africans; and
- The utmost caution should be used when permission for new developments is granted.

5.1.2.1. Environmental Impact Assessment Regulations of 4 December 2014, as amended.

A Scoping and Environmental Impact Reporting (S&EIR) process is applicable to all projects likely to have significant environmental impacts due to their nature or extent, activities associated with potentially high levels of environmental degradation, or activities for which the impacts cannot be easily predicted.

This report fulfils the requirements in terms of the Environmental Impact Assessment Regulations Section 24(5), as prescribed by the NEMA.

A list of activities to be undertaken as part of the proposed project provided in **Table 4-1**. A large-scale map is provided in **Appendix 4.**

5.1.2.2. DFFE Environmental Screening Tool

The DFFE requires that their Environmental Screening Tool be utilised prior to undertaking an application for any EA and that the report generated by the tool be submitted with the EA application. The tool is a geographically based web-enabled application which allows a proponent intending to submit an application for an EA to pre-screen their proposed site for any environmental sensitivities.

The Environmental Screening Tool allows for the generating of a pre-screening report referred to in Regulation 16(1)(b)(v) of the EIA Regulations (2014), whereby a screening report, as aforementioned, is required to accompany any application for EA. The screening report for the Alexander site will be submitted with the application (included in **Appendix 8**).

5.1.3 National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)

Through the NEM:WA, a new era of an integrated waste management system in South Africa has been established. The NEM:WA came into effect in July 2009. Provisions have been made in the form of legislative and regulatory tools to facilitate and ensure implementation of the Act by all spheres of government. A Waste Management Activity List was published in July 2009 which has clear thresholds on waste activities that need authorisation prior to commencement. The published Waste Management Activity List effectively replaces Schedule 1 of the NEMA and all waste related activities listed in EIA listing notices.

The NEM:WA provides, inter alia, for:

- Institutional arrangements and planning matters;
- National norms and standards for regulating the management of waste by all spheres of government (and the private sector);
- Specific waste management measures;
- Licensing and control of waste management activities;
- Remediation of contaminated land;
- The national waste information system; and
- Compliance and enforcement of the act and its regulations.
- National Waste Information Regulations (GNR 625 of August 2012).

5.1.3.1. List of Waste Management Activities that Have, or are likely to Have, a Detrimental Effect on the Environment: GNR 921 of 2013, as amended

The DFFE promulgated a revised list of activities for which a waste management licence is required, on 29 November 2013 (GNR 921). Category A and B waste management activities require a waste management licence.

Waste activities that are triggered by the proposed Alexander Mine have been identified and included in **Table 4-1**.

5.1.4 National Water Act (Act No. 36 of 1998)

The NWA guides the management of water in South Africa as a common resource. The Act aims to regulate the use of water and activities which may impact on water resources through the categorisation of 'listed water uses' encompassing water extraction, flow attenuation within catchments as well as the potential contamination of water resources, where the DWS is the administrating body in this regard.

Section 21 of the NWA defines various water uses, while Section 22 requires that a person may, amongst others, only use water if licensed in terms of the NWA. The use of water does not necessarily mean the consumptive use thereof but covers any aspects that have or could have an impact on a watercourse. Water uses are defined in the NWA and include the following activities as described in Section 21 of the Act:

21 (a) taking water from a water resource;

(b) storing water;

(c) impeding or diverting the flow of water in a watercourse;

(d) engaging in a stream flow reduction activity contemplated in section 36;

(e) engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1);

(f) discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;

(g) disposing of waste in a manner which may detrimentally impact on a water resource;

(h) disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;

(i) altering the bed, banks, course or characteristics of a watercourse;

(j) removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people; and

(k) using water for recreational purposes.

In terms of Section 22(1) a person may only undertake the abovementioned water uses if it is appropriately authorised:

22 (1) A person may only use water

(a) without a licence

(i) if that water use is permissible under Schedule 1;

(ii) if that water use is permissible as a continuation of an existing lawful use; or

(iii) if that water use is permissible in terms of a general authorisation issued under Section 39;

(b) if the water use is authorised by a licence under this Act.

The water uses associated with the proposed project are summarised in **Table 5-1** below.

Table 5-1: Water uses in terms of Section 21 of the National Water Act that are associated with the proposed Alexander Mining Project

Section 21 Water Use	Reason
S21(a): Taking water from a water resource	Abstracting water from the pit to allow for mining Abstraction of water from Riversdale underground compartment for service water during mining
S21(c) Impeding or diverting the flow of water in a watercourse and/or S21(i) altering the bed, banks, course or characteristics of a watercourse	All activities taking place within 500 m of a wetland or 100 m of a watercourse will be licensed under Section 21 c and i: • Mining complex • Opencast mining pits and stockpiles • Linear infrastructure
S21(g) Disposing of waste in a manner which may detrimentally impact on a water resource	Dust suppression using mine water. PCD Sumps within mine complex ROM stockpile Overburden stockpiles Dirty water channels & sumps STP

Section 21 Water Use	Reason
	Disposing of contaminated water to underground workings at Syferfontein (Riversdale compartment)
Section 21(f): Discharging waste or water containing waste into a water resource.	Discharge of treated sewage effluent
S21(j) Removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people	Removal of water from pit to allow for mining.

5.1.5 National Heritage Resources Act (Act 25 of 1999)

The National Heritage Resources Act (NHRA) legislates the necessity for a cultural and Heritage Impact Assessment (HIA) in areas earmarked for development, which exceed 0.5 ha. The Act makes provision for the potential destruction to existing sites, pending the archaeologist's recommendations through permitting procedures. Permits are administered by the South African Heritage Resources Agency (SAHRA). Should the proposed activities impact on heritage resources, application to the SAHRA would be required to obtain the necessary permits. The requirements of the NHRA have thus been addressed as an element of this process, specifically by the inclusion of a heritage assessment.

5.1.6 National Environmental Management: Air Quality Act (Act 39 of 2004)

The objective of this Act is –

- To protect the environment by providing reasonable measures for –
- The protection and enhancement of the quality of air in the Republic of South Africa;
- The prevention of air pollution and ecological degradation;
- Securing ecologically sustainable development while promoting justifiable economic and social development; and.
- Generally, to give effect to section 24(b) of the Constitution in order to enhance the quality of ambient air for the sake of securing an environment that is not harmful to the health and well-being of people.

In terms of the National Ambient Air Quality Standards (NAAQS) the limits on particulate matter generation ($PM^{2.5}$ and PM^{10}) have been set and are applicable to the proposed Alexander Mining Project. In conjunction with this the National Dust Control Regulations (NDCR) GNR 827 prescribes general measures for the control of dust in all areas including residential and light commercial areas. The NDCR is also relevant to the proposed project. An air quality assessment has been undertaken in accordance with the above-mentioned legislative guidelines.

5.1.7 National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004)

The purpose of the Biodiversity Act is to provide for the management and conservation of South Africa's biodiversity within the framework of the NEMA and to ensure the protection of species and ecosystems and sustainable use of indigenous biological resources.

In summary Chapter 5 of the Act specifically deals with species and organisms posing potential threats to biodiversity. The purpose of Chapter 5 is to:

- Prevent the unauthorised introduction and spread of alien species and invasive species to ecosystems and habitats where they do not naturally occur.
- Manage and control alien species and invasive species to prevent or minimise harm to the environment and to biodiversity.
- Eradicate alien species and invasive species from ecosystems and habitats where they may harm such ecosystems or habitats.

5.1.7.1. National Biodiversity Assessment

The National Spatial Biodiversity Assessment (NSBA) classifies areas as worthy of protection based on their biophysical characteristics, which are ranked according to priority levels. The Alexander Mining Project site has been identified to fall within an ecosystem which is listed as Endangered as well as within an area that that is "poorly protected".

5.1.8 Occupational Health and Safety Act (Act. 85 of 1993)

The Act makes provisions that address the health and safety of personnel working on the construction aspects of the proposed remediation. The Act addresses amongst others, the:

- Safety requirements for the operation of machinery;
- Protection of personnel against hazards to health and safety, arising out of or in connection with the activities of persons at work;
- Establishment of an advisory council for occupational health and safety; and
- Provision for matters connected therewith.

The law states that any person undertaking activities at work or on any premises shall ensure as far as is reasonably practicable that nothing about the manner in which work is undertaken is unsafe or creates a risk to health when properly used

Details on the legislation applicable to the proposed infrastructure development, as well as policies and guidelines used, is summarised in **Table 5-2.**

Table 5-2: Applicable legislation

Applicable Legislation and Guidelines Used to Compile the Report	Reference Where Applied	How Does This Development Comply with And Respond to The Policy and Legislative Context
LEGISLATION		
National Environmental Management Act, 1998 (Act 107 of 1998)	Entire document	The EIAR is compiled in accordance with the NEMA as well as the Regulations thereunder.

Applicable Legislation and Guidelines Used to Compile the Report	Reference Where Applied	How Does This Development Comply with And Respond to The Policy and Legislative Context
Government Notice Regulation (GNR) 324 to 327 dated 7 April 2017, as amended 11 June 2021: Environmental Impact Assessment Regulations 2014.	Entire document	The listed and triggered activities that are included in the application are listed in Table 4-1
GN 891 dated 2014: Guideline on Need and Desirability in terms of the Environmental Impact Assessment (EIA) Regulations, 2010	Section 6	The need and desirability of the project is described in Section 6
The National Heritage Resources Act, 1999 (Act 25 of 1999)	Section 10.1.1.15	A heritage impact assessment was conducted of the project area and will be submitted to the South African Heritage Resources Agency (SAHRA) and will be included in the EIAR.
National Environmental Management: Air Quality Act (Act 39 of 2004) and amendments	Section 10.1.1.13	An Air Quality Impact Assessment and Climate Change Impact Assessment was conducted and will be included in the EIAR.
GNR 827 dated 1 November 2013: National Dust Control Regulations		
GN 1210 dated 24 December 2009: National Ambient Air Quality Standards		
GN 486 dated 29 June 2012: National Ambient Air Quality Standard for Particulate Matter with Aerodynamic Diameter less than 2.5 Micron Metres ($PM_{2.5}$)		
GNR 533 dated 11 July 2014: Regulations Regarding Air Dispersion Modelling		
GN 144 dated 2 March 2012: Highveld Priority Area Air Quality Management Plan		
GNR 283 dated 2 April 2015: National Atmospheric Emission Reporting Regulations		
GN 275 dated 3 April 2017: National Greenhouse Gas Emission Reporting Regulations		
National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (NEM:BA)	Sections 10.1.1.8 10.1.1.9	A biodiversity impact assessment was conducted for the project which considered protected areas, as well as species of conservation concern, and will be included in the EIAR.
National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003) (NEM:PAA)		
Environment Conservation Act, 1989 (Act 73 of 1989) (ECA)		
National Water Act, 1998 (Act 36 of 1998)	Sections 10.1.1.5 10.1.1.6 10.1.1.7 10.1.1.8	An Integrated Water Use Licence Application (IWULA) is being compiled and will be submitted to the Department of Water and Sanitation for the new water uses associated with the proposed Alexander Mining Project.
GNR 267 dated 24 March 2017 in terms of the NWA: Water Use Licence Application and Appeals Regulations		The IWULA will follow the process outlined in the Regulations.

Applicable Legislation and Guidelines Used to Compile the Report	Reference Where Applied	How Does This Development Comply with And Respond to The Policy and Legislative Context
GN 466 dated 22 April 2016: Classes and Resource Quality Objectives of Water Resources for the Olifants Catchment	Section 10.1.1.5	The Resource Quality Objectives (RQOs) for the catchment must be maintained and the contaminated water and decant management will comply to these objectives. A Reserve Determination is being undertaken on behalf of the DWS, for this project.
National Environmental Management: Waste Act, 2008 (Act 59 of 2008) (NEM:WA) and amendments	Appendix 7	This application is an application for an integrated environmental authorisation which includes the waste management activities – refer to Table 4-1. The NEM:WA and Regulations thereunder will also be considered in the IWWMP.
Government Notice (GN) 921 dated 29 November 2013: List of Waste Management Activities that have, or are likely to have a detrimental Effect on the Environment		
GN 926 date 29 November 2013: National Norms and Standards for the Storage of Waste		
GN 332 dated 2 May 2014: Amendment to the List of Waste Management Activities that have, or are likely to have a detrimental Effect on the Environment		
GNR 633 dated 24 July 2015: Amendment to the List of Waste Management Activities that have, or are likely to have a detrimental Effect on the Environment		
GN 242 dated 11 March 2017: Amendment to the List of Waste Management Activities that have, or are likely to have, a detrimental Effect on the Environment		
GN 1094 dated 11 October 2017: Amendment to the List of Waste Management Activities that have, or are likely to have, a detrimental Effect on the Environment		
GNR 634 dated 23 August 2013: Waste Classification and Management Regulations		
GNR 635 dated 23 August 2013: National Norms and Standards for the Assessment of Waste for Landfill Disposal		
GNR 636 dated 23 August 2013: National Norms and Standards for Disposal of Waste to landfill		
GNR 632 dated 24 July 2015: Regulations regarding planning & management of residue stockpiles and residue deposits		
GNR 1147 dated 20 November 2015: Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations.	To be included in EIR	The financial provision for the project will be calculated and included in the EIR.
GN 1314 dated 26 October 2016: Amendments to the Financial Provision Regulations, 2016		

Applicable Legislation and Guidelines Used to Compile the Report	Reference Where Applied	How Does This Development Comply with And Respond to The Policy and Legislative Context
GNR 452 dated 20 April 2018: Amendment to the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations		
GNR 991 dated 21 September 2018: Amendments to the Financial Provision Regulations, 2015		
Explosives Act 26 of 1956 and its amendments	Section 10.1.1.16	A Blasting Impact Assessment was conducted and will be included in the EIAR.
Explosives Regulations of 1972: GNR 1604, as amended.		
Mine Health and Safety Act 29 of 1996 and amendments		
GNR 584 dated 10 July 2015: Regulations Relating to Explosives		
GUIDELINES/POLICIES/STANDARDS/PLANS/TOOLS		
Guideline: National Freshwater Ecosystem Priority Areas (NFEPA)	Section 10.1.1.6	The position of the proposed activities in relation to NFEPA system was assessed.
Mpumalanga Biodiversity Sector Plan (MBSP)	Section 10.1.1.9	The position of the proposed activities in relation to the priorities set in the MBSP was assessed.
United States Bureau of Mines Guidelines for safe blasting	Section 10.1.1.16	A Blasting Impact Assessment was conducted and will be included in the EIAR.
South African Water Quality Guidelines Volume 7: Aquatic Ecosystems, dated 1996	Section 10.1.1.8	The current water quality of surface water resources will be assessed against these guidelines and standards to describe the current status.
SANS 241-1:2015 Drinking water Part 1 – Microbiological, physical, aesthetic and chemical determinants	Section 10.1.1.5	
SANS 10103:2008 The measurement and rating of environmental noise with respect to annoyance and to speech communication	Section 10.1.1.12	A noise impact assessment will be conducted and included in the EIR.
IFC General EHS Guidelines on Environmental Noise Management		

6. NEED AND DESIRABILITY OF THE PROPOSED ACTIVITIES

The need and desirability of the proposed project is described below. This section has been compiled, taking into account the then Department of Environmental Affairs (DEA) (2010) Guideline on Need and Desirability, in terms of the EIA Regulations (GNR 891 of 2014).

Mining and manufacturing are the foremost contributors to the economy of the GSDM and NDM. Mining activities are mainly tied to coal, which serves as input material for the petrochemicals industry in Govan Mbeki Local Municipality (GMLM) and Emalahleni Local Municipality (ELM), and electricity generation for the various power stations. Sasol's petrochemical / synthetic fuels plants contribute to the national liquid petroleum, industrial and agricultural chemical markets as well as the national economy at a macro level by generating exports that will leverage foreign income into the county. Direct economic benefits are derived from wages, taxes and profits. Indirect economic benefits are derived from the procurement of goods and services and the spending power of employees.

Sasol's business case

The Sasol Mining Secunda coal reserves are being mined out and there were various options considered to manage a possible shortfall in reserves to achieve the life of coal (LOC) mandate up to at least 2050.

An opportunity to acquire additional coal reserves was identified in FY16. The Alexander coal Blocks were acquired from Anglo American Inyosi Coal in 2016 with a plan to deploy production sections into this area by July 2025. The Alexander reserves were acquired to replace coarse coal currently received from the Isibonelo Colliery when the Isibonelo operations cease. The coarse coal is used to balance the coal mix at SO. The SO intends to reduce their CO_2 emissions by 10% by 2030. They will achieve this by shutting down fine coal boilers and therefore require more coarse coal (+6.3mm). A combination of Sasol mining operations is scheduled to supply coal to SO until 2050. 123 million tonnes of coal are required from the Alexander reserves to balance the coal supply to SO.

In one of the alternatives investigated, Sasol has cut back the mineable reserves at Alexander by 39 million tonnes due to environmental and geotechnical sensitivities. To achieve the tonnes required from Alexander, a combination of mining methods will now be required.

As mentioned previously, the Alexander Mining Project is required to support Sasol's mandate by establishing access with the correct infrastructure into the Alexander reserves by July 2025 in order to replace the Isibonelo coal feedstock. In summary, Sasol's business objectives for the Alexander Mine include the following:

- Fulfil the 2050 mandate of supplying coal to SO at the lowest cost (balance of capital and operating costs over LOM);
- Minimise and delay capital spend where possible without compromising safety and functionality;
- Achieve beneficial steady-state operation in July 2025;
- Optimise the opencast production rate based on safe and efficient design considerations; and
- Limit the generation of fine coal to a minimum.

Environmental constraints and opportunities

Environmental constraints and opportunities were considered throughout the planning and pre-feasibility phases of the proposed Alexander Mining Project. Sasol undertook numerous iterations of the mine plan and mining methods as recommended by various specialists. Please refer to **Section 8.1** for a detailed description of the various environmental constraints and opportunities considered for this project.

Socio-Economic opportunities

The Mpumalanga Growth and Development Strategy's (Mpumalanga Provincial Government, 2004-2014) priorities include the enhancement of economic development to address poverty and unemployment; the development of multi-faceted infrastructure; reduction of poverty and hunger, child mortality, HIV and AIDS, malaria and other diseases. It also addresses the improvement of universal primary education; gender equality; as well as sustainable environmental development and management by focusing on waste management, air pollution, water resource and biodiversity protection.

Human resource development through skills investment and education; and promotion of good co-operative governance are also addressed. The development priorities highlighted in the Gert Sibande District Municipality 2018/2019 NC (IDP) (GDSM, 2018) and the Nkangala District Municipality 2017 IDP (NDM, 2017) promote the development of a diversified low carbon economy that is able to meet local needs in terms of job creation, increased incomes, climate change adaptation, wealth distribution, and challenges of inequality (GDSM, 2018).

Taking the above into consideration, the proposed project will result in a net positive socio-economic impact. Sasol has a skills development plan with various skills development programmes to develop both skilled and unskilled employees to enhance their performance. Some of the Sasol mining skills programmes are also offered to external / community members. Sasol also offers adult basic education and training (ABET), internships and bursaries to employees and community members. Learnerships are offered to mitigate the shortage of hard-to-fill vacancies for mining core skills. Sasol has implemented an Employment Equity (EE) strategy to align with transformation targets which focus on Historically Disadvantaged South Africans (HDSAs) and women in mining. Further to this, Sasol supports local economic development (LED) and corporate social investments (CSI) through the implementation of projects identified in the Social and Labour Plan (SLP) which are in line with the relevant Integrated Development Plans. Sasol has been involved in the development and upgrade of a community health centre which is aimed at providing a proper health care facility to community members.

7. PERIOD FOR WHICH THE ENVIRONMENTAL AUTHORISATION IS REQUIRED

The proposed Alexander Mining Project will be required until 2036, when the Life of Mine (LoM) is reached. The estimated overall project schedule is as follows:

Item	Year
Project concept, Pre-feasibility, and Feasibility studies	2018 - 2021
Preparation of Environmental Authorisation supporting documentation (EIR, EMPr, WMLAR, IWULA, GNR1147 reports)	2021 - 2022
Environmental Authorisations and Licences Issued	2022 - 2023
Submission of Section 102 application	2021 - 2022
Construction commences: Once authorisation has been received	From 2023 onwards
Construction: Once authorisation has been received	30 months
Operations / Life of Mine (LOM)	Commencing 2025, for 13 years

8. DESCRIPTION OF THE PROCESS FOLLOWED TO REACH THE PROPOSED OR PREFERRED SITE

8.1 Details of all alternatives considered

Various alternatives in terms of mine plan, mining method, infrastructure, and technologies were considered for the Alexander Mining Project. The Alexander coal Blocks were acquired from Anglo American Inyosi Coal in 2016 with a plan to deploy production sections into this area by July 2025. Various options for accessing the Alexander coal Blocks were assessed by Sasol Mining in 2016 and subsequently a Pre-feasibility Study was undertaken by GIBB Mining. The information discussed in this section has been obtained from the PFS completed by GIBB (2021).

8.1.1 The property on which or location where it is proposed to undertake the activity

Sasol Mining's strategy is to ensure the continued lowest cost supply of optimum quality coal to SO up to at least 2050. This is to fulfil Sasol's coal feedstock requirements in Sasol's Southern African value chain. The Sasol Mining Secunda coal reserves are being mined out and there were various options considered to manage a possible shortfall in reserves to achieve the LOC mandate up to at least 2050. An opportunity to acquire additional coal reserves was identified in FY16 and the Alexander coal reserves of ~125 Mt were acquired from Anglo American Inyosi Coal (AAIC) to reduce the shortfall.

The proposed mining development is therefore dictated by the locality of the available coal reserves which were granted to Sasol through the MR transfer from AAIC. Alternative locations are therefore not feasible or practicable and were therefore not considered. Please refer to **Section 8.1.3** for more information on the alternative layouts and mining methods considered for the proposed mining development.

8.1.2 The type of activity to be undertaken

Alternatives of the Alexander Mining Project have been subjected to numerous iterations and assessed in terms of the type of activity to be undertaken, the design/layout of the activity, and various technologies that will be implemented. The alternatives were informed by many aspects including the anticipated environmental and financial risks.

These alternatives have been summarised in **Table 8-1**.

Table 8-1: Summary of alternatives considered for the Alexander Mining Project (green shaded cells indicate the preferred options).

Aspect	Description	Alternative	Advantages	Disadvantages	Discussion/Mitigation
Mining method & mine plan	The mining method and mine plan have undergone a series of iterations to determine the most viable and effective mine plan. This process was informed by the following considerations: • Environmental constraints • WUL anticipated conditions • Opencast operations interface • Infrastructure main complex location • Linear infrastructure • COVID-19 • Social License to Operate	Underground mining – high extraction mining and bord and pillar, with access beneath the Debeerspruit (Figure 8-1).	High extraction and bord and pillar mining methods would allow for more product to be extracted. No additional infrastructure is needed since this alternative includes the use of existing infrastructure at Syferfontein.	High risk to environmental sensitivities by accessing the underground mine beneath the Debeerspruit.	Sasol, J&W, and GIBB collaborated in order to minimise the impact of mining on the environment through careful determination of the delineation of the environmental no-go areas and associated mining boundaries. All surface engineering designs have focused on maintaining the flow of water feeding the wetlands and water courses as far as is practicable. The mining method that is ultimately the most viable option considered the infrastructure requirements and possible impacts associated therewith. At this stage, the stability risks associated with underground mining are unacceptable using the technologies that are currently available. It is likely that underground mining in the Alexander Mining Project area may become feasible in the future when more information is available for the area and new extraction technologies that reduce stability risks can be implemented.
		Underground mining – high extraction mining and bord and pillar, with access using new shafts. Minable reserves considered impacts to wetlands (Figure 8-2).	High extraction and bord and pillar mining methods would allow for more product to be extracted. Reduced stability risks result in a reduced risk to environmental sensitivities.	Additional infrastructure is required since existing infrastructure at Syferfontein would not be used, including a PCD to manage dirty water, stockpiles and underground access via shafts at Alexander. Reduction in minable coal may not be economically feasible.	
		Underground mining – high extraction mining, bord and pillar, and longwall mining at Block 2, with access using new shafts. Investigations into opencast mining areas (Figure 8-3).	A combination of high extraction, bord and pillar, and longwall mining methods would allow for more product to be extracted. The opportunity to undertake opencast mining at the shallow areas of Alexander may increase the extractable coal reserves.	Additional infrastructure is needed for the addition of longwall mining including a larger PCD and more stockpiles. Possibly a greater impact to environmental sensitives due to larger mining area and higher occurrence of subsidence (longwall mining).	
		Underground (bord and pillar and high extraction mining) and opencast mining at Block 2; underground (bord and pillar, with areas of high extraction	More product can be extracted with an additional mining method (opencast mining) when compared to only utilising underground mining methods.	Additional infrastructure needed including larger PCD, more stockpiles, and boxcuts to access the underground mine. Significant risks for crown failure and difficult mitigation of risks at mine closure .	

Aspect	Description	Alternative	Advantages	Disadvantages	Discussion/Mitigation
		mining) at Block 3 and 4 (**Figure 8-4**). Block 3 and 4 would be accessed either by crossing underneath the Steenkoolspruit or via a boxcut at an adit.			
		Opencast mining only at Block 2 (Figure 8-5).	No similar stability risks as a result of underground mining (such as crown failure). There is a reduced infrastructure footprint associated with this alternative since a smaller PCD is required to manage dirty water arising from opencast mining only. Likewise, less stockpiles are required since a smaller area will be mined. The proposed opencast mine will also not require shafts.	Less product can be extracted using only opencast mining method.	
Linear infrastructure: overland conveyor	Various overland conveyor route options were investigated to link the Alexander mine material handling system with the Syferfontein overland conveyor.	Construct a new conveyor parallel to Isibonelo conveyor	Conveyor footprint limited to disturbed linear infrastructure corridor. Shortest distance between the Alexander tie-in and the Syferfontein bunker.	Minor impact to environment due to remaining within the linear infrastructure corridor.	Although from an environmental perspective the most obvious option for the overland conveyor is to take over the Isibonelo conveyor asset when it becomes available, this option is considered to be too high-risk since it is dependent on the outcome of the Sasol Mining – Anglo American negotiations with respect to the Isibonelo Mine. Hence, the preferred option for the overland conveyor route is to construct a new conveyor that runs parallel to the Isibonelo conveyor. Impacts to
		Use the existing Isibonelo conveyor.	No additional footprint resulting in disturbances to the environment.	High risk in terms of logistics and approval required from Anglo American.	

Aspect	Description	Alternative	Advantages	Disadvantages	Discussion/Mitigation
					the environment would be minor due to limiting the conveyor footprint within the linear infrastructure corridor and implementing effective mitigation measures where the conveyor crosses wetlands.
Linear infrastructure: powerlines	Overhead powerlines will be supplying Alexander Mine with electricity. These lines will run from the Eskom Rietfontein substation and provide firm power to the mine. Rietfontein is currently an 88 kV substation, however, Eskom is in the process of upgrading it to a 132 kV substation.	Construct both a 132 kV powerline running parallel to conveyor route within the potable water pipeline corridor, as well as a 132 kV powerline from the mine to the Rietfontein substation (Figure 8-10). This option was considered when various mining methods were being investigated which required more electricity.	Powerline with higher voltages can carry higher loads when compared to smaller powerlines.	Potential for voltages being induced onto the metal structures of the conveyor due to proximity to conveyor. More costly to install when compared to smaller powerlines. Greater potential for impact to the environment since this option requires the construction of two powerlines.	When considering the preferred option for the mining method and layout, smaller powerlines are sufficient to supply the Alexander Mining Project with power. Since the construction of smaller powerlines have a reduced footprint, this would be the preferred option. The powerlines are also positioned to cross the least number of wetlands as possible without introducing unnecessary direction changes. The optimal spans between poles were selected to minimise the number of poles that would have to be placed in the wetland area.
		Only construct two 22 kV powerline running from the mine to the Rietfontein substation (Figure 8-11).	Avoids sensitive wetland areas as far as possible. Existing farmhouses avoided. Limited crossings of infrastructure such as roads and other powerlines. Potential for voltages being induced onto the metal structures of the conveyor due to proximity to conveyor avoided. Shortest distance from the point of supply to	Smaller powerlines carry less load when compared to larger powerlines resulting in less electricity transmitted to the mine.	

Aspect	Description	Alternative	Advantages	Disadvantages	Discussion/Mitigation
			the mine. Accessibility to the lines from existing roads		
Mine office and infrastructure complex	A mine office and infrastructure complex is required to support the mining activities at the proposed Alexander mine. Various placements were considered, taking into account efficiency of product transport, impacts to the environment, and accessibility.	Use existing Syferfontein infrastructure.	No additional footprint resulting in disturbances to the environment.	Long distances to haul product.	The location of the mine office and infrastructure complex was dependent on the proposed mining method and mine plan chosen by Sasol, since the distance to transport product would need to be minimised. Although the use of existing infrastructure at Syferfontein would not have resulted in significant additional impacts, the distances required to haul the product made this option unfeasible. Practically, the mine office and infrastructure complex needs to be located near the proposed mining area. Possible impacts are reduced by taking cognisance of the environmental sensitivities in the area and designing the infrastructure in such a way to reduce impacts as much as possible.
		Construct a new mine office and infrastructure complex at the proposed Alexander mine in an area near the proposed opencast mining area (**Figure 8-6**).	The mine office and infrastructure complex is located closer to proposed mining area.	Although more options are available which allows for flexibility in terms of the placing of infrastructure, some options are not feasible due to their proximity to wetlands.	
		Construct a new mine office and infrastructure complex at the proposed Alexander mine within a specific area as informed by wetland buffers (**Figure 8-7**)	The mine office and infrastructure complex is located closer to proposed mining area. Buffers to wetlands were applied by the design engineers to limit impacts to wetlands.	There is limited flexibility in terms of infrastructure layout and the placement of infrastructure.	
Clean hards and Contaminated Stockpiles	Clean hards and contaminated stockpiles will be established as opencast mining progresses.	Establish various hards and contaminated stockpiles within the backfilled area in the opencast area (**Figure 8-8**) and south of Pit 1. This option was considered when more mining methods were	Stockpiles are located close to proposed mining area. The distance to drive to the stockpile in order to deposit material is reduced when compared to the elongated stockpile alternative.	Proposed stockpile is located within delineated wetlands. Limited space available on the backfilled opencast area when considering the planned ramps and the planned post-closure designs.	A larger contaminated stockpile outside of the mining area is preferred to multiple smaller contaminated stockpiles within the backfilled opencast area due to the limited space that is available to establish these dumps when considering the planned ramps and planned post-closure designs.

Aspect	Description	Alternative	Advantages	Disadvantages	Discussion/Mitigation
		being investigated resulting in more hards and contaminated materials needing to be excavated.			The preferred option also considers environmental sensitivities, and although the stockpiles cover a larger area, it is anticipated that this layout will have a reduced impact to wetlands when compared with the option to establish stockpiles on backfilled opencast areas. The following will be considered when establishing the stockpiles: • Results from the pre-mining soil survey will be used effectively for the stripping phase to lead to optimal stockpiling. • Ensure that a soil scientist participates in the stripping and stockpiling process (SACNASP-registered soil scientist). • Make sure that the stripping and stockpiling is carried out properly. • Limit vehicle traversing on both stockpiles and rehabilitated areas as far as possible.
		Establish a large, contaminated stockpile area located outside the mining areas and a second clean hards stockpile area next to the contaminated stockpile area, outside of the delineated wetlands. (Figure 8-9).	Stockpile is located close to proposed mining areas and is not located within wetlands. This option also includes a wetland buffer of ~70 m. Considers the planned ramps and planned post-closure designs.	The distance to drive to the stockpile in order to deposit material is greater when compared to the option to establish stockpiles within the mining area. A larger contaminated stockpile may be more susceptible to erosion if not managed correctly.	
Decant management	It is expected that opencast mining will affect the water quality and quantity of the Steenkoolspruit and the Debeerspruit. All active and passive methods of water management should be investigated.	Strategies for decant management are currently being investigated.			

8.1.2.1. Mining method and mine plan

Refer to **Table 8-1** for details on the alternatives considered for the Alexander Mining Project in terms of the mining method and mine plan.

Option 1

The coal reserves acquired from AAIC are adjacent to the existing Syferfontein Colliery. Initially, the Alexander Block was to be incorporated as a brownfields expansion of Syferfontein and to redeploy underground production sections into this coal reserve when the mining pitroom gets depleted. The mining method would consist of 70% high extraction mining and 30% bord and pillar, with access beneath the Debeerspruit. No surface infrastructure was associated with this option, with the exception of a ventilation shaft complex and underground pipelines and conveyors.

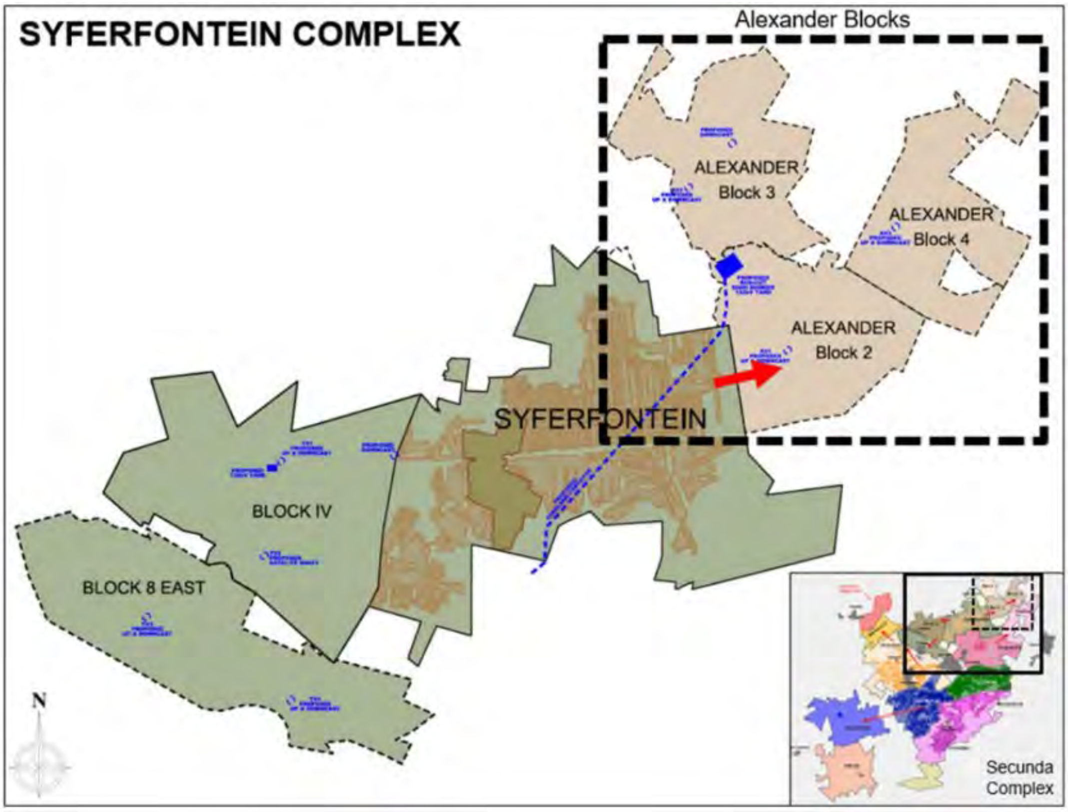


Figure 8-1: Option 1: Brownfields underground mining at Alexander mine with access to the reserve beneath the Debeerspruit (GIBB, 2021).

Option 2

The feasibility of undertaking the proposed Alexander Mining Project as a greenfields project was evaluated, which confirmed that the greenfields option is preferable to the brownfields option. The investigations to undermine the Debeerspruit were ceased, and the Alexander Mining Project was considered to be a standalone greenfields mine.

As a result of the Alexander Mining Project being a standalone project, new surface infrastructure would be required, including new shaft surface infrastructure and linear infrastructure. The underground mining extent was also reduced to not be beneath major watercourses in the area.

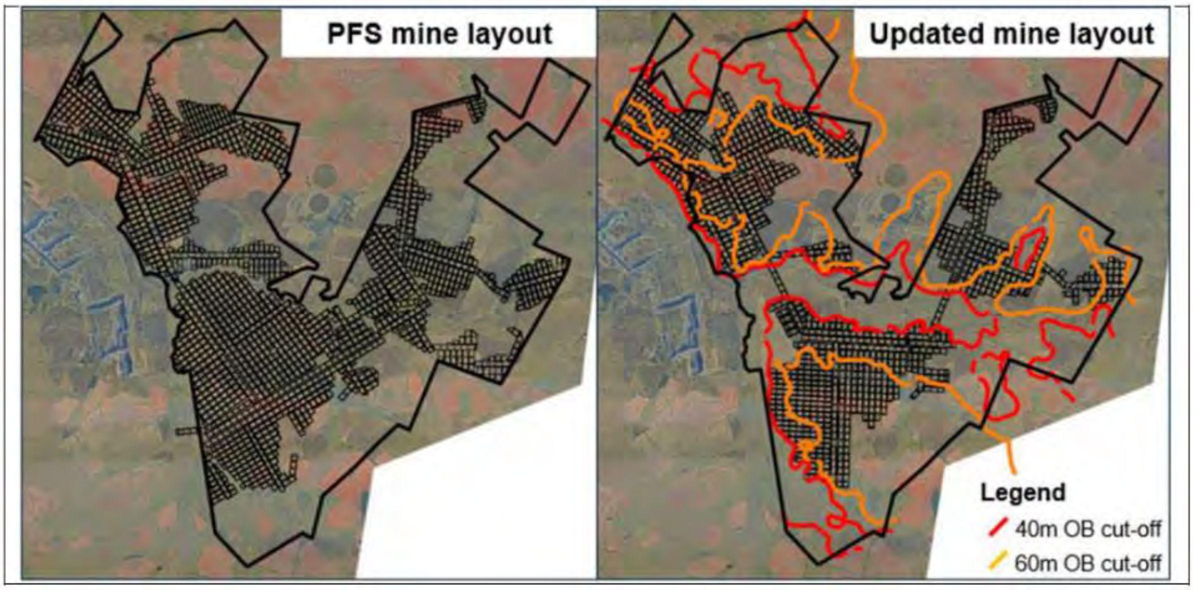


Figure 8-2: Option 2: Greenfields underground mining at Alexander mine shown as "Updated mine layout"(GIBB, 2021)

Option 3

A combination of underground mining methods – being high extraction mining, bord and pillar mining, and longwall mining – was considered, with access to the reserve being via sinking new shafts (**Figure 8-3**). High extraction mining, bord and pillar mining, and longwall mining would be done at Block 2, while underground mining (bord and pillar and high extraction) would still be pursued at Block 3 and 4.

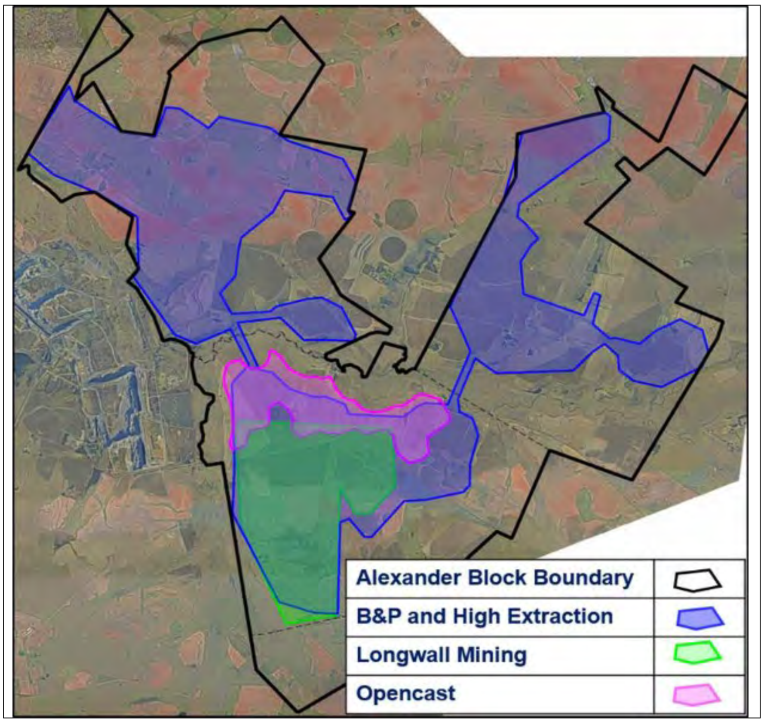


Figure 8-3: Option 3: Greenfield underground (high extraction mining, bord and pillar mining, and longwall mining) and opencast mining at Alexander mine (GIBB, 2021).

Option 4

Longwall mining was not feasible as per Option 3 (refer to **Table 8-1**). Opencast mining at Block 2 was further investigated and refined into three pits (Pit 1 to 3). Underground mining (bord and pillar and high extraction mining) would still be pursued at Block 2, Block 3, and Block 4, with access being either by crossing underneath the Steenkoolspruit or via boxcuts at adit within Block 3 and 4.

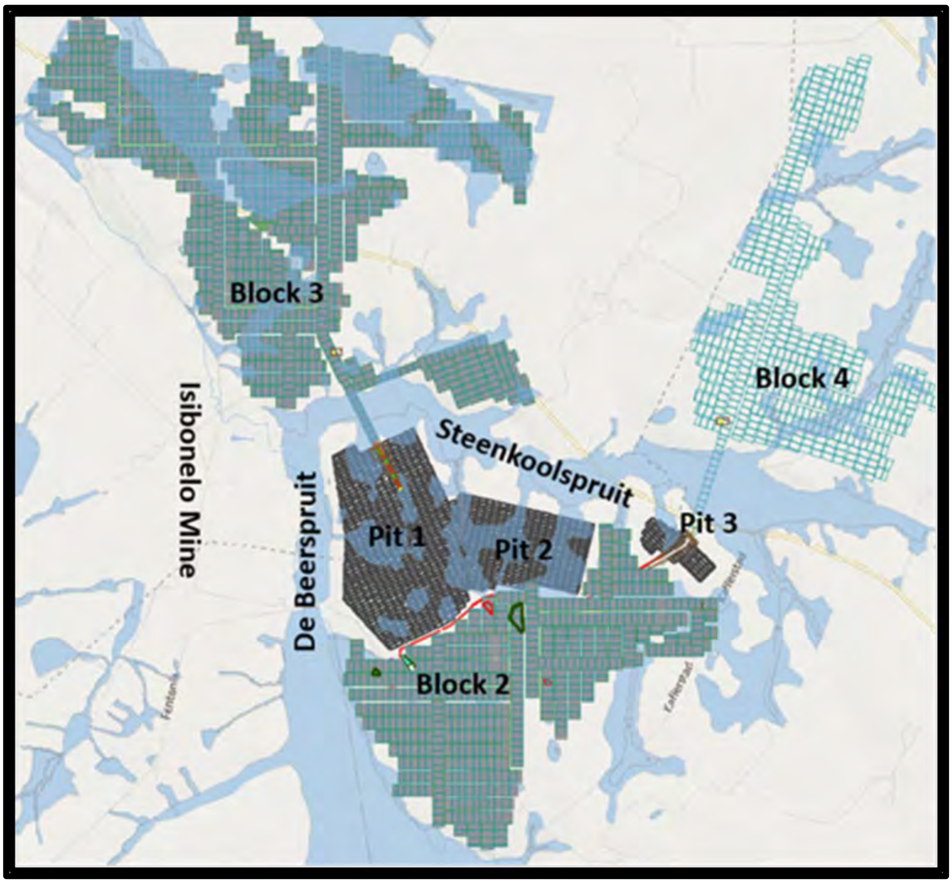


Figure 8-4: Option 4: Greenfield underground mining (high extraction and bord and pillar mining) at Block 2-4 and opencast mining at Block 2, with access to Block 3 and 4 being either by crossing underneath the Steenkoolspruit or via boxcuts or adits (GIBB, 2021).

Option 5 (preferred)

The preferred option only considers opencast mining at Block 2, with three pits namely Pit 1, Pit 2, and Pit 3 (**Figure 8-5**). This preferred mining method and layout was assessed by specialists and is the option that is described in this report.

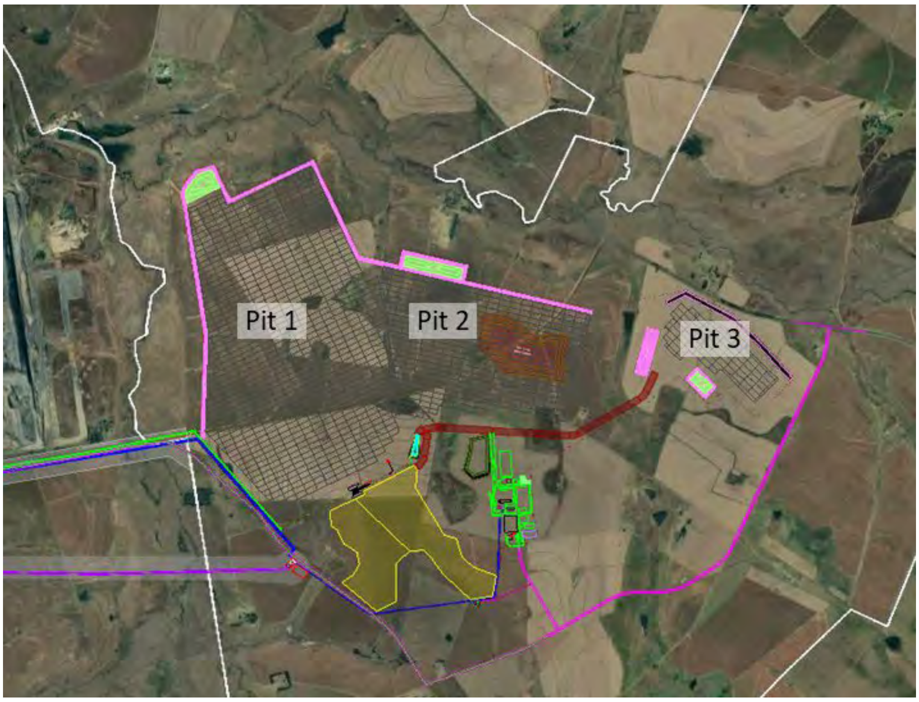


Figure 8-5: **Option 5: Greenfields opencast mining at Alexander mine (preferred option) (GIBB, 2021).**

8.1.3 The design or layout of the activity

Refer to **Table 8-1** for details on the alternatives considered for the Alexander Mining Project in terms of the design and layout of the project.

8.1.3.1. Mine office and infrastructure complex

Option 1

During the planning phase of the proposed Alexander Mining Project, various locations were investigated for the mine office and infrastructure complex, concentrated around the mine boundary and the linear infrastructure corridor (**Figure 8-6**).

Figure 8-6: **Option 1: Various options for the mine complex (GIBB, 2021).**

Option 2 (preferred)

Following engagements with various specialists, the preferred location of the mine office and infrastructure complex was determined, situated between the Steenskoolspruit system and the Debeerspruit system, south of the opencast mining area (**Figure 8-7**)[3].

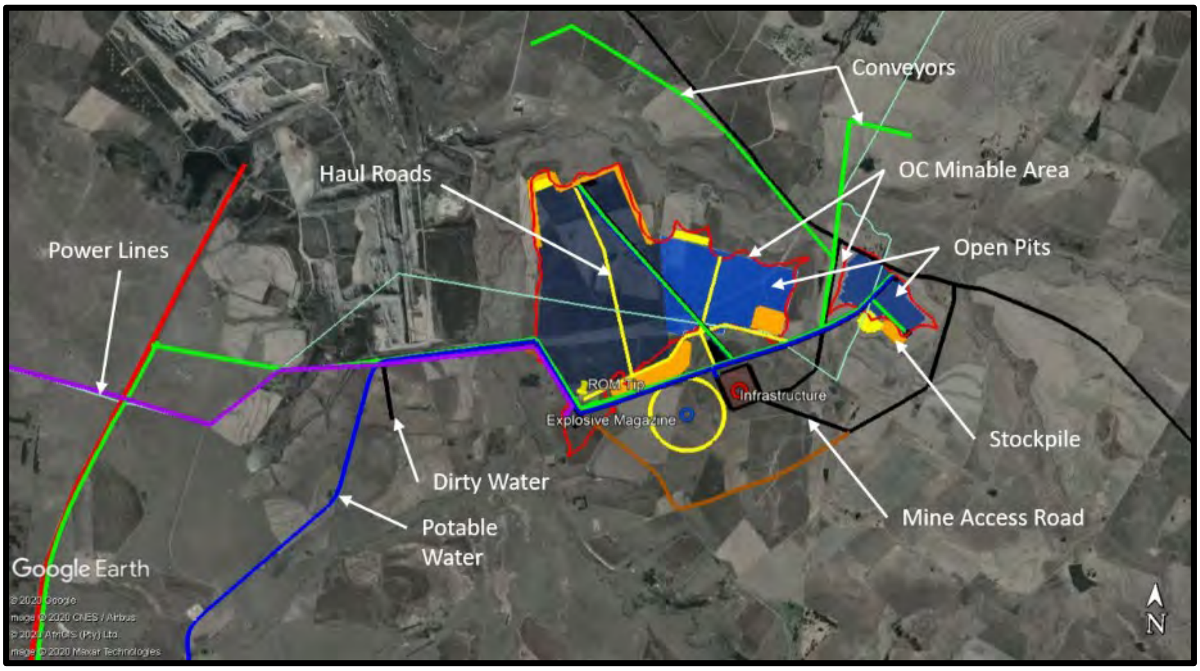


Figure 8-7: **Option 2: Mine complex location informed by environmental sensitivities (preferred option).**

[3] Please note, the mine complex layout has been refined further since the version presented in this image.

8.1.3.2. Clean hards and contaminated stockpiles

Option 1

When the pre-feasibility study was conducted, the hards and contaminated stockpiles were situated within the backfilled opencast mining area, as well as outside of the mining area as pictured in **Figure 8-8**.

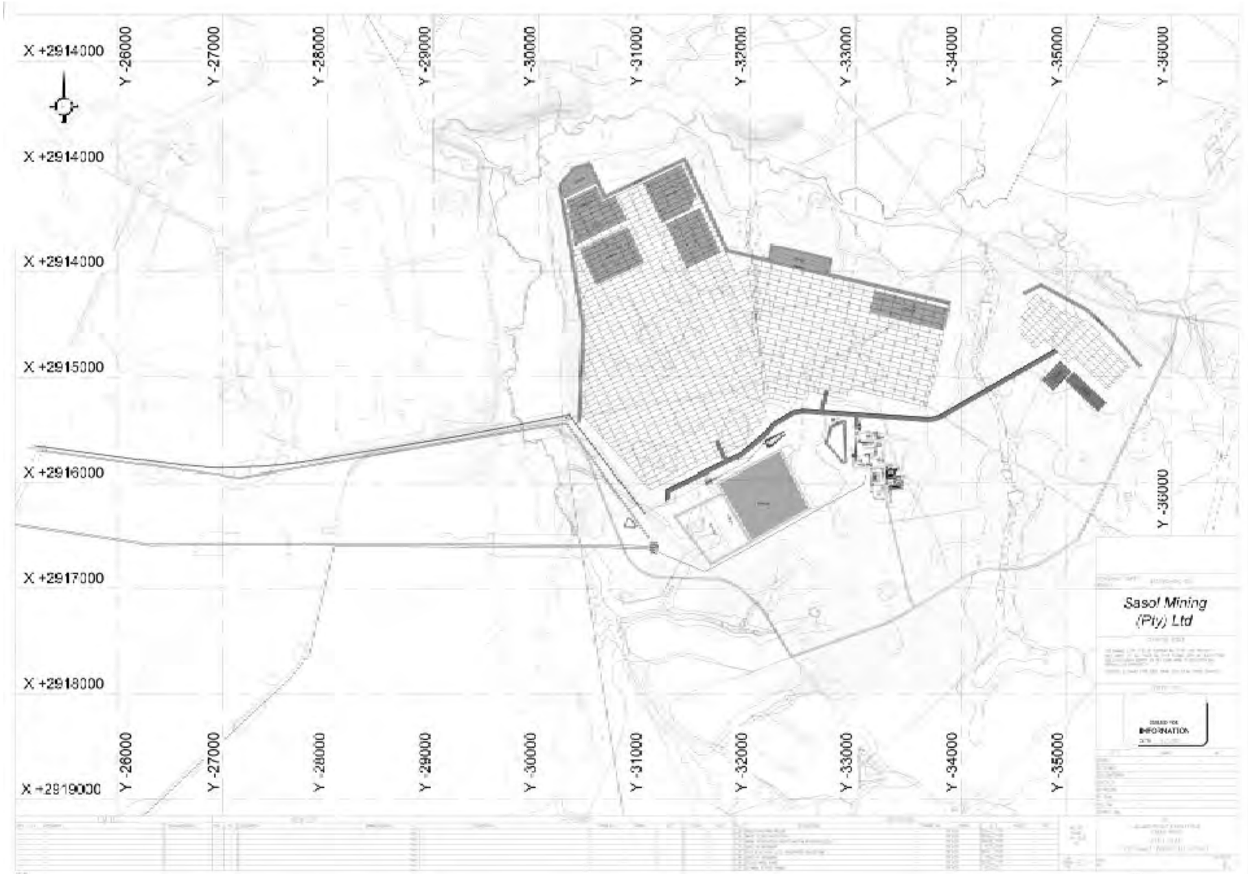


Figure 8-8: Option 1: Hards and contaminated stockpiles are located within the backfilled opencast area as well as south of Pit 1 (GIBB, 2021).

Option 2 (preferred)

After considering infrastructure requirements such as the placement of ramps and the post-closure rehabilitation designs, it was determined that a larger contaminated stockpile located outside of the opencast mining area would be more feasible when compared to Option 1 (**Figure 8-9**). The stockpile shapes have been optimised to avoid the delineated wetlands in the area.

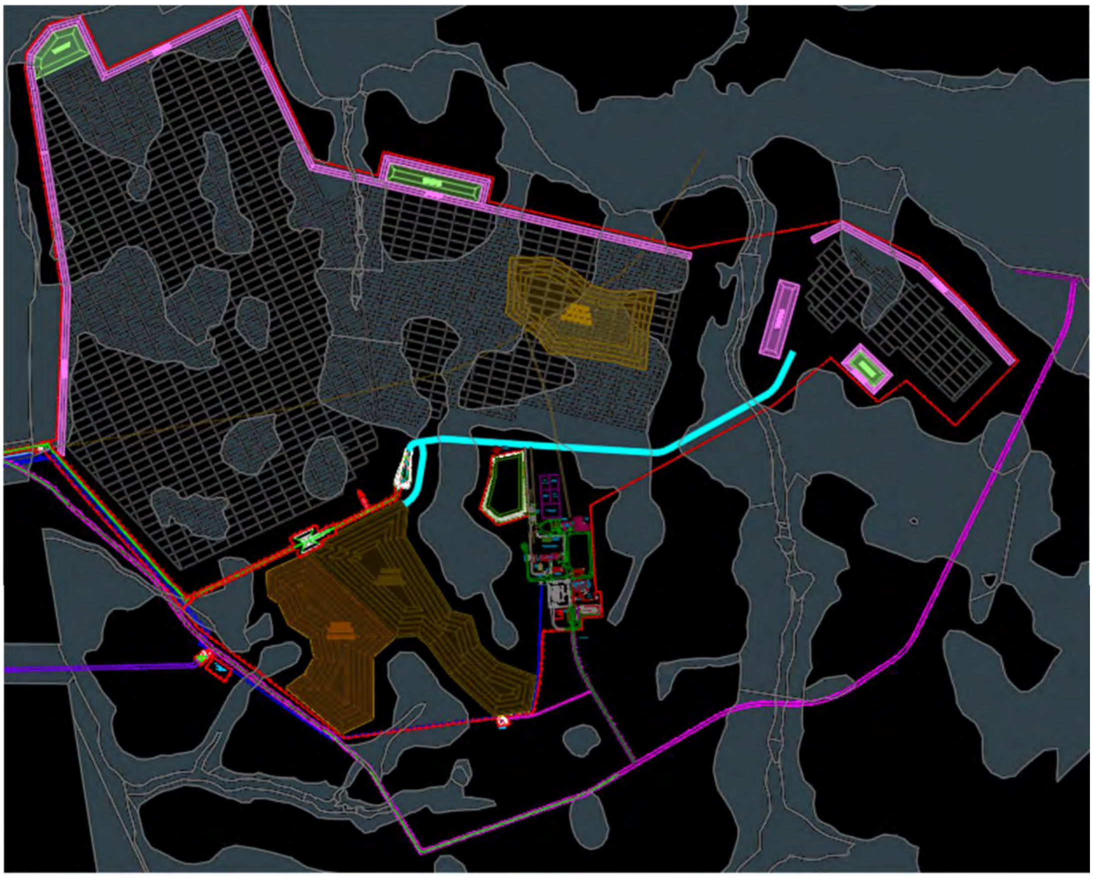


Figure 8-9: Option 2: Hards and contaminated stockpiles are located outside of the opencast mining area (preferred option) (GIBB, 2022).

8.1.3.3. Powerlines

Option 1

During pre-feasibility investigations, it was anticipated that 132 kV powerlines would be required to provide power to the proposed Alexander Mining Project area. Two routes were included namely from the Eskom Rietfontein substation to the mining area, and from the Syferfontein tie-in to the mining area (**Figure 8-10**).

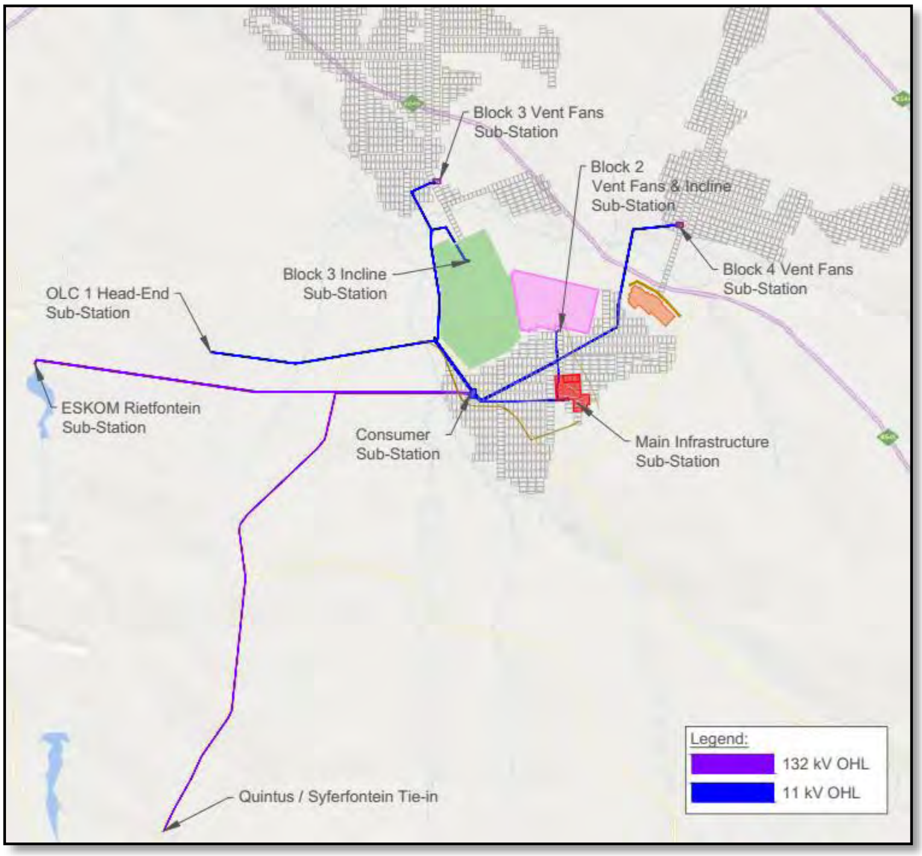


Figure 8-10: Option 1: 132 kV overhead Powerlines from the Eskom Rietfontein substation and from the Syferfontein tie-in.

Option 2 (preferred)

When considering the preferred reduced mine plan, smaller powerlines would be sufficient to provide power to the proposed Alexander Mining Project area. Only one powerline route would be required, which includes two 22 kV powerlines running from the Eskom Rietfontein substation to the mining area (**Figure 8-11**). This option was refined further with the replacement the 11 kV overhead powerlines (to the overland conveyor) indicated in the figure (blue) with 22 kV overhead powerlines.

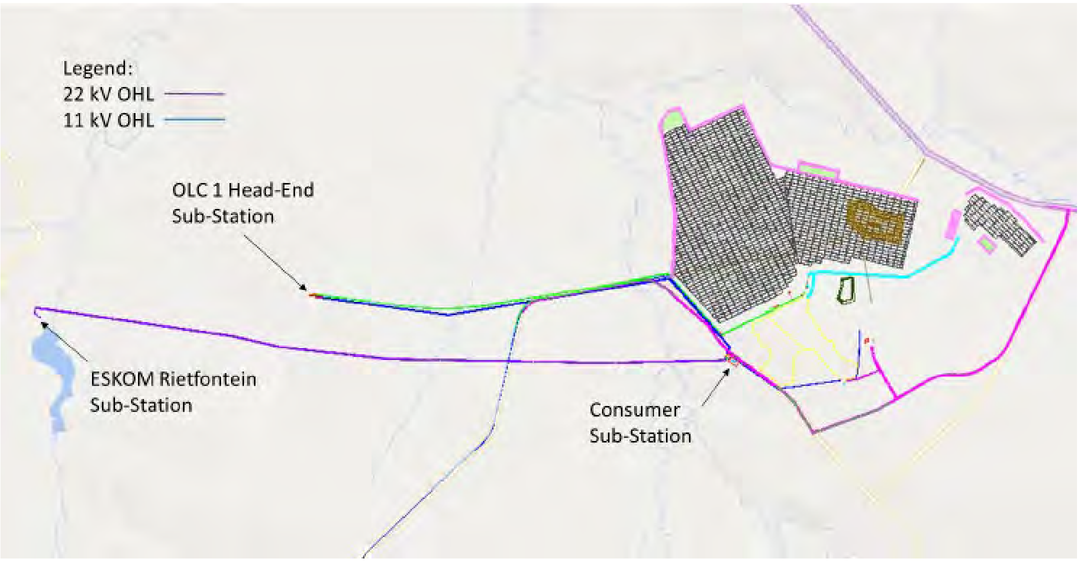


Figure 8-11: **Option 2: 22 kV distribution lines from the Eskom Rietfontein substation only (preferred option).**

8.1.3.4. Overland conveyor route

Option 1

In order to reduce potential impacts to the environment, it was initially investigated for Sasol to take over the existing Isibonelo overland conveyor when it becomes available to convey the coal from the head end of the overland feed conveyor to the SCS Syferfontein conveyor.

Option 2 (preferred)

Due to the risks associated with logistics and the Sasol Mining – Anglo American negotiations, the second option in terms of the overland conveyor is to construct a new conveyor running parallel to the existing Isibonelo conveyor to convey the coal to the SCS Syferfontein conveyor. This conveyor will tie-in directly to the Syferfontein network and will discharge coal onto the SCS Syferfontein conveyor.

8.1.4 The technology to be used in the activity

Refer to **Table 8-1** for details on the alternatives considered for the Alexander Mining Project.

8.1.5 The operational aspects of the activity

The operational alternatives directly relate to the mining method (discussed in **Section 8.1.4**) and the lay-out alternatives (discussed in **Section 8.1.3**). Refer to **Table 8-1** for details on the alternatives considered for the Alexander Mining Project.

8.1.6 The option of not implementing the activity

The option of not implementing the activity will result in Sasol not meeting its coal feedstock requirements in Sasol's Southern African value chain. This could therefore have implications for the country's electricity demand and local economy. Refer to

Section 6 for more information on the need and desirability of the Alexander Mining Project.

9. DETAILS OF THE PUBLIC PARTICIPATION PROCESS FOLLOWED

9.1 Public participation process followed

Public participation is essential and a legislated requirement for the environmental authorisation process for which Sasol is applying. The principles that demand communication with society at large are best embodied in the principles of the NEMA (Act 107 of 1998, Chapter 1). In addition, section 24(5), Regulation 54-57 of GNR 543 under the NEMA, guides the public participation process that is required for an EIA process.

The public participation for the proposed Alexander Mining Project will be undertaken in accordance with the stipulated requirements of the NEMA, Act 107 of 1998, as amended. The public participation process followed integrates the following applications:

- Environmental authorisation in accordance with the NEMA EIA Regulations of 2014, as amended;
- Application for an IWULA in terms of the provision of the NWA (Act 36 of 1998);
- Application for a Waste Management Licence in accordance with the NEM:WA Regulations of 2008.

9.1.1 Objectives of public participation in an environmental authorisation process

The objectives of public participation in environmental authorisation process are to provide sufficient and accessible information to Interested and Affected Parties (I&APs) in an objective manner. The objectives per EIA phase are discussed below.

9.1.1.1. During Scoping

- Assist the I&APs with identifying issues of concern and providing suggestions for enhanced benefits and alternatives;
- Provide I&APs with an opportunity to raise issues of concern and suggest project alternatives; and
- Verify that their issues have been considered and to help define the scope of the technical studies to be undertaken during the Impact Assessment Phase.

9.1.1.2. During Impact Assessment

- Verify that their issues have been considered either by the Specialist Studies, or elsewhere; and
- Comment on the findings of the EIA including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones.

The key objective of public participation is to ensure transparency throughout the process and to promote informed decision making.

9.1.2 Approach

The following approach was undertaken for the Scoping Phase:

The public participation process for the applications has been designed to satisfy the requirements laid down in the applicable legislation and guidelines. This section of the report highlights the key elements of the public participation process to date.

9.1.3 Methodology

The following activities were undertaken to facilitate involvement from I&APs during the scoping phase:

9.1.3.1. Application forms and notification letters

An environmental authorisation application form has been compiled for submission to the DMRE.

9.1.3.2. Identification of stakeholders

The identification of stakeholders is ongoing and is refined throughout the process. The identification of key stakeholders and community representatives (landowners and occupiers) for this project is important as their contributions are valued. Various stakeholders were identified as part of the EIA process; this included the following:

- Affected and surrounding landowners,
- Organs of State (national, provincial and local);
- Local business and interests;
- Media;
- Non-governmental Organisation (NGOs); and
- Community Based Organisations (CBOs).

According to the NEMA EIA Regulations under Section 24(5) of NEMA, a register of I&APs (Regulation 55 of GNR 543) must be kept by the public participation practitioner. Such a register has been compiled and is being kept updated with the details of I&APs throughout the process, refer to **Appendix 6** for the I&AP database.

9.1.3.3. Announcement of opportunity to become involved

The opportunity to participate in the environmental authorisation process was announced as follows:

- Distribution of an email to become involved, accompanied by a Background Information Document (BID) containing details of the environmental authorisation process, the proposed project and a registration sheet (See **Appendix 6** for a copy of the documents). The BIDs were also hand delivered to people residing near the proposed Alexander Mining Project area.
- A media advertisement, (**Appendix 6**) describing the proposed project and the listed activities which will be triggered by the proposed project, was placed in The Ridge Times and the Witbank News newspapers on 23 August 2022 and 19 August 2022 respectively. Proof of placement of advertisements will be included in the Final Scoping Report (FSR).

- Noticeboards (**Appendix 6**) were placed in conspicuous places within the vicinity of the mine and the local area. Placement of noticeboards was conducted on 19 August 2022 to invite stakeholder participation. Proof of placement of noticeboards will be included in the FSR.

9.1.3.4. Obtaining comment and contributions

The following opportunities are available during the Scoping phase for contribution from I&APs:

- Completing and returning the registration/comment sheets on which space was provided for comment. Comment sheets were made available with the BID and with the notification of the availability to review the Consultation Scoping Report (CSR);
- Providing comment telephonically or by email to the public participation office.

9.1.3.5. Comments and Response and acknowledgements

Issues and comments raised during the Scoping phase will be recorded and addressed in a Comments and Response Report (CRR) and appended to the FSR. The CRR will be updated to include I&AP contributions that may be received as the Scoping phase proceeds, and as the findings of the EIA become available. The contributions made by I&APs will be acknowledged in writing.

9.1.3.6. Consultation Scoping Report (CSR)

The purpose of the public participation process in the Scoping Phase is to enable I&APs to comment and contribute on the proposed project. At the end of Scoping, the issues identified by the I&APs and by the environmental technical specialists, will be used to define the Terms of Reference (ToR) for the Specialist Studies that will be conducted during the Impact Assessment Phase.

The CSR has been distributed for comment from 24 August 2022 to 23 September 2022 as follows:

- Placed in public venues within the vicinity of the project area (**Table 9-1**);
- Placed on the J&W website;
- Mailed to key stakeholders; and
- Copies will be made available at the stakeholder meeting/s.

I&APs can comment on the report in various ways, such as completing the comment sheet accompanying the report, and submitting individual comments in writing, telephonically or by email.

Table 9-1: Public places where the Consultation Scoping Report is available

PLACE	ADDRESS / CONTACT DETAILS	
Printed Copies		
Kriel Public Library	Cnr Quinton & Heinrich str, Kriel	
Bethal Public Library	Danie Nortjie Street, Bethal	
Electronic Copies		
Jones & Wagener website	www.jaws.co.za	Anelle Lotter, 011 519 0200

Meeting during public review of CSR

A meeting for stakeholders will be held on 8 September 2022 in Bethal, to provide them with a further opportunity to comment on the CSR and to meet and interact with the project team. The attendance registers and minutes of these meetings will be included in the Final Scoping Report.

9.1.3.7. Final Scoping Report (FSR)

The FSR will be updated with additional issues raised by I&APs and may contain new information. The document will be distributed to the competent authority for review and will be made available electronically for commenting authorities and I&APs, for information purposes.

In the Impact Assessment Phase of the EIA specialist studies will be conducted to assess the potential positive and negative impacts of the proposed project, and to recommend appropriate measures to enhance positive impacts and avoid or reduce negative ones. I&APs will be kept informed of progress.

9.1.3.8. Public Review of Consultation Environmental Impact Report (EIR), inclusive of the Waste Management Licence Application Report (WMLAR) and Environmental Management Programme (EMPr), as well as Draft Integrated Water Use Licence Application (IWULA)

The Consultation EIR/EMPr and Draft IWULA will be made available for public comment by following the same procedure as for the CSR. A public meeting will be held during the public review period to discuss impacts and mitigation measures.

9.1.3.9. Notification of availability of Final EIR/EMPr

Once the Final EIR/EMPr has been compiled, it will be made available to the public at the same time that it is submitted to the DMRE for approval. This will be done by means of:

- Emails will be sent to all I&APs registered on the stakeholder database; and
- The report will be loaded on the J&W website.

9.1.3.10. Announcement of the authority's decision

Once a decision is reached by the Competent Authority, I&APs will be notified of the decision and the appeal process to be followed. Refer to **Appendix 6** for more details on the public participation process, including copies of the BID, site notices and advertisement.

9.2 Summary of comments raised by I&APs

The list of I&APs consulted to date is provided in **Appendix 6**. Any comments or responses received from I&APs will be included in **Table 9-2** in the FSR.

Table 9-2: Summary of comments and responses

Interested and Affected Parties		Date Comments Received	Comments raised	EAPs response to issues as mandated by the applicant	Consultation Status
List the names of persons consulted in this column, and mark with an X where those who must be consulted were in fact consulted.					(Consensus / dispute, not / finalised, etc.)
AFFECTED PARTIES					
Landowner/s					
None received to date					
Lawful occupier/s of the land					
None received to date					
Landowners or lawful occupiers on adjacent properties					
None received to date					
Municipal councillor					
Municipality					
None received to date					
Organs of state (Responsible for infrastructure that may be affected by Roads Department, Eskom, Telkom, DWS etc)					

Interested and Affected Parties List the names of persons consulted in this column, and mark with an X where those who must be consulted were in fact consulted.		Date Comments Received	Comments raised	EAPs response to issues as mandated by the applicant	Consultation Status (Consensus / dispute, not / finalised, etc.)
None received to date					
Communities					
Dept. Land Affairs					
Mpumalanga Tourism and Parks Agency					
Traditional Leaders					
Dept. Environment Forestry and Fisheries					
None received to date					
Other Competent Authorities affected					
None received to date					
OTHER AFFECTED PARTIES					
None received to date					
INTERESTED PARTIES					
None received to date					

10. ENVIRONMENTAL ATTRIBUTES ASSOCIATED WITH THE SITE

This section provides a general description of the environment in which the project is located. The purpose of this section is to provide a perspective of the local environment within which the proposed Alexander Mining Project is located, with a view to identify sensitive issues/areas, which need to be considered when conducting the impact assessment.

Existing baseline information and specialist studies, as well as studies undertaken specifically for this project have been used to describe the current environment, are listed below:

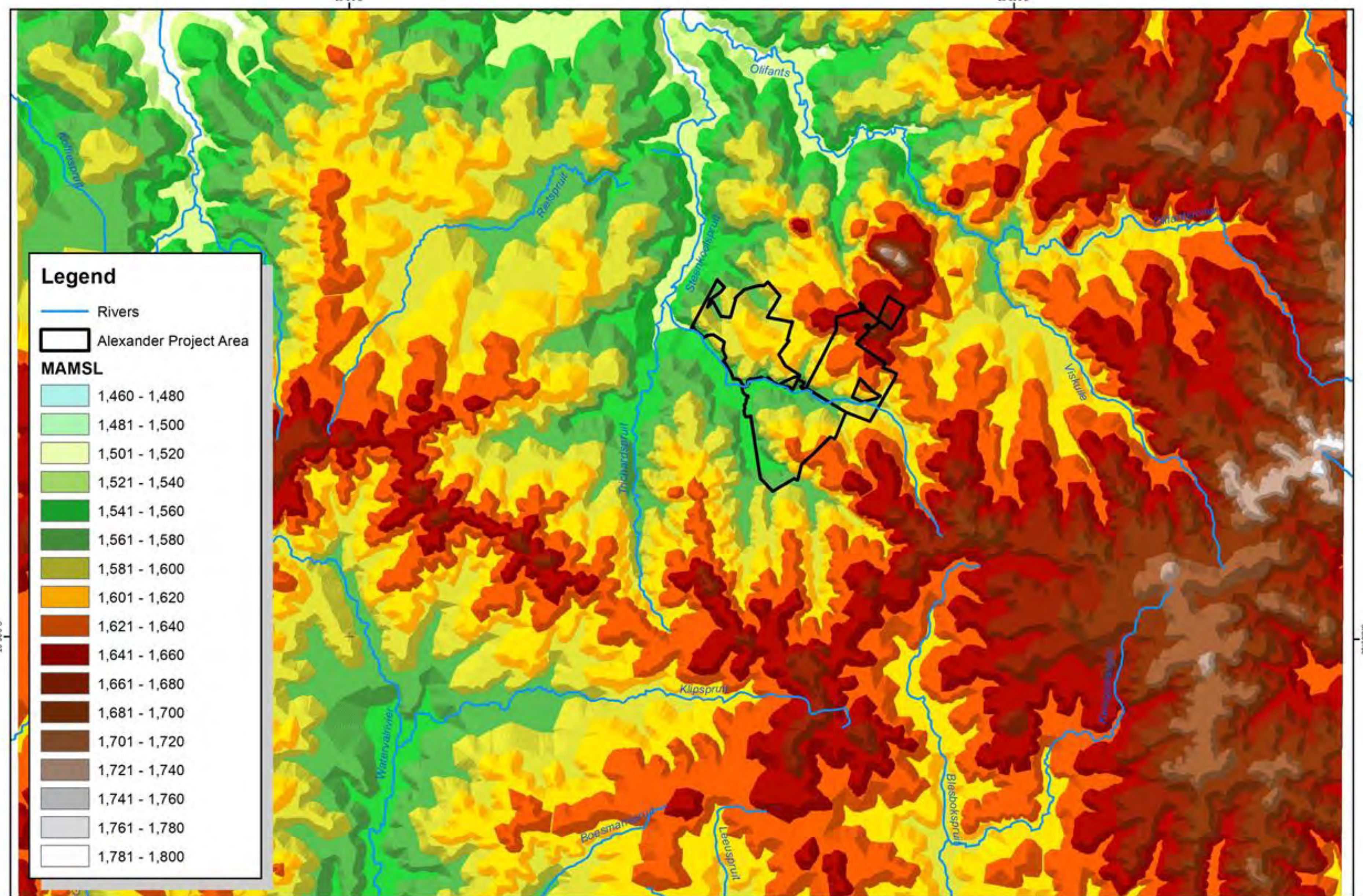
- Blast Management & Consulting (BMC) (2021). Blast and Vibration Assessment Scoping Report Proposed Alexander Mining Project. JAWS_Alexander Mining Project_210607V00_EIAScpg.
- Jones & Wagener (2021a): Alexander Mining Project Visual Assessment Report. Report number: JW181/18/G292-14-Rev3.
- Jones & Wagener (2021b): Alexander Mining Project Surface Water Specialist Study. Report number: JW173/21/G292-16-Rev0.
- Jones & Wagener (2021c): Alexander Mining Project Hydrogeological Report. Report number: JW280/20/G292-Rev0.
- Jones & Wagener (2021d): Alexander Mining Project Soil, Land Capability and Land Use Assessment Report. Report number: JW180/18/G292-13-Rev3.
- The Biodiversity Company (2021a): Wetland Baseline Assessment for the Proposed Alexander Mining Project.
- The Biodiversity Company (2021b): Aquatic and Riverine Baseline Assessment for the Proposed Alexander Mining Project.
- The Biodiversity Company (2021c): Terrestrial Biodiversity Baseline Assessment for the Proposed Alexander Mining Project.
- Airshed Planning Professionals (2021a): Alexander Mining Project: Baseline Air Quality Report. Report number: 20JAW02AB.
- Airshed Planning Professionals (2021b): Alexander Mining Project: Baseline Noise Survey Report. Report number: 17JAW03
- Airshed Planning Professionals (2021c): Climate Change Impact Statement for the Proposed Alexander Mining Project near Bethal, Mpumalanga. Report number: 20JAW02
- Digby Wells Environmental (2021). Sasol Mining (Pty) Ltd Alexander Mining Project – Heritage Baseline. Project Number: JAW7146.
- Conningarth Economists (2021). Alexander Mining Project. Socio-economic and Economic Feasibility Report. Report No.: Congarth 02/J&W-G292 – Rev2
- WSP (2021). Sasol Alexander Mining Project – Traffic Assessment Report. Project No. 24391

10.1 Baseline Environment

10.1.1 Type of environment affected by the proposed activity

10.1.1.1. Topography and drainage

The western and northern boundary of the study area are located at an elevation of 1 680 – 1 700 meters above mean sea level (mamsl) (**Figure 10-1**). The southern boundary is located at an elevation of 1 600 mamsl. The Trichardt/Dwars-in-die-Wegspruit and Debeerspruit drain through the study area from south to north creating an undulating landscape with topographic highs of 1 720 mamsl and lows of 1 520 mamsl. An east-west watershed runs through the southern part of the study area. This watershed forms part of the continental divide, with water on the northern part draining towards the Olifants River and the Indian Ocean, while water on the southern part drains towards the Vaal River and the Atlantic Ocean (J&W, 2021b).



Jones & Wagener	J&W JOB NUMBER: G292	REV NO Ver 1	DATE DRAWN: 21/05/2018 AUTHOR: K. Kruger	PROJECTION LO29 Cape	Sasol Mining - Alexander Mining Project Topography Map	0 2.5 5 10 Kilometers 1:250 000

10.1.1.2. Climate

The Alexander Mining project area is located in the Mpumalanga Highveld region where the climate is characterised as generally dry.

Temperature

Summers are warm to hot with an average daily high temperature of approximately 27˚C (with occasional extremes up to 35˚C). Winters are mild-to-cold with an average daily high of approximately 15˚C (with occasional extreme minima as low as -10˚C). Frost and mist are frequently experienced during the winter months on the Mpumalanga Highveld (J&W, 2021b).

Precipitation and evaporation

Most of the precipitation is experienced during the summer months, mostly in the form of afternoon thundershowers. Mean Annual Precipitation (MAP) is 707 mm, with 85% of the annual rainfall occurring between October and March. Mean annual evaporation (MAE) in the region is approximately 1 600 mm (J&W, 2021b).

The MAP and MAE for the region in which the site resides can be seen in **Table 10-1** and **Figure 10-2.**

Table 10-1: Average monthly rainfall and evaporation depths (J&W, 2021b).

Month	Average rainfall (mm)	Average pan evaporation (mm)
October	77.2	167.1
November	112.1	157.6
December	121.9	173.6
January	129.9	170.5
February	90.5	142.1
March	82.0	140.3
April	38.0	107.9
May	19.9	90.8
June	9.6	73.8
July	6.8	80.8
August	8.9	107.0
September	21.8	138.6
Annual Total	718.6	1550

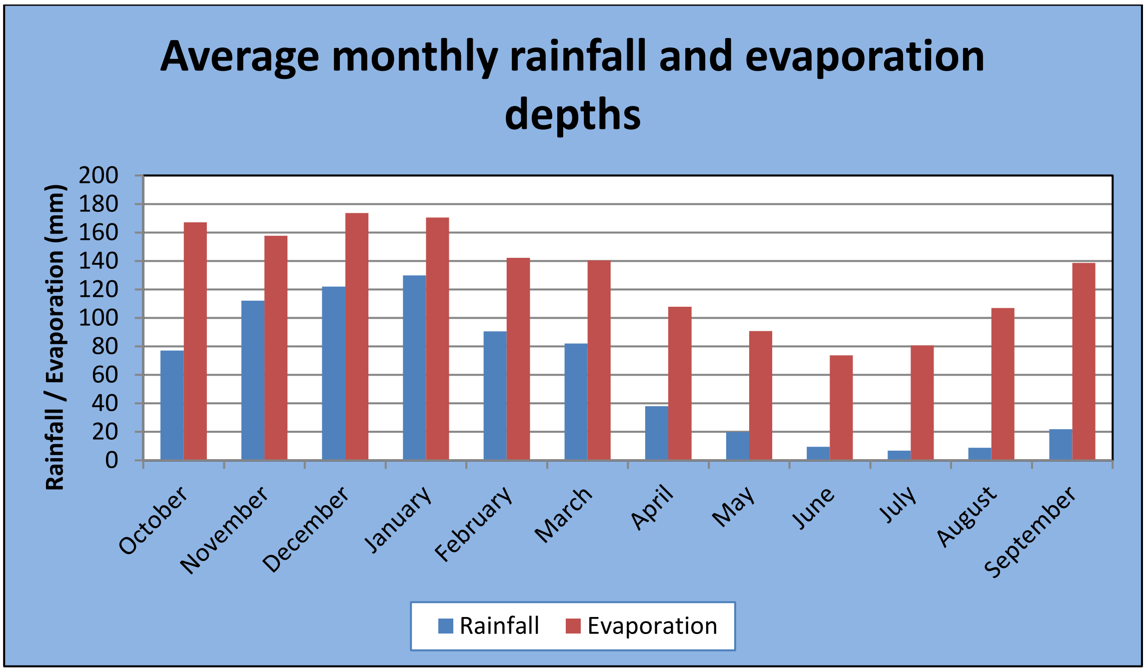


Figure 10-2: Average monthly rainfall and evaporation depths (J&W, 2021b).

Wind

The area experiences north-westerly flow winds. The north-north-westerly wind flow is more dominant during day-time conditions, with northerly and north-easterly wind flow more dominant during the night. Calm conditions occurred 2.93% of the period summarised (Airshed, 2021a).

The period wind field and diurnal variability in the wind field are shown in the **Figure 10-3** below.

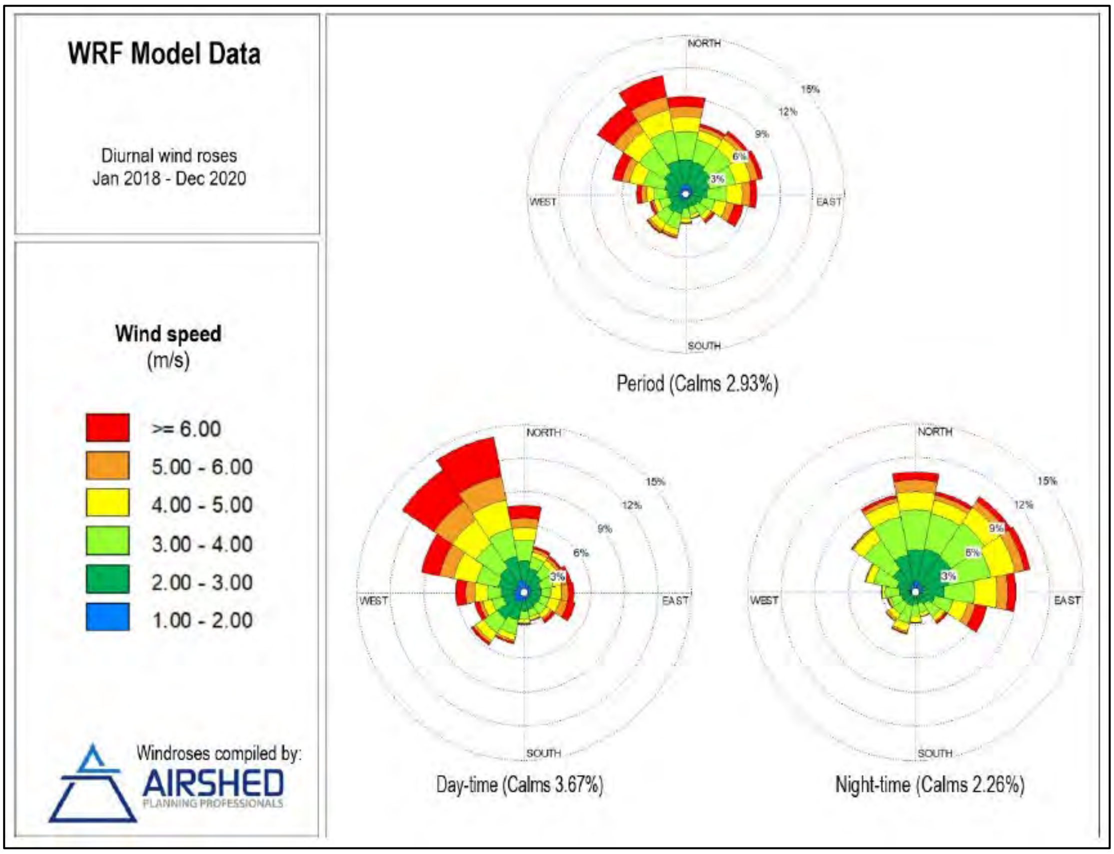


Figure 10-3: **Period, day-, and night-time wind roses (WRD data, 2018 to 2020)**

10.1.1.3. Geology

Regional geology

Sediments of the Vryheid Formation of the Ecca Group underlie the study area (**Figure 10-4**). The Vryheid Formation (Ecca Group) mainly comprises mudstone, siltstone and fine- to coarse-grained sandstone (pebbly in places). Large sections of the study area are underlain by alluvium, especially along the river floodplains, as well as dolerite sills. Both these lithologies influences groundwater flow and hence contaminant migration.

Typically, the different lithofacies of the Karoo Basin are mainly arranged in upward coarsening deltaic cycles (up to 80 m thick in the southeast). Linear coastline cycles are, however, fairly common particularly in the thin north-western part of the basin. A relatively thin fluvial interval (60 m thick) which grades distally into deltaic deposits towards the southwest and south occurs approximately in the middle of the formation in the east and northeast. Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams (J&W, 2021c).

Five coal seams, numbered from bottom to top as No. 1 - 5, are present. The average thickness of the No. 4 Seam is 3.3 m, ranging from 2.4 m to 3.6 m. Where the Nos. 3 and 4 Seams are mined together, their combined height averages 3.6m (range 2.7 m to 4.5 m).

The Ecca sediments overlie the Dwyka Group (referred to as the Dwyka tillite). This formation consists of proper tillite, siltstone and sometimes a thin shale development. The upper portion of the Dwyka sediments may have been reworked, in which case carbonaceous shale and even inclusions of coal may be found. Dolerite intrusions are common in this type of geological terrain and represent the roots of the volcanic system and are presumed to be of the same age as the extrusive lavas (Fitch and Miller, 1984). The B4 dolerite sill overlies large parts of this area. The level of erosion that affected the Main Karoo basin has revealed the deep portions of the intrusive system, which displays a high degree of tectonic complexity. The Karoo dolerite, which includes a wide range of petrological facies, consists of an interconnected network of dykes and sills and it is nearly impossible to single out any particular intrusive or tectonic event. It would, however, appear that a very large number of fractures were intruded simultaneously by magma and that the dolerite intrusive network acted as a shallow stockwork-like reservoir (J&W, 2021c).

Local geology

The No.4 seam will be mined which has an approximate thickness of 4.5 m. The other coal seams are either not fully developed or are discontinued in the area (Digby Wells, 2015).

Available geological and geophysical data show that there are a large number of sills and dykes at the project area that has resulted in the devolatilisation of parts of the coal seam – **Figure 10-5**. The Digby Wells, 2015, study concluded that at the Syferfontein mining area the No.4 coal seam floor forms an NNE-SSW coal floor contour high roughly in the middle of the reserve, ranging in elevation between 1 520 and 1 527 mamsl. The coal floor also dips towards the eastern part of the reserve to a localised low of 1 505 mamsl. Another coal floor elevation low can be seen in the most southern part of the study area, dipping to an elevation of 1 495 mamsl (Digby Wells, 2015).

According to previous studies conducted in the study area, the Karoo sediments were intruded by two phases of post-Karoo dolerite intrusions. The oldest intrusive (commonly known as the B4 sill), is a fine to medium crystalline dolerite sill, mostly restricted to the surface, with a maximum thickness of 48.5 m (Digby, Wells 2015). This sill was found to be mostly eroded in the lower lying areas.

The B4 sill was found to be surface bound throughout the mining area (refer to **Figure 10-5**), transgressing the No.4 coal seam (Digby Wells, 2015). The B8 dolerite sill is a fine grained (porphyritic) dolerite and intruded later than the B4 sill, along with semi-planar features. Displacement of the coal seams caused by dolerite intrusion was recorded to range from no displacement, to more or less the thickness of the given coal seam.

The dolerite occurrences in the area have specific significance with regard to the hydrogeology of the study area. Not only can groundwater compartments exist as a result of these features, but the possible groundwater interaction between mines, will also be a function of the dolerite distribution (Digby Wells, 2015).

Figure 10-6 represents a typical geological profile sourced from historical data indicating the lithology that may be expected. The geology consists of weathered soil to a depth of 10 – 15 m. Below the weathered zone, carbonaceous shale is present, with fine-grained sandstone with a thickness of between 15 m and 22 m at various depths. Below this, shale occurs to a depth of approximately 50 m, with sandstone again underlying the shale in places and thin coal layers with a thickness of approximately 4 m.

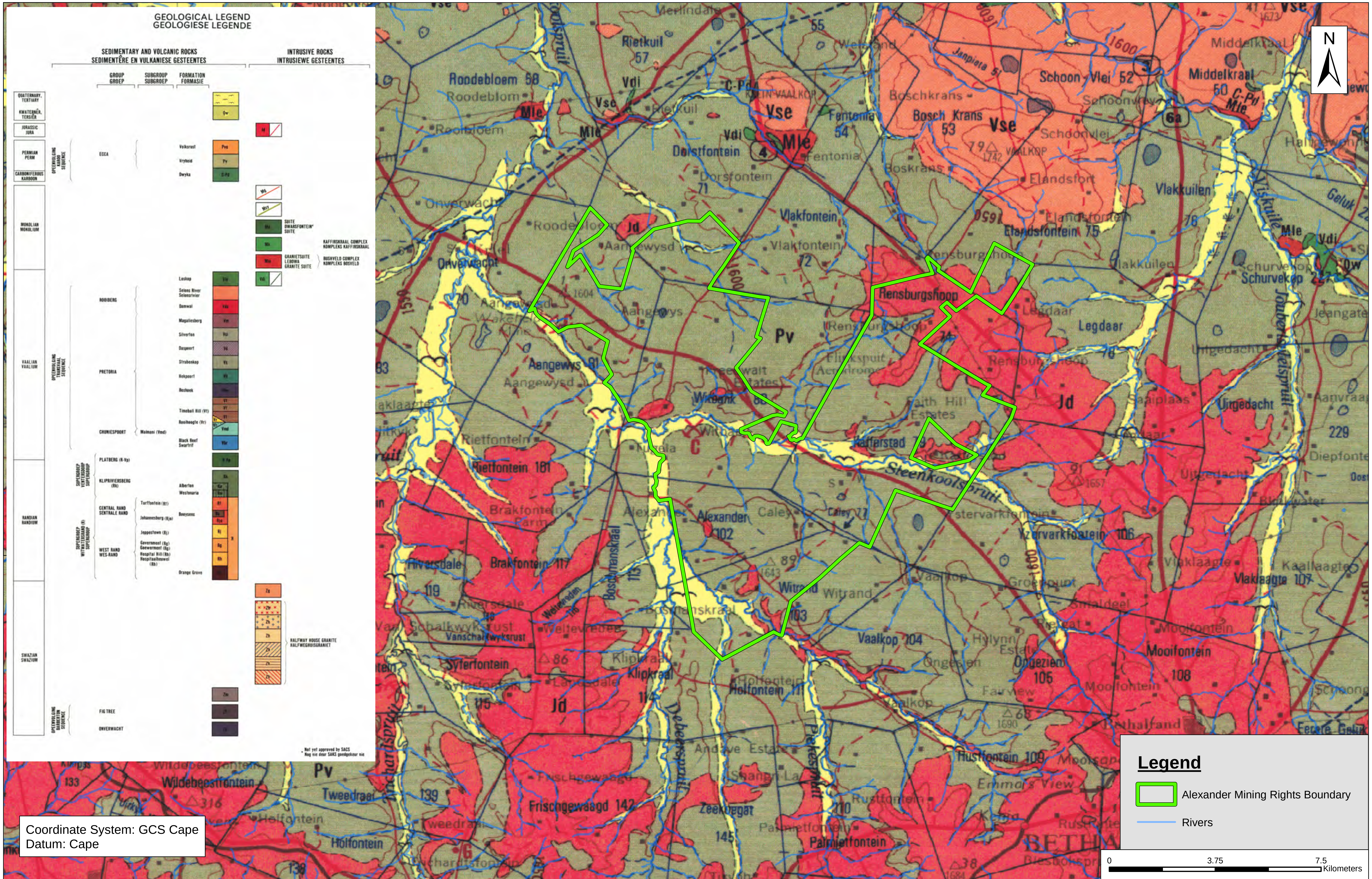


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Figure 10-4

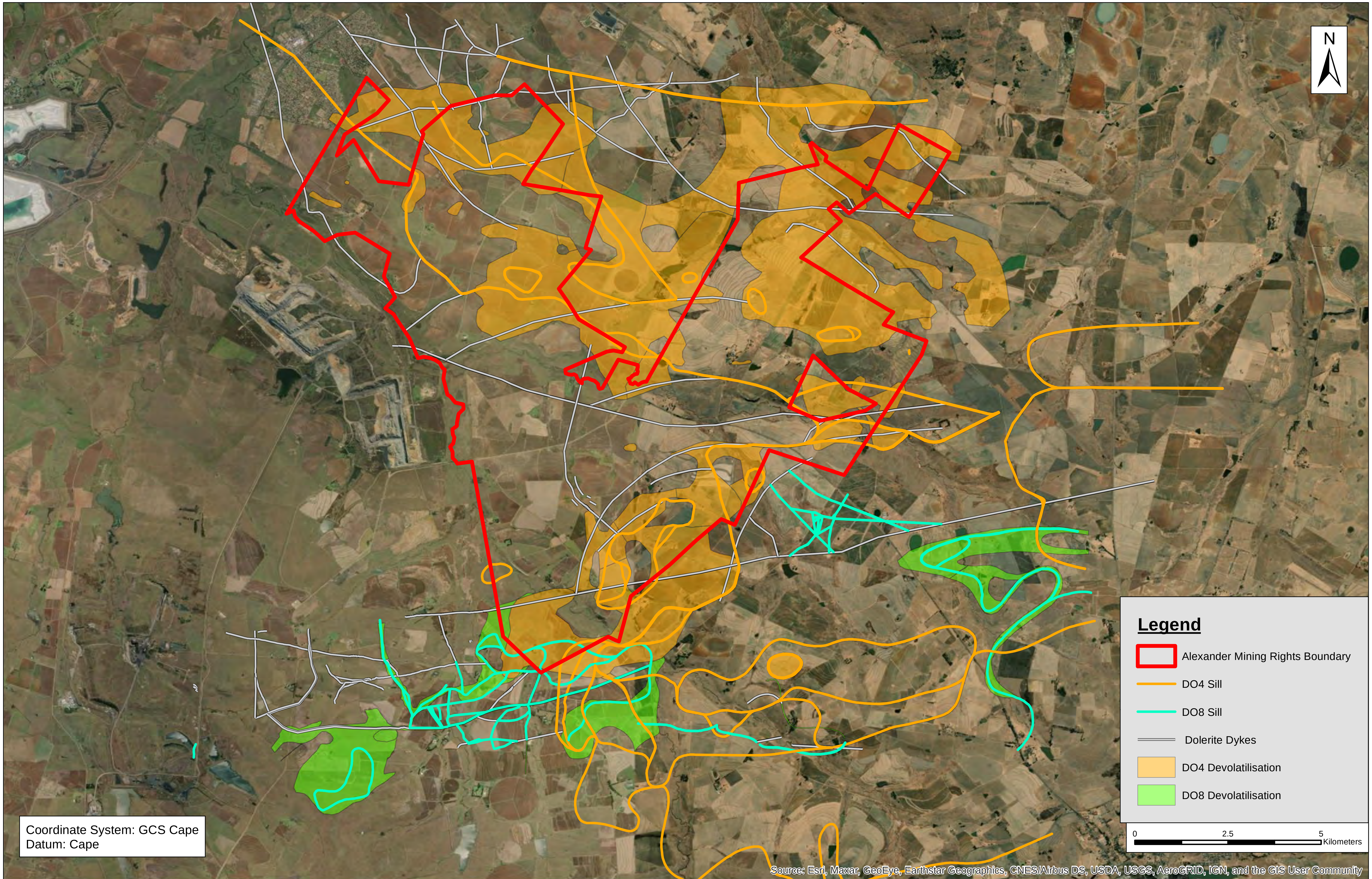

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Figure 10-5

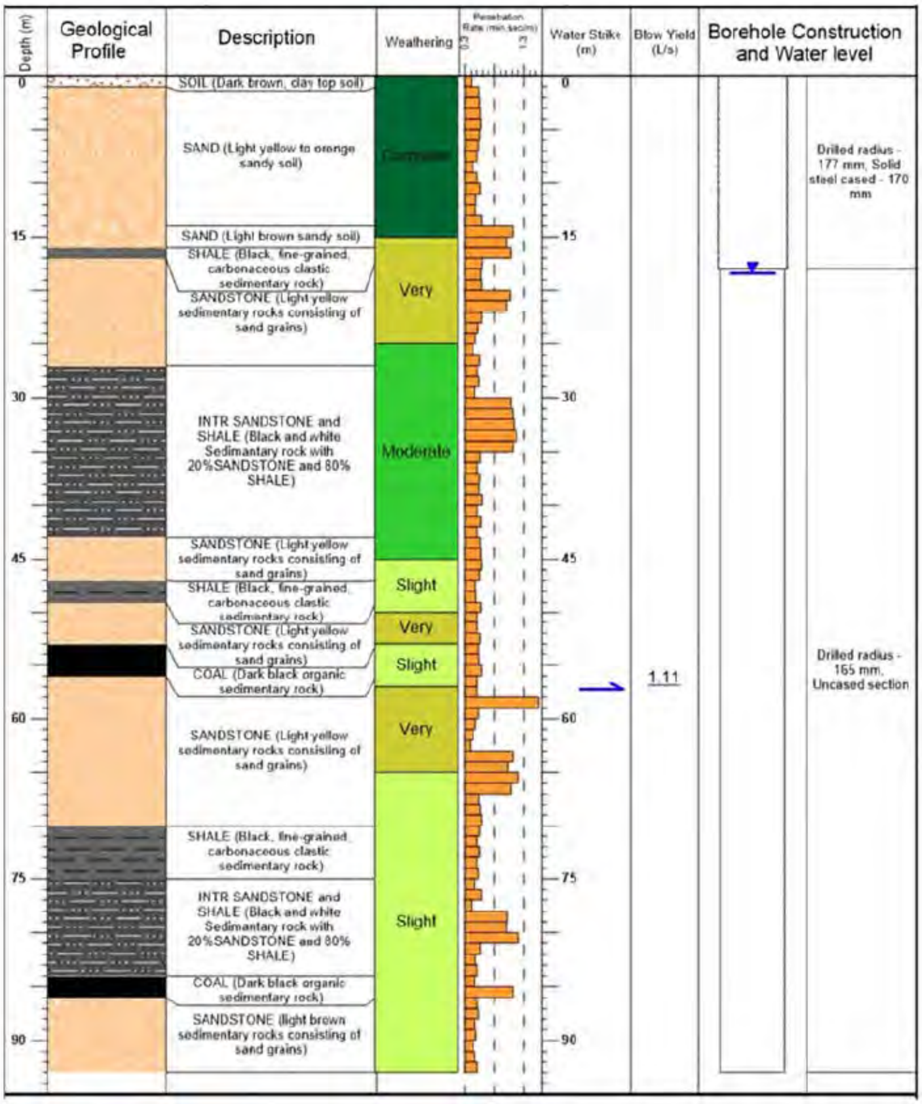


Figure 10-6: **An example of a geological profile that can be expected at the project area (Digby Wells, 2015)**

10.1.1.4. Soils, land use and land capability

Soils

Soil distribution

The distribution of the soils within the Alexander Mining Project area and the infrastructure corridors (**Figure 10-7**) is closely linked to the topography and parent materials from which they are derived, as well as the flooding regime of the area. The free-draining soils (Clovelly, Hutton, Griffin) derived from the sediments (sandstone and shales) are generally associated with the midslope and upper midslope areas in the northern sector of the mapped area, upslope of the rivers, secondary and tertiary drainage lines. Structured (Sterkspruit, Swartland and Valsrivier), and more clay rich (less easily drained) soils associated with the intrusive dolerite dykes and sills are found in the centre portion of the area mapped, occupying a range of topographical positions outside of the wetland environments (J&W, 2021d).

The heavier, dark grey to mottled coloured clay rich colluvium and hydromorphic soils dominate the low lying, gently sloping riverine and wetland environments. While the above scenario may be characteristic of some of the areas on site, black clayey soils (like Willowbrook, Arcadia, Rensburg etc) are dominant and were recorded on the highest lying areas. The gently sloping nature of the terrain, and the underlying hard rock (dolerite) capping the coal reserves, limit water infiltration and result in inundation of the soils. It is this fluctuation of the water table, as well as the underlying geology that has led to the formation and dominance of these soil types (J&W, 2021d).

The soils were grouped into:

- Clay soils;
- Valley bottom/ plain soils;
- Apedal red/brown soils; and
- Shallow soils.

Soil Forms Identified

A total of twenty-nine (29) natural soil forms were identified (**Table 10-2**) in the larger study area. Each of the soil groups and the main Soil Forms are described in more detail below.

Table 10-2: Natural soil forms identified in Alexander (J&W, 2021d)

Topsoil Horizon	Subsoil Horizons		Soil Form	Map Code
Vertic	Gley*	-	Rensburg	Rg
	Lithic (previously unspecified)-		Arcadia*	Ar
	Hard Rock	-	Rustenburg*	Rs
Melanic	Gley*	-	Willowbrook	Wo
	Pedocutanic-		Bonheim	Bo
	Soft Carbonate	-	Steendal	Sn
	Lithic	-	Mayo	My
	Alluvial (previously unspecified)		Inhoek*	Ik
Orthic	Gley*	-	Katspruit	Ka
	Albic*	Gley	Kroonstad	Kd
	Albic*	Soft Plinthic	Longlands	Lo
	Yellow-Brown Apedal	Gleyic*	Pinedene	Pn
		Red Apedal	Griffin	Gf
		Soft Plinthic	Avalon	Av
		Hard Plinthic	Glencoe	Gc
		Lithic*	Clovelly*	Cv
	Yellow-Brown Apedal		Ermelo*	Er
	Red Apedal	Soft Plinthic	Bainsvlei	Bv
	Red Apedal		Hutton	Hu
	Alluvial		Dundee	Du
	Soft Plinthic	Gleyic*	Westleigh	We
	Hard Plinthic	-	Dresden	Dr
	Prismacutanic		Sterkspruit	Ss
	Pedocutanic	Gleyic*	Sepane	Se
	Pedocutanic	Lithic	Swartland	Sw
	Pedocutanic		Valsrivier	Va
	Neocutanic		Oakleaf	Oa
	Lithic	-	Glenrosa	Gs

Topsoil Horizon	Subsoil Horizons		Soil Form	Map Code
	Hard Rock	-	Mispah	Ms

*Denotes soil forms/horizons updated/new in the 2018 Soil Classification, a Natural and Anthropogenic System for South Africa.

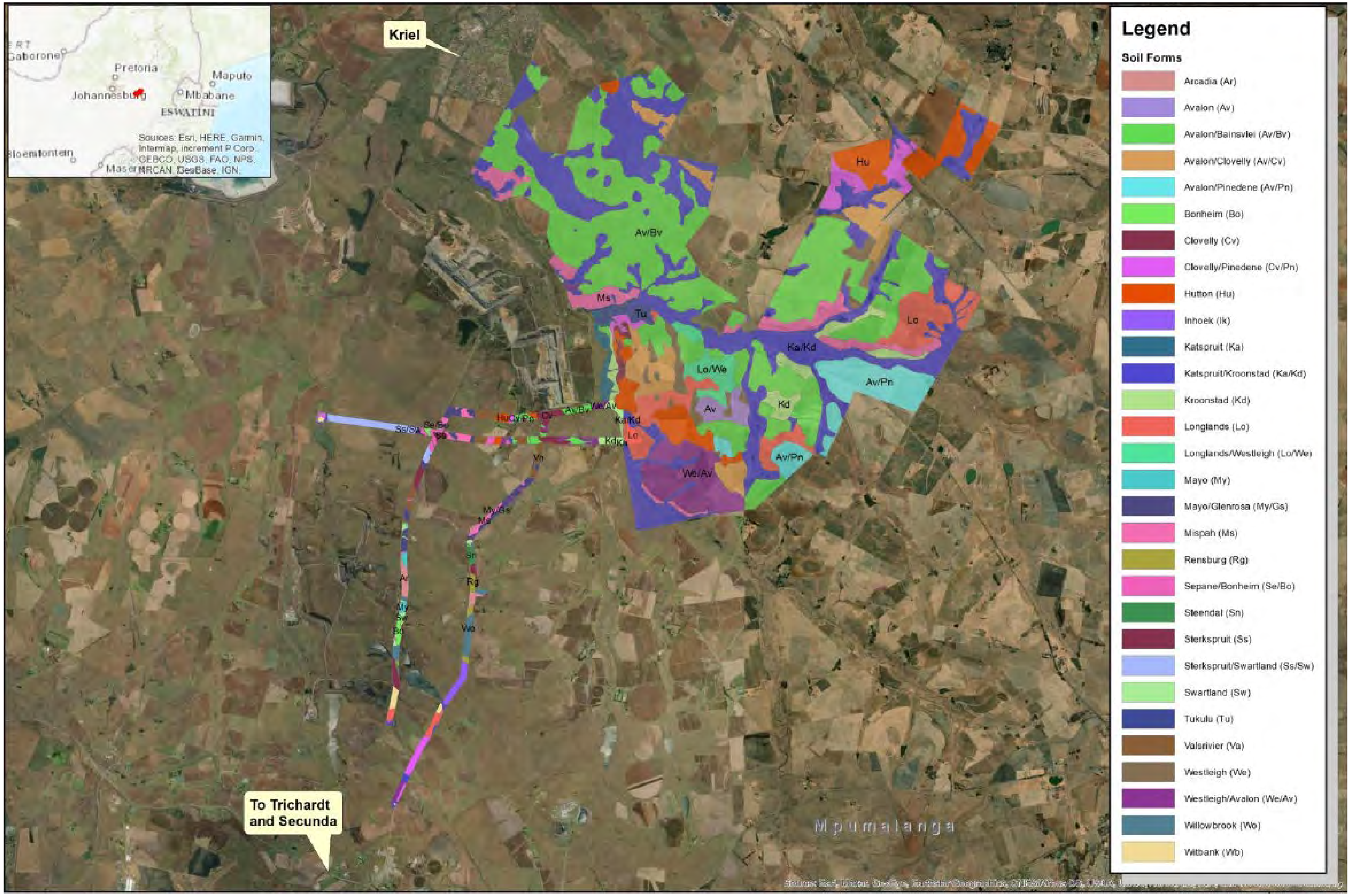


Figure 10-7: Soil forms identified in the Alexander mining area and infrastructure corridor (J&W, 2021d).

Soil Chemical Properties

Sampling of the soils for nutrient status was confined where possible to areas of uncultivated land. However, some of the grazing lands might well have been fertilized in the past, and the results may not be truly representative of the soils in their natural state. The chemistry of the dominant soil forms is given in **Table 10-3.**

Table 10-3: Soil chemistry of the main soil forms (J&W, 2021d).

Constituent	Arcadia	Willow-brook	Steendal	Inhoek	Rensburg	Clovelly	Avalon/ Westleigh
pH	5-6	6.5-7	5-6	5-6	4-5	5-7	3.8 – 6.7
EC (mS/m)	41-46	85-153	34-79	23-95	62-87	33-154	
CEC	24-27	32-45	29-44	22-39	17-19	7-25	2.2-12.1
SAR	0.19-0.26	0.49-0.56	0.36-0.62	0.36-0.62	0.2-0.36	0.13-0.32	0-0.6
Total N (%)	0.13	0.11	0.09-0.14	0.1-0.16	0.1-0.11	0.07-0.66	
P (mg/kg)	2	2-2.78	1.8-2.5	1.9-28.2	1.9-2.2	2.1-2.6	4-72
K (mg/kg)	215	65-208	110-154	91-744	91-333	104-174	44-299
Ca (mg/kg)	1624	2122-6764	2764-3784	3244-2984	3094-3322	425-977	230-1803
Mg (mg/kg)	1345	2160-2729	1321-2096	948-1488	981-1022	133-1479	42-336
S (mg/kg)	24.9	110-235	38-57	14.9-22.5	18.6-22.5	19.3-111	3-13

**Results combined from the various previous baseline and current farmer reports*

Land capability

The land capability distribution classes for Alexander is shown in **Table 10-4** and **Figure 10-8** below.

Table 10-4: Land Capability Classes for Alexander (J&W, 2021d).

Land Capability	Area (ha)	Area (%)
Arable	5 025	49.74
Grazing	1 915	18.96
Wilderness	464	4.59
Wetland	2 699	26.71
Total Area	10 103 ha	100%

Arable

Arable land dominated the study area as 50% of the Alexander area comprise thereof. The land capable of sustaining arable crop production comprises the deep well drained, red (Hutton) and yellow-brown (Clovelly and Griffin) soils that occur on the midslope and upper midslope positions. In addition, there are areas associated with the more structured soil Forms, specifically the Valsrivier Form soil, that are capable of cultivation under good management conditions. The more structured and hydromorphic soils are not considered to be arable soils under the classification (J&W, 2021d).

Some of the heavier structured soils, as well as large areas of the hydromorphic soil types (Avalon's and Westleigh's) have been cultivated at present, specifically in the northern part of the survey area.

Grazing

The areas that classify as grazing land are generally confined to the shallower and more structured soil forms that are moderately well drained comprising 19% of the Alexander area. These soils are generally darker in colour and are not always free draining to a depth of 750 mm but are capable of sustaining palatable plant species, especially since only the subsoils (at a depth of 500 mm) are periodically saturated. There are no rocks or pedocrete fragments in the upper horizons of any of the soil groups, which will limit the land capability to wilderness land (J&W, 2021d).

Conservation/Wilderness

The areas that classify as either conservation, or wilderness land are found associated with the shallow rocky soils that were mapped in association with the ridge slope positions that are defined by the less resistant dolerite dykes that have intruded into the sediments. These areas are confined predominantly to the southern portion of the area mapped (J&W, 2021d).

Wetland

The wetland areas are defined in terms of the wetland delineation guidelines, which use both soil topography as well as botanic criteria to define the limits to this domain. In general, this zone is dominated by hydromorphic soils, and plant life that is associated with aquatic processes. The soils are generally dark grey to black in the topsoil horizons, and high in transported clays, and show pronounced mottling on gleyed backgrounds in the subsoils. The soils are within the zone of groundwater influence. The area investigated is dissected by a number of prominent drainage lines that terminate in prominent river systems. The combination of soil types and hydromorphic vegetation was used to delineate the wetland soils. The distribution of the land capability classes is illustrated on **Figure 10-8**.

Agricultural Data and Economics

Production figures were obtained from the socio-economic assessment undertaken by Conningarth Economists (2021). The production information was provided by interviews or via email correspondence with the various farming operations within the study area, undertaken in June 2018. The farmers who provided data included the following:

- Mr Nicol de Vos owner of Vosstoffel (Pty) Ltd., farming on the farms or portions of the farms Langsloot 99 IS, Zondagsfontein 124 IS, Zondagskraal 125 IS, Dieplaagte 123 IS, Rietfontein 100 IS, Spandow 121 IS and Tweedraai 139 IS.
- Mr Ryno Beukes, farming on the farms or portions of the farms Syferfontein 120 IS, Boschmanskraal, 113 IS, Klipkraal 114 IS, Holfontein 111 IS, Weltevreden 116 IS, Syferfontein 115 IS and Frischgewaagd 142 IS.
- Mr Francois de Wet, farming on the farms or portions of the farms Van Schalkwyksrust 118 IS, Zeekoegat 145 IS and Witrand 103 IS.
- Mr H (Hennie) Marais, farming on the farm Zwakfontein 120 IS (seven Portions).
- Mr Henry Dunn, farming on the farms or portions of the farms Alexander 102 IS and Witbank 80 IS. Data was submitted by email.
- Mr HJ (Kobus) Pieterse, farming on the farms or portions of the farms Alexander 102 IS, Witbank 80 IS and Witrand 103 IS. Data was submitted by email.

The figures submitted to the specialists was limited to annual turnover numbers based on the average agriculture production over the 5-year period in the specific year prices, and not constant prices.

Agricultural statistics was sourced from the Protein Research Foundation website (https://www.proteinresearch.net/index.php?page=home-page) accessed on the 8th of February 2022 and included maize and soya prices for the period 2016 - 2021.

Agro-climatic information was sourced from Conradie's 2012 research paper titled "South Africa's Climatic Zones: Today, Tomorrow", CSIR.

Agro-Climatic Classification

The Secunda area falls into an area classified as Moist Highveld Grassland (based on vegetation types - Kruger, Climate Regions – Climate of South Africa), the cold interior (SANS 204-2), or a temperate, dry winter, warm summer region (Cwb) according to the Koppen-Geiger classification system.

In Secunda, the climate is warm and temperate. In winter, there is much less rainfall than in summer. The average annual temperature is 15.7 °C and the annual rainfall is 817 mm.

Production Figures

From the farmer interviews, the consolidated turnover for the study area per product was calculated and the results are shown in **Table 2-5** below. The biggest income was generated by the dryland production of maize at R81m in 2020/21, followed by the dryland production of soya at R38m over the same period. Smaller contributors include irrigated grazing land, hay production as well as game farming.

Table 10-5: Annual Agricultural Turnover

Product	Hectares	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
		Mill Rand	Mill Rand	Mill Rand	Mill Rand	Mill Rand
Maize – Dryland	3 961	R64.09	R67.34	R66.39	R73.02	R81.13
Soya Beans - Dryland	2 558	R30.21	R31.74	R30.65	R34.41	R38.24
Irrigated Grazing	90	R3.59	R3.77	R3.67	R4.09	R4.54
Eragrostis Hay	277	R5.90	R6.20	R5.57	R6.72	R7.47
Livestock & Game	3 621	R5.43	R5.70	R5.63	R6.18	R6.87
Total	**10 507**	**R109.22**	**R114.75**	**R111.91**	**R124.42**	**R138.25**

Using the price statistics from the Protein Research Foundation, the above turnover numbers were equated to production prices, tonnages as well as production (t/ha) for the 5-year period starting in 2016. It should be noted that no product statistics was available for the grazing, hay and game farming operations for the Trichardt area. From the data it can be seen that the maize production has fluctuated between 6.1 and 7.8 t/ha, while the soya fluctuated between 2.2 and 2.6 t/ha.

Table 10-6: Agricultural Production Figures 2016 - 2021

Product	Hectares	2016/2017	2017/2018	2018/2019	2019/2020	2020/2021
Maize Price – Dryland	R/t	2 673.0	2 208.0	2 494.0	2 610.0	2 633.0
Soya Beans Price-Dryland	R/t	5 291.0	5 221.0	5 250.0	5 235.0	5 897.0
Maize – Dryland tonnes	t	23 976.8	30 498.2	26 619.9	27 977.0	30 812.8
Soya Beans - Dryland tonnes	t	5 709.7	6 079.3	5 838.1	6 573.1	6 484.7
Maize – Dryland production t/ha	3 961	6.1	7.7	6.7	7.1	7.8
Soya Beans - Dryland production t/ha	2 558	2.2	2.4	2.3	2.6	2.5

Labour Figures

The labour figures related to the above agricultural areas were determined by the socio-economic specialist to be as follows:

- Permanent – 181;
- Temporary - 22;
- **Total - 203.**

The production from the area that is to be affected by opencast mining and associated infrastructure is estimated as 881ha out of the 3961ha of cropland within the mining right. Production from the total area is estimated as R81.1m, of which an estimated R16m will be lost per year due to the opencast mining and surrounding stockpiles and infrastructure.

The socio-economic assessment by Conningarth Economists (2021) calculated that the potential loss of income will equate to a loss of 4 agricultural jobs, as opposed to the creation of 527 mining job opportunities and the generation of an additional R428m to the GDP over the life of the project. They regarded the nett socio-economic impact to be positive.

Land use

The land use of Alexander is shown in **Table 10-7** and **Figure 10-9** below. The dominant land use on Alexander is cultivated fields.

The minor land uses include wetlands, water, urban areas, mines and their dams (Syferfontein and Isibonelo), woodlands, shrubland and plantations. A very small portion of degraded eroded and bare land was also found (J&W, 2021d).

Table 10-7: Alexander Mining Project Land Use (J&W, 2021d).

Land Use	Ha	%
Bare none vegetated	4	0.04

Land Use	Ha	%
Cultivated comm fields	5 664	56
Grassland	3 273	32
Plantation/Bush	224	2.2
Mining	22	0.22
Urban/ built-up	23	0.22
Water	22	0.22
Wetlands	922	9.1
Total	10 154	100

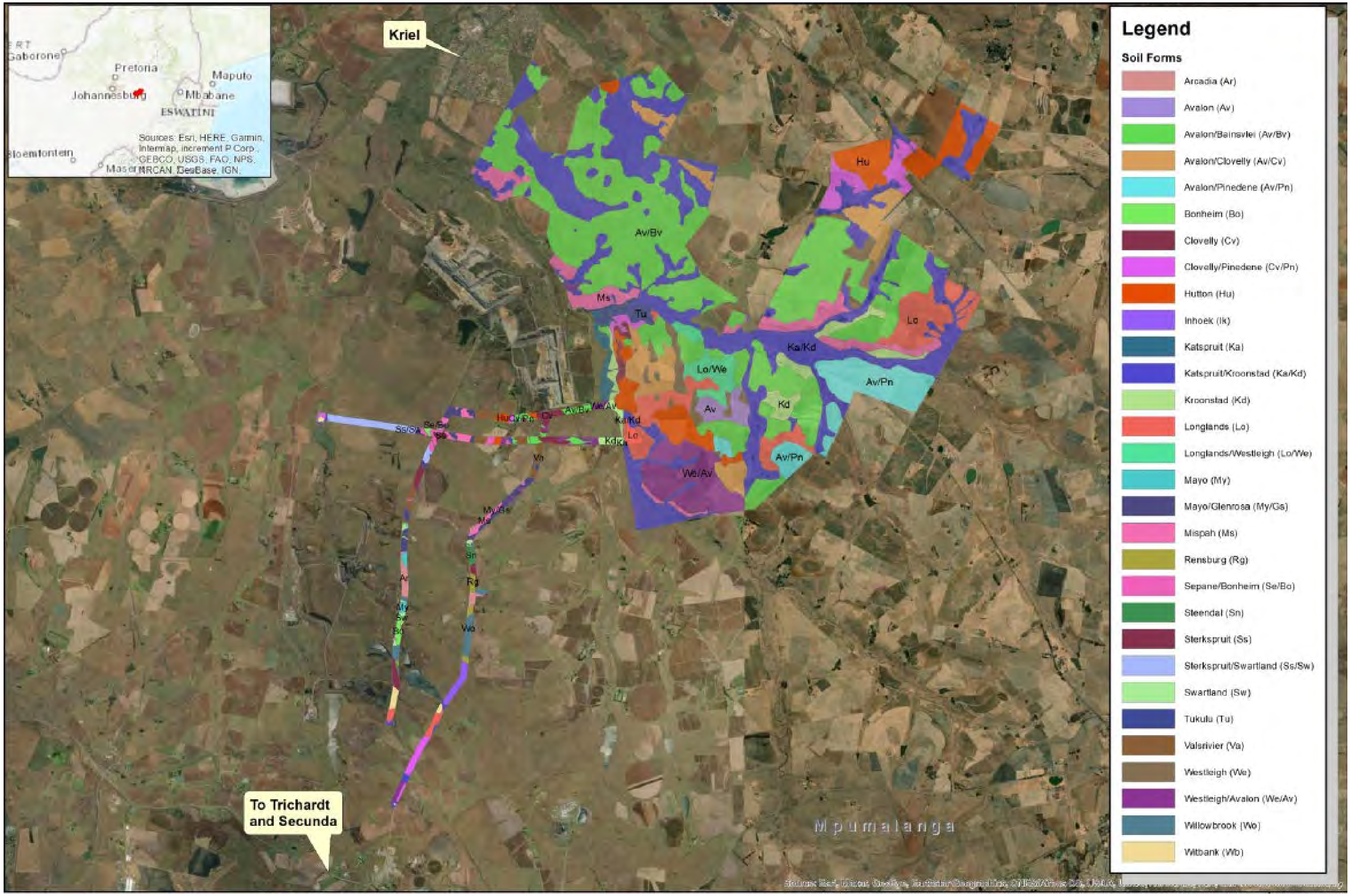


Figure 10-8: Land capability classes for Alexander Mining Project (J&W, 2021d).

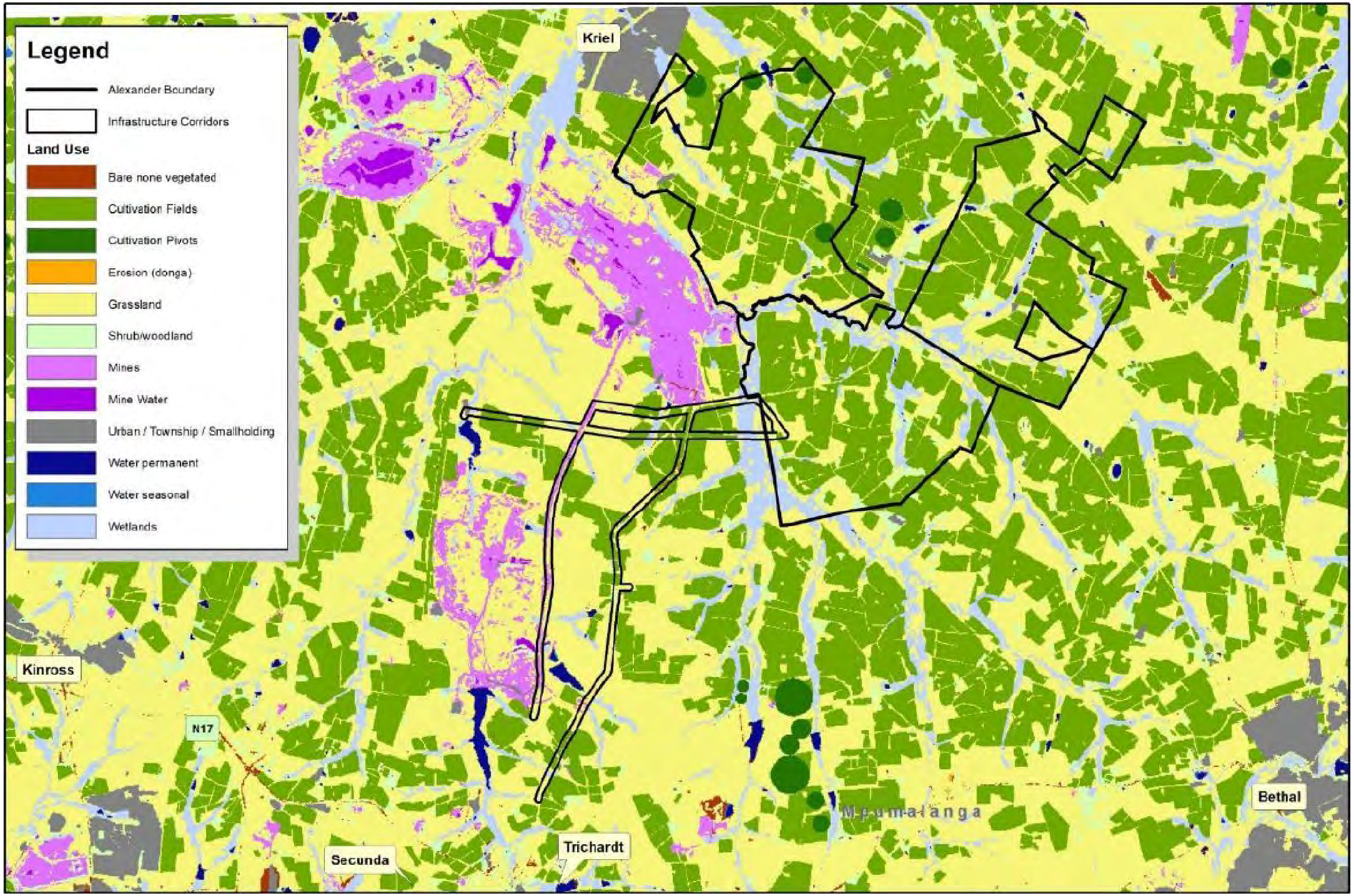


Figure 10-9: Alexander Mining Project land use (J&W, 2021d).

10.1.1.5. Surface water

Water Management Area, Catchments, and Drainage

Catchment description

The Alexander area lies within Quaternary sub-catchment B11C, with the north western and north eastern tips of the mine boundary lying in Quaternary sub-catchments B11D, B11B and B11A respectively, of the Limpopo-Olifants primary drainage region (refer to Figure 10-10 taken from "Surface Water Resources of South Africa – 2012" Vol 1 (Midgley, Pitman & Middleton, 2012) (WR2012)).

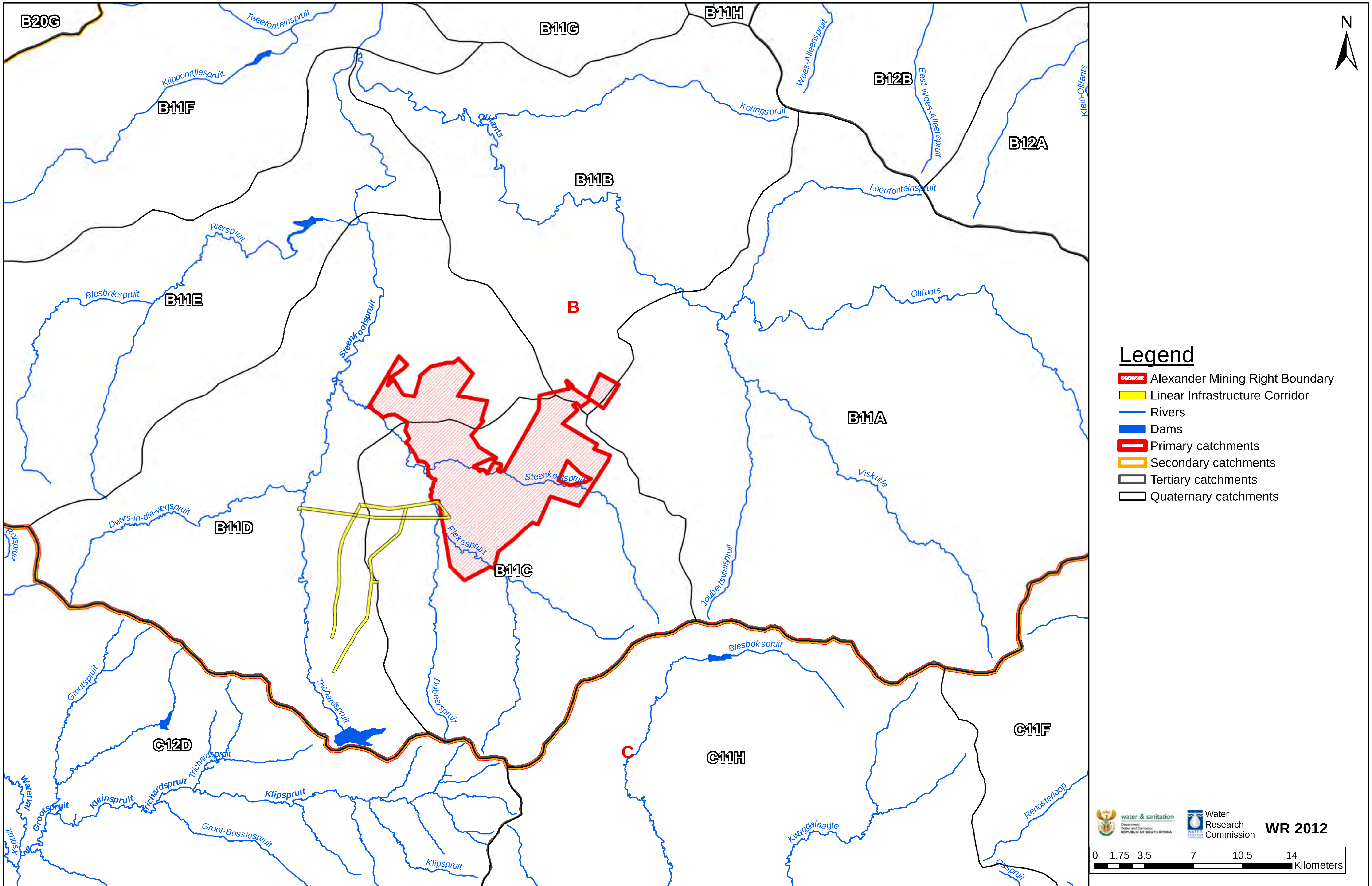
The majority of the area drains in a north-westerly direction towards the Steenkoolspruit, with the southern portion draining west towards the Piekespruit and Debeerspruit. The north-eastern corner of the proposed mining area draining towards a tributary of the Steenkoolspruit. The Steenkoolspruit joins the Olifants River, which lies to the north of the site. (J&W, 2021b).

The study area lies within the Witbank Dam catchment, which is part of the Loskop Dam catchment. These areas fall within the Olifants Water Management Area (WMA). The Olifants River flows through the Witbank Dam, and further downstream into the Loskop Dam. From the Loskop Dam, the Olifants River flows through Mpumalanga and the central part of the Kruger National Park to Mozambique.

Receiving water body

The receiving water body for the assessment of the potential surface water quality impacts related to the Alexander Mining Project is considered to be Witbank Dam. The use of this dam is motivated on the basis that (J&W, 2021b):

- Beyond the Witbank Dam, the potential impact of the mine becomes extremely small due to the water volumes in the catchment and the dilution effects.
- Furthermore, by the time the water reaches Witbank Dam (and even before then), it is required to be suitable for use (i.e. comply with the relevant Resource Water Quality Objectives (RWQO) for all of the expected uses (drinking water, agricultural, industrial and aquatic ecosystems). Thus, by achieving compliance in terms of these, no additional impacts are expected downstream of Witbank Dam. The receiving water body is relevant only in so far as it defines the aerial extent of the catchment to be considered in the impact assessment and described in the baseline study.
- The use of Witbank Dam is based on the relatively small size of the Alexander Mining Project area compared to the catchment for Witbank Dam. The next largest dam is Loskop Dam.
- The catchment area to the Witbank Dam, is reported as 3 579 km^2 while that for Loskop Dam totals some 12 285 km^2. The proposed Alexander Mining Project area (i.e. mine boundary) is approximately 73 km^2. The mine area thus totals approximately 2% of the Witbank Dam catchment, and only some 0.6% of the Loskop Dam catchment.
- The mean annual runoff (MAR) for Loskop Dam is 384 x 10^6 m^3 and Witbank Dam is some 125 x 10^6 m^3, while the MAR for the proposed mining area (i.e. mine boundary) is estimated at 4.5 x 10^6 m^3.



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Alexander Mining Project IRP
Site in relation to Quaternary sub catchments and boundaries (J&W, 2021b)

Job No: G292-55

Figure 10-10

Mean Annual Runoff

The expected MAR values for various catchments affected by the mining in relation to the receiving water body (i.e. Witbank dam and Loskop Dam) are presented in **Table 10-8** and **Figure 10-11**.

Figure 10-11 provides all nodes to which catchments were delineated and **Figure 10-12** shows the catchment boundaries and nodes.

Table 10-8: MAR for catchments relevant to Alexander (J&W, 2021b).

Catchment	Catchment area (km^2)	MAR ($x\ 10^6\ m^3$)	% of MAR at Witbank Dam	% of MAR at Loskop Dam
Alexander within entire mine boundary				
A_01	399.62	24.91	19.93	6.49
A_02	11.06	0.69	0.55	0.18
A_03	27.64	1.72	1.38	0.45
A_04	5.28	0.32	0.26	0.08
A_05	9.17	0.57	0.46	0.15
A_06	3.65	0.23	2.92	0.95
A_07	57.50	3.58	2.86	0.93
A_08	15.72	0.98	0.78	0.26
A_09	105.98	6.60	5.28	1.72
A_10	20.80	2.86	2.29	0.74
A_11	197.87	12.33	9.86	3.21
A_12	359.72	22.42	17.94	5.84
A_13	134.05	8.36	6.69	2.18
A_14	17.56	1.10	0.88	0.29
A_15	20.61	0.50	0.40	0.13
A_16	10.64	0.65	0.52	0.17
A_17	18.06	1.13	0.90	0.29
A_18	20.61	1.28	1.02	0.33
A_19	9.46	0.58	0.46	0.15
AL1	2.8	0.18	0.14	0.05
AL2	0.8	0.05	0.04	0.01
AL3	5.6	0.34	0.27	0.09
AL4	7.3	0.44	0.35	0.11
AL5	0.4	0.03	0.02	0.01
AL6	1.6	0.1	0.08	0.03
AL7	2.3	0.14	0.11	0.04
AL8	1.1	0.07	0.06	0.02
AL9	1.1	0.07	0.06	0.02
AL10	104	6.48	5.18	1.69

Catchment	Catchment area (km^2)	MAR ($x\ 10^6\ m^3$)	% of MAR at Witbank Dam	% of MAR at Loskop Dam
AL11	105	6.54	5.23	1.70
AL12	20.6	2.83	2.26	0.74
AL13	127	7.92	6.34	2.06
ALFL1	7.87	0.48	0.38	0.12
ALFL2	5.37	0.33	0.26	0.08
ALFL3	18	1.13	0.90	0.29
ALFL4	5.18	0.31	0.25	0.08
ALFL5	3.3	0.21	0.17	0.05
ALFL6	1.43	0.09	0.07	0.02
ALFL7	400.2	24.94	19.95	6.50
ALFL8	3.91	0.25	0.20	0.06
ALFL9	0.45	0.03	0.02	0.01
ALFL10	1.25	0.08	0.06	0.02
ALFL11	0.8	0.05	0.04	0.01
ALFL12	0.36	0.02	0.02	0.01
ALFL13	0.44	0.03	0.02	0.01
ALFL14	357.94	22.31	17.85	5.81
ALFL15	0.23	0.01	0.01	0.00
ALFL16	0.14	0.01	0.01	0.00
ALFL17	0.29	0.02	0.01	0.00
ALFL18	0.31	0.02	0.02	0.01
ALFL19	0.27	0.02	0.01	0.00
ALFL20	0.48	0.03	0.02	0.01
ALFL21	0.34	0.02	0.02	0.01
ALFL22	0.08	0.01	0.00	0.00
ALFL23	3.51	0.22	0.18	0.06
ALFL24	0.17	0.01	0.01	0.00
ALFL25	0.22	0.01	0.01	0.00
ALFL26	0.21	0.01	0.01	0.00
Alexander Infrastructure routes - Pipeline				
ALPIP1	1.02	0.06	0.05	0.02
ALPIP2	6.76	0.41	0.33	0.11
ALPIP3	0.66	0.04	0.03	0.01
ALPIP4	0.06	0.00	0.00	0.00
ALPIP5	0.41	0.03	0.02	0.01
ALPIP6	0.14	0.01	0.01	0.00
Alexander Infrastructure routes - Conveyor				
ALCON1	10.1	0.62	0.49	0.16

Catchment	Catchment area (km²)	MAR (x 10^6 m^3)	% of MAR at Witbank Dam	% of MAR at Loskop Dam
ALCON2	10.71	0.65	0.52	0.17
ALCON3	5.18	0.31	0.25	0.08
ALCON4	3.65	0.23	0.18	0.06
ALCON5	2.6	0.16	0.13	0.04
ALCON6	0.86	0.05	0.04	0.01
ALCON7	11.32	0.71	0.56	0.18
ALCON8	0.34	0.02	0.02	0.01
ALCON9	1.51	0.10	0.08	0.02
ALCON10	1.96	0.12	0.10	0.03
ALCON11	5.26	0.33	0.27	0.09
ALCON12	3.98	0.25	0.20	0.07
ALCON13	0.73	0.05	0.04	0.01
ALCON14	3.48	0.22	0.18	0.06
ALCON15	0.38	0.02	0.02	0.01
ALCON16	0.08	0.01	0.00	0.00
ALCON17	0.29	0.02	0.01	0.00
ALCON18	0.81	0.05	0.04	0.01
ALCON19	0.24	0.02	0.01	0.00
ALCON20	1.52	0.10	0.08	0.02
ALCON21	0.44	0.03	0.02	0.01
Alexander Infrastructure routes - Powerline				
ALPOW1	107.62	6.70	5.36	1.75
ALPOW2	4.56	0.29	0.23	0.07
ALPOW3	2.97	0.19	0.15	0.05
ALPOW4	5.24	0.32	0.25	0.08
ALPOW5	63.78	3.97	3.18	1.03
ALPOW6	200.46	12.49	9.99	3.25
ALPOW7	5.62	0.34	0.27	0.09
ALPOW8	107.66	6.70	5.36	1.75
ALPOW9	152.35	9.50	7.60	2.47
ALPOW10	5.48	0.33	0.27	0.09
Witbank Dam	3 579	125	100	32.55
Loskop Dam	12 285	384	-	100

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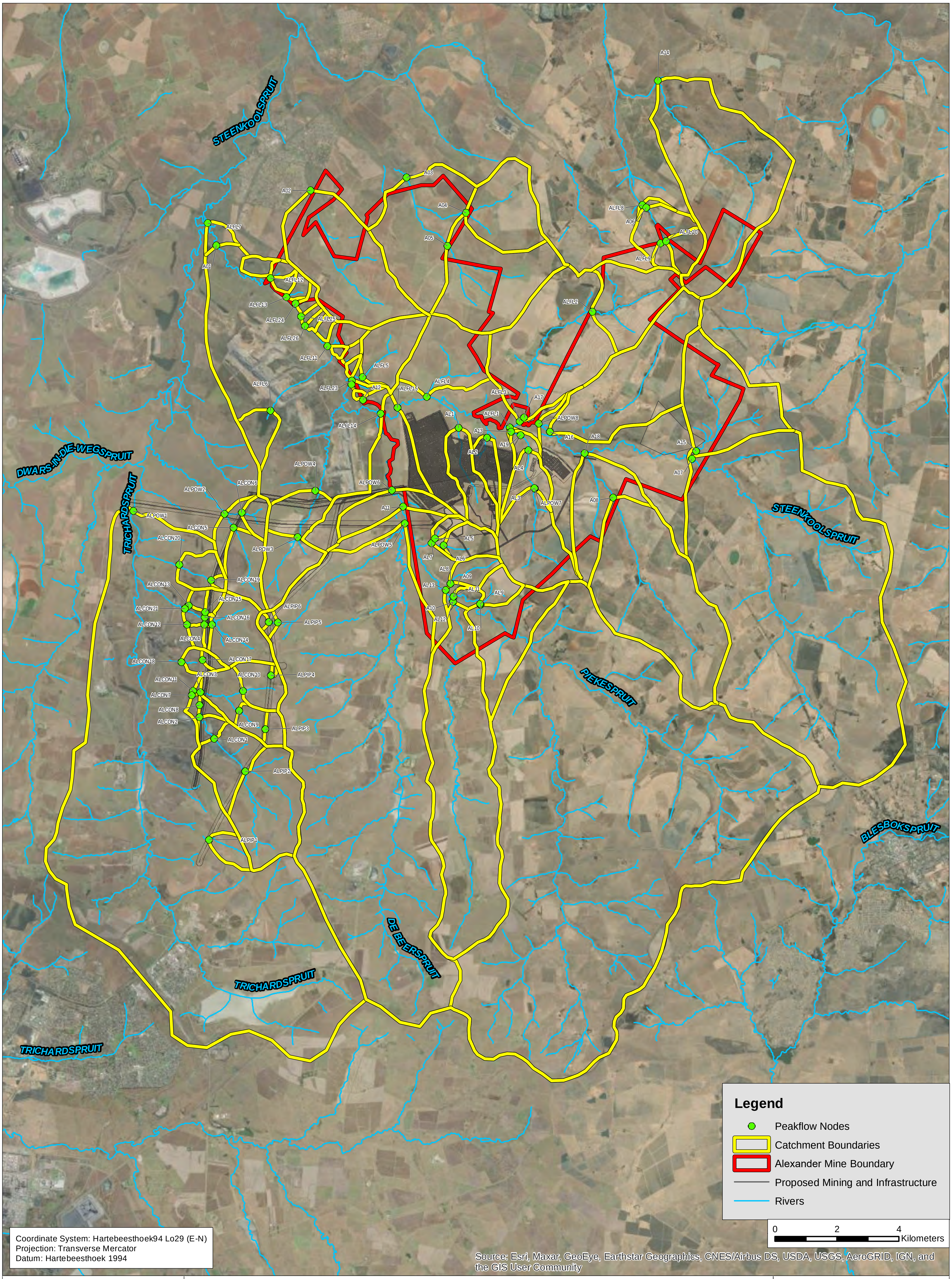
All Catchment Nodes (J&W, 2021b)

Job No: G292-55

Figure 10-11



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Alexander Mining Project IRP
All Catchment Boundaries and Nodes (J&W, 2021b)

Job No: G292-55

Figure 10-12

Dry Weather Flow

The expected Dry Weather Flow (DWF) for various catchments is presented in **Table 10-9** and the catchments considered can be seen in **Figure 10-11** and **Figure 10-12.**

Table 10-9: DWF for catchments relevant to the Alexander Mining Project (J&W, 2021b).

Catchment	Catchment area (km^2)	Computed DWF (x 10^6 m^3 per month average)
Alexander within entire mine boundary		
A_01	399.62	0.20
A_02	11.06	0.01
A_03	27.64	0.01
A_04	5.28	0.00*
A_05	9.17	0.00*
A_06	3.65	0.00*
A_07	57.50	0.03
A_08	15.72	0.01
A_09	105.98	0.05
A_10	20.80	0.01
A_11	197.87	0.10
A_12	359.72	0.18
A_13	134.05	0.07
A_14	17.56	0.01
A_15	20.61	0.01
A_16	10.64	0.01
A_17	18.06	0.01
A_18	20.61	0.01
A_19	9.46	0.00*
AL1	2.8	0.00*
AL2	0.8	0.00*
AL3	5.6	0.00*
AL4	7.3	0.00*
AL5	0.4	0.00*
AL6	1.6	0.00*
AL7	2.3	0.00*
AL8	1.1	0.00*
AL9	1.1	0.00*
AL10	104	0.05
AL11	105	0.05

Catchment	Catchment area (km²)	Computed DWF (x 10^6 m^3 per month average)
AL12	20.6	0.01
AL13	127	0.07
ALFL1	7.87	0.00
ALFL2	5.37	0.00
ALFL3	18	0.01
ALFL4	5.18	0.00
ALFL5	3.3	0.00
ALFL6	1.43	0.00
ALFL7	400.2	0.20
ALFL8	3.91	0.00
ALFL9	0.45	0.00
ALFL10	1.25	0.00
ALFL11	0.8	0.00
ALFL12	0.36	0.00
ALFL13	0.44	0.00
ALFL14	357.94	0.18
ALFL15	0.23	0.00
ALFL16	0.14	0.00
ALFL17	0.29	0.00
ALFL18	0.31	0.00
ALFL19	0.27	0.00
ALFL20	0.48	0.00
ALFL21	0.34	0.00
ALFL22	0.08	0.00
ALFL23	3.51	0.00
ALFL24	0.17	0.00
ALFL25	0.22	0.00
ALFL26	0.21	0.00
Alexander Linear infrastructure - Pipeline		
ALPIP1	1.02	0.00
ALPIP2	6.76	0.00
ALPIP3	0.66	0.00
ALPIP4	0.06	0.00
ALPIP5	0.41	0.00
ALPIP6	0.14	0.00
Alexander Linear infrastructure - Conveyor		

Catchment	Catchment area (km^2)	Computed DWF ($x 10^6 m^3$ per month average)
ALCON1	10.1	0.01
ALCON2	10.71	0.01
ALCON3	5.18	0.00
ALCON4	3.65	0.00
ALCON5	2.6	0.00
ALCON6	0.86	0.00
ALCON7	11.32	0.01
ALCON8	0.34	0.00
ALCON9	1.51	0.00
ALCON10	1.96	0.00
ALCON11	5.26	0.00
ALCON12	3.98	0.00
ALCON13	0.73	0.00
ALCON14	3.48	0.00
ALCON15	0.38	0.00
ALCON16	0.08	0.00
ALCON17	0.29	0.00
ALCON18	0.81	0.00
ALCON19	0.24	0.00
ALCON20	1.52	0.00
ALCON21	0.44	0.00
Alexander Linear infrastructure- Powerline		
ALPOW1	107.62	0.05
ALPOW2	4.56	0.00
ALPOW3	2.97	0.00
ALPOW4	5.24	0.00
ALPOW5	63.78	0.03
ALPOW6	200.46	0.10
ALPOW7	5.62	0.00
ALPOW8	107.66	0.05
ALPOW9	152.35	0.08
ALPOW10	5.48	0.00

Note: * denotes DWF less than 0.01 X $10^6 m^3$ per month

Flood Peaks and Volumes

The catchment areas and slopes were determined from the contour plan provided by Sasol.

The peak flows calculated using each method were evaluated for each node and a representative value adopted. The 1:50 and 1:100 year for each node, together with catchment areas, are presented in **Table 10-10**. The catchment boundaries and nodes are provided in **Figure 10-12.**

Table 10-10: Peak flows determined for Alexander Mining Project (J&W, 2021b).

Catchment	Area (km²)	Recurrence interval	Flood Peaks (m³/s)
Alexander within entire mine boundary			
A_01	399.62	50 year	472
		100 year	597
A_02	11.06	50 year	79
		100 year	100
A_03	27.64	50 year	172
		100 year	215
A_04	5.28	50 year	72
		100 year	90
A_05	9.17	50 year	93
		100 year	118
A_06	3.65	50 year	65
		100 year	81
A_07	57.50	50 year	172
		100 year	218
A_08	15.72	50 year	92
		100 year	116
A_09	105.98	50 year	247
		100 year	311
A_10	20.80	50 year	78
		100 year	99
A_11	197.87	50 year	359
		100 year	458
A_12	359.72	50 year	526
		100 year	664
A_13	134.05	50 year	267
		100 year	342
A_14	17.56	50 year	96
		100 year	121
A_15	20.61	50 year	76

Catchment	Area (km²)	Recurrence interval	Flood Peaks (m³/s)
		100 year	96
A_16	10.64	50 year	71
		100 year	91
A_17	18.06	50 year	98
		100 year	123
A_18	20.61	50 year	107
		100 year	135
A_19	9.46	50 year	71
		100 year	90
AL1	2.8	50 year	36
		100 year	46
AL2	0.8	50 year	20
		100 year	26
AL3	5.6	50 year	81
		100 year	103
AL4	7.3	50 year	86
		100 year	109
AL5	0.4	50 year	12
		100 year	15
AL6	1.6	50 year	37
		100 year	46
AL7	2.3	50 year	48
		100 year	61
AL8	1.1	50 year	29
		100 year	36
AL9	1.1	50 year	38
		100 year	48
AL10	104	50 year	325
		100 year	413
AL11	105	50 year	311
		100 year	394
AL12	20.6	50 year	97
		100 year	122
AL13	127	50 year	386
		100 year	489
ALFL1	7.87	50 year	54.09
		100 year	65.61
ALFL2	5.37	50 year	65.08
		100 year	78.94

Catchment	Area (km^2)	Recurrence interval	Flood Peaks (m^3/s)
ALFL3	18	50 year	131.71
		100 year	159.75
ALFL4	5.18	50 year	64.86
		100 year	78.67
ALFL5	3.3	50 year	48.61
		100 year	58.96
ALFL6	1.43	50 year	12.59
		100 year	15.27
ALFL7	400.2	50 year	408.49
		100 year	495.21
ALFL8	3.91	50 year	69.18
		100 year	83.91
ALFL9	0.45	50 year	12.83
		100 year	15.56
ALFL10	1.25	50 year	36.42
		100 year	44.18
ALFL11	0.8	50 year	30.51
		100 year	37.01
ALFL12	0.36	50 year	15.85
		100 year	19.22
ALFL13	0.44	50 year	14.61
		100 year	17.72
ALFL14	357.94	50 year	406.59
		100 year	494.07
ALFL15	0.23	50 year	7.22
		100 year	8.76
ALFL16	0.14	50 year	3.50
		100 year	4.30
ALFL17	0.29	50 year	10.54
		100 year	12.78
ALFL18	0.31	50 year	4.60
		100 year	5.60
ALFL19	0.27	50 year	10.05
		100 year	12.19
ALFL20	0.48	50 year	8.00
		100 year	9.70
ALFL21	0.34	50 year	6.80
		100 year	8.30
ALFL22	0.08	50 year	1.60

Catchment	Area (km2)	Recurrence interval	Flood Peaks (m3/s)
		100 year	1.90
ALFL23	3.51	50 year	56.80
		100 year	68.89
ALFL24	0.17	50 year	3.40
		100 year	4.20
ALFL25	0.22	50 year	5.20
		100 year	6.30
ALFL26	0.21	50 year	4.30
		100 year	5.21
Alexander Linear infrastructure- Pipeline			
ALPIP1	1.02	50 year	18.70
		100 year	22.68
ALPIP2	6.76	50 year	71.81
		100 year	87.10
ALPIP3	0.66	50 year	21.58
		100 year	26.18
ALPIP4	0.06	50 year	2.00
		100 year	2.50
ALPIP5	0.41	50 year	12.80
		100 year	17.77
ALPIP6	0.14	50 year	3.70
		100 year	5.10
Alexander Linear infrastructure- Conveyor			
ALCON1	10.1	50 year	76.47
		100 year	92.75
ALCON2	10.71	50 year	73.81
		100 year	89.52
ALCON3	5.18	50 year	60.50
		100 year	73.38
ALCON4	3.65	50 year	48.50
		100 year	58.82
ALCON5	2.6	50 year	28.00
		100 year	33.96
ALCON6	0.86	50 year	18.65
		100 year	22.62
ALCON7	11.32	50 year	76.66
		100 year	92.98
ALCON8	0.34	50 year	7.45
		100 year	9.04

Catchment	Area (km^2)	Recurrence interval	Flood Peaks (m^3/s)
ALCON9	1.51	50 year	28.48
		100 year	34.54
ALCON10	1.96	50 year	36.46
		100 year	44.22
ALCON11	5.26	50 year	67.23
		100 year	81.55
ALCON12	3.98	50 year	49.58
		100 year	60.14
ALCON13	0.73	50 year	10.72
		100 year	13.00
ALCON14	3.48	50 year	47.44
		100 year	57.54
ALCON15	0.38	50 year	9.08
		100 year	11.01
ALCON16	0.08	50 year	2.07
		100 year	2.52
ALCON17	0.29	50 year	10.36
		100 year	12.56
ALCON18	0.81	50 year	18.99
		100 year	23.04
ALCON19	0.24	50 year	8.58
		100 year	10.40
ALCON20	1.52	50 year	28.65
		100 year	34.75
ALCON21	0.44	50 year	7.00
		100 year	8.60
Alexander Linear infrastructure- Conveyor			
ALPOW1	107.62	50 year	174.87
		100 year	211.44
ALPOW2	4.56	50 year	42.62
		100 year	51.70
ALPOW3	2.97	50 year	40.32
		100 year	48.90
ALPOW4	5.24	50 year	45
		100 year	54
ALPOW5	63.78	50 year	148.59
		100 year	179.80
ALPOW6	200.46	50 year	278.77
		100 year	338.75

Catchment	Area (km^2)	Recurrence interval	Flood Peaks (m^3/s)
ALPOW7	5.62	50 year	50.93
		100 year	61.77
ALPOW8	107.66	50 year	199.16
		100 year	241.56
ALPOW9	152.35	50 year	199.30
		100 year	242.18
ALPOW10	5.48	50 year	50.37
		100 year	61.09

Note:

1:50year = Floods with a recurrence interval of 1 in 50years, or 2% risk of occurrence in any one year.

1:100year = Floods with a recurrence interval of 1 in 100years, or 1% risk of occurrence in any one year.

Floodlines

J&W have reviewed all the existing reports and noted that for the Alexander area, SLR have done floodlines for this area which covered a portion of the streams within the mining area based on where the shaft area was to be placed at that point in time and have been included (J&W, 2021b).

J&W, as part of the 2017/2018 study, determined the 1:100 year floodlines at Alexander. Subsequently the 1:100 year floodlines have been determined along various watercourse crossings for the proposed infrastructure routes. These floodlines have been computed during this study.

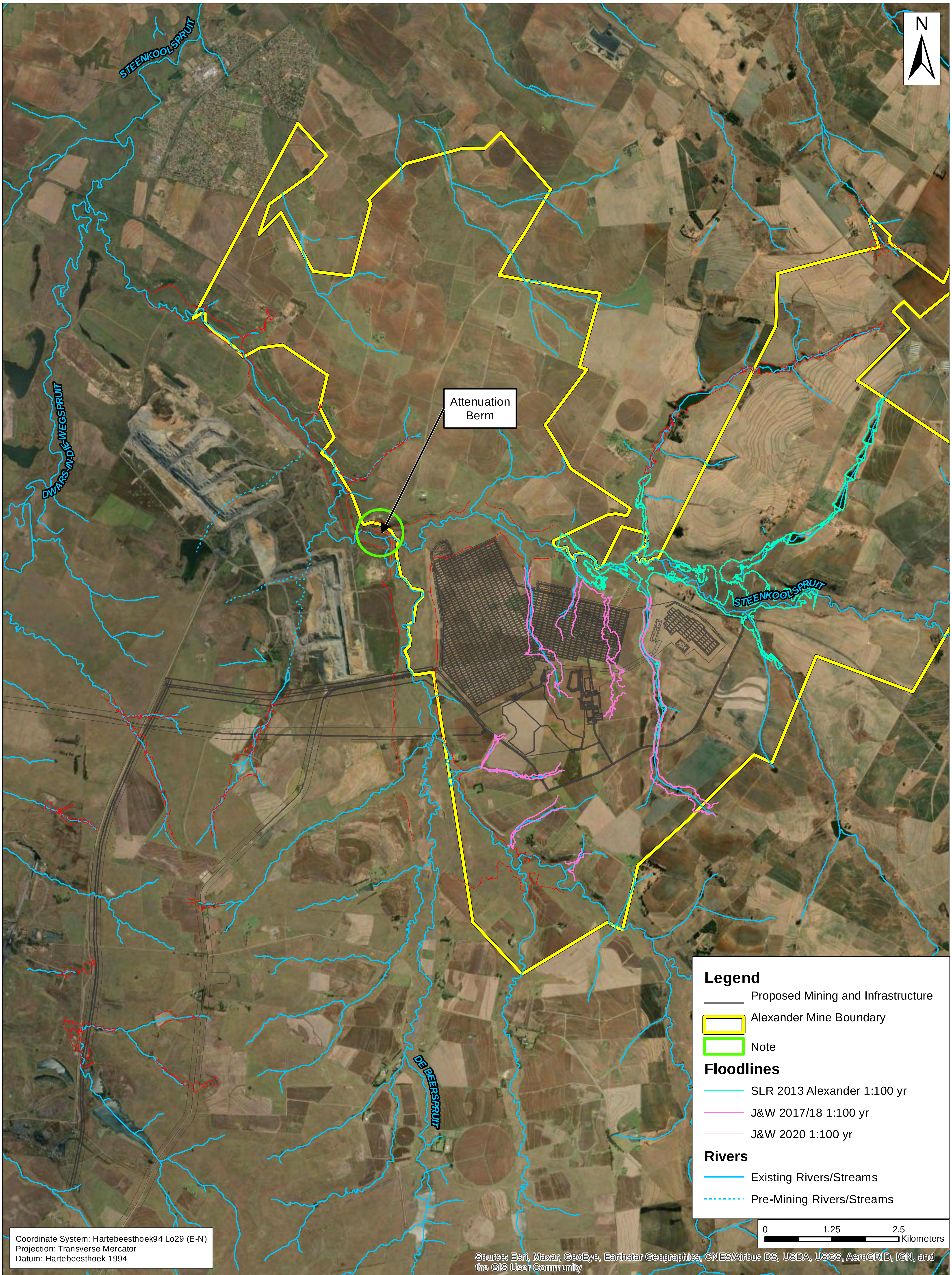
Floodlines were determined based on the calculated flood peaks at each node, as indicated in **Table 10-10**.

A site visit was conducted from 10 November 2020 to 12 November 2020, to measure several culverts and bridges across the site that may act as a hydraulic control points. When determining floodlines, the streams were defined by inputting a number of cross sections along the length of the watercourse. The cross sections are determined from the survey data. Cross sections were measured at approximately 20 m intervals on average, as well as at significant features which may act as controls, such as bridges or culverts (J&W, 2021b).

The 1:100 year floodlines were determined and are indicated in **Figure 10-13**. This figure also includes floodlines carried out as part of the previous studies undertaken for Alexander.

It should be noted that the accuracy of the floodlines produced in this study is commensurate with the accuracy of the DTM data provided.

The floodlines given here are considered suitable for planning purposes only and are not certified. Where infrastructure is to be located adjacent to the streams, the floodlines should be determined more accurately using a DTM developed from a field survey at the area of concern.



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Alexander Mining Project IRP
1:100 year Floodlines (J&W, 2021b)

Job No: G292-55

Figure 10-13

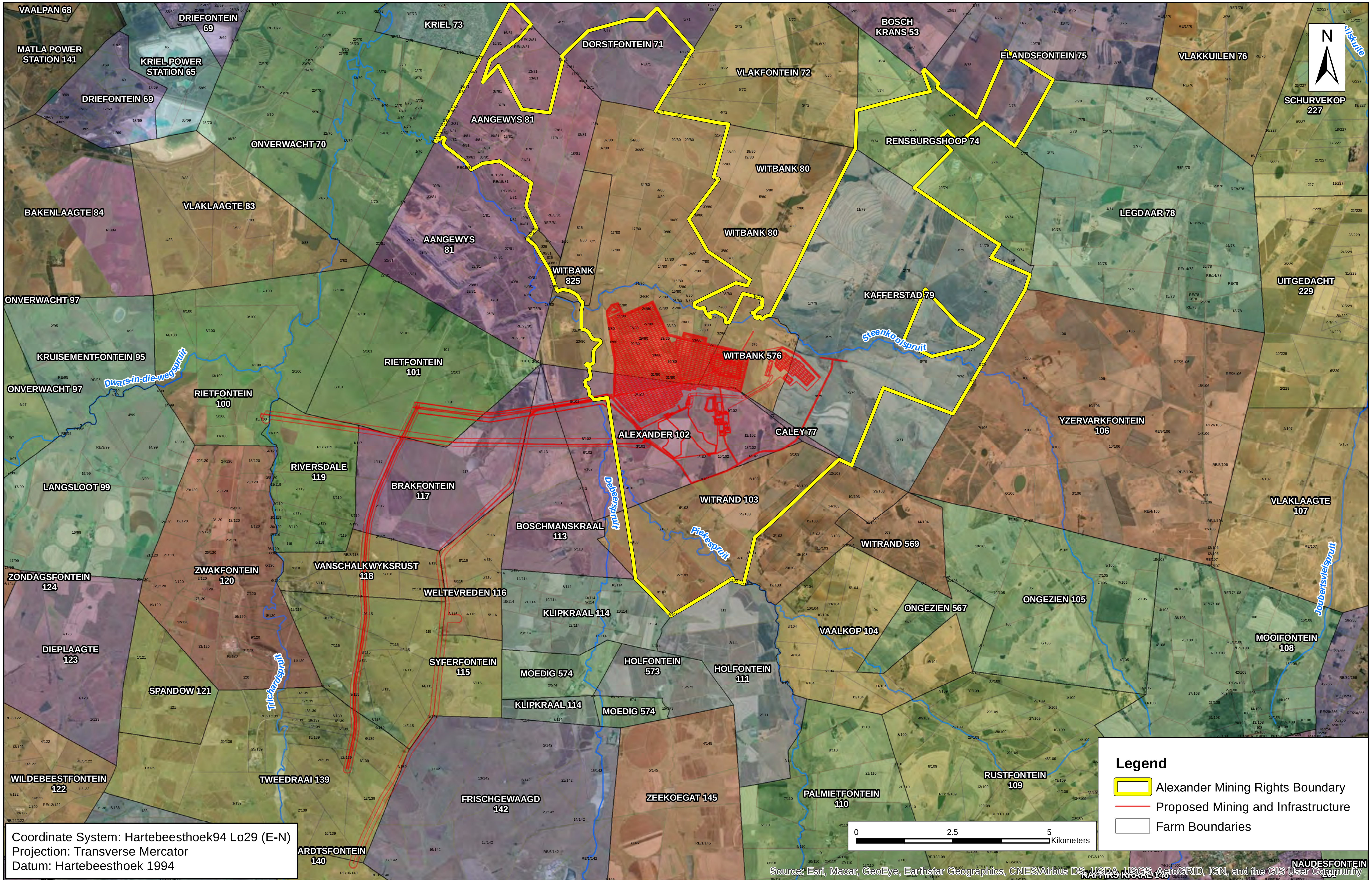
Downstream surface water users

For the Alexander area, SLR conducted a study in 2016, which consisted of a review of the available cadastral data and information from stakeholder database. SLR found that there are a total of 96 farm portions, across 11 parent farms which fall within the Alexander mine area. A total of 10 landowners completed the questionnaire, many of whom owned a number of land portions within the Alexander mine area.

The survey concluded the following:

- All of the surveyed water users were reliant on borehole water for domestic uses and relied on septic tanks for the disposal of sewage water.
- Most of the surveyed water users frequently used borehole water for irrigation and livestock watering.
- Livestock used several of the small dams across the Alexander mine area.
- None of the surveyed water users used water from the dams for irrigation.
- None of the surveyed water users abstracted water from the local watercourses.

Figure 10-14 shows the farm portions covered by the mining area.



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Alexander Mining Project IRP
Farm Portions (J&W, 2021b)

Job No: G292-55

Figure 10-14

Surface water quality

As part of this 2017/2018 as well as this study, water quality sampling and testing was commissioned by J&W for the Alexander area. The sampling was carried out over a four-month period (i.e. May 2018 to November 2018 and September 2020, November 2020, December 2020 and January 2021).

In addition to the water quality monitoring undertaken across the mine and infrastructure area, as part of the wetland reserve determination study, nine surface water monitoring locations were sampled and analysed over a ten month period from September 2020 to June 2021 as input to the wetland reserve.

Surface water quality monitoring locations

The surface water monitoring locations for each of the mining areas are illustrated in **Figure 10-15** and the coordinates of these points are given in **Table 10-11** and **Table 10-12**.

Table 10-11: List of surface water monitoring locations (J&W, 2021b).

Sampling Location	Coordinates	
	Latitude	Longitude
Alex 01	S26 16 53.31514	E029 14 39.33789
Alex 02	S26 15 51.23754	E029 16 25.29019
Alex 03	S26 15 45.16318	E029 18 19.00069
Alex 06	S26 16 15.90236	E029 23 00.79498
Alex 07	S26 20 38.31042	E029 24 00.88628
Alex 08	S26 21 17.22606	E029 22 14.93760
Alex 09	S26 23 37.55572	E029 20 16.39303
Alex 10	S26 24 03.37917	E029 19 09.25405
Alex 11	S26 21 43.46684	E029 18 12.82407
Alex16_SLR	S26 19 28.62785	E029 18 26.89837
Alex18_SLR	S26 18 24.55000	E029 20 50.74000
V04_Sample 2	S26 20 59.47022	E029 17 50.82319
V04_Sample 3	S26 21 17.64606	E029 18 03.88497
V04_Sample 5	S26 23 23.95390	E029 15 30.35816
V04_Sample 6	S26 25 13.42478	E029 15 22.32767
V04_Sample 8	S26 19 59.13705	E029 20 12.63105
V04_Sample 9	S26 21 57.29119	E029 16 02.49146

Sampling Location	Coordinates	
	Latitude	Longitude
V04_Sample 10	S26 23 24.72744	E029 15 40.83419
V04_Sample 11	S26 24 33.66492	E029 15 10.09937
V04_Sample 12	S26 25 49.25974	E029 14 52.90137
V04_Sample 13	S26 25 53.96373	E029 15 27.04353
V04_Sample 14	S26 26 15.13263	E029 15 32.14174
V04_Sample 15	S26 26 21.59075	E029 15 09.64255
V04_Sample 16	S26 27 10.61084	E029 14 28.86655
V04_Sample 17	S26 27 02.23604	E029 14 04.84042
Sample 2	S26 21 34.38382	E029 14 42.74152
Sample 3	S26 22 19.73739	E029 15 07.46835
Sample 4	S26 22 33.60896	E029 14 14.20355
Sample 5	S26 23 10.94025	E029 13 55.86353
Sample 6	S26 23 19.61777	E029 14 27.15653
Sample 7	S26 24 07.32002	E029 13 51.85489
Sample 9	S26 24 38.76174	E029 13 56.68841
Sampling UP1	S26 20 56.82322	E029 13 01.83491
Sampling UP2	S26 21 13.65158	E029 13 30.08997
Sampling UP3	S26 21 14.79264	E029 14 26.99741
Sampling DP4	S26 21 27.34283	E029 12 50.97371
Sampling DP5	S26 21 29.74972	E029 15 05.80203
Sampling DP6	S26 21 54.59420	E029 14 55.94693
Sampling UP7	S26 21 20.85563	E029 18 24.29165

Table 10-12: List of surface water monitoring locations identified for the wetland reserve determination study (J&W, 2021b).

Sampling Location	Coordinates	
	Latitude	Longitude
SKS-2	S26 14 05.73360	E029 15 43.52040

Sampling Location	Coordinates	
	Latitude	Longitude
DWARS-1	S26 16 39.02880	E029 14 10.27320
EWR-SKS1	S26 17 22.61400	E029 15 24.06600
GAME-SKS	S26 19 33.95280	E029 18 11.94480
ALL 7	S26 21 03.27240	E029 17 54.85560
ALL 5	S26 22 16.00320	E029 18 28.58040
BIO 1	S26 20 29.25600	E029 23 00.86640
BIO 2	S26 24 25.52040	E029 20 47.23800
BIO 3	S26 24 50.10120	E029 17 55.14720

Surface water quality objectives

In 2016 the DWS published Classes and RQOs of water resources for the Olifants and Vaal catchment. One of the key elements of this document is RQO for river quality in the Olifants catchment. In this document the catchment is divided into various Integrated Unit of Analysis (IUA) areas and Resource Units. Each IUA has a set of water quality constituents for which limits have been set.

The Alexander mining area is located within IUA 1, which is referred to as the Upper Olifants River catchment and within Resource Unit 11.

In addition to the above, the DWS published in 2018, Water Quality Planning Limits (WQPLs) for the Upper and Middle Olifants catchments. The Alexander mining area falls within the Management Unit (MU) 7 of the Upper Olifants Water Management Area. MU& drain to the Witbank Dam.

Therefore the RQO as well as the WQPL against which the water quality monitoring data have been compared, are presented in **Table 10-13**.

Table 10-13: RQOs for IUA 1 Upper Olifants River Catchment (J&W, 2021b).

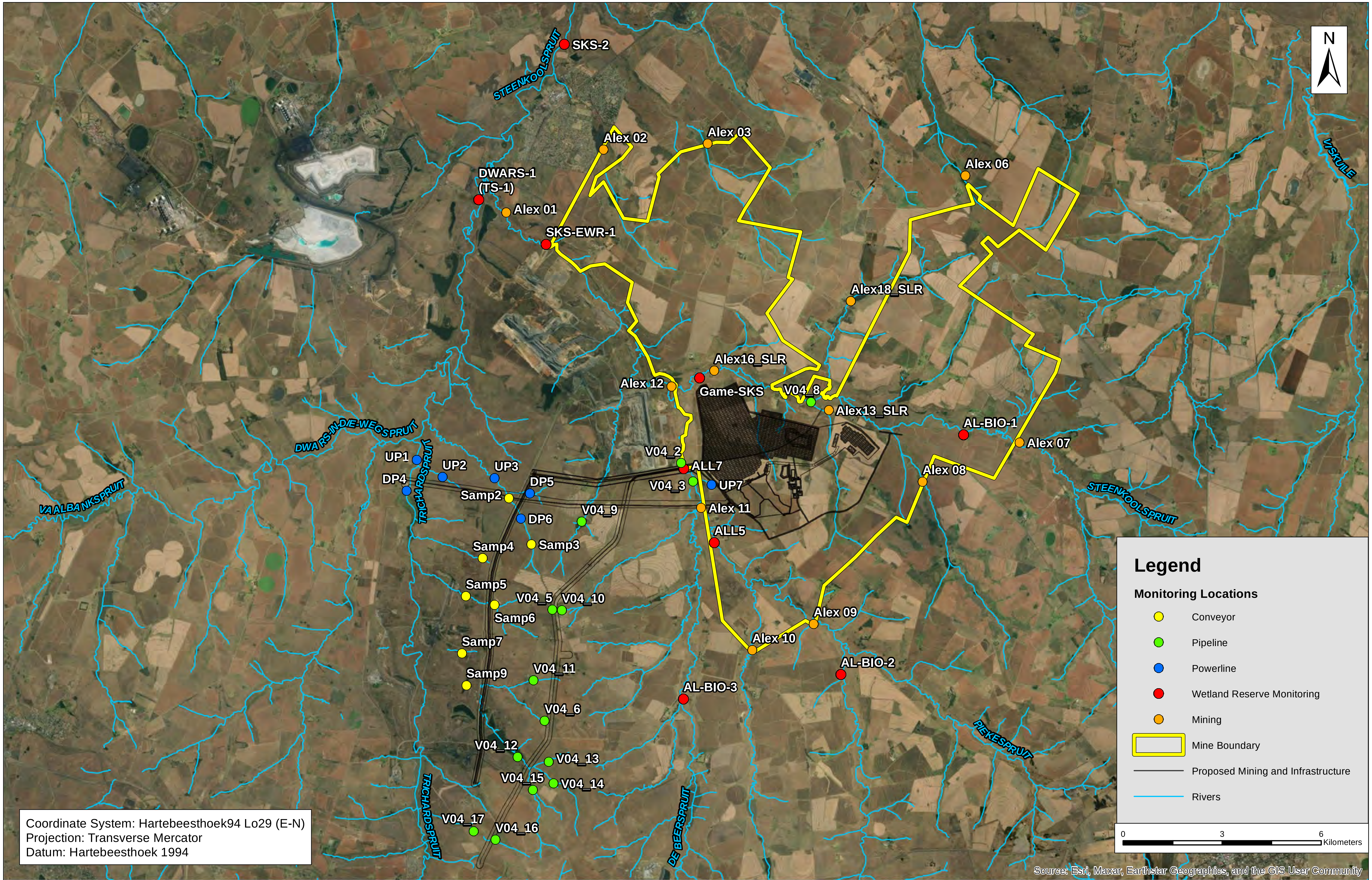
Constituent	Unit	SANS 241 2015 screening guidelines	RQO 2016 Olifants River IUA 1, Resource Unit 11	WQPL 2018 Upper Olifants MU 7
Electrical conductivity (EC) @ 25ºC	m-S/m	170	111	70
Chemical Oxygen Demand (COD)	mg/ℓ	NG		
pH	-	5 to 9.7		6.5-8.4
Chemical, Inorganic				
Alkalinity	mg $CaCO_3$/ℓ	NG	-	120
Boron (B)	mg/ℓ	2.4	-	0.5

Constituent	Unit	SANS 241 2015 screening guidelines	RQO 2016 Olifants River IUA 1, Resource Unit 11	WQPL 2018 Upper Olifants MU 7
Calcium (Ca)	mg/ℓ	NG	-	55
Chloride (Cl)	mg/ℓ	300	-	65
Fluoride (F)	mg/ℓ	1.5	-	0.75
Magnesium (Mg)	mg/ℓ	NG	-	70
Potassium (K)	mg/ℓ	NG	-	25
Sodium (Na)	mg/ℓ	200	-	70
Sulphate (SO_4)	mg/ℓ	500	500	250
Total Dissolved Solids (TDS)	mg/ℓ	1200	-	450
Metals, Dissolved				
Iron (Fe)	mg/ℓ	2	-	0.3
Aluminium (Al)	mg/ℓ	NG	-	0.02
Manganese (Mn)	mg/ℓ	0.40	- -	0.15
Chromium VI (Cr VI)	mg/ℓ	NG	- -	7
Plant Nutrients				
Nitrate (NO_3)	mg/ℓ as N	11	4	0.3
Ammonium (NH_4)	mg/ℓ as N	1.5	0.100	0.05
Phosphate (PO_4)	mg/ℓ as P	NG	0.125	0.25
Nickel (Ni)	mg/ℓ	0.07	-	
Arsenic (As)	mg/ℓ	0.010	-	
Antimony (Sb)	mg/ℓ	0.020	-	
Barium(Ba)	mg/ℓ	0.70	-	
Beryllium(Be)	mg/ℓ	NG	-	
Cadmium (Cd)	mg/ℓ	0.0030	-	
Total Chrome (Total Cr)	mg/ℓ	0.050	-	
Cobalt (Co)	mg/ℓ	0.50	-	
Copper (Cu)	mg/ℓ	2.0	-	
Lead (Pb)	mg/ℓ	0.010	-	
Mercury (Hg)	mg/ℓ	0.006	-	
Molybdenum (Mo)	mg/ℓ	NG	-	
Selenium (Se)	mg/ℓ	0.010	-	
Tin (Sn)	mg/ℓ	NG	-	
Vanadium (V)	mg/ℓ	0.20	-	

Constituent	Unit	SANS 241 2015 screening guidelines	RQO 2016 Olifants River IUA 1, Resource Unit 11	WQPL 2018 Upper Olifants MU 7
Zinc (Zn)	mg/ℓ	5.0	-	

*Specific to Dams taken from the 2016 Classes and Resource Quality Objectives of water resources for the Olifants catchment.

The summarised baseline water quality results, for the data provided by Sasol as well as the areas sampled as part of this study, can be seen in **Table 10-14** to **Table 10-18** to where the average, maximum and minimum concentrations are presented, together with the coefficient of variation. Values in red indicate where the RQO for the Olifants River catchments or the SANS 241 guidelines are exceeded. It is important to note that the 2016 RQO does not provide limits for all constituents and therefore the SANS 241 guidelines were used in this case. However, there are certain constituents for which limitations are not specified.



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Alexander Mining Project IRP

Surface Water Quality Monitoring Locations (JW, 2021b)

Job No: G292-55

Figure 10-15

Table 10-14: 2017/2018 Water Quality monitoring results – Mining areas (J&W, 2021b).

Mine	Sample Location	RQO and SANS Guidelines	pH	EC mS/m	TDS mg/ℓ	TALK mg/ℓ	Cl mg/ℓ	SO_4 mg/ℓ	N_NO_3 mg/ℓ	Ca mg/ℓ	Mg mg/ℓ	Na mg/ℓ	K mg/ℓ	Al mg/ℓ	Fe mg/ℓ	Mn mg/ℓ
		SANS 241 2015	5-9.7	170	1200	-	300	500	11	-	-	200	-	-	2	0.4
		RQO 2016 Olifants UIA 1	-	111	-	-	-	500	4	-	-	-	-	-	-	-
Mine	Sample Location	WQPL 2018 (MU7)	6.5-8.4	70	450	120	65	250	0.3	55	70	70	25	0.02	0.3	0.15
Alexander	Alex 1	Average	8.22	88.20	603.25	227.25	26.55	240.40	0.44	56.88	49.90	80.03	6.88	0.03	0.75	0.36
		Maximum	8.36	116.00	794.00	272.00	34.80	357.00	0.63	71.50	62.70	114.00	13.70	0.03	1.99	0.69
	Sampling period:	Minimum	7.93	26.80	193.00	152.00	12.90	12.60	0.22	22.70	17.40	18.40	4.20	0.03	0.12	0.03
	May 2018 and July 2018	Coeff of Variation %	2.40	46.86	46.67	23.11	35.69	65.58	46.25	40.76	43.67	54.37	66.57		143.80	77.20
	Alex 2	Average	7.82	30.60	208.00	156.00	23.10	5.95	0.51	45.80	11.70	18.80	4.92	0.09	0.90	1.42
		Maximum	7.82	30.60	208.00	156.00	23.10	5.95	0.51	45.80	11.70	18.80	4.92	0.09	0.90	1.42
	Sampling period:	Minimum	7.82	30.60	208.00	156.00	23.10	5.95	0.51	45.80	11.70	18.80	4.92	0.09	0.90	1.42
	May 2018 and July 2018	Coeff of Variation%														
	Alex 3	Average	8.16	44.30	261.50	127.25	28.65	60.15	0.54	24.95	17.50	34.83	13.45	0.35	0.37	0.05
		Maximum	8.49	51.90	322.00	150.00	34.30	81.90	0.70	28.50	20.60	43.00	15.60	0.57	0.61	0.08
	Sampling period:	Minimum	7.94	33.10	217.00	105.00	22.70	47.40	0.28	21.30	15.10	30.50	11.30	0.25	0.23	0.03
	May 2018 and July 2018	Coeff of Variation%	2.87	19.34	17.37	14.67	20.93	26.54	33.93	12.76	13.29	16.00	16.09	41.84	47.49	42.61
	Alex 6	Average	8.40	57.95	335.25	220.75	16.65	63.40	0.40	37.13	40.20	28.43	8.15	0.16	0.23	0.04
		Maximum	8.62	60.20	373.00	241.00	21.20	74.50	0.51	40.50	44.30	29.50	10.50	0.25	0.42	0.07
	Sampling period:	Minimum	8.16	55.20	313.00	192.00	11.20	55.40	0.27	31.50	37.80	25.60	6.59	0.04	0.01	0.02
	May 2018 and July 2018	Coeff of Variation%	2.31	3.57	8.19	9.45	24.79	12.66	30.13	10.50	7.20	6.64	20.39	59.32	76.33	47.38
	Alex 7	Average	8.55	94.73	572.50	394.75	54.08	83.38	0.48	52.65	70.45	61.48	3.73	0.05	0.01	0.14
		Maximum	8.62	110.00	724.00	485.00	79.00	107.00	0.49	58.80	88.30	81.50	4.35	0.06	0.03	0.18
	Sampling period:	Minimum	8.39	76.20	419.00	279.00	31.70	72.00	0.47	42.80	49.30	40.60	2.99	0.04	0.00	0.07
	May 2018 and July 2018	Coeff of Variation%	1.24	17.33	22.96	21.65	44.69	19.19	3.08	13.14	25.59	30.79	17.05	31.26	192.85	37.58
	Alex 8	Average	8.41	84.60	492.75	270.25	60.55	83.90	0.42	51.80	34.58	85.28	6.12	0.14	0.42	0.38
		Maximum	8.45	92.80	575.00	280.00	76.60	107.00	0.47	62.70	38.10	112.00	9.21	0.22	0.96	0.59
	Sampling period:	Minimum	8.34	79.00	432.00	264.00	41.60	55.40	0.38	43.80	32.60	65.40	4.05	0.05	0.02	0.13
	May 2018 and July 2018	Coeff of Variation%	0.57	7.85	12.40	2.87	23.90	25.77	15.53	16.18	7.09	24.93	35.81	91.32	95.98	62.21
	Alex 9	Average	8.44	71.85	432.25	288.75	34.20	70.68	0.68	38.58	49.08	56.10	3.72	0.05	0.22	0.35
		Maximum	8.55	78.70	514.00	354.00	46.50	78.30	0.68	46.00	53.70	74.00	3.93	0.10	0.39	0.75
	Sampling period:	Minimum	8.21	60.00	361.00	245.00	21.40	65.30	0.68	32.50	37.90	39.60	3.54	0.02	0.04	0.11
	May 2018 and July 2018	Coeff of Variation%	1.87	11.60	14.79	16.02	40.73	8.40		16.84	15.25	30.23	4.32	79.90	66.95	79.77
	Alex 10	Average	8.45	65.00	377.25	261.25	36.55	37.63	0.34	47.13	30.43	53.60	5.05	0.08	0.11	0.20
		Maximum	8.61	71.00	457.00	291.00	52.40	43.70	0.49	50.80	33.40	74.50	5.69	0.11	0.23	0.27
	Sampling period:	Minimum	8.36	56.60	317.00	241.00	19.70	32.70	0.22	42.70	26.30	35.70	4.16	0.05	0.04	0.16
	May 2018 and July 2018	Coeff of Variation%	1.30	10.08	16.97	8.98	40.74	13.76	41.02	7.43	11.02	33.69	12.79	36.49	103.79	25.77
	ALEX11	Average	8.51	71.55	421.00	284.25	38.15	59.18	0.48	40.53	40.05	60.80	4.79	0.16	0.13	0.13
		Maximum	8.62	81.80	545.00	367.00	57.60	71.80	0.69	44.80	47.90	91.20	6.16	0.16	0.15	0.19
	Sampling period:	Minimum	8.44	59.00	311.00	214.00	21.80	50.70	0.23	35.60	30.20	33.40	3.80	0.16	0.10	0.06
	May 2018 and July 2018	Coeff of Variation%	0.91	16.13	24.75	22.72	48.99	15.99	47.93	11.27	20.14	42.65	24.05	0.00	27.18	51.24
	ALEX16	Average	8.44	80.50	470.00	291.50	50.58	74.45	0.30	50.75	39.60	69.28	5.05	0.06	0.15	0.21
		Maximum	8.58	90.20	595.00	379.00	68.10	93.90	0.36	52.20	48.00	90.40	6.38	0.08	0.19	0.38
	Sampling period:	Minimum	8.36	66.70	357.00	225.00	32.70	63.10	0.24	46.90	30.00	40.80	3.94	0.03	0.11	0.11
	May 2018 and July 2018	Coeff of Variation%	1.20	13.91	21.70	22.31	36.19	18.14	27.33	5.06	18.64	34.98	22.92	40.36	22.49	57.48
	ALEX18	Average	8.17	113.50	772.33	162.00	68.83	362.33	0.65	70.63	63.40	81.27	20.87	0.37	0.40	0.49
		Maximum	8.35	148.00	1095.00	173.00	99.10	564.00	1.10	93.30	89.00	115.00	29.20	0.52	0.56	0.53
	Sampling period:	Minimum	7.96	88.50	558.00	155.00	53.20	236.00	0.33	50.60	44.20	57.50	15.30	0.27	0.23	0.44
	May 2018 and July 2018	Coeff of Variation%	2.41	27.20	36.83	5.95	38.09	48.71	62.41	30.40	36.40	36.94	35.23	34.61	40.88	8.84

Table 10-15: 2020/2021 Water Quality monitoring results – Infrastructure areas: Powerline (J&W, 2021b)

Mine	Sample Location	RQO and SANS Guidelines	pH	EC mS/m	TDS mg/ℓ	TALK mg/ℓ	Cl mg/ℓ	SO_4 mg/ℓ	N_NO_3 mg/ℓ	Ca mg/ℓ	Mg mg/ℓ	Na mg/ℓ	K mg/ℓ	Al mg/ℓ	Fe mg/ℓ	Mn mg/ℓ
		SANS 241 2015	5-9.7	170	1200	-	300	500	11	150	70	200	50	300	2	0.4
		RQO 2016 Olifants UIA 1	-	111	-	-	-	500	4	-	-	-	-	-	-	-
Mine	Sample Location	WQPL 2018 (MU7)	6.5-8.4	70	450	120	65	250	0.3	55	70	70	25	0.02	0.3	0.15
Powerline	UP1	Average	7.90	33.28	231.00	96.00	16.00	46.75	2.15	21.50	14.25	20.50	4.50	0.35	0.13	0.25
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.30	36.80	266.00	120.00	18.00	51.00	4.00	26.00	17.00	21.00	4.80	0.55	0.23	0.65
		Minimum	7.70	30.60	212.00	72.00	14.00	41.00	0.30	18.00	12.00	20.00	4.00	0.16	0.07	0.08
		Coeff of Variation %	3.58	8.86	10.64	20.69	10.21	9.94	121.69	17.19	15.56	2.82	7.70	48.28	65.79	105.25
	UP2	Average	8.18	126.58	897.50	358.00	136.25	199.75	0.10	48.50	88.75	103.00	3.55	0.41	0.35	0.07
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.50	216.00	1478.00	620.00	265.00	356.00	0.10	75.00	164.00	191.00	4.00	0.93	0.35	0.13
		Minimum	7.60	22.30	220.00	68.00	13.00	36.00	0.10	13.00	12.00	12.00	3.10	0.13	0.35	0.03
		Coeff of Variation%	4.93	65.21	59.33	63.43	0.00	71.34		53.94	71.97	74.24	13.11	109.14		68.29
	UP3	Average	7.25	49.75	395.00	208.00	11.50	51.50	0.70	31.50	26.00	30.00	4.10	0.53	1.08	0.45
	Sampling period: Sep 2020 to Jan 2021	Maximum	7.40	54.10	400.00	252.00	12.00	69.00	1.30	34.00	29.00	34.00	5.00	0.53	1.08	0.71
		Minimum	7.10	45.40	390.00	164.00	11.00	34.00	0.10	29.00	23.00	26.00	3.20	0.53	1.08	0.19
		Coeff of Variation%	2.93	12.37	1.79	29.92	0.00	48.06	121.22	11.22	16.32	18.86	31.04			81.44
	UP7	Average	7.70	121.50	948.50	351.00	63.00	239.50	1.23	110.25	57.50	69.75	7.78	0.20	0.04	0.74
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.00	141.00	1060.00	484.00	79.00	343.00	2.40	122.00	77.00	94.00	9.60	0.20	0.07	2.14
		Minimum	7.50	105.00	824.00	240.00	45.00	147.00	0.20	96.00	45.00	54.00	4.80	0.20	0.03	0.04
		Coeff of Variation%	2.81	12.83	10.96	28.85	0.00	37.76	89.68	11.58	27.00	24.62	27.75		46.30	163.84
	DP4	Average	7.95	30.48	216.00	80.00	16.00	46.75	1.03	19.25	12.75	18.50	4.58	0.38	0.17	0.10
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.30	31.60	276.00	92.00	17.00	51.00	1.50	20.00	13.00	21.00	4.90	0.57	0.27	0.17
		Minimum	7.70	28.70	180.00	72.00	14.00	41.00	0.20	19.00	12.00	16.00	4.40	0.19	0.09	0.05
		Coeff of Variation%	3.33	4.08	19.30	10.80	0.00	9.30	70.01	2.60	3.92	11.25	5.16	49.62	55.93	50.52
	DP5	Average	9.03	50.55	396.00	197.00	16.25	71.50	0.33	20.50	33.25	44.00	2.90	0.39	0.28	0.16
	Sampling period: Sep 2020 to Jan 2021	Maximum	10.30	90.20	702.00	300.00	35.00	188.00	0.40	32.00	60.00	83.00	3.50	0.96	0.51	0.17
		Minimum	7.00	17.90	134.00	52.00	5.00	24.00	0.20	11.00	9.00	9.00	2.00	0.12	0.05	0.16
		Coeff of Variation%	15.71	62.17	62.01	56.18	0.00	109.68	34.64	42.25	68.33	76.53	27.37	101.43	114.34	2.49
	DP6	Average	7.37	28.50	216.00	86.67	11.67	39.67	2.60	17.67	13.33	13.00	6.70	1.13	0.25	0.77
	Sampling period: Sep 2020 to Jan 2021	Maximum	7.90	34.00	258.00	152.00	13.00	73.00	4.80	21.00	17.00	15.00	7.70	1.56	0.56	1.71
		Minimum	7.00	19.20	152.00	52.00	10.00	13.00	1.40	11.00	9.00	9.00	5.70	0.71	0.06	0.24
		Coeff of Variation%	6.42	28.42	26.07	65.33	0.00	77.02	73.38	32.68	30.31	26.65	14.93	37.73	109.27	106.22

Table 10-16: 2020/2021 Water Quality monitoring results – Infrastructure areas: Pipeline (J&W, 2021b)

Mine	Sample Location	RQO and SANS Guidelines	pH	EC mS/m	TDS mg/ℓ	TALK mg/ℓ	Cl mg/ℓ	SO_4 mg/ℓ	N_NO_3 mg/ℓ	Ca mg/ℓ	Mg mg/ℓ	Na mg/ℓ	K mg/ℓ	Al mg/ℓ	Fe mg/ℓ	Mn mg/ℓ
		SANS 241 2015	5-9.7	170	1200	-	300	500	11	-	-	200	-	-	2	0.4
		Olifants UIA 1	-	111	-	-	-	500	4	-	-	-	-	-	-	-
Mine	Sample Location	WQPL 2018 (MU7)	6.5-8.4	70	450	120	65	250	0.3	55	70	70	25	0.02	0.3	0.15
Pipeline	V04_2	Average	8.25	99.33	706.50	215.00	32.75	263.00	0.10	44.50	49.25	103.25	4.80	0.34	0.34	1.12
		Maximum	8.50	224.00	1666.00	272.00	50.00	864.00	0.10	78.00	111.00	283.00	7.40	0.51	0.34	3.82
	Sampling period:	Minimum	7.90	44.70	352.00	120.00	14.00	36.00	0.10	25.00	22.00	27.00	3.40	0.16	0.34	0.16
	Sep 2020 to Jan 2021	Coeff of Variation%	3.05	84.39	90.74	30.85	0.00	152.52	0.00	51.98	84.28	116.95	37.58	50.73		159.82
	V04_3	Average	8.43	56.88	366.50	218.00	31.00	50.25	0.15	31.25	28.50	46.00	3.68	0.28	0.15	0.25
		Maximum	8.80	67.30	424.00	248.00	42.00	70.00	0.20	38.00	33.00	63.00	4.40	0.43	0.37	0.37
	Sampling period:	Minimum	7.80	37.30	290.00	136.00	13.00	36.00	0.10	25.00	20.00	18.00	3.00	0.18	0.04	0.12
	Sep 2020 to Jan 2021	Coeff of Variation%	5.16	23.86	15.46	25.09	0.00	28.44	47.14	19.96	21.53	46.18	17.41	38.97	124.03	40.18
	V04_5	Average	6.90	22.50	195.00	86.00	8.50	14.00	Below detectable limits	15.50	7.50	8.50	15.65	0.20	2.56	0.80
		Maximum	7.00	24.80	222.00	104.00	9.00	14.00		17.00	8.00	10.00	15.70	0.20	4.97	1.16
	Sampling period:	Minimum	6.80	20.20	168.00	68.00	8.00	14.00		14.00	7.00	7.00	15.60	0.20	0.14	0.43
	Sep 2020 to Jan 2021	Coeff of Variation%	2.05	14.46	19.58	29.60	0.00			13.69	9.43	24.96	0.45		133.46	64.54
	V04_6	Average	7.68	47.78	388.50	138.00	27.25	80.75	1.55	16.25	14.25	59.00	5.63	1.99	0.99	0.63
		Maximum	8.10	79.50	602.00	172.00	53.00	161.00	3.00	22.00	19.00	109.00	8.00	4.95	1.60	1.12
	Sampling period:	Minimum	7.30	24.80	268.00	88.00	10.00	25.00	0.10	10.00	10.00	27.00	3.40	0.73	0.19	0.24
	Sep 2020 to Jan 2021	Coeff of Variation%	4.30	51.73	40.05	25.98	0.00	76.21	132.30	31.13	26.49	63.40	38.03	99.81	60.80	61.74
	V04_8	Average	8.25	73.23	472.50	257.00	47.50	72.00	0.53	42.75	38.75	49.25	5.03	0.24	0.20	0.19
		Maximum	8.40	89.40	540.00	300.00	75.00	97.00	1.00	49.00	47.00	70.00	6.30	0.43	0.20	0.23
	Sampling period:	Minimum	7.90	49.40	342.00	164.00	22.00	49.00	0.10	35.00	22.00	26.00	4.10	0.16	0.20	0.14
	Sep 2020 to Jan 2021	Coeff of Variation%	2.89	24.55	19.14	25.01	0.00	31.55	84.55	13.56	30.42	40.52	21.15	54.07		20.60
	V04_9	Average	8.35	22.13	162.50	90.00	8.50	17.25	0.10	13.50	9.75	15.75	4.25	0.73	0.32	0.47
		Maximum	9.50	28.50	192.00	124.00	11.00	19.00	0.10	17.00	13.00	20.00	4.60	0.91	0.48	0.81
	Sampling period:	Minimum	7.50	17.40	140.00	64.00	6.00	15.00	0.10	10.00	7.00	12.00	4.00	0.56	0.19	0.19
	Sep 2020 to Jan 2021	Coeff of Variation%	11.13	23.18	13.38	29.14	0.00	9.90	0.00	26.01	28.24	24.52	7.06	25.05	39.60	60.76
	V04_10	Average	8.78	41.10	301.00	134.00	19.00	59.25	0.35	25.00	20.50	24.75	12.38	0.37	0.35	0.40
		Maximum	9.80	52.00	364.00	180.00	25.00	94.00	0.40	34.00	31.00	36.00	14.40	0.84	0.79	0.60
	Sampling period:	Minimum	7.40	28.70	242.00	84.00	14.00	30.00	0.30	18.00	12.00	15.00	10.90	0.11	0.07	0.13
	Sep 2020 to Jan 2021	Coeff of Variation%	11.86	28.67	20.58	30.88	0.00	49.29	20.20	28.28	44.08	40.05	13.24	88.13	111.78	52.09
	V04_11	Average	8.35	17.28	117.00	51.00	6.50	29.75	1.50	9.50	6.75	11.25	4.30	0.70	0.37	0.11
		Maximum	9.00	18.30	132.00	60.00	7.00	31.00	2.80	10.00	7.00	12.00	4.60	0.91	0.43	0.16
	Sampling period:	Minimum	7.40	16.50	98.00	44.00	6.00	29.00	0.20	9.00	6.00	11.00	4.10	0.44	0.25	0.06
	Sep 2020 to Jan 2021	Coeff of Variation%	8.61	4.83	12.52	13.39	0.00	3.22	122.57	6.08	7.41	4.44	5.02	27.92	21.94	36.56
	V04_12	Average	8.28	59.63	400.50	210.00	14.75	100.25	0.45	35.00	37.00	35.00	3.30	0.27	0.05	0.40
		Maximum	8.80	93.80	628.00	380.00	27.00	156.00	0.60	53.00	78.00	47.00	4.90	0.28	0.06	1.08
	Sampling period:	Minimum	7.60	46.70	312.00	140.00	10.00	80.00	0.30	28.00	23.00	31.00	1.00	0.27	0.04	0.03
	Jul 93 to Aug 2017	Coeff of Variation%	6.03	38.37	38.06	54.51	0.00	37.11	47.14	34.52	73.88	22.86	49.79	3.35	16.91	146.91
	V04_13	Average	8.93	30.73	232.00	80.00	18.25	53.75	1.60	19.75	17.50	14.50	3.80	0.52	0.18	0.24
		Maximum	10.10	38.60	274.00	96.00	30.00	77.00	1.60	24.00	25.00	23.00	4.60	1.23	0.64	0.51
	Sampling period:	Minimum	7.20	20.70	184.00	56.00	8.00	32.00	1.60	14.00	11.00	7.00	3.30	0.12	0.03	0.12
	Sep 2020 to Jan 2021	Coeff of Variation%	14.01	29.83	18.18	21.21	0.00	36.85		22.02	35.69	50.52	15.64	119.38	165.15	78.52
	V04_14	Average	8.13	60.10	407.50	240.00	22.00	65.50	0.15	46.00	40.75	20.00	4.00	0.50	0.17	0.38
		Maximum	8.90	107.00	670.00	548.00	38.00	126.00	0.20	95.00	76.00	37.00	5.40	1.03	0.23	1.11
	Sampling period:	Minimum	7.70	27.40	220.00	88.00	8.00	39.00	0.10	23.00	15.00	7.00	2.50	0.14	0.11	0.10
	Sep 2020 to Jan 2021	Coeff of Variation%	6.69	60.31	50.63	87.55	0.00	61.96	47.14	72.10	70.31	72.34	30.07	92.56	51.39	129.84
	V04_15	Average	8.85	50.68	366.50	145.00	37.50	80.00	2.50	23.50	26.25	42.25	3.80	0.60	0.21	0.18
		Maximum	9.90	79.90	542.00	176.00	87.00	144.00	2.50	30.00	36.00	81.00	4.30	1.54	0.56	0.32
	Sampling period:	Minimum	7.50	24.60	226.00	96.00	9.00	20.00	2.50	16.00	14.00	12.00	2.80	0.17	0.03	0.09
	Sep 2020 to Jan 2021	Coeff of Variation%	11.24	51.20	43.12	23.88	0.00	77.65		24.69	41.77	78.91	18.61	106.14	148.22	52.29
	V04_16	Average	7.67	61.80	453.33	108.00	35.67	152.00	0.70	36.33	24.00	52.00	7.90	0.87	0.26	0.34
		Maximum	7.90	122.00	870.00	140.00	83.00	367.00	1.20	71.00	47.00	110.00	13.00	1.94	0.36	0.76
	Sampling period:	Minimum	7.40	24.40	228.00	68.00	10.00	40.00	0.20	14.00	9.00	17.00	5.20	0.23	0.16	0.13
	Sep 2020 to Jan 2021	Coeff of Variation%	3.28	85.18	79.69	33.95	0.00	122.53	101.02	83.77	84.27	97.28	55.94	107.57	55.41	106.05
	V04_17	Average	8.20	87.60	634.00	296.00	41.50	135.50	1.15	60.00	49.50	49.50	7.10	0.58	0.05	0.11
		Maximum	8.40	109.00	764.00	396.00	55.00	164.00	2.20	77.00	64.00	64.00	8.40	0.64	0.05	0.15
	Sampling period:	Minimum	8.00	66.20	504.00	196.00	28.00	107.00	0.10	43.00	35.00	35.00	5.80	0.53	0.05	0.07
	Sep 2020 to Jan 2021	Coeff of Variation%	3.45	34.55	29.00	47.78	0.00	29.75	129.12	40.07	41.43	41.43	25.89	13.12		53.87

Table 10-17: 2020/2021 Water Quality monitoring results – Infrastructure areas : Conveyor (J&W, 2021b).

Mine	Sample Location	RQO and SANS Guidelines	pH	EC mS/m	TDS mg/ℓ	TALK mg/ℓ	Cl mg/ℓ	SO_4 mg/ℓ	N_NO_3 mg/ℓ	Ca mg/ℓ	Mg mg/ℓ	Na mg/ℓ	K mg/ℓ	Al mg/ℓ	Fe mg/ℓ	Mn mg/ℓ
		SANS 241 2015	5-9.7	170	1200	-	300	500	11	-	-	200	-	-	2	0.4
		Olifants UIA 1	-	111	-	-	-	500	4	-	-	-	-	-	-	-
		WQPL 2018 (MU7)	6.5-8.4	70	450	120	65	250	0.3	55	70	70	25	0.02	0.3	0.15
Conveyor	Samp2	Average	8.20	135.67	1084.00	282.67	20.00	434.00	0.35	85.33	87.67	95.67	3.70	0.38	0.65	0.21
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.30	150.00	1190.00	312.00	22.00	502.00	0.50	87.00	98.00	118.00	5.00	0.52	0.99	0.23
		Minimum	8.10	122.00	938.00	260.00	19.00	350.00	0.20	83.00	76.00	67.00	2.90	0.29	0.44	0.20
		Coeff of Variation%	1.22	10.33	12.05	9.42	0.00	17.80	60.61	2.44	12.62	27.26	30.70	33.32	45.66	8.92
	Samp3	Average	7.60	52.73	384.00	152.00	28.67	88.33	0.25	32.33	28.33	31.67	8.17	0.97	0.38	0.94
	Sampling period: Sep 2020 to Jan 2021	Maximum	7.90	112.00	802.00	264.00	66.00	241.00	0.40	70.00	64.00	72.00	9.90	1.97	0.98	1.85
		Minimum	7.10	19.20	162.00	72.00	9.00	7.00	0.10	10.00	8.00	9.00	7.20	0.19	0.04	0.33
		Coeff of Variation%	5.74	97.61	94.33	65.74	0.00	149.78	84.85	101.47	109.37	110.59	18.42	93.28	137.81	85.05
	Samp4	Average	7.90	103.20	832.00	168.00	19.00	330.33	0.20	69.33	50.67	79.33	4.10	0.36	0.12	0.31
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.00	157.00	1296.00	224.00	24.00	640.00	0.20	114.00	73.00	129.00	5.40	0.61	0.12	0.37
		Minimum	7.80	73.40	580.00	100.00	16.00	171.00	0.20	46.00	38.00	53.00	2.90	0.21	0.12	0.18
		Coeff of Variation%	1.27	45.23	48.36	37.42	0.00	81.20	0.00	55.81	38.29	54.25	30.56	58.38		35.54
	Samp5	Average	8.40	103.57	734.67	248.00	15.33	267.00	0.20	33.67	37.33	135.00	6.80	0.40	0.10	0.17
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.70	145.00	1022.00	356.00	21.00	373.00	0.20	43.00	54.00	201.00	7.50	0.60	0.18	0.18
		Minimum	8.00	58.70	408.00	144.00	11.00	124.00	0.20	21.00	20.00	72.00	5.50	0.27	0.03	0.15
		Coeff of Variation%	4.29	41.76	42.04	42.76	0.00	48.15		33.78	45.56	47.82	16.57	44.35	100.63	7.59
	Samp6	Average	7.77	56.77	422.00	150.67	10.00	127.33	1.75	38.33	24.33	42.33	4.40	0.33	0.14	0.48
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.80	75.90	562.00	244.00	15.00	290.00	3.30	57.00	31.00	47.00	6.60	0.34	0.34	0.53
		Minimum	7.10	46.60	346.00	40.00	4.00	23.00	0.20	27.00	21.00	34.00	1.60	0.32	0.03	0.44
		Coeff of Variation%	11.68	29.21	28.77	68.43	0.00	112.10	125.26	42.49	23.73	17.09	58.03	4.94	128.67	13.60
	Samp7	Average	8.07	43.97	303.33	124.00	8.00	88.67	0.20	17.00	12.67	52.33	3.23	0.29	0.29	0.49
	Sampling period: Sep 2020 to Jan 2021	Maximum	9.30	49.30	338.00	156.00	9.00	94.00	0.20	22.00	15.00	72.00	4.80	0.32	0.45	1.08
		Minimum	7.10	36.00	272.00	72.00	7.00	85.00	0.20	14.00	11.00	38.00	0.60	0.27	0.06	0.11
		Coeff of Variation%	13.93	15.99	10.92	36.64	0.00	5.33		25.64	16.43	33.66	70.95	11.14	69.65	104.15
	Samp9	Average	8.05	53.05	452.00	198.00	9.00	77.00	0.20	23.50	17.50	61.50	5.20	0.51	0.11	0.38
	Sampling period: Sep 2020 to Jan 2021	Maximum	8.70	66.40	508.00	232.00	10.00	108.00	0.20	25.00	21.00	92.00	9.00	0.66	0.18	0.60
		Minimum	7.40	39.70	396.00	164.00	8.00	46.00	0.20	22.00	14.00	31.00	1.40	0.36	0.05	0.15
		Coeff of Variation%	11.42	35.59	17.52	24.28	0.00	56.94		9.03	28.28	70.14	103.35	41.69	83.08	83.34

Table 10-18: 2020/2021 Water quality monitoring results- Wetland Reserve monitoring points (J&W, 2021b)

Mine	Sample Location	RQO and SANS Guidelines	pH	EC mS/m	TDS mg/ℓ	SO_4 mg/ℓ
		SANS 241 2015	5-9.7	170	1200	500
		Olifants UIA 1 Resource Unit 11	-	111	-	500
	Sample Location	WQPL 2018 (MU7)	6.5-8.4	70	450	250
Alexander	SKS-EWR-1	Average	8.20	96.02	707.40	276.20
		Maximum	8.40	218.00	1678.00	837.00
		Minimum	7.80	38.20	308.00	44.00
		Coeff of Variation %	0.03	0.68	0.75	1.21
	Game-SKS	Average	8.23	64.51	413.00	63.50
		Maximum	8.70	83.00	538.00	93.00
		Minimum	7.50	35.60	236.00	38.00
		Coeff of Variation%	0.04	0.26	0.21	0.34
	SKS-2	Average	7.50	55.89	381.20	118.60
		Maximum	7.70	132.00	924.00	408.00
		Minimum	7.20	30.90	198.00	45.00
		Coeff of Variation%	0.02	0.57	0.60	0.99
	DWARS-1(TS-1)	Average	7.95	45.46	327.60	94.10
		Maximum	8.20	136.00	1032.00	464.00
		Minimum	7.80	28.10	172.00	39.00
		Coeff of Variation%	0.02	0.72	0.78	1.39
	ALL5	Average	8.39	56.65	372.80	45.80
		Maximum	8.90	75.30	476.00	58.00
		Minimum	7.80	34.90	250.00	34.00
		Coeff of Variation%	0.04	0.25	0.20	0.18
	ALL7	Average	8.23	95.41	715.40	268.10
		Maximum	8.60	299.00	2596.00	1458.00
		Minimum	7.90	37.70	284.00	33.00
		Coeff of Variation%	0.03	0.93	1.10	1.83
	AL-BIO-1	Average	8.34	70.77	451.60	74.00
		Maximum	8.60	96.90	622.00	215.00
		Minimum	8.00	39.90	304.00	30.00
		Coeff of Variation%	0.03	0.29	0.22	0.74
	AL-BIO-2	Average	8.55	56.97	393.40	63.40
		Maximum	8.80	90.60	610.00	118.00
		Minimum	7.80	29.80	176.00	37.00
		Coeff of Variation%	0.03	0.34	0.33	0.47
	AL-BIO-3	Average	8.23	55.78	372.00	41.70
		Maximum	8.50	74.80	500.00	73.00
		Minimum	7.90	33.90	282.00	26.00
		Coeff of Variation%	0.03	0.25	0.19	0.32

Figure 10-16 to **Figure 10-21** indicate the average and maximum concentrations measured at each monitoring location, in terms of compliance with the RQO or SANS 241, pH, electrical conductivity (EC) and sulphate (SO_4) respectively.

Baseline water quality interpretation

The values for various constituents measured around the project area were compared to the RQO for the Olifants River catchments and SANS 241 guidelines; pH, SO_4, EC, Iron (Fe) and Manganese (Mn) are discussed below:

pH

The pH of natural waters is a measurement of the acidity/alkalinity and is the result of complex acid-base equilibrium of various dissolved compounds. The pH of most raw water sources is within the range of 6.5 to 8.5 (DWAF, 1996). A decrease in the pH of water in a mining area will be an indication of acid mine drainage (AMD).

The results in **Table 10-14** to **Table 10-17** indicate the following:

- Mining Area:
  - On average and for the maximum recorded, pH levels exceeded the upper limit for pH when compared to the WQPL. These locations include: Alex 3, Alex 6, Alex 7, Alex 8,Alex 9 Alex,10, Alex 11 and Alex 16.
  - All monitoring locations are within the required lower limit for pH when compared to the WQPL.
- Infrastructure routes
  - On average, pH levels at all monitoring locations are within the required range as per WQPL.
  - The maximum recorded pH levels that were higher than the range as per WQPL were noted at monitoring location DP5 (along the powerline) as well as at Sample 5 and Sample 6 (along the Conveyor)
  - On average and for the maximum recorded, pH levels exceeded the upper limit for pH when compared to the WQPL. These locations include: V04-2,V04-3,V04-10,V04-11,V04-12, V04-13, V04-14 and V04-15.

The elevated pH at these locations may be due to agricultural activities within the catchment, indicating the use of agricultural lime.

Sulphate (SO_4)

The concentration of sulphates in surface water is typically low (~5mg/ℓ), although concentrations of several hundred mg/ℓ may occur where dissolution of sulphate minerals or discharge of sulphate-rich effluents takes place (DWAF, 1996). AMD decanting or seeping from mining areas can increase the sulphate in surface water significantly. Chemical fall-out during rain events in areas where coal burning takes place can also increase the sulphate content of surface water bodies.

Sulphate is a key indicator of water affected by coal mining. The results in **Table 10-14** to **Table 10-17** indicate the following:

- Mining Area:

- On average, the majority of monitoring locations within the Alexander mining area within the required sulphate concentration WQPL limits with the exception of Alex 18_SLR.
- Elevated sulphate concentration higher than the WQPL limits was noted at monitoring location Alex18_SLR. This is due to one sampling run in November 2018 that exceeded the limit of 500mg/l. This monitoring point is within an in-stream dam. There is no mining in the area and therefore it is not certain as to why elevated sulphate has been recorded here. It is recommended that further monitoring in the area be undertaken.
- Maximum recordings for Suphate were exceeded at Alex 1 when compared to the WQPL. This sampling point is located downstream of the Isibonelo mining area.

- Infrastructure routes:
  - On average, the majority of monitoring locations are within the required sulphate concentration limits.
  - Elevated sulphate concentration higher than the WQPL was noted at monitoring locations UP2 (along the powerline), V04_2 and V04-16 (along the pipeline), sample 2, sample 4, sample 5 and sample 6 (along the conveyor). The elevated sulphate concentrations at these locations may be attributed to existing mining activities along these routes.

Electrical conductivity (EC)

Electrical conductivity (EC) is a measure of the ability of water to conduct an electrical current, which is as a result of the presence of charged ions such as carbonate, bicarbonate, chloride, sulphate, nitrate, potassium, calcium and magnesium (DWAF, 1996). It is therefore an indicator of the salinity, or total salt content, of water. Accumulation of salts can influence the potential to use the water downstream by water users, such as irrigation for agriculture, as well as livestock watering.

The results in **Table 10-14** to **Table 10-17** indicate the following:

- Mining Area:
  - On average as well as maximum recorded, elevated EC levels that exceeded the WQPL were noted at monitoring locations Alex 1, Alex 7, Alex 8, Alex 9, Alex 10, Alex 11, Alex 16 and Alex 18.
- Infrastructure routes:
  - On average and maximum recorded, elevated EC levels at the majority of sampling locations were within the WQPL with the exception of UP 2 and UP 7 (along the powerline), V04-2, V04-8, V04-14 and V04-17 (along the pipeline) as well as sample 2, sample 4 and sample 5 (along the conveyor).
  - Maximum recorded EC levels which exceeded the WQPL for EC included monitoring point V04-6, V04-12, V04-15 and V04-16 (along the pipeline) as well as sample 3 and sample 6 (along the conveyor).

Elevated EC for these locations may be attributed to both farming and mining activities in the area, with influences from the use of fertilisers as well as the existing mining in the area.

Iron (Fe)

Iron (Fe) is the fourth most abundant element, constitutes 5% of the earth's crust and is found in many minerals. An important mineral in the context of this investigation is pyrite (FeS), which is often associated with coal formations. Iron can be present in water as dissolved ferric iron (Fe III), as ferrous iron (Fe II) or as suspended iron hydroxides. The concentration of dissolved iron in unpolluted surface water is typically in the range of 0.001 - 0.5 mg/ℓ (DWAF, 1996). The SANS241 for iron was set as 2 mg/ℓ.

The results in **Table 10-14** to **Table 10-17** indicate the following:

- Mining Area:
  - On average and maximum recorded, elevated Fe at the majority of sampling locations exceeded the WQPL.
- Infrastructure routes:
  - On average and maximum recorded, elevated Fe at the majority of sampling locations along the powerline as well as pipeline exceeded the WQPL.
  - Maximum recorded Fe levels which exceeded the WQPL for Fe included monitoring point V04-3, V04-13, V04-15 and V04-16 (along the pipeline).
  - On average and maximum recorded, elevated Fe that exceeded the WQPL were noted at monitoring points sample 2 and 3 along the conveyor.
  - Maximum recorded Fe levels which exceeded the WQPL for Fe included monitoring point sample 6 and sample 7 along the conveyor.

Manganese (Mn)

Manganese (Mn) is a relatively abundant element which constitutes 0.1% of the earth's crust. The median concentration in fresh water is 8 µg/ℓ, with a range of 0.02 to 130 µg/ℓ (DWAF, 1996).

The results in **Table 10-14** to **Table 10-17** indicate the following:

- Mining Area:
  - On average and maximum recorded, elevated Mn that exceeded the WQPL were noted at monitoring points Alex 1, Alex 2, Alex 8, Alex 9, Alex 10, Alex 16 and Alex 18.
  - Maximum recorded Mn which exceeded the WQPL for Mn included monitoring points Alex7 and Alex 11.
- Infrastructure routes:
  - On average and maximum recorded, elevated Mn that exceeded the WQPL were noted at monitoring points UP3, UP7 and DP6 (along the powerline), V04-2, V04-5, V04-6 and V04-9 (along the pipeline) as well as sample 4, sample 6 and sample 7 (along the conveyor).
  - Maximum recorded Mn which exceeded the WQPL for Mn included monitoring points UP1 (along the powerline), V04-10, V04-12, V04-13, V04-14 and V04-16 (along the pipeline) as well as sample 9 (along the conveyor).

Other constituents

Other constituents that were exceeded included:

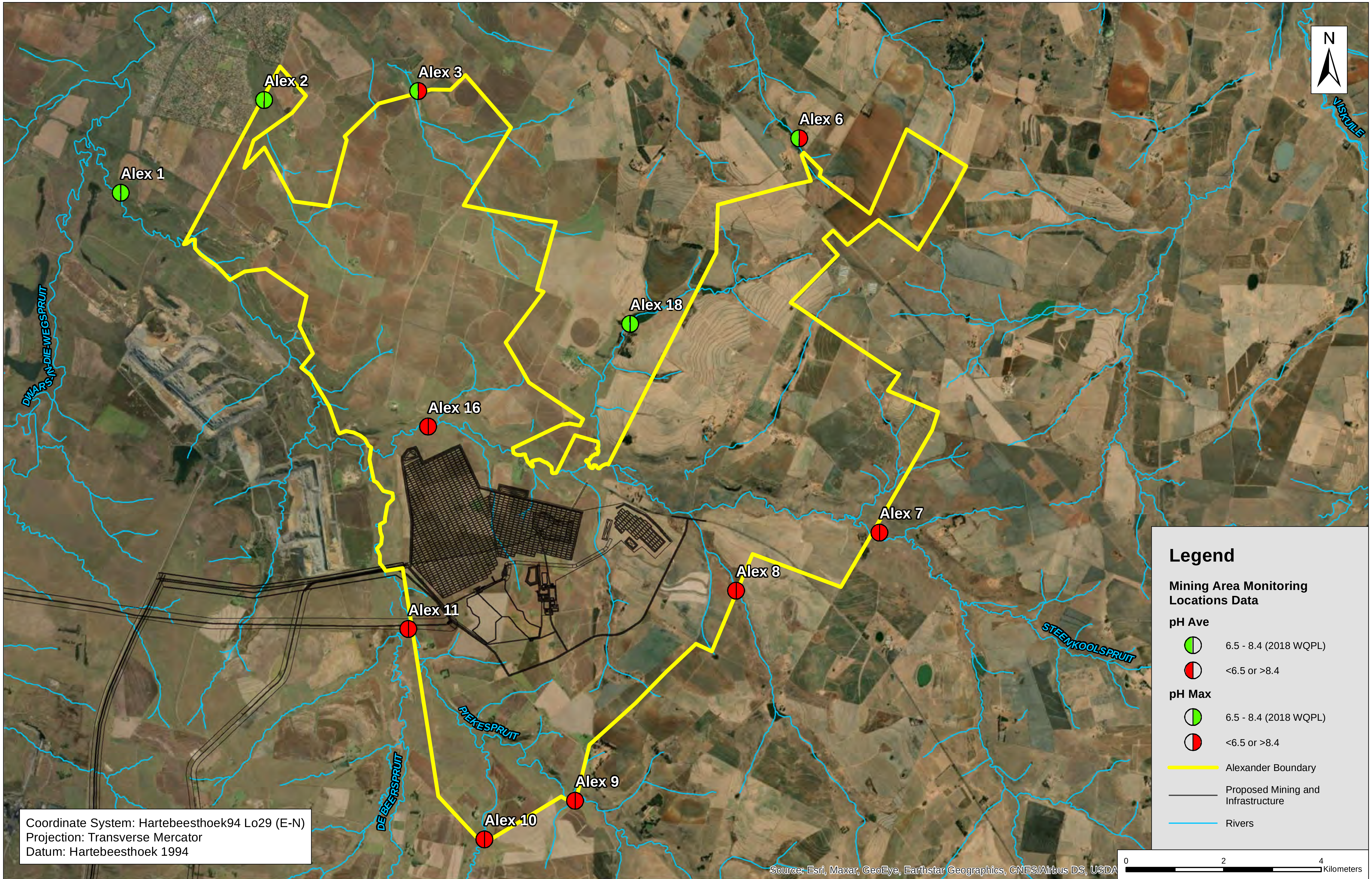
- Mining Area:

- Aluminium, TDS as well as Nitrates were exceeded at all monitoring locations when compared to the WQPL.
- Sodium was exceeded at the majority of monitoring locations when compared to the WQPL.
- Chloride was exceeded at Alex 7, Alex 8, Alex 16 and 18, Magnesium was exceeded at Alex 7 and 8,Calcium was exceeded at Alex 1, Alex 7 , Alex 8 and Alex 18 locations when compared to the WQPL.

- Infrastructure area:

- Along the pipeline: TDS, Aluminium and Nitrate were exceeded for the majority of locations. Chloride was exceeded at V04-8, V04-15 and V04-16, Calcium was exceeded at V04-2, V04-14 and V04-16, Magnesium was exceed at V04-2 and V04-12 and Sodium was exceeded at V04-2, V04-6-Vo4-15 and V04-16 when compared to the WQPL.
- Along the powerline: Aluminium and Nitrate were exceeded for the majority of locations. Calcium was exceeded at UP2 and UP7, Magnesium was exceed at V04-2 and V04-12 and Sodium was exceeded at V04-2, V04-6-Vo4-15 and V04-UP2 when compared to the WQPL.
- Along the Conveyor: TDS, Aluminium and Sodium were exceeded for the majority of locations. Nitrate was exceeded at sample2, sample 3 and sample 6, Calcium was exceeded at sample 2, sample 3 and sample 4, Magnesium was exceed at sample 2 and sample 4 when compared to the WQPL.

The above elevated concentrations may be due to agricultural activities and existing mining activities in the surrounding area.



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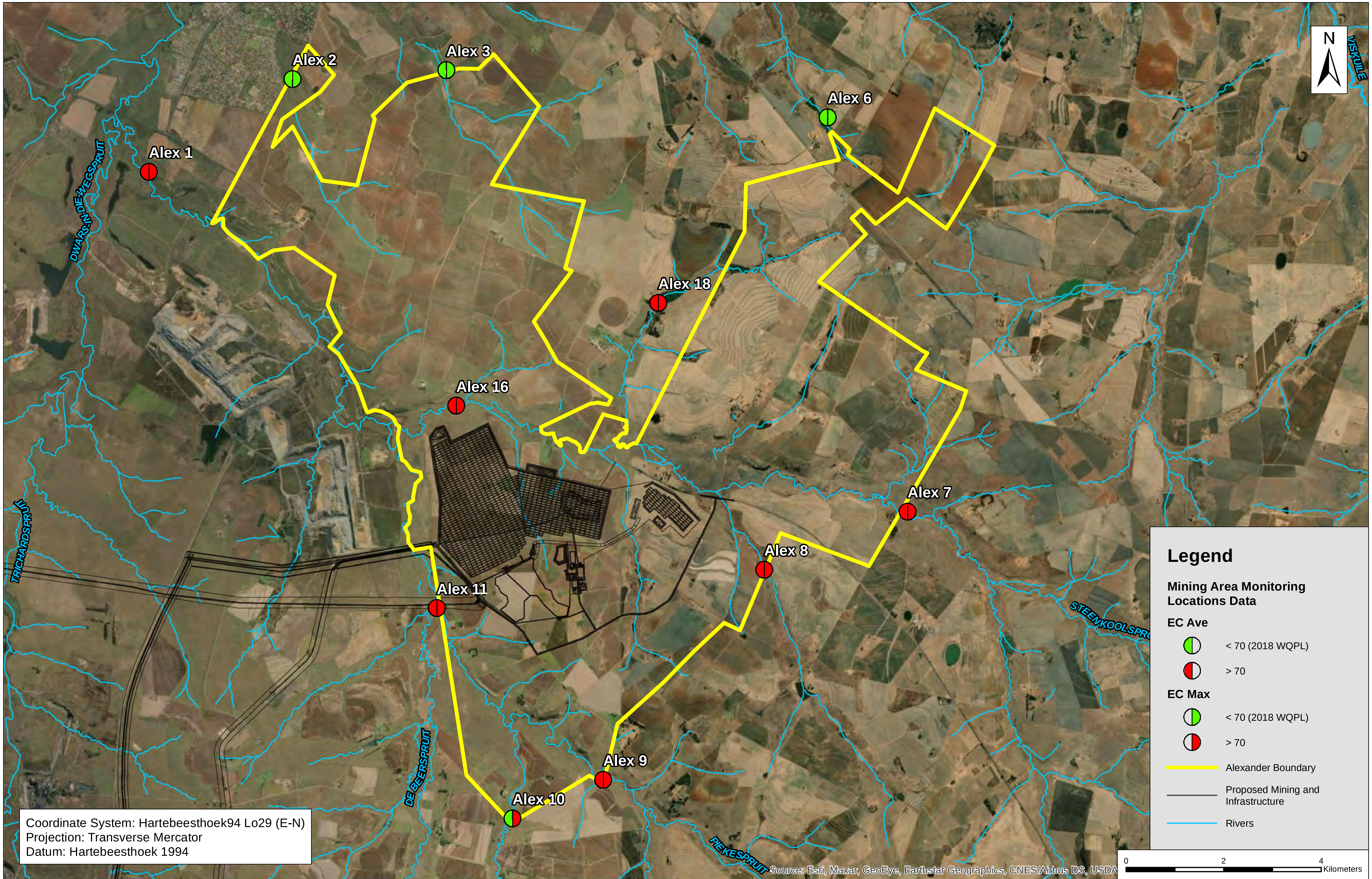
pH Levels - Mining Area (J&W, 2021b)

Job No: G292-55

Figure 10-16



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EC Values - Mining Area (J&W, 2021b)

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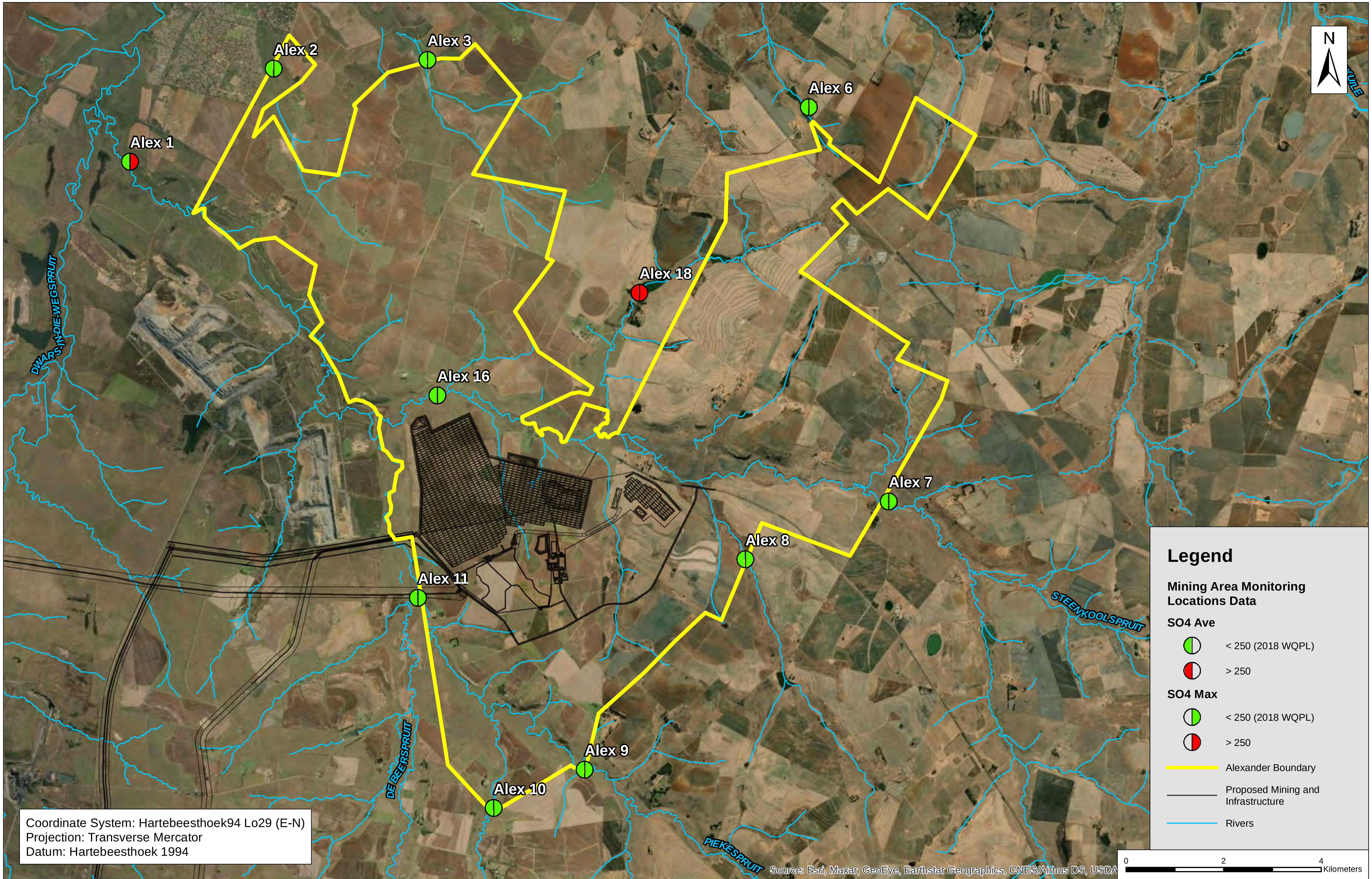
Figure 10-17



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SO4 Values - Mining Area (J&W, 2021b)

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Figure 10-18

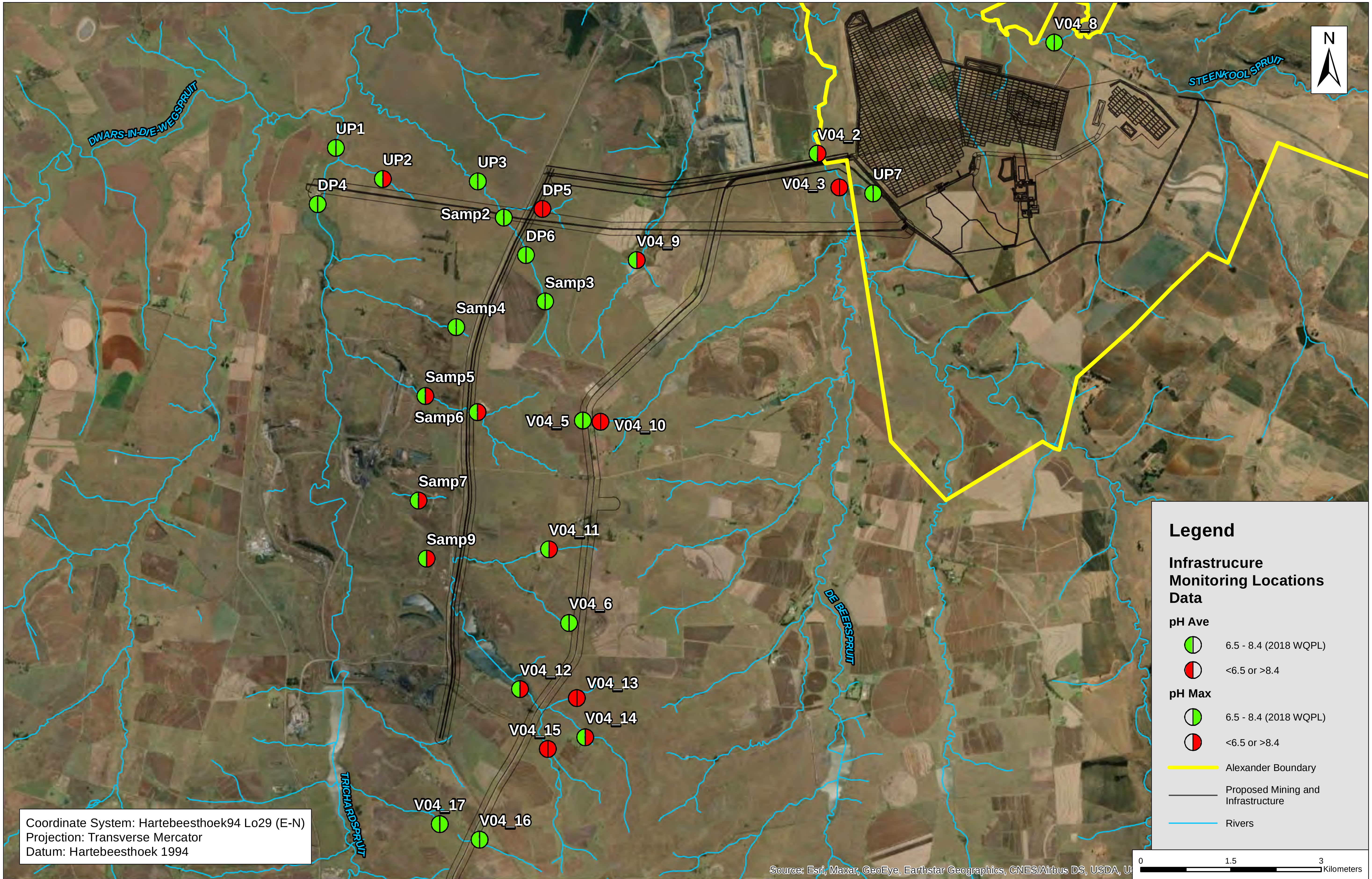

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Figure 10-19

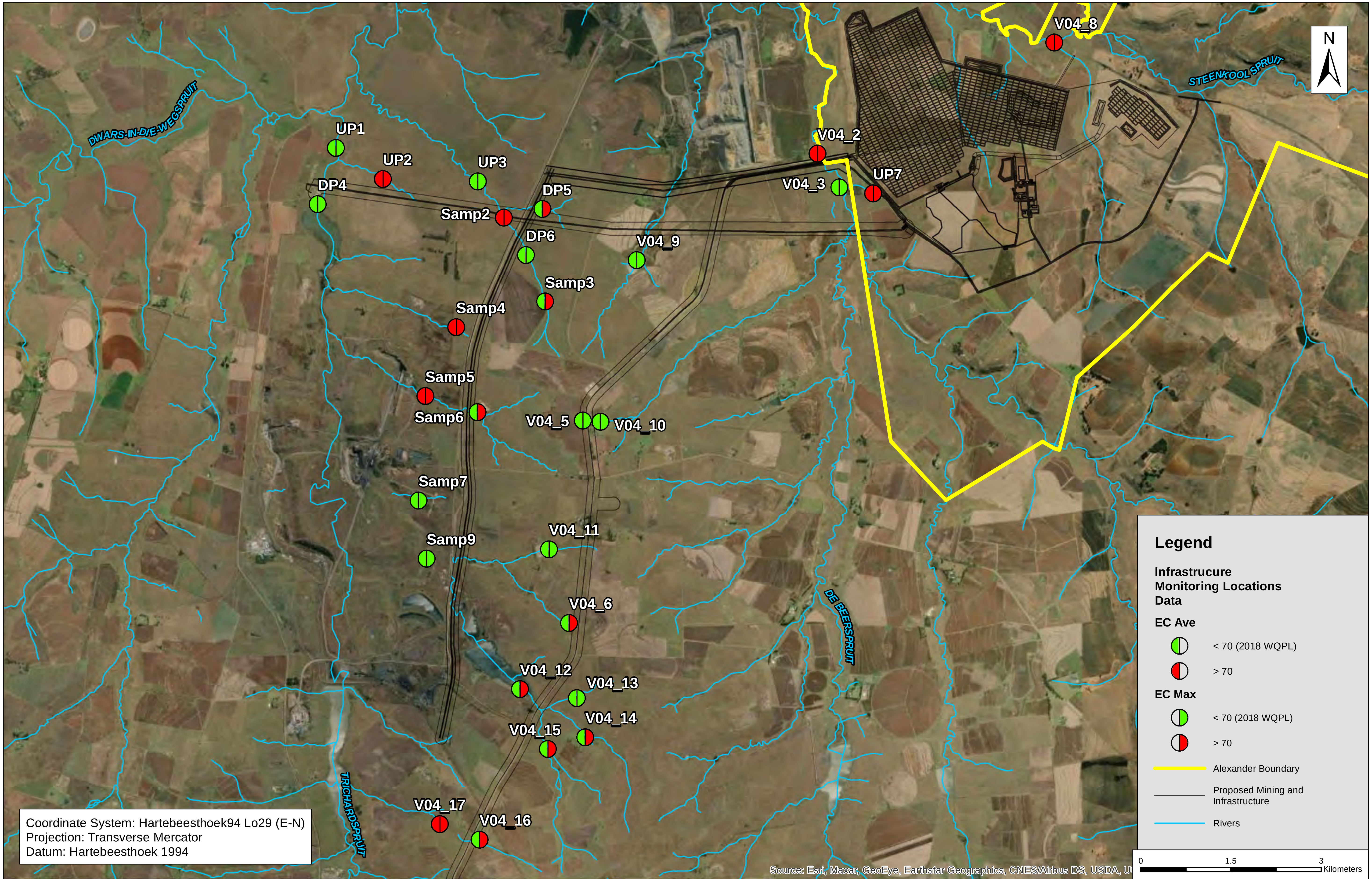

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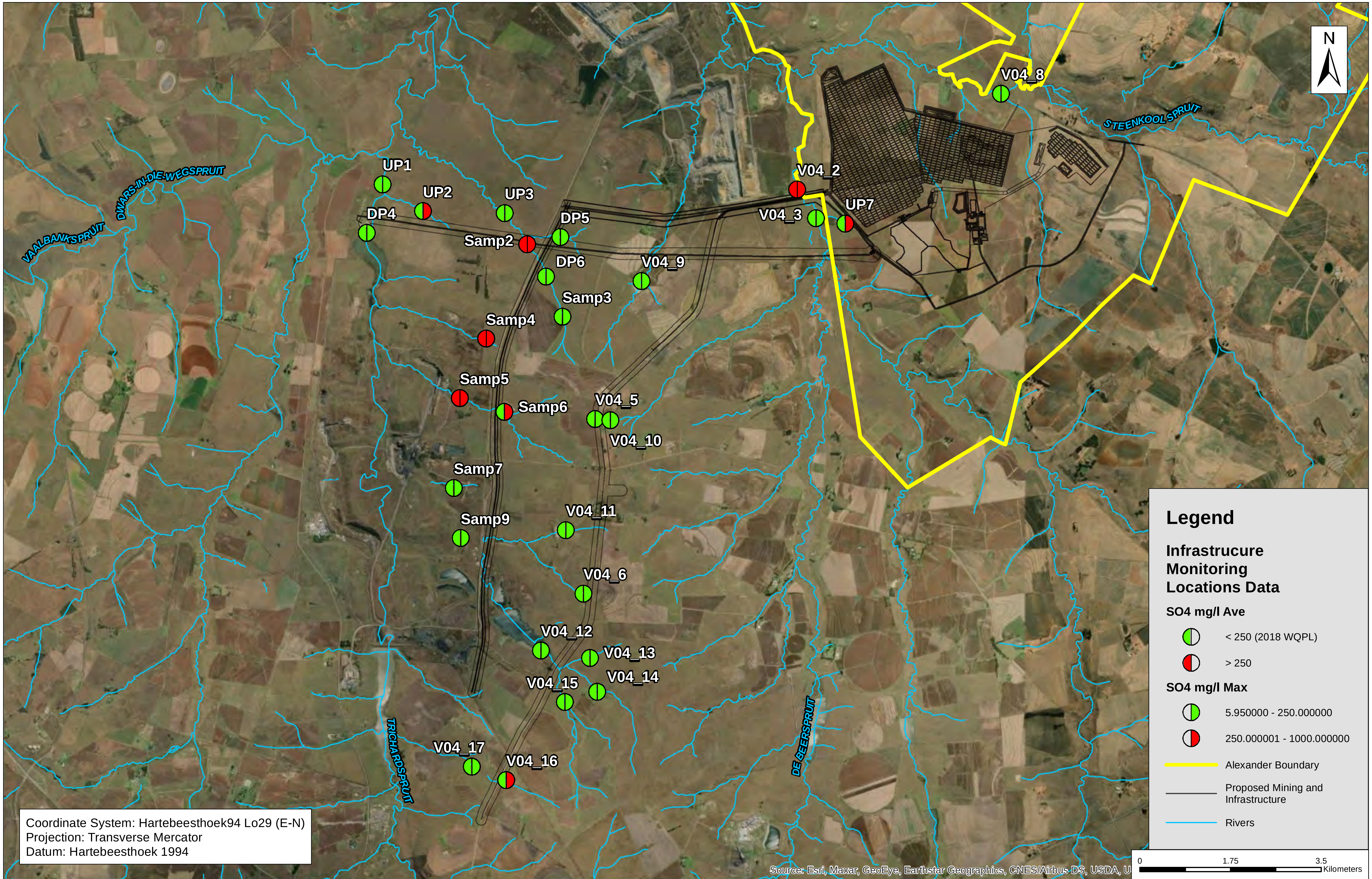
Figure 10-20



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Sasol Mining (Pty) Ltd
Alexander Mining Project IRP
SO4 Values - Infrastructure Area (J&W, 2021b)

Job No: G292-55

Figure 10-21

10.1.1.6. *Wetlands*

Wetland Consulting Services (WCS) and The Biodiversity Company (TBC) undertook wetland delineations and assessment within the Alexander Mining Project area in 2016 and 2019, respectively. Following these assessments, TBC undertook an updated wetland assessment in 2021. Based on the data collated together with the findings of 2021 field verification, a total of 259 natural wetland units and 77 artificial impoundments occurs within the project area. This assessment focusses on the classification and assessment of the natural wetlands, in terms of their PES, IS as well their ecosystem services provision (TBC, 2021a).

Delineated wetlands

To facilitate the practical assessment of these wetlands, a novel classification system was devised that expands upon the level 1-4 national wetland classification system (Ollis et al., 2013). First all the wetlands were grouped into one of five main HGM types following Ollis et al. (2013). These included floodplains, channelled valley-bottoms, unchanneled valley-bottoms, seeps, and depressions. It was then necessary to increase the resolution of the assessment in a way that was both intuitive and ecologically meaningful to prioritise wetlands in lieu of the planned reserve determination.

To do this the wetlands were further classified under two criteria namely ecological state and degree of saturation[4]. In terms of Present Ecological State (PES), known PES ratings and current fieldwork results were used to classify each wetland as either (1) intact (largely natural to moderately modified) or (2) disturbed (largely modified to seriously modified). Lastly all wetlands were further classified following the principles of the Ollis et al. (2013) level 5 classification which considers hydroperiod, with each wetland being classified as either (a) perennial (permanently to seasonally inundated) or (b) non-perennial (seasonally to temporarily inundated). This yielded four main wetland groups into which each of the five main HGM types were classified namely (1a) intact-perennial, (1b) intact-non-perennial, (2a) disturbed-perennial and (2b) disturbed-non-perennial. This classification system yielded a total of 17 wetland subgroups or (hereafter called HGM units), these were each subjected to detailed assessment.

This classification represents a combination of both top down (landscape level classifications) and bottom up (by saturation level and degree of degradation based on landcover and, prior knowledge and fieldwork observation) classification approaches. A combination of top-down and bottom-up approaches to wetland classification is advocated by Sieben et al. (2018) on the premise that it provides the maximum information value for ecosystem service determination. The approach employed here, places emphasis on wetland classification by ecosystem services provision and the rationale behind this is that it the ecosystem services provided by a wetland provides the most useful and biologically meaningful interpretation of a wetland's value. The objective of the top-down, bottom up approach was to simultaneously reduce the dimensionality of the 2019 wetland classification with the aim of uncovering a simple and intuitive yet biologically meaningful classification that would allow for the thorough and repeatable scoring of a much smaller grouping of wetlands to uncover a gradient in their ecosystem services provision and

[4] It is important to note that this approach allows for the intuitive ordering of the wetland subgroups being assessed from higher (intact and permanently saturated) to lower (disturbed and temporarily saturated) ecological importance. It is based on the premise that (given similar catchment influences) wetlands that are more intact and saturated are likely to be of higher ecological importance and provide greater ecosystem services than those are more impacted and drier. This classification approach was devised in consideration of the need to prioritise wetlands for future reserve determination. It was opted for over a catchment-based approach as it provides a more ecologically meaningful classification while at the same time reducing the number of assessment units to a more manageable subset for the upcoming reserve determination.

therefore their overall importance which in turn would allow for the prioritisation of wetlands for reserve determination (TBC, 2021a).

The level 1-4 classification of these HGM units as per the national wetland classification system (Ollis et al., 2013) is presented in **Table 10-19**. Maps showing the extent of the wetland areas within the MRA and linear infrastructure corridors are shown in **Figure 10-22** to **Figure 10-24** respectively.

Table 10-19: Wetland classification as per SANBI guideline (Ollis et al. 2013)

Wetland System	Level 1	Level 2		Level 3	Level 4		
	System	DWS Ecoregion/s	NFEPA Wet Veg	Landscape Unit	4A (HGM)	4B	4C
Group 1a							
HGM 1	Inland	Highveld	MHGG 3,4	Plain	Floodplain	Floodplain Flat	N/A
HGM 2	Inland	Highveld	MHGG 3,4	Valley floor	Channelled valley-bottom	N/A	N/A
HGM 3	Inland	Highveld	MHGG 3,4	Valley floor	Unchannelled valley-bottom	N/A	N/A
HGM 4	Inland	Highveld	MHGG 3,4	Slope	Seep	WCO	N/A
Group 1b							
HGM 5	Inland	Highveld	MHGG 3,4	Valley floor	Channelled valley-bottom	N/A	N/A
HGM 6	Inland	Highveld	MHGG 3,4	Valley floor	Unchannelled valley-bottom	N/A	N/A
HGM 7	Inland	Highveld	MHGG 3,4	Slope	Seep	WCO	N/A
HGM 8	Inland	Highveld	MHGG 3,4	Bench	Depression	Endorheic	WCO
Group 2a							
HGM 9	Inland	Highveld	MHGG 3,4	Plain	Floodplain	Floodplain Flat	N/A
HGM 10	Inland	Highveld	MHGG 3,4	Valley floor	Channelled valley-bottom	N/A	N/A
HGM 11	Inland	Highveld	MHGG 3,4	Valley floor	Unchannelled valley-bottom	N/A	N/A
HGM 12	Inland	Highveld	MHGG 3,4	Slope	Seep	WCO	N/A
HGM 13	Inland	Highveld	MHGG 3,4	Bench	Depression	Endorheic	WCO
Group 2b							
HGM 14	Inland	Highveld	MHGG 3,4	Valley floor	Channelled valley-bottom	N/A	N/A
HGM 15	Inland	Highveld	MHGG 3,4	Valley floor	Unchannelled valley-bottom	N/A	N/A
HGM 16	Inland	Highveld	MHGG 3,4	Slope	Seep	WCO	N/A
HGM 17	Inland	Highveld	MHGG 3,4	Bench	Depression	Endorheic	WCO
Artificial							
HGM18*	-						

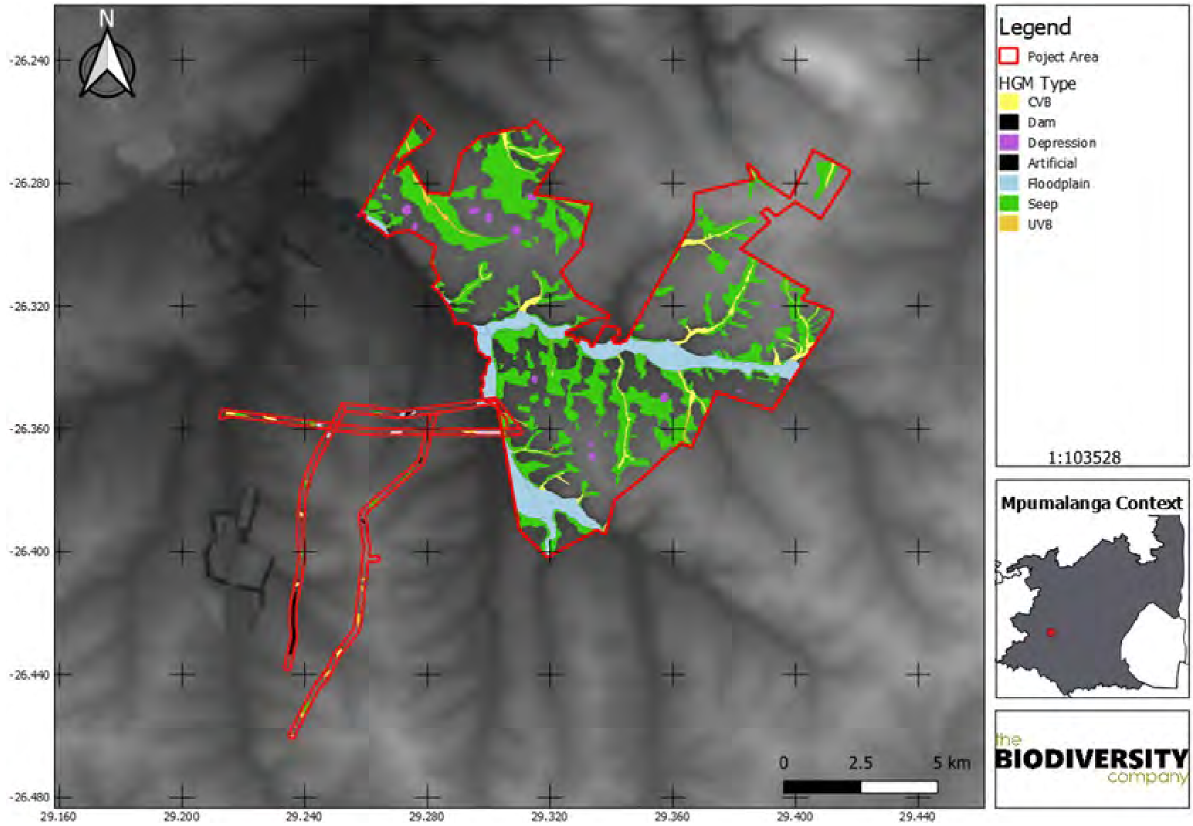


Figure 10-22: Wetland HGM units within the Alexander Mining Project (TBC, 2021a).

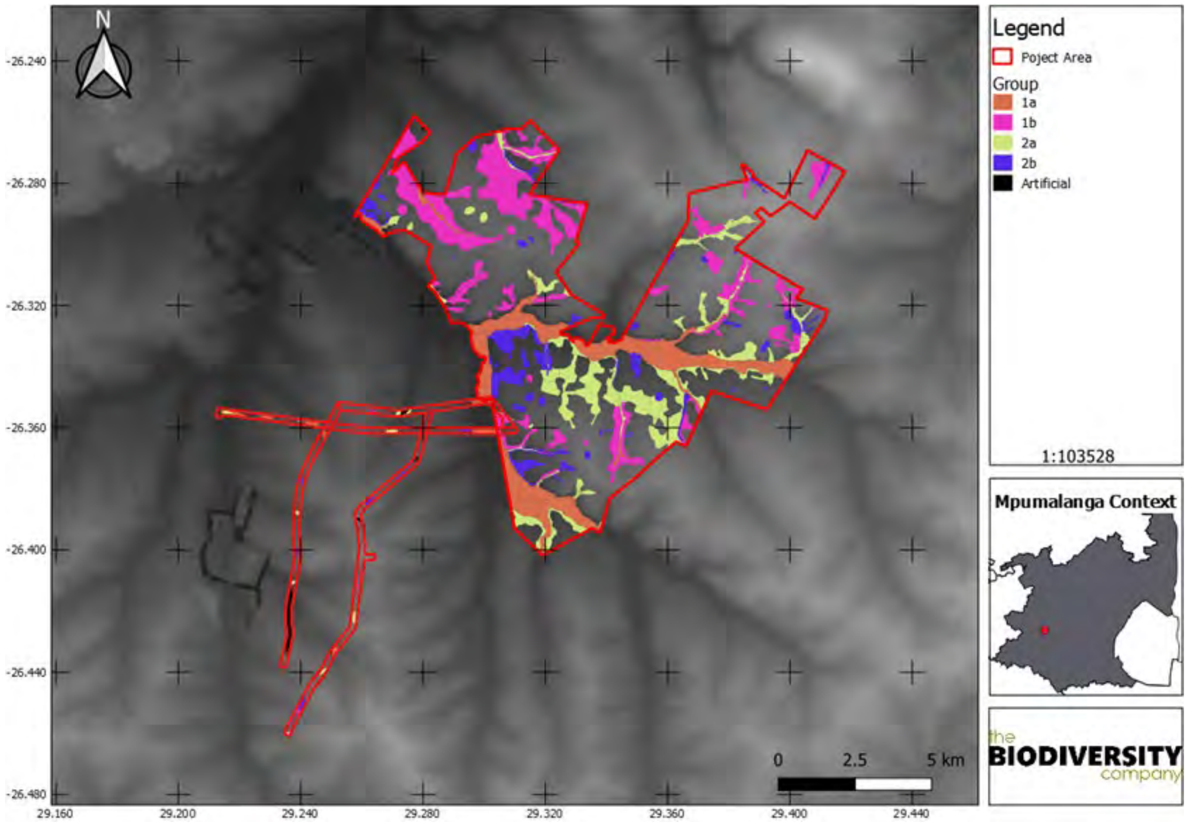


Figure 10-23: **Wetland HGM groups within the Alexander Mining Project (TBC, 2021a).**

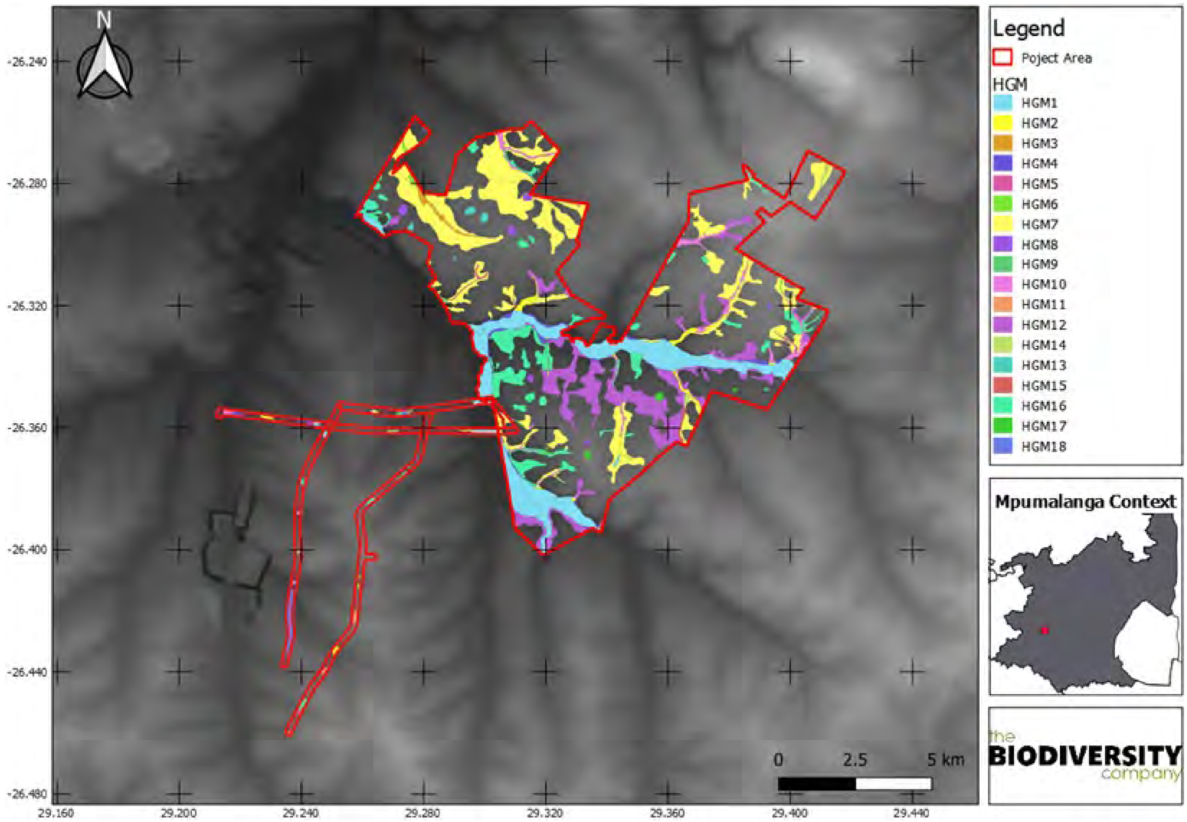


Figure 10-24: Wetland HGM Units within Alexander (gradient in colours represents main groupings. More intact (greens) less intact (purple through reds), artificial wetlands are an exception to this classification and are shown in black (TBC, 2021a).

<u>Wetland Description</u>

<u>Floodplains</u>: Although seven distinct floodplains can be discerned, they can essentially be grouped into two main floodplain systems namely the Steenkoolspruit system and the Piekespruit/Debeerspruit system, both of which merge at a confluence along the western boundary of the project area to continue as the Steenkoolspruit. The main flow paths of each system remain in a relatively intact state. Both are large, well developed and relatively intact floodplains which display typical floodplain features. These include a highly sinuous stream channel, large floodplain depressions and an abundance of well vegetated backwaters and meander cut-offs. These systems are distinctly “U” shaped, well vegetated and are perennially inundated with a large proportion of their flow paths occupied by permanent and seasonal zone vegetation. The tributary floodplains are considerably smaller, narrower and more impacted (by dams and croplands) (TBC, 2021a).

<u>Channelled Valley-Bottoms</u>: Numerous channelled valley-bottom wetlands occur throughout the project area, but in most instances are associated with higher slope gradients. It is likely that most of these systems are naturally channelled, although numerous dams along most of their lengths have undoubtedly contributed to artificially increased bed and bank erosion in some of these wetlands (where outflows are concentrated, and sediment deprived). Many of the channelled valley-bottoms, however, are characterised by a bedrock-dominated flow path which naturally ameliorates the effects of the increased floodpeaks received from the surrounding croplands (TBC, 2021a).

Unchannelled Valley-Bottoms: Most rare are the unchannelled valley-bottoms. They occur mainly in the more natural grassland areas in the south-western regions of the project area and linear infrastructure corridor. They are typically associated with a lower slope gradient than the channelled valley-bottoms (TBC, 2021a).

Seeps: The most numerous and extensive HGM type are the seeps. These are very large seasonally to temporarily inundated wetlands. In the project area they flank most of the floodplain valley-bottom wetlands but also occur on the flatter crest areas in areas where the water table intersects the surface. Rainwater likely contributes most greatly to the recharge of these wetlands, particularly the seasonally-temporarily saturated seeps. However, some seeps particularly those along the northern bank of the Steenkoolspruit show evidence of strong surface-groundwater linkages as evidenced by the presence of several artesian springs. Due to their size and position it is likely that these systems contribute significantly to the recharge and streamflow regulation of the valley-bottom wetlands with which they are associated (TBC, 2021a).

Depressions: Depressions within the project were mainly associated with the plateau areas on hill crests. Their occurrence on flatter ground makes them highly prone to transformation by commercial crop cultivation. This was especially true for some of the shallower less saturated depressions which are harder to distinguish on the ground. Depressions are inward draining basins with an enclosed topography that allows for water to accumulate within the system. Depressions, in some cases, are also fed by lateral sub-surface flows in cases where the dominant geology allows for these types of flows. The depressions in the project area were classified as inward draining (endorheic) systems (TBC, 2021a).

Wetland Ecosystem Services

The ecosystem services provided by the wetlands identified on site were assessed and rated using the WET-EcoServices method (Kotze *et al.* 2008; **Table 10-20**).

A distinct gradient in ecosystem services was identified amongst the wetland groups. Broadly, the more intact and highly saturated wetlands (Group 1a) were found to provide the most important ecosystem services with overall scores varying from Very High to High (depending on the HGM unit) while the most impacted and temporarily saturated wetlands (Group 2b) provide the least important levels of ecosystems services with overall scores of Moderately Low. The two groups in the middle of this spectrum (Groups 1b and 2a) show similar levels of ecosystem provision and scored Intermediate. Although the Group 2a wetlands are more impacted than Group 1b wetlands, their higher saturation levels and vegetation densities mean that they work harder to trap and assimilate nutrients and toxicants that they receive from their catchments than do the more temporary saturated natural wetlands (TBC, 2021a).

Overall, the wetlands within the project area provide important indirect regulating and supporting services relating to flood attenuation, streamflow regulation, sediment trapping and nutrient and toxicant removal. As the wetlands are not situated in a rural community setting (prevailing land use being commercial agriculture and mining) the wetlands are not considered important from a cultural perspective nor in terms the direct provision of water and harvestable resources on a subsistence level. Except for Group 2b the wetlands in the project area all are considered highly important from a biodiversity maintenance perspective, supporting a unique and diverse floral assemblage while providing important foraging, shelter and movement corridors for a wide diversity of wetland associated fauna.

Of all the HGM units, the Group 1 (1a) floodplains in particular, provide the highest levels of ecosystem services with an overall score of High due to their large size, high channel sinuosity, abundance of depressions and largely intact vegetation cover. Specifically, they play an important role in attenuating floods received from their large (often ploughed catchments). They also play an important role in assimilating toxicants received from mining and agricultural practices, supporting unique, charismatic and conservation important biodiversity as well as their aesthetic, recreational (e.g., bird watching and fishing) and educational values.

Next most important are the Group 1-3 (1a, 1b and 2a) valley-bottom wetlands, particularly the unchannelled systems. Their broad, shallow flow paths and high saturation levels allow for the proliferation of wetland vegetation, slow diffuse flows and consequently efficient trapping of sediments and assimilation of nutrients and toxicants. These aspects also make them important from a streamflow regulation perspective.

The Group 1-3 (1a, 1b and 2a) seeps, likely play an important role in stream flow regulation and recharge for the floodplain and valley-bottom wetlands particularly during low flow periods. Additionally, the seeps play a large role in trapping sediments from mining and agriculture due to their diffuse subsurface flow and shallow gradient.

All the depressions are considered important from a sediment trapping perspective, yet the Group 2 (1b) and 3 (2a) depressions also provide important water quality enhancement and biodiversity maintenance benefits.

Table 10-20: The ecosystem services being provided by the identified HGM units within the Alexander Mining Project (TBC, 2021a).

				Wetland Unit	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5	HGM 6	HGM 7	HGM 8	HGM 9	HGM 10	HGM 11	HGM 12	HGM 13	HGM 14	HGM 15	HGM 16	HGM 17
Ecosystem Services Supplied by Wetlands	Indirect Benefits	Regulating and supporting benefits		Flood attenuation	2.7	2.3	2.3	1.9	2.1	2.0	1.7	1.6	2.5	2.3	2.2	1.8	2.0	1.9	1.8	1.6	1.8
				Streamflow regulation	3.0	2.5	2.5	2.5	2.2	2.3	2.2	1.7	2.0	2.8	2.5	2.3	1.7	1.8	2.0	1.8	1.2
			Water Quality enhancement benefits	Sediment trapping	3.6	2.4	2.9	2.8	1.9	2.0	2.1	2.7	2.3	1.7	2.4	2.3	2.8	1.4	1.6	1.7	2.3
				Phosphate assimilation	3.1	1.9	3.2	2.7	1.6	2.1	2.4	2.4	2.0	1.7	2.3	2.1	2.8	1.4	1.7	1.7	1.8
				Nitrate assimilation	3.2	1.9	2.9	2.6	1.5	2.0	2.1	2.1	1.9	1.7	2.3	2.1	2.4	0.9	1.4	1.3	1.3
				Toxicant assimilation	2.8	1.8	2.6	2.4	1.4	1.9	1.9	2.0	2.1	1.8	2.4	2.2	2.5	1.3	1.6	1.5	1.6
				Erosion control	3.3	2.8	3.1	2.8	2.3	2.5	2.3	2.4	2.7	2.0	2.3	2.1	2.4	1.6	1.8	1.3	1.6
				Carbon storage	2.7	2.3	2.3	2.3	1.3	1.7	1.3	1.7	1.7	1.3	1.7	1.3	1.3	0.7	1.0	0.7	0.7
	Direct Benefits			Biodiversity maintenance	4.0	3.8	4.0	3.8	3.5	3.5	3.5	3.3	2.2	3.5	3.5	2.2	1.9	1.1	0.9	0.6	0.6
		Provisioning		Provisioning of water for human use	3.7	2.6	2.6	1.3	1.2	1.4	0.7	0.8	2.0	2.0	2.1	1.1	0.8	0.6	0.8	0.5	0.4
				Provisioning of harvestable resources	2.0	1.4	1.4	1.0	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.8	0.8	0.2	0.2	0.2	0.2
				Provisioning of cultivated foods	1.8	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.2	1.2	1.2	1.2	1.2	0.6	0.6	0.6	0.6
		Cultural		Cultural heritage	1.5	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3
				Tourism and recreation	3.6	2.3	2.4	1.9	2.3	2.0	1.7	2.0	1.6	1.3	0.9	1.0	1.3	0.4	0.4	0.3	0.4
				Education and research	4.0	1.5	2.0	1.5	1.5	2.0	1.5	1.5	1.0	1.0	1.0	1.0	1.0	0.8	0.8	0.8	0.8
				Overall	44.9	30.7	35.5	30.6	25.0	27.6	25.7	26.3	26.4	25.4	27.8	23.7	25.1	15.0	16.9	14.7	15.5
				Average	3.0	2.0	2.4	2.0	1.7	1.8	1.7	1.8	1.8	1.7	1.9	1.6	1.7	1.0	1.1	1.0	1.0

Wetland Health

The PES of the wetlands identified within project area is provided in **Table 10-21** to **Table 10-24**, and can be seen in **Figure 10-25**. Overall, Group 1 (a and b) wetlands are the most intact varying between Largely Natural (HGMs 2, 4 and 7) to Moderately Modified (HGMs 1, 3, 5, 6 and 8) while Group 2 (a and b) wetlands varied between Largely Modified (HGMs10,11,12,13 and 15) and Seriously Modified (HGMs 9, 14, 16, 17). In short, the most intact wetlands are the Group 1 channelled valley-bottoms and seeps (situated in the west along the proposed linear infrastructure corridor) while the most impacted wetlands are the Group 2b seeps and depressions which have been completely transformed by crop cultivation (TBC, 2021a).

All the wetlands within the project area are subject to similar catchment impacts but vary in terms of the intensity and proximity of these impacts. Catchment impacts centre on the conversion of large areas of mesic highveld grassland to commercial crop cultivation and, in places coal mining but also include encroachment by alien and invasive species (AIS) and the presence of impeding features such as roads and dams. Commercial crop production has led to the creation of vast exposed soil surfaces during intercrop periods which increase the runoff potential of the catchment. This in turn increases the potential for erosion in the steeper valley-heads while heightening sediment deposition towards the toes of lower energy wetlands (TBC, 2021a).

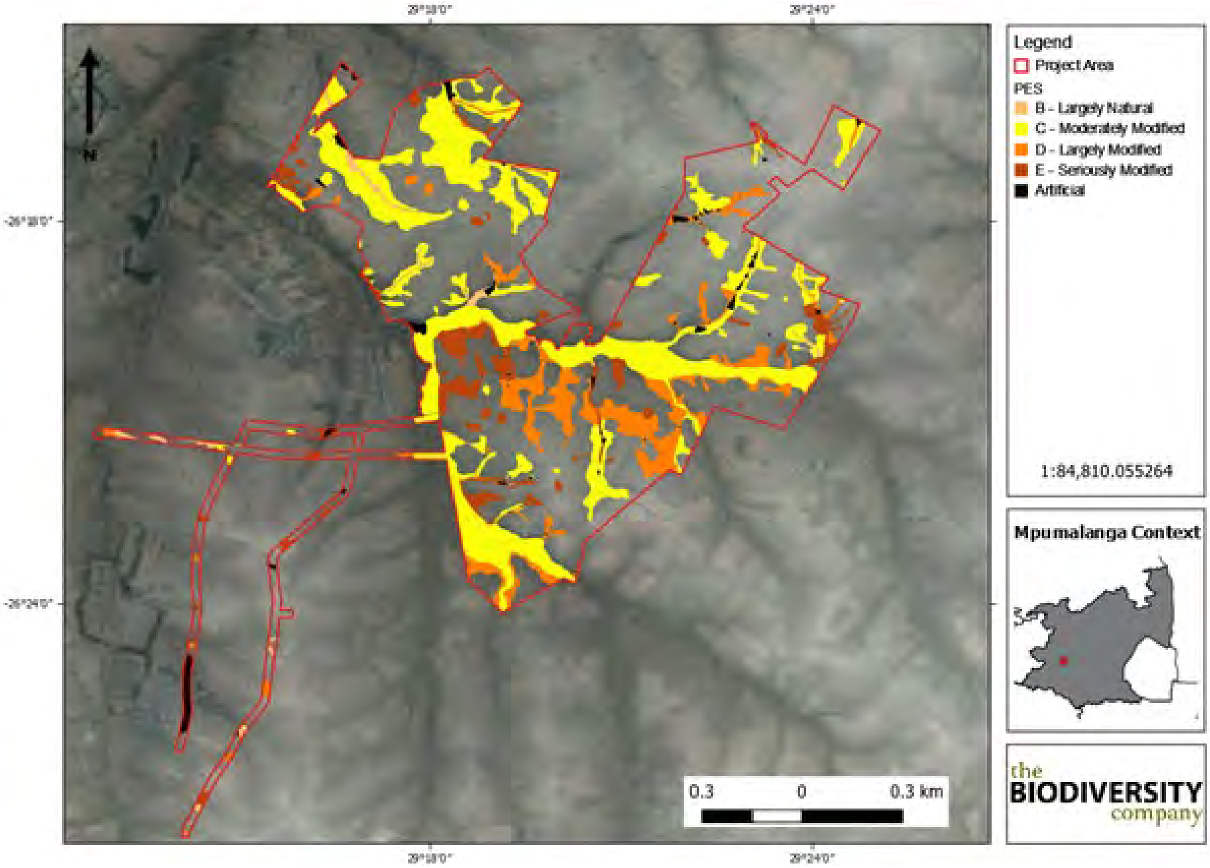


Figure 10-25: **Spatial representaion of Wetland PES (TBC, 2021a).**

Table 10-21: PES scores for Group 1a HGM and rationale behind rating (TBC, 2021a).

Unit	Description	PES			
		H	G	V	Overall
Group 1a					
HGM1 (F)	The upper catchments of the Steenkoolspruit and Piekespruit have a catchment, that although dominated by commercial crop cultivation, is largely devoid of surface mining operations, industrial and high-density residential developments and their associated water deteriorating effects. Alien bush clumps are present but very few and scattered. Dams present but mostly free of large impoundments. Naturally channelled, high channel sinuosity, depressions abundant. Grazing intensity high.	3.5 Moderately Modified (Class C)	1.4 Largely Natural (Class B)	1.6 Moderately Modified (Class C)	2.4 Moderately Modified (Class C)
HGM2 (CVB)	Mostly situated in north-eastern parts of proposed mining area and linear corridors. These systems remain in a largely natural state. Catchments mostly devoid of infrastructure and heavy industry. Most of their catchments are under non-irrigated commercial crop cultivation (mainly maize but also soya on turf soils). Exposed soil surfaces therefore comprise a large proportion of the catchment during intercrop periods. This makes these systems prone to increased floodpeaks from runoff and sediment deposition, but they appear to have a large enough buffer and low enough catchment slope to ameliorate this. No obvious signs of artificial inundation from mining, waste-water treatment works or residential developments. Moderate sized dams occur on some of the HGM2 wetlands but does not appear to be adversely affecting geomorphology through downstream erosion and the dams are not intensively abstracted from due to the no irrigation cultivation practices. Aside from a few dams no other obvious signs of channel straightening or modification. Slight sediment deposition accumulation in dams. Vegetation is largely intact. Alien bush clumps (mainly *Eucalyptus*) present but very few, small and scattered, mainly associated with homesteads. Encroachment by other non-woody AIS low. Grazing intensity moderate-high.	3 Moderately Modified (Class C)	0.5 Largely Natural (Class B)	1.7 Largely Natural (Class B)	1.9 Largely Natural (Class B)
HGM3 (UVB)	Located on the far southern and western portions of the linear corridor. Their catchments remain largely intact comprised mostly of grassland, and although some crop cultivation is present they remain devoid of heavy industry. Large sand roads bisect some of these wetlands. Minor erosion is present in the southern-most wetland due to the impeding nature of the sand roads. These wetlands also have small alien bush clumps in their upper catchments. Dams are absent. Floodpeaks not increased significantly. Sediment regime tends towards a losing environment. Grazing intensity is low. These systems may be prone to erosion if catchment bare or hardened surface increase any more in catchment.	3 Moderately Modified (Class C)	2.3 Moderately Modified (Class C)	0.9 Largely Natural (Class B)	2.2 Largely Natural (Class B)
HGM4 (S)	Located along western regions of linear corridor. Minimal catchment impacts. No artificial water inputs. Catchment mainly grassland, minimal hardened, bare and exposed soil surfaces. Low floodpeak potential. Little to no evidence of erosion. Vegetation integrity intact, high diversity hydromorphic grassland which supports several orchid species suggesting low levels of past soil disturbance. Grazing intensity low.	1 Largely Natural (Class B)	1.2 Largely Natural (Class B)	0.5 Largely Natural (Class B)	0.9 Largely Natural (Class B)

Table 10-22: PES scores for Group 1b HGM units and rationale behind rating (TBC, 2021a).

Unit	Description	PES H	PES G	PES V	PES Overall
Group 1b					
HGM5 (CVB)	Two channelled valley-bottom wetlands. Catchments impacted by terraced crop cultivation practices but no heavy industry in catchment. Grazing pressure high. This together with large areas of exposed soil in catchment during intercrop periods make these wetlands prone to erosion. Both show signs of the start of significant headcut erosion near toe. Gulley formation in catchment. Vegetation largely devoid of alien bush clumps and other non-woody AIS.	3.5 Moderately Modified (Class C)	2.17 Moderately Modified (Class C)	2.5 Moderately Modified (Class C)	2.8 Moderately Modified (Class C)
HGM6 (UVB)	All of these wetlands have small catchments and are predominantly seasonal to temporarilyy saturated. Catchment impacted by terraced commercial crop cultivation yet lacks heavy industry. Alien bush clumps (*Eucalyptus*) present and abundant. No obvious signs of artificial water inputs. No obvious signs of erosion. Grazing intensity low.	3 Largely Modified (Class D)	0.55 Largely Natural (Class B)	1.15 Largely Natural (Class B)	1.8 Largely Natural (Class B)
HGM7 (S)	Widely distributed throughout the project area. However, the largest examples are found in the north-western region. Like all of the wetlands in the project area the catchments of these seeps are impacted by commercial crop cultivation. However, they remain devoid of heavy industry. Like most in the area the croplands are mainly reliant on rainwater and do not intensively irrigate. These seeps themselves, however, remain largely devoid of cultivation and support a moderately diverse hydromorphic grassland. Their predominantly seasonal to temporary saturation levels, do however make them prone to future transformation. Some of the wetland vegetation has been slightly impacted by pasture grass cultivation. Grazing pressure is moderate and a decrease in surface roughness apparent. Few signs of significant erosion. Potential for deleterious floodpeaks, in their current state is low due to sufficient vegetation buffers. Prevalence of AIS is low.	4 Largely Modified (Class D)	1.125 Largely Natural (Class B)	2.05 Moderately Modified (Class C)	2.6 Moderately Modified (Class C)
HGM8 (D)	Similar impacts to HGM 7	4 Largely Modified (Class D)	1.1 Largely Natural (Class B)	2.1 Moderately Modified (Class C)	2.6 Moderately Modified (Class C)

Table 10-23: PES scores for Group 2a HGM Units and rationale behind the rating (TBC, 2021a).

Unit	Description	PES H	PES G	PES V	PES Overall
Group 2a					
HGM9 (F)	These are relatively small floodplains. All of which are impacted by the presence of multiple moderate to large dams. Significant impeding features such as these dams as well as large roads have altered the sediment regime and created sediment deprived concentrated flows downstream of them with erosive consequences. Channel erosion is significant and noticeable in terms of bank incisement yet high grass sward density and soil stability preclude the formation of peripheral gullies. Alien bush clumps are present in high enough densities to likely have a small impact on water quantity. All of the floodplains have catchments that are impacted by commercial crop cultivation, but some are also impacted by mining activities. The geomorphology of the lower reaches of the Steenkoolspruit in the north has been visibly impacted by past flow	7.5 Seriously Modified (Class E)	4.55 Largely Modified (Class D)	6.35 Seriously Modified (Class E)	6.3 Seriously Modified (Class E)

Unit	Description	PES H	PES G	PES V	PES Overall
	path modifications, rehabilitation efforts and channel diversion. The hydromorphic vegetation reflects past disturbances in that it portrays a visibly lower diversity of species and an increased prevalence of non-woody AIS. Grazing intensity is low.				
HGM10 (CVB)	Small to moderately sized channelled valley bottoms. All are impacted by dams within the HGM unit. All have catchments impacted by commercial crop cultivation but none are impacted by heavy industry. No obvious artificial inputs are evident. The dams are, however, mostly small. Impeding features, although present, have not had a major impact on downstream channel geomorphology. One aspect common to all of these wetlands, however, is that they show signs of past soil disturbance. Consequently, their vegetation integrity has been largely modified in terms of diversity, yet AIS remain relatively under control. Minimal channel straightening or canalisation has occurred. Grazing intensity is moderate.	4 Largely Modified (Class D)	2.92 Moderately Modified (Class C)	5.1 Largely Modified (Class D)	4.0 Largely Modified (Class D)
HGM11 (UVB)	These two, small, unchanneled valley bottom wetlands are situated on the southern-most end of the linear corridor. Both are bisected by a large regional sand road which acts as a significant impeding feature, causing flow path erosion downstream of it. Both have catchments impacted only by commercial crop cultivation which does, however, take up almost all their catchment. Both systems are prone to increased floodpeaks and, during the wet season, sedimentation. Portions of either system show signs of past soil disturbance. No signs of artificial water inputs. Alien bush clumps absent and non-woody AIS encroachment moderate to low. Grazing pressure is also low.	6 Seriously Modified (Class E)	2.8 Moderately Modified (Class C)	2.4 Moderately Modified (Class C)	4.1 Largely Modified (Class D)
HGM12 (S)	The catchments of these seeps have been heavily and almost entirely impacted by commercial crop cultivation. Alien bush clumps are present but few, scattered and likely to have negligible impacts on water losses, however the increased evapotranspirative losses associated with the croplands likely do. No artificial water inputs are evident. The setting remains rural and no heavy industry is present within the catchments. The buffers of these wetlands have been heavily encroached upon by the croplands. Although some of the wetlands have been cultivated, large tracts of cropland-free wetland still persist. Erosion is present but slight. Grazing intensity is Moderate. Vegetation integrity has been somewhat compromised by the crop cultivation and is encroached in most places by weedy annuals.	6.5 Seriously Modified (Class E)	2.025 Moderately Modified (Class C)	3.95 Moderately Modified (Class C)	4.5 Largely Modified (Class D)
HGM13 (D)	These depressions are situated mainly in the north-western region of the project area and are subject to much the same impacts as faced by the seeps except for having a somewhat more impacted sediment regime which, due to their endorheic drainage patterns, tends towards sediment accumulation from the surrounding croplands.	6.5 Seriously Modified (Class E)	2.83 Moderately Modified (Class C)	3.95 Moderately Modified (Class C)	4.7 Largely Modified (Class D)

Table 10-24: PES scores for Group 2b HGM units and rationale behind the rating (TBC, 2021a).

Unit	Description	PES H	PES G	PES V	PES Overall
Group 2b					
HGM14 (CVB)	These seasonally to temporarily inundated channelled valley-bottoms are small, narrow and have been heavily impacted by crop cultivation. Minimal to no wetland buffer remains. Natural hydromorphic vegetation remains but has been heavily encroached by non-woody AIS. These wetlands are prone to erosion. Grazing intensity is low.	7.5 Seriously Modified (Class E)	3 Moderately Modified (Class C)	5.7 Largely Modified (Class D)	5.7 Largely Modified (Class D)

Unit	Description	PES			
		H	G	V	Overall
HGM15 (UVB)	These wetlands are also heavily but not entirely impacted by crop cultivation. No artificial water inputs are evident. Natural hydromorphic vegetation remains but is encroached by non-woody AIS. Grazing pressure is low. These wetlands are prone to sediment accumulation from the surrounding croplands.	4 Largely Modified (Class D)	3.1 Moderately Modified (Class C)	5.6 Largely Modified (Class D)	4.2 Largely Modified (Class D)
HGM16 (S)	Almost all of the temporary to seasonally inundated seeps have been completely transformed by crop cultivation. They are difficult to discern to the untrained eye especially without soil sampling. Consequently, they are prone to ploughing over. Almost no natural hydromorphic vegetation remains in these wetlands. The tillage practices associated with the croplands have drastically altered the distribution and retention time of water in these wetlands, artificially increasing their drainage and decreasing their retention times. Consequently, the vegetation integrity is highly to completely compromised and no longer functional.	9 Seriously Modified (Class E)	5.18 Largely Modified (Class D)	8 Seriously Modified (Class E)	7.6 Seriously Modified (Class E)
HGM17 (D)	These depressions face much the same impacts as the Group 4 (HGM 16) seeps and are likewise Seriously Modified.	9 Seriously Modified (Class E)	5.18 Largely Modified (Class D)	8 Seriously Modified (Class E)	7.6 Seriously Modified (Class E)

Wetland Importance and Sensitivity

The results of the IS assessment are shown in and **Table 10-25**. From a regional perspective the MPHG dataset recognises floodplains within the upper reaches of the Debeerspruit as wetland FEPAs. These occur along the southern boundary of the project area. According to the NFEPA Wetveg dataset, the linear infrastructure corridor and the rest of the project area are zoned under Mesic Highveld Grasslands Group (MHGG) 3 and 4 respectively. In these areas all wetland hydrogeomorphic types are considered Critically Endangered and Not Protected, except for seeps in MHGG 4 which are Endangered and Not Protected (Nel and Driver, 2012).

It is important to note that the floodplain wetlands and the catchments that occur within the MRA have been officially recognised and gazetted as priority wetlands and catchments respectively.

At a local scale, a gradient in IS was uncovered among the wetland groups with scores decreasing from Group 1a to Group 2b. Scores varied from Very High (HGMs 1-3) through High (HGMs 4-9 and 11) and Moderate (HGMs 12-15 and 10) to Low (HGMs16 and 17).

Wetlands with a Very High IS were restricted to Group 1a floodplains and valley-bottoms. These highly saturated, largely natural to modified wetlands represent some of the most intact wetland habitat in the region, providing ideal habitat for most of the regionally occurring conservation important biodiversity. Wetland and biodiversity work by TBC in these wetlands has revealed resident populations of Cape Clawless Otter (*Aonyx capensis*), Serval (*Leptailurus serval*), Caracal (*Caracal caracal*), Brown Hyaena (*Hyaena brunnea*), Secretarybird (*Sagittarius serpentarius*) Blue Korhaan (*Eupodotis caerulescens*) (TBC, 2021a).

Wetlands with a High IS were mostly Group 1b wetlands but also included HGM 4 and 11. Although mainly temporarily saturated (except for HGM 4 and 11), these wetlands remain predominantly natural and provide suitable habitat for several conservation important species. During fieldwork HGM 4 was found to support several species of orchids (e.g. *Habenaria epipactidea* and *Eulophia ovalis var. ovalis*). Most of these wetlands also support extensive swathes of dense *Imperata cylindrica*, the breeding habitat frequented by African Grass Owl (*Tyto capensis*). Indeed, a pair of Grass Owls were flushed from the upper-most reaches of HGM 7 during a TBC survey in 2018. The current fieldwork did not yield direct observations but signs of their presence (i.e. runs and landing aprons) persist in this wetland (TBC, 2021a).

Except for HGM 16 and 17, all other wetlands are of Moderate IS. These wetlands are noticeably impacted yet still retain enough natural habitat to remain ecologically functional and provide important movement corridors for local fauna in a landscape dominated by commercial crop cultivation. In contrast, the ecological integrity of HGMs 16 and 17 is severely compromised with little or no remaining natural wetland habitat and therefore importance to wetland associated biota.

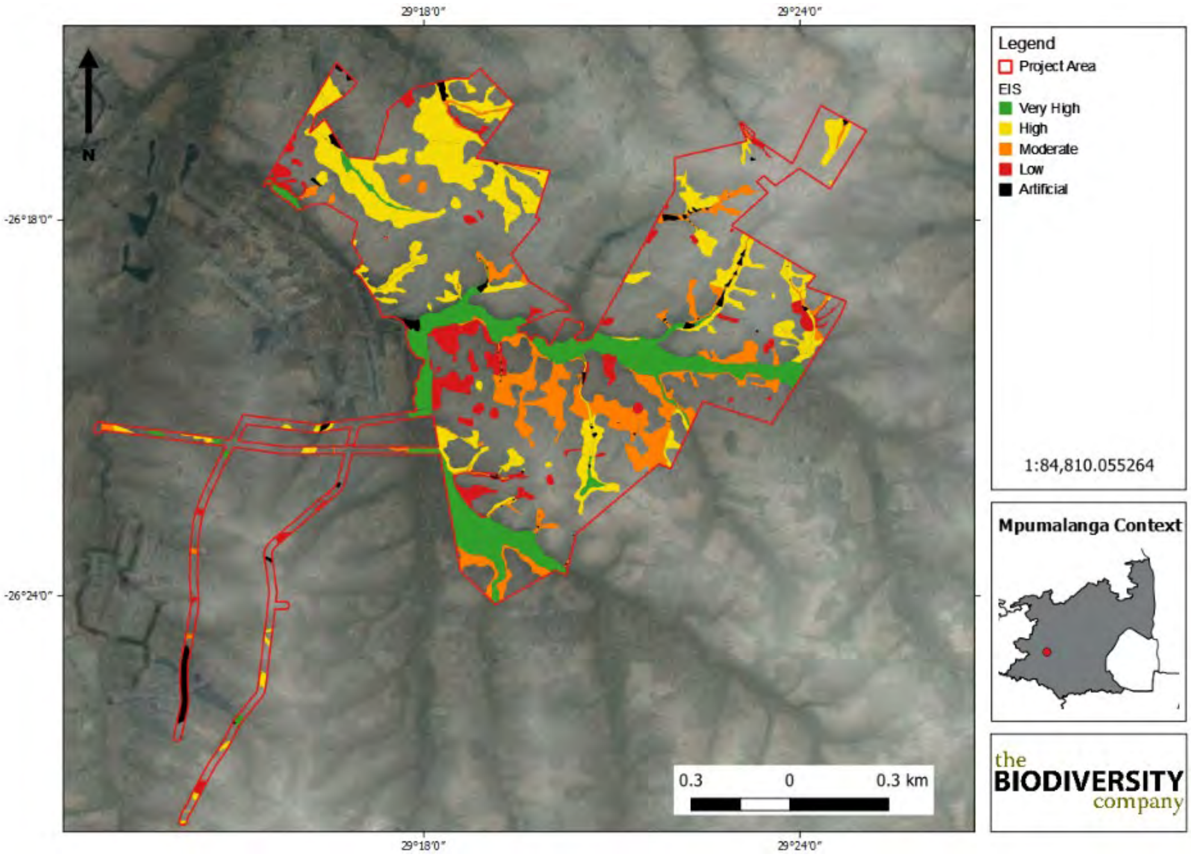


Figure 10-26: **Spatial representation of Wetland IS (TBC, 2021a)**

Table 10-25: **Importance and Sensitivity results for the wetland area (TBC, 2021a).**

Wetland Importance and Sensitivity	Group 1a				Group 1b				Group 2a					Group 2b			
	HGM 1	HGM 2	HGM 3	HGM 4	HGM 5	HGM 6	HGM 7	HGM 8	HGM 9	HGM 10	HGM 11	HGM 12	HGM 13	HGM 14	HGM 15	HGM 16	HGM 17
Ecological Importance & Sensitivity	4.0	3.3	3.7	2.7	3.0	3.0	2.7	2.7	2.3	2.0	2.3	1.6	1.4	1.7	1.7	1.0	1.0
Hydrological/Functional Importance	3.0	2.2	2.7	2.5	1.8	2.1	2.0	2.1	2.2	1.9	2.3	2.0	2.2	1.4	1.6	1.4	1.5
Direct Human Benefits	0.5	1.5	1.6	1.1	0.5	1.3	1.0	1.1	0.5	1.1	1.0	0.9	0.9	0.5	0.5	0.4	0.4

10.1.1.7. Groundwater

Aquifer types

The Alexander mining area is situated on the interbedded siltstone/sandstone and shale of the Vryheid Formation. Three aquifers were identified underlying the Alexander mining area. These aquifers include (J&W, 2021c):

Weathered Aquifer (Karoo Formations): A shallow, weathered aquifer exists in the weathered shale and sandstone at an average depth of 10m – 20m below ground level. The most consistent water strike is located at the fresh bedrock / weathering interface.

Fractured Aquifer (Karoo Formations): The primary porosity of the Vryheid Formation is very low. Any water bearing capacity is therefore associated with secondary joints, bedding planes and faults. The contact zones of dolerite intrusions are characterised by cooling joints and fractures, which are considered the primary source of groundwater flow within the deeper formations.

Mined-Out Void: An artificial groundwater system developed during the mining process. As the mining of coal progresses, a void will open that changes the hydrodynamics of the overlying aquifers. Additionally, any subsidence, goafing and/or pillar failure that may take place as a result of mining, is likely to compromise the integrity of the hanging wall above the mine and may change its hydraulic parameters by orders of magnitude. This is likely to have a marked influence on water levels and potential mine water discharge areas.

Aquifer classification

Based on information collected during the hydrocensus it can be concluded that the aquifer system in the study area can be classified as a "Minor Aquifer System".

Aquifer parameters

A summary of the hydraulic conductivities determined by (2003) for the study area are summarised in **Table 10-26**. Tests performed on a combination of sandstone / shale / coal / dolerite layers yielded a K-value of 0.0035 m/day. Similarly, test performed on sandstone layers, coal and dolerite individually yielded K-values of 0.0026, 0.30 and 0.032 m/day, respectively.

JMA (2003) proposed hydraulic conductivity values for the shallow aquifers, deep aquifers and coal seams of the study area, based on averages of geometric and harmonic means of collected data. These K-value are as follows, 0.02 m/day for the shallow weathered zone aquifers, 0.0035 m/day for the deep Karoo aquifers and 0.3 m/day for the coal seams.

Table 10-26: Hydraulic conductivity values (JMA, 2003).

Lithology	Hydraulic Conductivity (K) (m/day)
Sandstone / Shale / Coal / Dolerite	0.0035
Sandstone	0.0026
Coal	0.3000
Dolerite	0.032

JMA (2003) conducted porosity tests on a total of 34 samples of the main sandstone units of the study area. The findings are shown in **Table 10-27**. The average porosity for the sandstone units within the study area is 6.7%, or 0.067.

Table 10-27: Porosity of sandstone units (JMA, 2003).

Lithology	Minimum	Maximum	Average
Fine-grained sandstone	1.6%	11.4%	5.4%
Medium to coarse-grained sandstone	4.7%	14.5%	9.3%
Average	1.6%	14.5%	6.7%

The large range in porosity for the fine and medium grained sandstone is a function of the degree of weathering. It also depends on the extent (depth) of weathering. The difference in porosity between the different grain-size sandstones is evident (JMA, 2003).

The average effective porosity (neff) for the shallow weathered zone is approximated as 3%, and the average effective porosity (neff) for the deep Karoo aquifer zone is taken as 0.67% (JMA, 2003).

The Storativity (S) or Storage Coefficient was not tested on site, but values from other studies in the area are available. Rison Groundwater Consulting (2007) estimated the storativity of the perched / weathered zone aquifers as 5×10^{-3} and the storativity of the fractured rock as 5.0×10^{-5}. The Storativity of the coal is approximated at 5×10^{-2}, while the storativity of the dolerite is 5.0×10^{-6}. These values are estimated by professional judgement and form potential parameters for calibration.

Groundwater vulnerability

Aquifer vulnerability assessment indicates the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer.

The aquifer vulnerability for a contaminant released from surface to a specified position in the groundwater system after introduction at some location above the uppermost aquifer was determined using the criteria described below and assuming a worst-case scenario (J&W, 2021c):

- Highly vulnerable (> 60), the natural factors provide little protection to shield groundwater from contaminating activities at the land surface.
- Medium Vulnerable = 30 to 60%, the natural factors provide some protection to shield groundwater from contaminating activities at the land surface, however based on the contaminant toxicity mitigation measures will be required to prevent any surface contamination from reaching the groundwater table.
- Low Vulnerability (< 30 %), natural factors provide relatively good protection and if there is little likelihood that contaminating activities will result in groundwater degradation.
- The Groundwater Decision Tool (GDT) calculated a vulnerability value of **52%**, which is medium.

Aquifer protection

A Groundwater Quality Management Index (GQMI) of 4 was estimated for the study area from the ratings for the Aquifer System Management Classification. According to this estimate a **medium-level groundwater protection** is required for the aquifer. Reasonable and sound groundwater protection measures based on the modelling will therefore be recommended to ensure that no cumulative pollution affects the aquifer, even in the long term.

DWA's water quality management objectives are to protect human health and the environment. Therefore, the significance of this aquifer classification is that measures must be taken to limit the risk to the following environments:

- The protection of the underlying aquifer.

Groundwater gradients, levels, and flow

The first important aspect when evaluating the hydrogeological regime and groundwater flow mechanisms is the groundwater gradients. Groundwater gradients, taking into consideration fluid pressure, are used to determine the hydraulic head which is the driving force behind groundwater flow. The flow governs the migration of contaminants, and a detailed assessment of the flow is required to determine sub-surface flow directions from the mines and potential contaminant sources (J&W, 2021c).

In most geological terrains, the groundwater mimics the topography and to test if this is the case within the study area the available groundwater levels, based on the hydro censuses, were plotted against the topography (represented by the borehole collar elevations). The result of this assessment is presented in **Figure 10-27**. This graph indicates a very good correlation (96%) between the topography and the groundwater level, which suggests that groundwater flow will follow the topographical gradient.

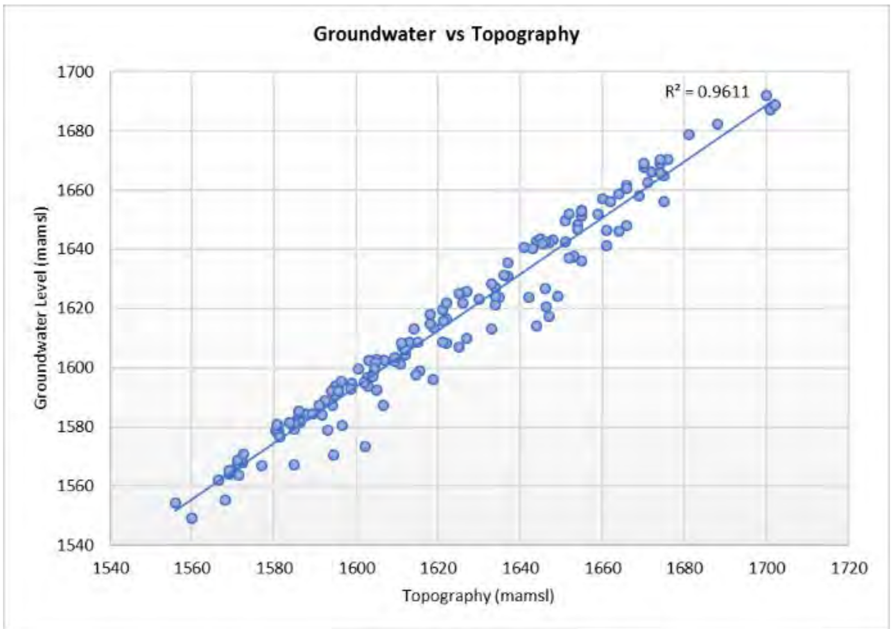


Figure 10-27: Correlation between topography and groundwater level (J&W, 2021c).

Groundwater recharge

Recharge is defined as the process by which water is added from outside to the zone of saturation of an aquifer, either directly into a formation, or indirectly by way of another formation. Approximately 15.64 mm/a of precipitation was calculated to recharge to the groundwater system.

Recharge to the weathered-fractured aquifer was also calculated to equate to approximately 5% as can been seen in **Table 10-28**.

Table 10-28: Recharge calculation for the shlaoow unconfined aquifer (J&W, 2021c).

Recharge Estimation			
Method	mm/a	% of rainfall	Certainty (Very High = 5; Low = 1)
Various schematic maps			
Soil	48.9	6.9	3
Geology	10.1	3.5	2
Vegter	65	9.1	3
Acru	60	8.4	3
Harvest Potential	50	7.0	3

Groundwater quality

An assessment of the background water quality was based on the sampling of external user's boreholes which are located within the Alexander coal reserve and surrounding area. The chemistry results have been tabulated and screened using the Dixon outlier test as a first measure to eliminate potential impacted boreholes (EPA, 2009). The elimination process was applied to all the groundwater constituents for which sufficient data had been recorded. From these results a generalised water quality signature has been included in **Table 10-29**.

Table 10-29: Summary of the background groundwater quality data (J&W, 2021c)

Variable	Minimum	Median	Average	Maximum
pH	6.97		7.7	8.3
EC	21	75	77	166
TDS	137	452	480	1048
Ca	25	63	74	147
Mg	8.3	25	35	87
Na	14	50	63	174
K	0.57	3.6	4.1	12
Si	6.2	17	16	27
Total Alkalinity	66	303	295	524
Cl	3.8	19	45	157
SO4	3.6	53	62	198
NO3 as N	0.040	2.5	5.0	25
F	0.040	0.16	0.22	0.59
Al	0.011	0.010	0.014	0.020
Fe	0.010	0.040	0.036	0.080
Mn	0.010	0.010	0.018	0.060

In addition to the statistical evaluation of the background groundwater quality, a Piper diagram was constructed to evaluate the background signature – **see Figure 10-28**. It is noted that the median water signature has been added to the piper diagram

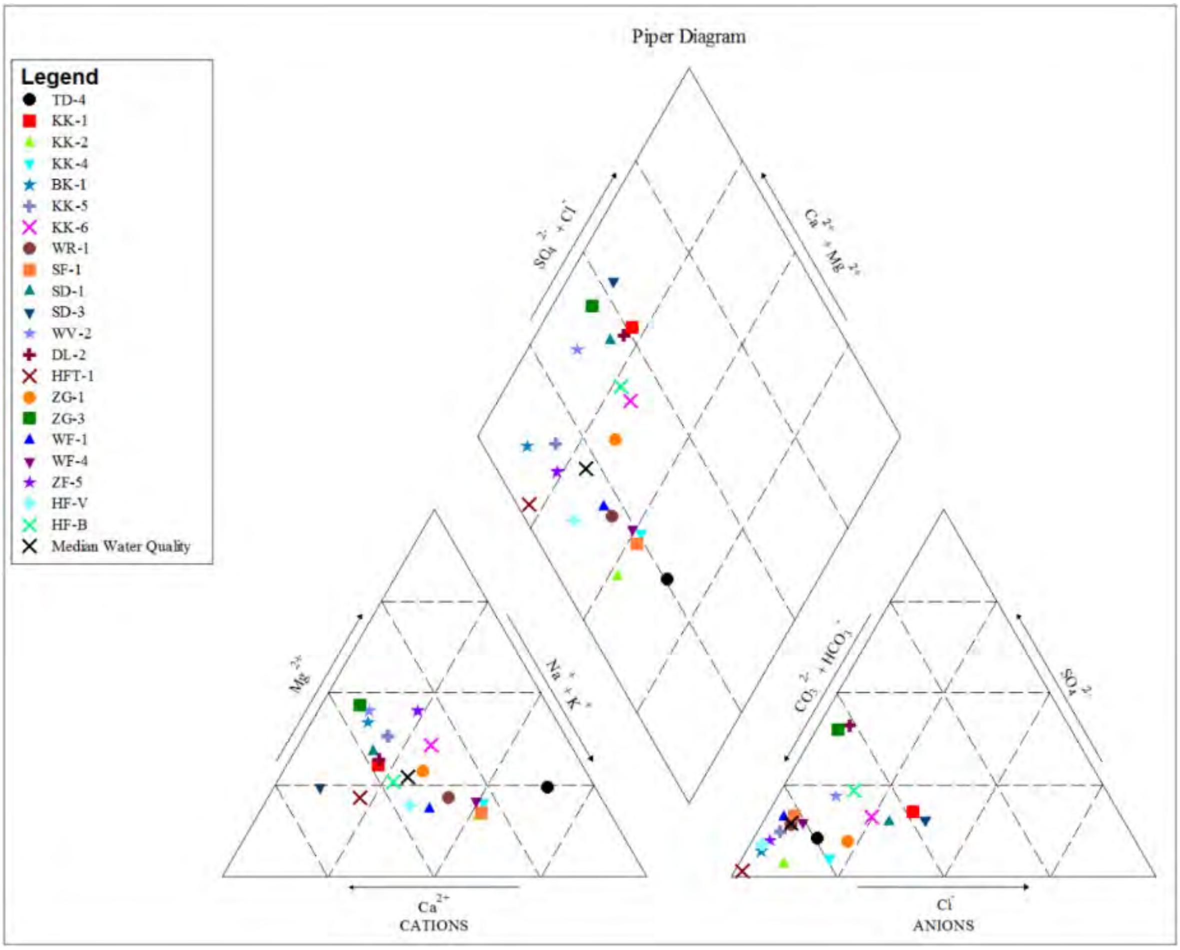


Figure 10-28: **Piper diagram for the background groundwater chemistry (J&W, 2021c).**

10.1.1.8. *Aquatic Ecosystems*

The totality of the delineated Sub Quaternary Reaches (SQR's) associated with the project area were sampled in 2016-2017. The layout of the sampling points and details of the points are represented in **Figure 10-29.** For the purposes of this assessment the B11C-1472 and B11C-1501 are referred to as the Piekespruit for this study (TBC, 2021b).

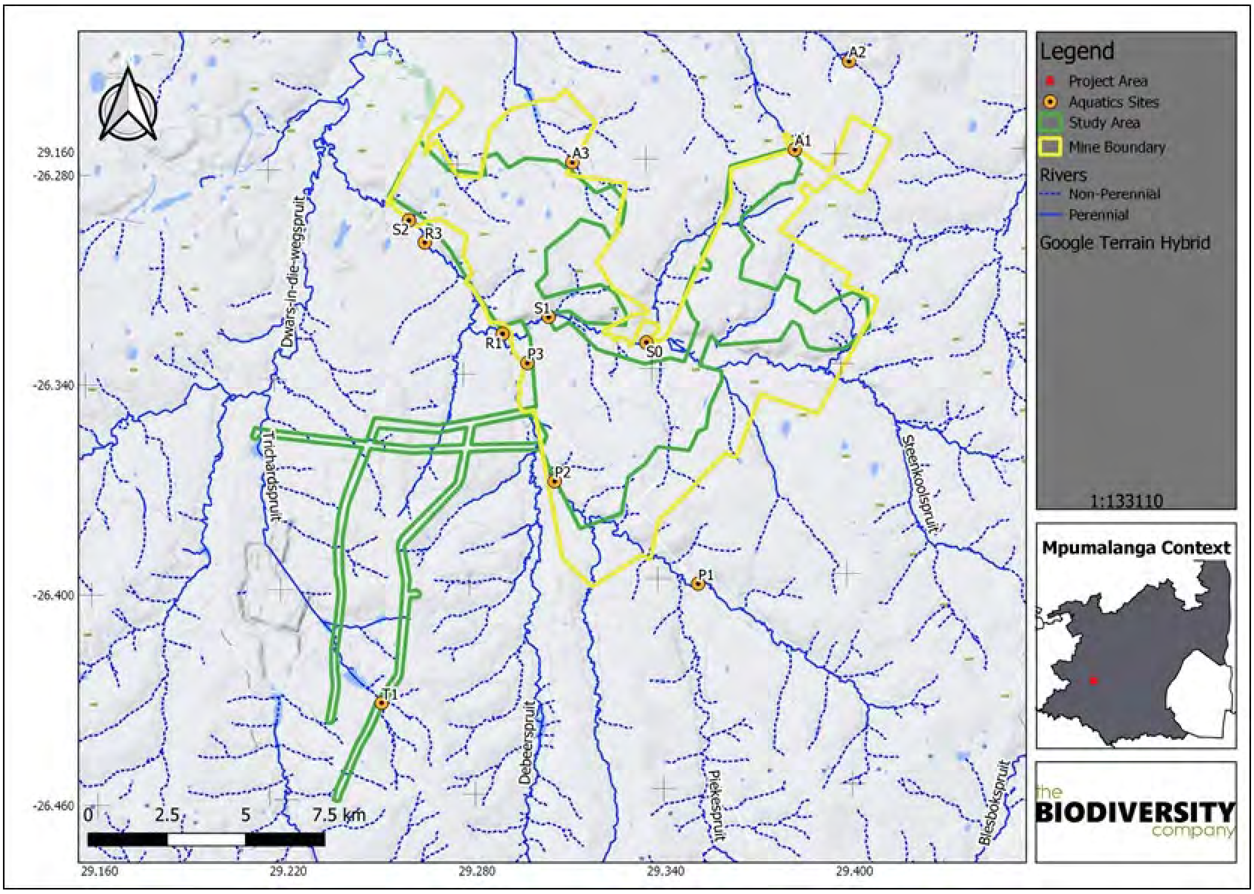


Figure 10-29: The localion of Alexander and the assessed sites (TBC, 2021b).

In situ water quality

In situ water quality analysis was conducted during the study at multiple points along the watercourses in the project area which contained water. Results have been compared to limits stipulated in the Target Water Quality Range (TWQR) for aquatic ecosystems (DWAF, 1996). The results of the June 2018 and January 2021 assessment are presented in **Table 10-30**. Sites A1, A2 and A3 were omitted as the downstream cumulative effects were focussed on with upper reaches baseline covered in 2018. These sites only contained pools in 2018 and therefore were not considered to add value to the updated baseline.

Table 10-30: In situ surface water quality results (June 2018 and January 2021) (TBC, 2021b).

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
TWQR*	6.5-9.0	** ≤ 1110	>5.00	5-30
June 2018				

Site	pH	Conductivity (µS/cm)	DO (mg/l)	Temperature (°C)
P1	8.6	631	7.9	10
P2	7.8	590	8.2	14
P3	7.8	636	7.6	15
S1	7.7	601	7.5	15
S2	7.8	650	6.1	14
A1	6.7	809	5.1	13
A2	7.7	463	6.2	12
A3	6.5	442	5.4	10
		January 2021		
P1	8.17	291	6.4	24.1
P2	8.39	539	5.7	25.2
P3	8.20	589	5.8	23.7
S0	8.29	724	6.2	25.3
S1			No access	
S2	8.30	677	5.7	23.3
R1	7.99	632	3.3	23.9
R3	8.36	661	6.1	23.5
T1	7.81	910	9.2	22.2

*TWQR – Target Water Quality Range; ** Resource Quality Objective (DWS, 2016b) Levels exceeding guideline levels are indicated in red

The water quality results derived pH values ranging from 8.6 at P1 to 6.5 at A3 in 2018 and from 8.39 at P2 to 7.81 at T1 in 2021. The levels of pH were determined to be within the guideline values stipulated in the Target Water Quality Range for aquatic ecosystems (TWQR, DWAF, 1996). The concentrations of dissolved solids as measured in conductivity were found to range from 809 µS/cm at A1 to 442 µS/cm at A3 in 2018 and from 910 µS/cm at T1 to 291 µS/cm at P1 in 2021. The dissolved solids as measured by electrical conductivity were determined to be within the RQOs for the catchment (DWS, 2016b). The concentration of dissolved oxygen was found to be above threshold effect concentrations throughout the project areas and deemed suitable fort aquatic biota (DWAF, 1996). The only exception to this is R1 sampled in 2021 which is suspected to result from inundation resulting in a dam which have naturally low dissolved oxygen levels due to lack of flow and differentiation in the water column (Carr *et al*., 2020). Sites up and downstream have levels which are within TWQR guidelines. The water temperatures observed during the two surveys indicated typical seasonal results.

The levels of dissolved solids obtained from this study indicated modified water quality from what would be expected in source zones, which would typically have dissolved solid levels of less than 100 µS/cm. Land-use in the catchments has therefore modified the water quality in the considered river reaches. Mean and Standard Error Mean (SEM) conductivity values for spatial framework are presented below (**Table 10-31**). As indicated in the statistical assessment, limited overall variation between the river reaches in each of the respective watercourses was observed. This provides an indication that catchment areas are uniformly modified with similar land-use in each catchment.

Table 10-31: Conductivity Levels Across Watercourses (June 2018 and January 2021) (TBC, 2021b).

River	Mean and Standard Error Mean Conductivity (µS/cm)	
Year	2018	2021
Piekespruit/Lower Debeerspruit	619±14	473±92
Steenkoolspruit	625±24	632±19

The concentrations of dissolved solids were determined to be similar across the various catchments. However, as stipulated above, the levels of dissolved solids were determined to be elevated from what would be expected in a source zone watercourse. These results therefore confirm impacted water quality in the considered river reaches. Although it is likely that the low flow period had concentrated dissolved solids due to limited dilution form rainfall, however runoff from surrounding agriculture during the high flow period would increase the concentration of dissolved solids in the catchment resulting in water quality impairment within the receiving watercourses. The high flow results did however indicate similar influences as in the low flow indicated by similar mean dissolved solid levels. Further assessment of the biological responses will provide additional insight into this. Evidence supporting the above statement on influx of pollutants from altered land use was indicated by the observation of algal growth in all of the watercourses considered in this study (TBC, 2021b).

Previous assessments completed by SLR (2016b) indicated elevated dissolved manganese and electrical conductivity throughout the lower Steenkoolspruit, Piekespruit and Debeerspruit. Considering the elevated levels of manganese and fluctuations in pH, can increase the toxicity of dissolved elements and needs to be monitored carefully.

In conclusion, the watercourses associated with the various project areas have been negatively impacted through diffuse and point source agricultural runoff as well as urban and coal mine runoff. The results of this assessment corroborated the water quality results derived in J&W (2019a). Sample points located at the downstream reaches on the Steenkoolspruit (at site Alex01; J&W, 2019a), indicate high levels of conductivity and an increased concentration of sulphates. In addition, the levels of total manganese were determined to be above the chronic effect concentrations of 0.37 mg/l in the October 2018 survey (0.694 mg/l) (DWAF, 1996). The high levels of sulphate and concentrations of manganese can be attributed to historical and active coal mining activities which in the past have shown to reduce local water quality (Dabrowski and de Klerk, 2013). In addition to corroborating the results obtained in this study, the results of SLR (2016a) and SLR (2016b) for the Steenkoolspruit, Debeerspruit and Piekespruit indicate similar conditions (TBC, 2021b).

Habitat Integrity Assessment

The Intermediate Habitat Integrity Assessment (IHIA) was completed for the Piekespruit, Steenkoolspruit and a tributary of the Trichardtspruit as described in the IHIA methodology component of this study. The spatial framework of which constitutes a 5 km reach of the Piekespruit, Steenkoolspruit and tributary of the Trichardtspruit was used to complete the IHIA and represented in **Table 10-32**, **Table 10-33**. and **Table 10-34** respectively.

As can be seen in **Table 10-32**, the results of the reach based IHIA for the Piekespruit indicated moderately modified (class C) instream and riparian habitats for both the 2018 and 2021 survey periods. This indicates a loss and change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged. A single impoundment within the main stem of the Piekespruit and several agricultural impoundments were observed during the assessment.

Furthermore, severe bank erosion and several low water crossing points were also noted in the Piekespruit altering flow, channel and bed characteristics. The extent of erosion was such that connectivity between the marginal and riparian vegetation has ceased. Compounding impacts in the Piekespruit has resulted in the sedimentation of the watercourse and the subsequent alteration of the riverbed. The causative factor for the modification of the Piekespruit was related to cumulative land use related impacts throughout the catchment (TBC, 2021b).

Table 10-32: The Intermediate Habitat Integrity Assessment results for the Piekespruit/Lower Debeerspruit (TBC, 2021b).

Criterion	Impact Score	Weighted Score	Impact Score	Weighted Score
	2018		2021	
Instream				
Water abstraction	5	2.8	6	3.4
Flow modification	5	2.6	5	2.6
Bed modification	15	7.8	15	7.8
Channel modification	15	7.8	16	8.3
Water quality	12.5	7	13	7.3
Inundation	5	2	5	2.0
Exotic macrophytes	5	1.8	5	1.8
Exotic fauna	10	3.2	10	3.2
Solid waste disposal	5	1.2	5	1.2
Total Instream Score	63		62	
Instream Category	C		C	
Riparian				
Indigenous vegetation removal	12.5	6.5	12	6.2
Exotic vegetation encroachment	10	4.8	11	5.3
Bank erosion	15	8.4	15	8.4
Channel modification	15	7.2	15	7.2
Water abstraction	5	2.6	6	3.1
Inundation	5	2.2	5	2.2
Flow modification	5	2.4	5	2.4
Water quality	10	5.2	9	4.7
Total Riparian Score	61		61	
Riparian Category	C		C	

Table 10-33 indicates the results of the IHIA for the Steenkoolspruit. It is noted that largely modified (class D) instream and riparian habitat for both the 2018 and 2021 survey periods. This indicates a large loss of natural habitat, biota and basic ecosystem functions has occurred. Extensive erosion and subsequent bed and channel modification was largely responsible for the degree of modification in the watercourse. Furthermore, historical and active mining activities in the lower sections of the considered reaches have modified instream habitat through various river diversions. Solid waste and livestock impacts were also noted in the watercourse in the lower reaches. River

diversions, damming and road crossings have resulted in altered flow, bed and channel characteristics and inundation in the watercourse as selected locations such as at R1.

Table 10-33: The Intermediate Habitat Integrity Assessment results for the Steenkoolspruit

Criterion	Impact Score	Weighted Score	Impact Score	Weighted Score
	2018		2021	
Instream				
Water abstraction	5	2.8	6	3.4
Flow modification	10	5.2	11	5.7
Bed modification	20	10.4	20	10.4
Channel modification	20	10.4	20	10.4
Water quality	15	8.4	15	8.4
Inundation	5	2	6	2.4
Exotic macrophytes	5	1.8	5	1.8
Exotic fauna	10	3.2	10	3.2
Solid waste disposal	15	3.6	15	3.6
Total Instream Score	52		51	
Instream Category	D		D	
Riparian				
Indigenous vegetation removal	15	7.8	15	7.8
Exotic vegetation encroachment	15	7.2	16	7.7
Bank erosion	20	11.2	20	11.2
Channel modification	20	9.6	20	9.6
Water abstraction	5	2.6	5	2.6
Inundation	5	2.2	7	3.1
Flow modification	5	2.4	5	2.4
Water quality	10	5.2	10	5.2
Total Riparian Score	51		50	
Riparian Category	D		D	

The results of the IHIA for the tributary of the Trichardtspruit indicated largely modified (class D) instream habitat and seriously modified (class E) riparian habitat (**Table 10-34**). This indicates a large loss of natural habitat, biota and basic ecosystem functions has occurred to instream habitat while the loss of natural habitat, biota and basic ecosystem functions is extensive in the riparian habitat. Within the larger catchment area there are critical levels of influence to the Trichardtspruit from mining activities causing canalization, vegetation removal, exotic vegetation encroachment and water abstraction to a serious level. This combined with the effects of large-scale urbanization and agriculture which make use of small dams for irrigation has resulted in channel, bed and flow modifications with resultant lack of bed and bank stabilisation. The nutrient runoff from irrigation, return flow from mining as well as road infrastructure has caused eutrophication within the system (TBC, 2021b).

Table 10-34: The Intermediate Habitat Integrity Assessment results for the tributary of the Trichardtspruit (TBC, 2021b).

Criterion	Impact Score	Weighted Score
Instream		
Water abstraction	4	2.2
Flow modification	15	7.8
Bed modification	20	10.4
Channel modification	20	10.4
Water quality	15	8.4
Inundation	10	4.0
Exotic macrophytes	5	1.8
Exotic fauna	8	2.6
Solid waste disposal	6	1.4
Total Instream Score	51	
Instream Category	D	
Riparian		
Indigenous vegetation removal	15	7.8
Exotic vegetation encroachment	16	7.7
Bank erosion	21	11.8
Channel modification	19	9.1
Water abstraction	5	2.6
Inundation	7	3.1
Flow modification	16	7.7
Water quality	9	4.7
Total Riparian Score	46	
Riparian Category	E	

Macroinvertebrate Community Assessment

The results of the macroinvertebrate assessment using the South African Scoring System Version 5 (SASS5) for the sites in the considered river reaches are presented in **Table 10-35** below.

Table 10-35: Macroinvertebrate assessment results recorded during the survey (June 2018 and January 2021) (TBC, 2021b).

Site	SASS5	Taxa	ASPT	*Class (Dallas, 2007)
2018				
P1	126	27	4.7	A
P2	140	29	4.8	A
P3	94	22	4.3	B
S1	120	24	5.0	B
S2	37	8	3.6	E/F
2021				
P1	71	16	4.4	C
P2	89	21	4.2	B
P3	97	22	4.4	B
S1	No access			

S2	73	15	4.9	B
R1	72	17	4.2	C
R3	90	20	4.5	B
T1	69	18	3.8	D

*ASPT: Average score per taxon; ** Highveld Lower - Ecoregion

The results of the low flow 2018 SASS5 assessment indicated total sensitivity scores ranging from 140 at P2 to 37 at S2. The diversity of taxa observed ranged from 29 at P2 to 8 at S2. The derived ASPT value (average sensitivity score) for the sites ranged from 5.0 at S1 to 3.6 at S2. The ecological classes obtained ranged from class A at P1 and P2 to class E/F at S2. The SASS5 scores obtained during the June 2018 survey largely corroborate the results obtained in the previous studies in the region (SLR, 2016a; Digby Wells Environmental, 2013; 2017, Sasol, 2014; MENCO, 2017).

Results from the 2021 survey indicate a decrease in river health within the Piekespruit indicated by the assigned class which have decreased for P1 and P2. The change is illuminated when the mean SASS5 score is considered for the reach which decrease from 120 to 86 indicating that the assemblage composition has changed and is comprised of more tolerant taxa. The most sensitive taxa during the 2021 taxa included Atyidae, Aeshnidae, Hydracarina and Hydraenidae which all have a sensitivity score of 8, while this included species such as Lestidae in 2018 which score a 10 (more sensitive). The interpretation of the particular invertebrates present within each reach is provided through the completion of the MIRAI (TBC, 2021b).

Fish communities

The results of the qualitative fish community assessment are provided in **Table 10-36**. A total of five native fish species were captured during the June 2018 survey while four were present in 2021. The species which was not resampled in 2021 was *Tilapia sparrmanii* (Banded tilapia). While *Tilapia sparrmani* were not sampled it is assumed that, with increased efforts, these fish would be sampled due to presence of habitat required by these specialists. A single alien invasive species, *Cyprinus carpio* (Common Carp), was observed at four of the sampling points in 2018, with a second (*Gambusia affinis* - Mosquitofish) present in 2021 at R3 in the Steenkoolspruit. The non-native species originally from the Vaal River system, *Labeo umbratus* (Moggel), were observed in the reaches sampled in the Olifants WMA including Steenkoolspruit in the past. The expected species *Labeobarbus polylepis* (Small-Scale Yellowfish) *and Enteromius cf. brevipinnis* were not sampled during 2018 and 2021 surveys. Previous aquatic ecology studies completed in the Steenkoolspruit and Piekespruit confirm the absence of the abovementioned species (SLR, 2016a). However, *Labeobarbus aeneus* (Smallmouth Yellowfish) were recorded in the Digby Wells Environmental 2016 study. The species *Labeobarbus polylepis* is sensitive to modification of riverbeds, channels and flow, their absence further corroborates the findings of the IHIA and MIRAI. *Enteromius cf. brevipinnis* are considered to be headwater species with low tolerances for marginal habitat disturbance and water quality modification. The absence of *Enteromius cf. brevipinnis* serves to confirm the IHIA and MIRAI results obtained in this study. Further, the previous studies confirm the presence of non-native Vaal River system fish species in the upper reaches of the Olifants WMA (SLR, 2016a).

The fish community sampled during the assessment ranged from 43% at P1 to 71% at P2 and P3 in 2018 and from14% at S2 to 57% at P2 and P3 in 2021. The fish community sampled during this assessment effectively establishes the baseline fish communities at each site during the low and high flow periods with consistency between species sampled. It is however recommended that temporal trends within the fish communities are investigated further.

No International Union for the Conservation of Nature (IUCN) red listed species of conservational concern were obtained in this assessment. However, *Enteromius cf. brevipinnis* are anticipated to be an undescribed species and are expected in the region. Given the unknown distribution of the fish species, this taxon is therefore regarded as listed.

Table 10-36: Fish community assessment for June 2018 and January 2021 (TBC, 2021b).

2018					
Species/Site	P1	P2	P3	S1	S2
Clarias gariepinus (LC)	0	1	1	1	0
Enteromius anoplus (LC)	1	1	1	1	1
Enteromius paludinosus (LC)	1	1	1	1	1
Enteromius cf. brevvipinnis (CR)	0	0	0	0	0
Tilapia sparrmani (LC)	1	1	1	1	1
Pseudocrenilabrus philander (LC)	0	1	1	0	1
Labeobarbus polylepis (LC)	0	0	0	0	0
***Cyprinus carpio*	1	1	1	0	0
**Labeo umbratus*	0	1	0	1	0
Total Native Species	3	5	5	4	4
Total Expected Native Species	7	7	7	7	7
% Fish Community Sampled	43	71	71	57	57

2021								
Species/Site	P1	P2	P3	S1	S2	R1	R3	T1
Clarias gariepinus (LC)	0	1	1		0	1	0	1
Enteromius anoplus (LC)	0	1	1		0	0	1	1
Enteromius paludinosus (LC)	1	1	1		1	1	0	0
Enteromius cf. brevvipinnis (CR)	0	0	0		0	0	0	0
Tilapia sparrmani (LC)	0	0	0		0	0	0	0
Pseudocrenilabrus philander (LC)	1	1	1	No Access	0	1	1	1
Labeobarbus polylepis (LC)	0	0	0		0	0	0	0
***Cyprinus carpio*	0	0	0		0	0	0	1
**Gambusia affinis*	0	0	0		0	0	1	0
**Labeo umbratus*	0	0	0		0	0	0	0
Total Native Species	2	4	4		1	3	2	3
Total Expected Native Species	7	7	7		7	7	7	7
% Fish Community Sampled	29	57	57		14	43	29	43

0 = Absent; 1 = Present, *alien invasive species; **native alien species

Overall PES for the Piekespruit and Steenkoolspruit

The PES assessment for the Piekespruit and Steenkoolspruit are based on the collective data collected based on the June 2018 and January 2021 surveys. The results are provided in **Table 10-37** and **Table 10-38**, respectively.

Table 10-37: Present Ecological Status of the Piekespruit (June 2018 and January 2021) (TBC, 2021b).

Aspect Assessed	Ecological Category	
	2018	2021
Instream Ecological Category	63	51
Riparian Ecological Category	61	50
Aquatic Invertebrate Ecological Category	61	60
Ecostatus	class C/D	class D

The results of the PES assessment in the Piekespruit derived a moderately/largely modified status in 2018, decreasing to largely modified in 2021. The modified nature of the watercourse can primarily be attributed to diffuse agricultural runoff compounded by instream habitat modification in the form of sedimentation and channel incision (TBC, 2021b).

Table 10-38: Present Ecological Status of the Steenkoolspruit (June 2018 and January 2021) (TBC, 2021b).

Aspect Assessed	Ecological Category	
	2018	2021
Instream Ecological Category	52	51
Riparian Ecological Category	51	46
Aquatic Invertebrate Ecological Category	42	41
Ecostatus	class D	class D

The ecological status of the Steenkoolspruit during the 2018 and 2021 study period was determined to be largely modified (class D). The modified nature of the watercourse was driven by diffuse agricultural runoff and livestock impacts compounded by instream habitat modification in the form of river diversions and historical open pit mining activities.

The summary of the baseline assessment is visually represented for the project area in **Figure 10-30**. It is noted that the PES of the Dwars in die Wegspruit which is presented on the map, was obtained from the TBC (2019a). The sampling points selected in this assessment covered upstream source zones as well as areas downstream of mining disturbance. It was often observed during this assessment that instream degradation of the assessed watercourses occurs at the source of the waterbodies. Urbanised catchments and extensive agriculture in the catchments are the factors largely responsible for the level of degradation. Given the findings of this assessment, no pristine or natural waterbodies were observed or expected in any of the mining right areas (TBC, 2021b).

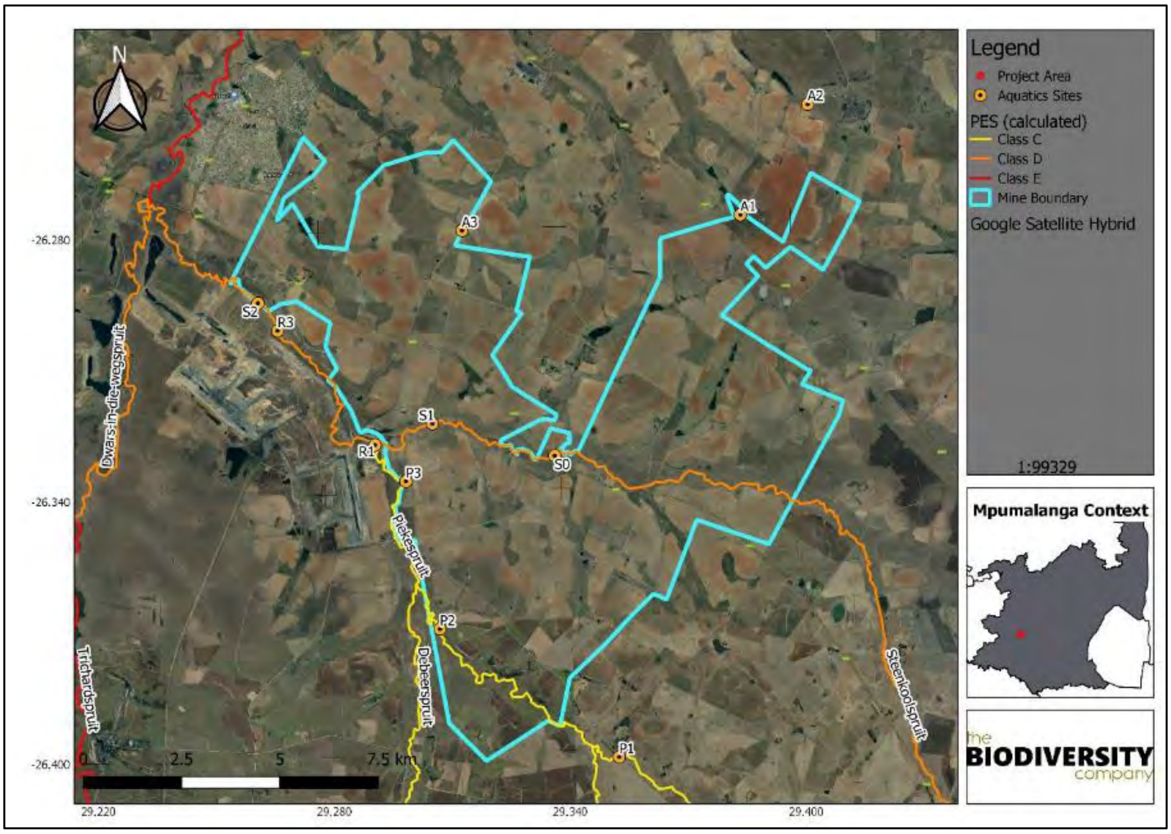


Figure 10-30: Summary of the PES classifications of watercourses associated with the Alexander mining area (TBC, 2021b).

10.1.1.9. Terrestrial biodiversity

Desktop spatial assessment

A desktop assessment based on spatial data that are provided by various sources such as the Mpumalanga Tourism and Parks Agency (MTPA) and South African Biodiversity Institute (SANBI), was done to describe the general area and habitat.

Mpumalanga Biodiversity Sector Plan

In terms of the Mpumalanga Biodiversity Sector Plan (MBSP), the study area overlaps with the following as can be seen in **Figure 10-31**:

- Critical Biodiversity Area (CBA) Irreplaceable and Important;
- Ecological Support Areas (ESA) local corridor;
- Other Natural Area (ONA); and
- Moderately or Heavily Modified Areas (MMA's or HMA's).

Figure 10-32 shows the study area superimposed on the MBSP Freshwater CBA map. Based on this, the study area will overlap with:

- Critical Biodiversity Area (CBA);
- Other Natural Area (ONA); and
- Heavily Modified Areas (HMA's).

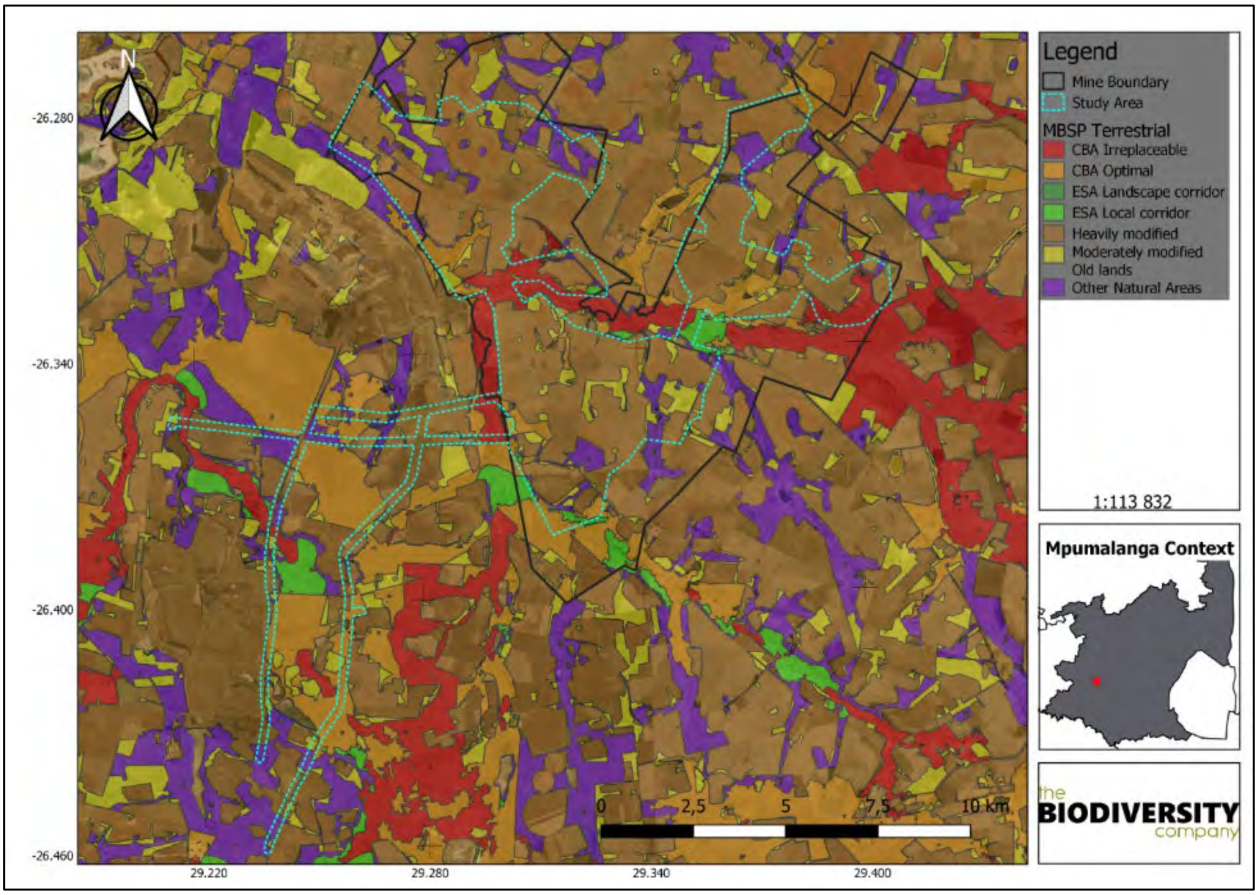


Figure 10-31: Alexander in relation to the MBSP Terrestrial

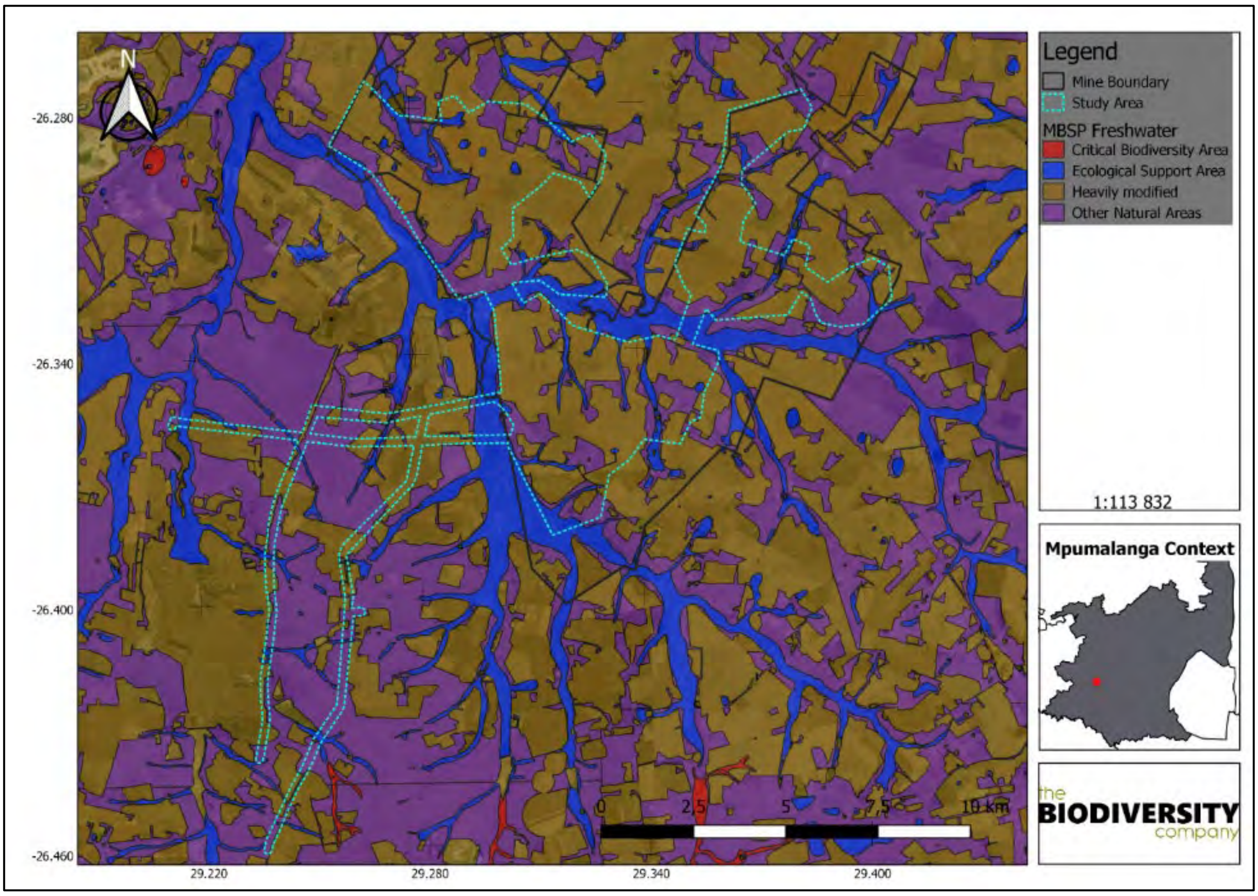


Figure 10-32: Alexander in relation to the MBSP Freshwater

National Biodiversity Assessment

The two headline indicators assessed in the National Biodiversity Assessment are ecosystem threat status and ecosystem protection level:

Ecosystem Threat Status

The proposed study area was superimposed on the terrestrial ecosystem threat status (**Figure 10-33**). As seen in this figure the study area falls across one ecosystem, which is listed VU. The ecosystem status is based on a regional assessment as habitat has been threatened by amongst others mining and agriculture.

Figure 10-33: Alexander showing the ecosystem threat status of the associated terrestrial ecosystem (NBA, 2018)

Ecosystem Protection Level

Based on this the terrestrial ecosystems associated with the proposed study area are rated as not protected (NP) and poorly protected (PP) (**Figure 10-34**). This means that these ecosystem types (and associated habitats) are not protected or not protected well anywhere in the country (such as in nationally protected areas).

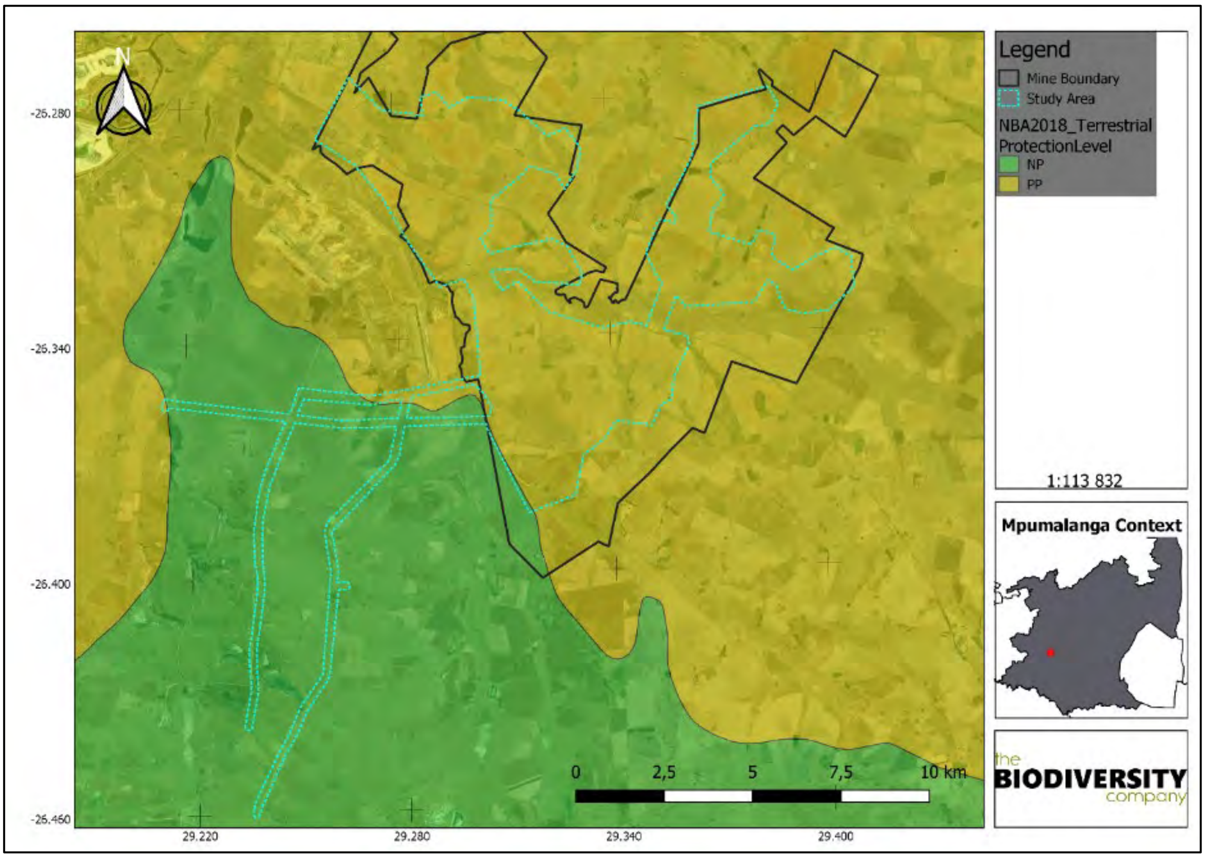


Figure 10-34: Alexander showing the level of protection of the terrestrial ecosystems (NBA, 2018)

National Biodiversity Assessment: Wetlands

Ecosystem threat status (ETS) of river ecosystem types is based on the extent to which each river ecosystem type had been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LC, with CR, EN and VU ecosystem types collectively referred to as ‘threatened’ (Van Deventer et al., 2019; Skowno *et al.,* 2019).

Figure 10-35 shows that CR and LC wetlands occur in the study area, while **Figure 10-36** shows that these systems are “not protected” and “poorly protected”. CR rivers which are “poorly protected” also run through the study area (**Figure 10-35** and **Figure 10-36**).

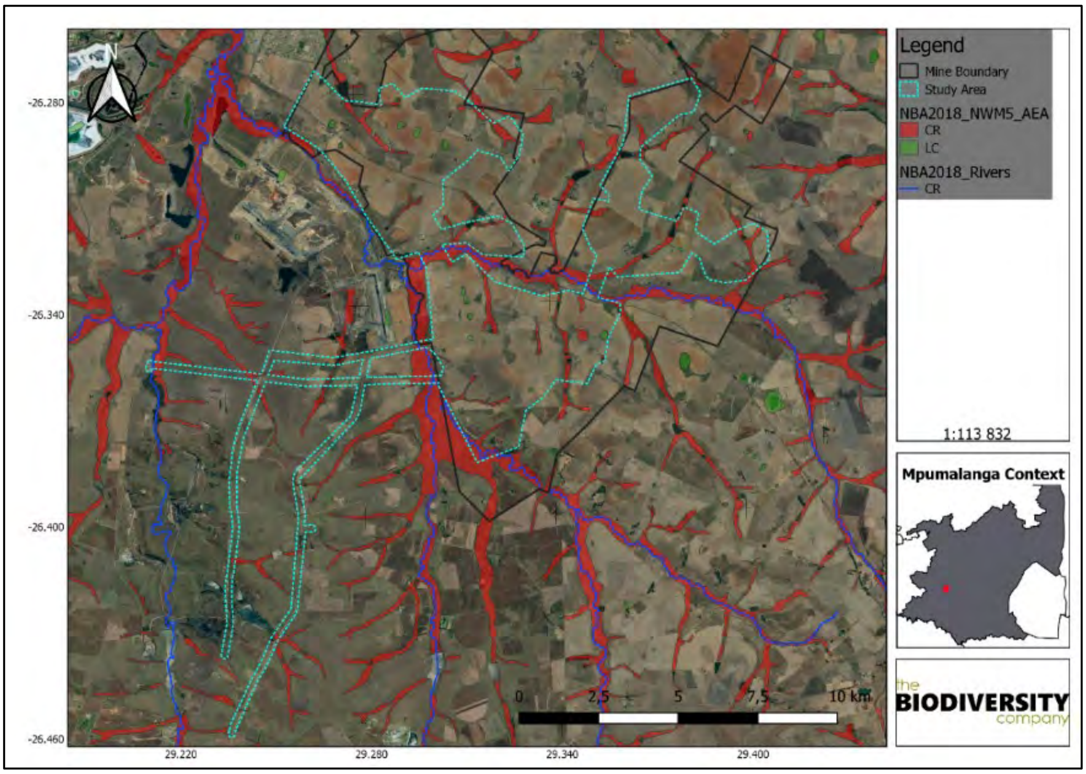


Figure 10-35: **Alexander in relation to the threat status of the wetlands and rivers (NBA, 2018)**

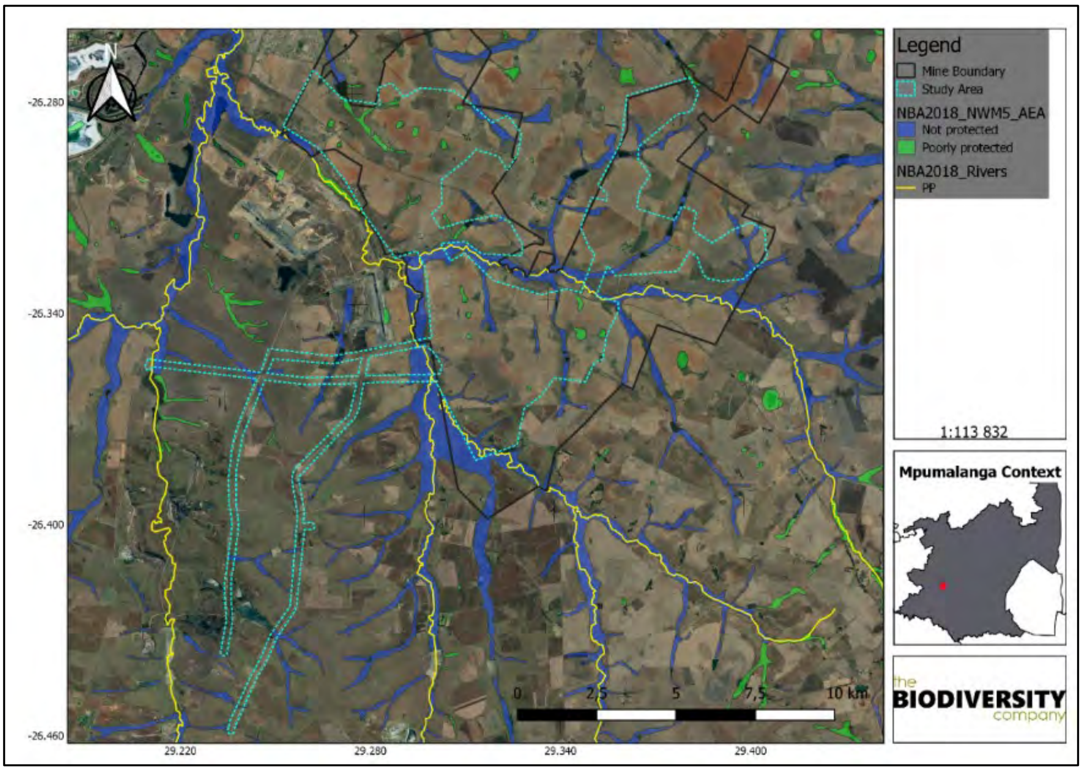


Figure 10-36: **Alexander in relation to the protection level of the wetlands and rivers (NBA, 2018)**

Mpumalanga Highveld Wetlands

The purpose of the Mpumalanga Highveld Grasslands (MPHG) Wetlands project was to: Ground-truth and refine the current data layers of the extent, distribution, condition and type of freshwater ecosystems in the Mpumalanga Highveld coal belt, to support informed and consistent decision-making by regulators in relation to the water and biodiversity (SANBI, 2012).

The MPHG Wetlands data also classifies NFEPA land cover based on the defined condition of each area. These are known as the NFEPA wetland conditions categories. The categories are listed in **Table 10-39** and are represented in relation to the study area in **Figure 10-37**.

Table 10-39: A breakdown of the NFEPA wetland condition categories as defined by the MPHG datasets

Description of NFEPA wetland conditions categories.
PES equivalent provides a description of the condition category that is broadly equivalent to that used by the Department of Water Affairs to describe Present Ecological State. Percentage of total area in each condition category is also provided.

PES equivalent	NFEPA condition	Description	% of total wetland area*
Natural or Good	AB	Percentage natural land cover ≥ 75%	47
Moderately modified	C	Percentage natural land cover 25-75%	18
Heavily to critically modified	DEF	Riverine wetland associated with a D, E, F or Z ecological category river	2
	Z1	Wetland overlaps with a 1:50,000 "artificial" inland water body from the Department of Land Affairs: Chief Directorate of Surveys and Mapping (2005-2007)	7
	Z2	Majority of the wetland unit is classified as "artificial" in the wetland delineation GIS layer	4
	Z3	Percentage natural land cover < 25%	20

** This percentage excludes the unmapped wetlands that have been irreversibly lost due to draining, ploughing and concreting*

Figure 10-37 shows the study area in relation to the Mpumalanga Highveld Grasslands Wetlands data as provided by SANBI. This dataset also reveals that wetlands with a PES of D (largely modified) can be found in the central part of the property. Class C (moderately modified) wetlands can be found mainly in the northern section while class AB (natural to largely natural) wetlands are present in the southern portions.

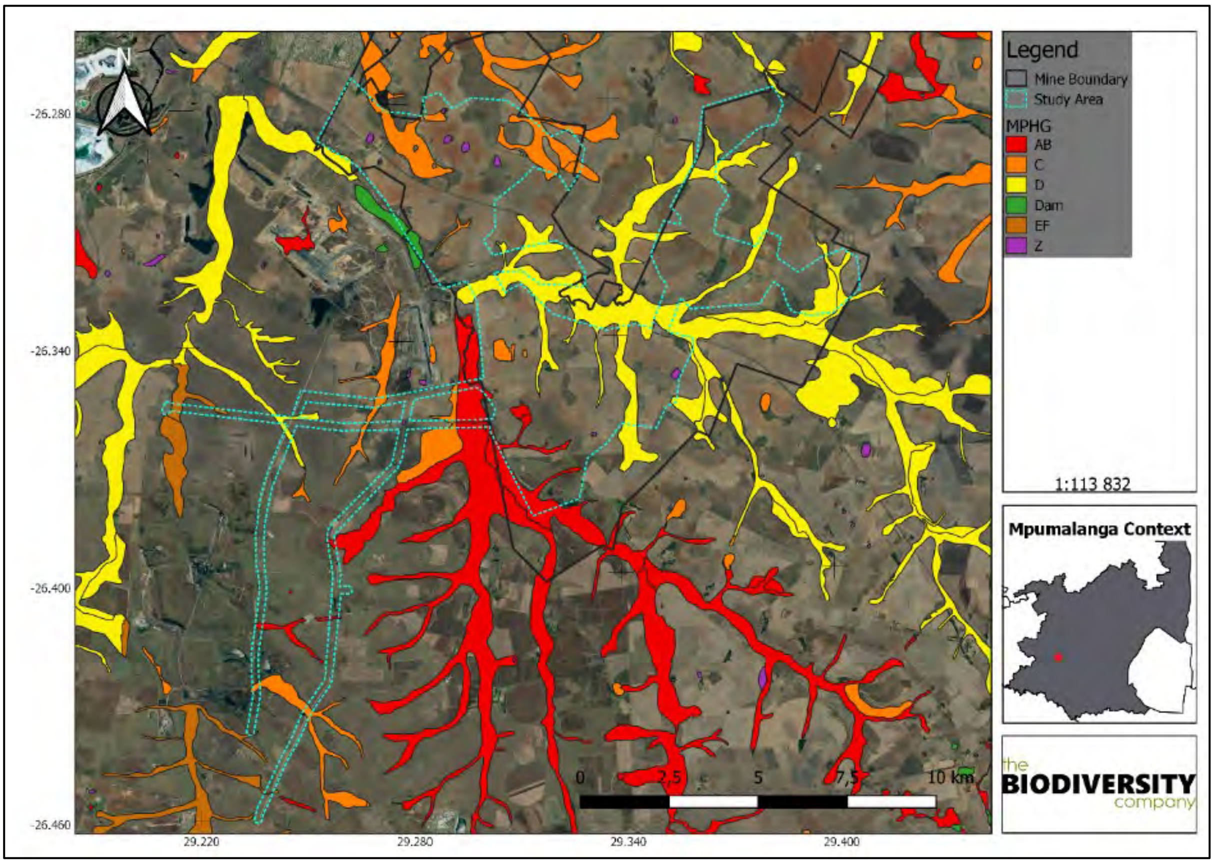


Figure 10-37: Alexander in relation to the Mpumalanga Highveld Grasslands Wetlands.

Terrestrial floral biodiversity

<u>Vegetation types</u>

Alexander is situated within the Grassland biome and comprises several vegetation types. Alexander falls with the Soweto Highveld Grassland and Eastern Highveld Grassland vegetation types (**Figure 10-38**).

The Soweto Highveld Grassland vegetation type typically comprises of an undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. Scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover. This vegetation type is classified as Endangered (Mucina & Rutherford, 2006).

The Eastern Highveld Grassland vegetation type occurs on slightly to moderately undulating planes, including some low hills and pan depressions. The vegetation is a short dense grass land dominated by the usual highveld grass composition (*Aristida, Digitaria, Eragrostis, Themeda, Tristachya etc*.) with small scattered rocky outcrops with, wiry sour grasses and some woody species. Some 44% transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams. No serious alien invasions are reported. This vegetation type is classified as Endangered (Mucina & Rutherford, 2006).

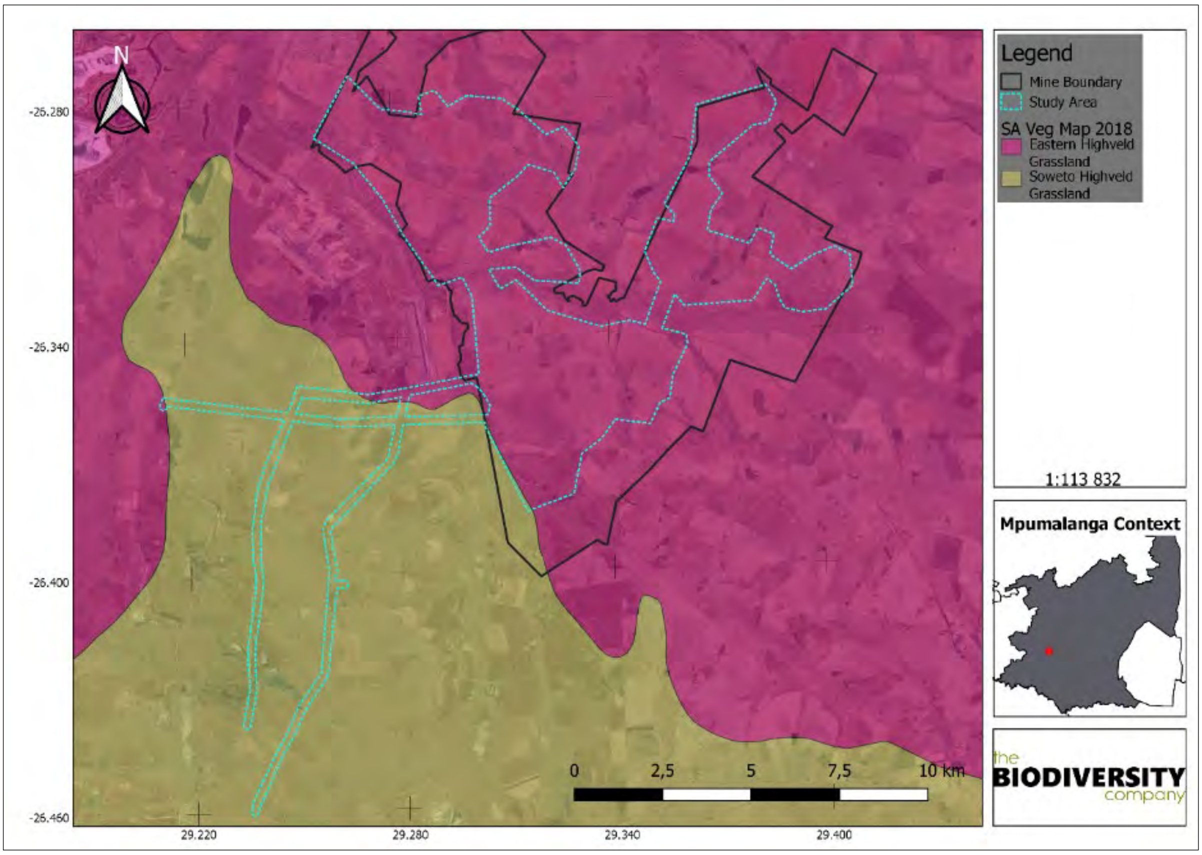


Figure 10-38: Alexander showing the vegetation type based on the Vegetation Map of South Africa, Lesotho and Swaziland (BGIS, 2018).

Plant species of conservation concern

Based on the Plants of Southern Africa (BODATSA-POSA, 2020) database, 461 plant species are expected to occur in the project area. The list of expected plant species is provided in Appendix A of the Biodiversity Specialist report. Of the 461-plant species, six species are listed as being SCCs (**Table 10-40**).

Table 10-40 Flora SCCs expected in the project area (TBC, 2021c).

Family	Taxon	Author	IUCN	Ecology	Habitat
Aizoaceae	*Khadia carolinensis*	(L. Bolus) L.Bolus	VU	Indigenous; Endemic	Well-drained, sandy loam soils among rocky outcrops, or at the edges of sandstone sheets, Highveld Grassland, 1700 m.
Amaryllidaceae	*Nerine gracilis*	R.A.Dyer	VU	Indigenous; Endemic	Undulating grasslands in damp areas
Asphodelaceae	*Kniphofia typhoides*	Codd	NT	Indigenous; Endemic	Low lying wetlands and seasonally wet areas in climax *Themeda triandra* grasslands on heavy black clay soils, tends to disappear from degraded grasslands.
Fabaceae	*Argyrolobium longifolium*	(Meisn.) Walp.	VU	Indigenous; Endemic	Ngongoni and sandstone grassland. Small populations only exist.
Fabaceae	*Argyrolobium campicola*	Harms	NT	Indigenous; Endemic	Highveld grassland
Fabaceae	*Lessertia phillipsiana*	Burtt Davy	DD	Indigenous; Endemic	Uncertain, possibly rocky hills or plains.

Vegetation assessment

The vegetation assessment was conducted throughout the extent of the study area (TBC, 2021c). A total of 172 tree, shrub and herbaceous plant species were recorded in the study area during the 11 to 15 January 2021 field assessment (**Table 10-41**). Plants listed as Category 1 alien or invasive species under the National Environmental Management: Biodiversity Act (NEMBA) appear in green text. Plants listed in Category 2 or as 'not indigenous' or 'naturalised' according to NEMBA, appear in blue text.

Eight plant species were recorded (**Table 10-41**) that are protected by the Mpumalanga Nature Conservation Act 10 of 1998: Schedule 11. According to the list of protected species under Schedule 11; no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate, or in any other manner acquire or dispose of any protected plant unless he or she is the holder of a permit which authorises him or her to do so.

In addition, thirteen (13) Category 1b invasive plant species were recorded within the study area, and it is recommended that an alien invasive plant management programme be implemented in compliance of section 75 of the NEM:BA. The NEM:BA listed species identified within the study area are marked in green (**Table 10-41**).

Table 10-41: Vulnerable, endangered and alien trees, shrubs and weeds recorded (TBC, 2021c).

Family	Genus	Species	Author1	Rank1	Sp2	Author2	Rank 2	Sp3	IUCN	Mpumalanga Schedule 11	NEMBA
Agavaceae	*Agave*	*americana*	L.	*subsp.*	*americana*						
Aizoaceae	*Khadia*	*carolinensis*	*(L.Bolus) L.Bolus*						VU		
Amaranthaceae	*Amaranthus*	*hybridus*	L.	*subsp.*	*hybridus*		*var.*	*hybridus*			
Amaryllidaceae	*Boophone*	*disticha*	(L.f.) Herb.						LC	X	
Amaryllidaceae	*Crinum*	*bulbispermum*	(Burm.f.) Milne-Redh. & Schweick.							X	
Amaryllidaceae	*Cyrtanthus*	*tuckii*	Baker	*var.*	*tuckii*					X	
Asphodelaceae	*Aloe*	*ecklonis*	Salm-Dyck						LC	X	
Asteraceae	*Bidens*	*bipinnata*	L.								
Asteraceae	*Bidens*	*pilosa*	L.								
Asteraceae	*Campuloclinium*	*macrocephalum*	(Less.) DC.								Cat 1b
Asteraceae	*Cirsium*	*vulgare*	(Savi) Ten.								Cat 1b
Asteraceae	*Conyza*	*bonariensis*	(L.) Cronquist								
Asteraceae	*Cosmos*	*bipinnatus*	Cav.								
Asteraceae	*Geigeria*	*burkei*	Harv.	*subsp.*	*burkei*				NE		
Asteraceae	*Tagetes*	*minuta*	L.								
Cannaceae	*Canna*	*indica*	L.								Cat 1b
Fabaceae	*Acacia*	*mearnsii*	De Wild.								Cat 2
Fabaceae	*Robinia*	*pseudoacacia*									Cat 1b
Fabaceae	*Trifolium*	*africanum*	Ser.	*var.*	*africanum*				NE		
Iridaceae	*Gladiolus*	*elliotii*	Baker						LC	X	
Iridaceae	*Gladiolus*	*crassifolius*	Baker						LC	X	
Myrtaceae	*Eucalyptus*	*camaldulensis*									Cat 1b
Nyctaginaceae	*Mirabilis*	*jalapa*	L.								Cat 1b
Onagraceae	*Oenothera*	*stricta*	Ledeb. ex Link	*subsp.*	*stricta*						

Family	Genus	Species	Author1	Rank1	Sp2	Author2	Rank 2	Sp3	IUCN	Mpumalanga Schedule 11	NEMBA
Onagraceae	*Oenothera*	*rosea*	L'Hér. ex Aiton								
Orchidaceae	*Eulophia*	*ovalis*	Lindl.	*var.*	*ovalis*				LC	X	
Orchidaceae	*Habenaria*	*epipactidea*	Rchb.f.						LC	X	
Poaceae	*Arundo*	*donax*	L.								Cat 1b
Poaceae	*Paspalum*	*urvillei*	Steud.								
Poaceae	*Pennisetum*	*clandestinum*	Hochst. ex Chiov.								Cat 1b
Polygonaceae	*Persicaria*	*lapathifolia*	(L.) Gray								
Pteridaceae	*Pellaea*	*calomelanos*	(Sw.) Link	*var.*	*calomelanos*						
Rosaceae	*Pyracantha*	*angustifolia*	(Franch.) C.K.Schneid.								Cat 1b
Salicaceae	*Populus*	*alba*	L.	*var.*	*alba*						Cat 2
Salicaceae	*Populus*	*deltoides*	Bartram ex Marshall	*subsp.*	*deltoides*						
Solanaceae	*Datura*	*ferox*	L.								Cat 1b
Solanaceae	*Datura*	*stramonium*	L.								Cat 1b
Verbenaceae	*Verbena*	*bonariensis*	L.								Cat 1b
Verbenaceae	*Verbena*	*brasiliensis*	Vell.								Cat 1b

Terrestrial faunal biodiversity

Avifauna

Based on the South African Bird Atlas Project, Version 2 (SABAP2) database, 203 bird species are expected to occur in the vicinity of the project area (pentads 2610_2910; 2610_2915; 2610_2920; 2615_2915; 2615_2920; 2620_2910; 2620_2915; 2620_2920; 2615_2910). The full list of potential bird species is provided in Appendix B.

Of the expected bird species, twelve (12) species are listed as SCC either on a regional scale or international scale (**Table 10-42**). The SCC include the following:

- One (1) species that are listed as EN on a regional basis;
- Five (5) species that are listed as VU on a regional basis; and
- Four (4) species that are listed as NT on a regional basis.

Table 10-42 List of bird species of regional or global conservation importance that are expected to occur in pentads mentioned above (SABAP2, 2020, ESKOM, 2015; IUCN, 2017)

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Regional (ESKOM, 2015)	IUCN (2017)	
Calidris ferruginea	Sandpiper, Curlew	LC	NT	Low
Circus ranivorus	Marsh-harrier, African	EN	LC	Moderate
Eupodotis caerulescens	Korhaan, Blue	LC	NT	High
Falco biarmicus	Falcon, Lanner	VU	LC	High
Geronticus calvus	Ibis, Southern Bald	VU	VU	Moderate
Glareola nordmanni	Pratincole, Black-winged	NT	NT	Moderate
Oxyura maccoa	Duck, Maccoa	NT	NT	Moderate
Phoenicopterus minor	Flamingo, Lesser	NT	NT	Moderate
Phoenicopterus ruber	Flamingo, Greater	NT	LC	Moderate
Sagittarius serpentarius	Secretarybird	VU	VU	High
Sterna caspia	Tern, Caspian	VU	LC	Moderate
Tyto capensis	Grass-owl, African	VU	LC	Moderate

Mammals

The IUCN Red List Spatial Data (IUCN, 2017) lists 74 mammal species that could be expected to occur within the vicinity of the project area (refer to Appendix C of the Biodiversity Specialist report for the complete list).

Of the 74 small to medium sized mammal species, sixteen (16) are listed as being of conservation concern on a regional or global basis (**Table 10-43**). The list of potential species includes:

- Two (2) that is listed as EN on a regional basis;
- Five (5) that are listed as VU on a regional basis; and
- Eight (8) that are listed as NT on a regional scale.

Eight of the SCCs expected have a low likelihood of occurrence based on the lack of suitable habitat and food sources in the project area.

Table 10-43 List of mammal species of conservation concern that may occur in the project area as well as their global and regional conservation statuses (IUCN, 2017; SANBI, 2016)

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Amblysomus septentrionalis	Highveld Golden Mole	NT	NT	Low
Aonyx capensis	Cape Clawless Otter	NT	NT	High
Atelerix frontalis	South Africa Hedgehog	NT	LC	Moderate
Crocidura maquassiensis	Makwassie musk shrew	VU	LC	Moderate
Dasymys incomtus	African Marsh rat	NT	LC	Moderate
Eidolon helvum	African Straw-colored Fruit Bat	LC	NT	Low
Felis nigripes	Black-footed Cat	VU	VU	Moderate
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	High
Leptailurus serval	Serval	NT	LC	High
Mystromys albicaudatus	White-tailed Rat	VU	EN	Low
Ourebia ourebi	Oribi	EN	LC	Low
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyaena	NT	NT	Low
Pelea capreolus	Grey Rhebok	NT	NT	Low
Poecilogale albinucha	African Striped Weasel	NT	LC	Moderate
Redunca fulvorufula	Mountain Reedbuck	EN	LC	Low

Herpetofauna

Reptiles

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2021) 39 reptile species are expected to occur in the project area (refer to Appendix D of the Biodiversity Specialist report for the full list). Of these 39 species two are SCCs (**Table 10-44**).

Table 10-44 Expected reptile SCC that may occur in the project area.

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Regional (SANBI, 2016)	IUCN (2017)	
Crocodylus niloticus	Nile Crocodile	VU	LC	Low
Smaug giganteus	Giant Dragon Lizard	VU	VU	Low

Amphibians

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the ADU (ADU, 2021) Twenty-two (22) amphibian species are expected to occur in the project area (refer to Appendix E of the Biodiversity Specialist report for the full list). No amphibian SCC are expected to occur in the project area.

Terrestrial assessment

Avifauna

One hundred and one (101) species were recorded in the study area during the surveys based on either direct observations, vocalisations, or the presence of visual tracks and signs (**Table 10-45**) (TBC, 2021c).

Three bird SCC were recorded during the survey, namely Blue Korhaan (*Eupodotis caerulescens*), Secretarybird (*Sagittarius serpentarius*) and African Grass-owl (*Tyto capensis*).

Based on the various wetland habitats encountered in the study area, the likelihood that other bird SCCs occur there is rated as high. Many important roosting and nesting sites were noted during the survey around the wetland and marsh areas.

Incidental records of other bird SCC were noted from two landowners (pers comm. Mr Dunn, 2018) in the area. Both landowners mentioned that they have seen Flamingos and Cranes on their properties and based on the extensive suitable habitat for both these species and previous records (EWT, 2018) of them occurring there, it is taken as evident that these species occur within the study area.

Table 10-45: A list of sensitive avifauna species recorded for the study area (TBC, 2021c)

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Amandava subflava	Waxbill, Orange-breasted	Unlisted	Unlisted
Buteo vulpinus	Buzzard, Common	Unlisted	Unlisted
Eupodotis caerulescens	Korhaan, Blue	LC	NT
Falco naumanni	Kestrel, Lesser	Unlisted	LC
Falco rupicolus	Kestrel, Rock	Unlisted	LC
Fulica cristata	Coot, Red-knobbed	Unlisted	LC
Gallinago nigripennis	Snipe, African	Unlisted	LC
Gallinula angulata	Moorhen, Lesser	Unlisted	LC
Gallinula chloropus	Moorhen, Common	Unlisted	LC
Larus cirrocephalus	Gull, Grey-headed	Unlisted	LC
Megaceryle maximus	Kingfisher, Giant	Unlisted	Unlisted
Phalacrocorax africanus	Cormorant, Reed	Unlisted	Unlisted
Phalacrocorax carbo	Cormorant, White-breasted	Unlisted	LC
Platalea alba	Spoonbill, African	Unlisted	LC
Sagittarius serpentarius	Secretarybird	VU	VU
Scopus umbretta	Hamerkop	Unlisted	LC
Turdus olivaceus	Thrush, Olive	Unlisted	LC
Tyto capensis	Grass-owl, African	VU	LC

Mammals

Overall, mammal diversity in the study area was moderate to high, with eighteen (18) mammal species being recorded during the surveys based on either direct observation, camera trap photographs or the presence of visual tracks and signs (**Table 10-46**).

Four (4) mammal SCCs were recorded in the study area (**Table 10-46**). There appears to be healthy populations of Cape Clawless Otters (*Aonyx capensis*) along the wetland areas and in the dams within the study area and adjacent to it. Serval (*Leptailurus serval*) occurred throughout the study area. Brown Hyaena (*Parahyaena brunnea*) were observed in the forested rocky ridge within the Alexander study area.

Table 10-46: Mammal species recorded in the study area (TBC, 2021c).

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Antidorcas marsupialis	Springbok	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Atelerix frontalis	South Africa Hedgehog	NT	LC
Atilax paludinosus	Water Mongoose	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Herpestes sanguineus	Slender Mongoose	LC	LC
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ichneumia albicauda	White-tailed Mongoose	LC	LC
Leptailurus serval	Serval	NT	LC
Otomys irroratus	Vlei Rat	LC	LC
Parahyaena brunnea	Brown Hyaena	NT	NT
Potamochoerus larvatus	Bushpig	LC	LC
Redunca arundinum	Southern Reedbuck	LC	LC
Suricata suricatta	Suricate	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC

Herpetofauna (Reptiles and Amphibians)

Nine (9) reptile species were recorded in the study area during the surveys (**Table 10-47**). None of the species were classed as SCC. Reptile diversity was notably high in the study area considering the extent of existing agricultural activities which has already transformed some of the natural ecosystems (TBC, 2021c).

Five (5) amphibian species were recorded in the study area during the surveys based on visual observations as well as from calls made by various frog species (**Table 10-47**).

Table 10-47: Herpetofauna species recorded in the study area (TBC, 2021c).

Species	Common Name	South African Endemic	Conservation Status	
			Regional (SANBI, 2016)	Global (IUCN, 2017)
		Reptiles		
Crotaphopeltis hotamboeia	Red-lipped Snake	No	LC	LC
Dasypeltis scabra	Rhombic Egg-eater	No	LC	LC
Duberria lutrix	Common Slug-eater	No	LC	LC
Hemachatus haemachatus	Rinkhals	No	LC	LC
Leptotyphlops scutifrons conjunctus	Eastern Thread Snake	No	LC	LC
Lycodonomorphus rufulus	Brown Water Snake	No	LC	Unlisted
Psammophis crucifer	Cross-marked Grass Snake	No	LC	LC
Psammophylax rhombeatus	Spotted Grass Snake	No	LC	LC
Trachylepis punctatissima	Speckled Rock Skink	No	LC	Unlisted
		Amphibians		
Bufo rangeri	Raucous Toad	No	LC	LC
Cacosternum boettgeri	Common Caco	No	LC	LC
Sclerophrys gutturalis	Guttural Toad	No	LC	LC
Strongylopus grayii	Clicking Stream Frog	No	LC	LC
Xenopus laevis	Common Platanna	No	LC	LC

Habitat assessment and sensitivity

The main habitat types identified across the study area were initially identified largely based on aerial imagery. These main habitat types were refined based on the field coverage and data collected during the survey. The preliminary delineated habitats can be seen in **Figure 10-39** to **Figure 10-40**. Emphasis was placed on prioritising timed meander searches within the natural habitats and therefore habitats with a higher potential of hosting SCC. The main habitats that were delineated discussed below:

<u>Semi-natural Mesic Grassland (Moist Grassland and Rocky Grassland)</u>

In a broad spectrum, the Mesic Grassland habitat includes grassland areas that are connected to and play a crucial role with the wetland habitats, in this case rocky grassland and moist grasslands collectively. This habitat type is regarded as semi-natural grassland, but slightly disturbed due to grazing by livestock and human infringement in areas close to the roads. The Mesic Grassland habitat persists in an area transformed largely due to agriculture due to the fact that these areas don't allow the land use due to topography and water saturation (TBC, 2021c).

This habitat unit can thus be regarded as critically important, not only within the local landscape, but also regionally; it acts are a buffer for the wetland habitats and the only remaining greenlands, used for habitat, foraging area and movement corridors for fauna (including SCC) within a landscape fragmented by agriculture and mining to more natural areas where they may reproduce. The habitat sensitivity of the Mesic Grassland is regarded as high, due to floral and faunal species recorded as well as the role of this intact habitat to biodiversity within a very fragmented local landscape, not to mention the various ecological datasets (TBC, 2021c).

Modified Grassland (Disturbed and Degraded)

The disturbed habitat is regarded as areas that has been impacted by edge effects of transformed areas as well as direct impacts from littering, overgrazing, dumping and infringement. The degraded grassland habitat is habitat where the condition of these grassland's ranges from moderately disturbed (largely due to grazing) to semi-natural grassland but fragmented grassland. The difference between this habitat and the disturbed grassland is the extent of the disturbance in the disturbed grassland being more severe.

Collectively these habitats can be regarded as modified grassland. These habitats are not entirely transformed but in a constant modified state as it cannot recover to a more natural state due to ongoing disturbances and pressures imposed from the surrounding transformed areas and the current land use, in most cases grazing pastures. These areas are considered to have a low-moderate sensitivity due to the fact that these areas may be used as a movement corridor and in many cases form a barrier between the more natural mesic grassland and the modified/transformed areas (TBC, 2021c).

Wetlands and watercourses

This habitat unit represents the wetland areas as well as watercourse areas. These habitats are represented in the wetland assessment as conducted by The Biodiversity Company (2021). Even though somewhat disturbed, the ecological integrity, importance and functioning of these areas play a crucial role as a water resource system and an important habitat for various fauna and flora, including the SCC recorded. The preservation of this system is the most important aspect to consider for the proposed development, even more so due to the high sensitivity of the area according to the various ecological datasets. CBAs are terrestrial and aquatic areas of the landscape that need to be maintained in a natural or near-natural state to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. CBAs are areas of high biodiversity value and need to be kept in a natural state, with no further loss of habitat or species (MTPA, 2014). All wetlands delineated, still represent their CBA status, especially CBA: Irreplaceable and CBA: Optimal. Thus, if these areas are not maintained in a natural or near natural state then biodiversity targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land and resource uses (SANBI-BGIS, 2017). This habitat needs to be protected and improved due to the role of this habitat as a water resource (TBC, 2021c).

Transformed

This habitat unit represents all areas of agriculture farms, mainly Maize and Soya (old and recent), associated roads, built infrastructure and all mining infrastructure. Due to the transformed nature of this habitat, it is regarded as having a low concern sensitivity.

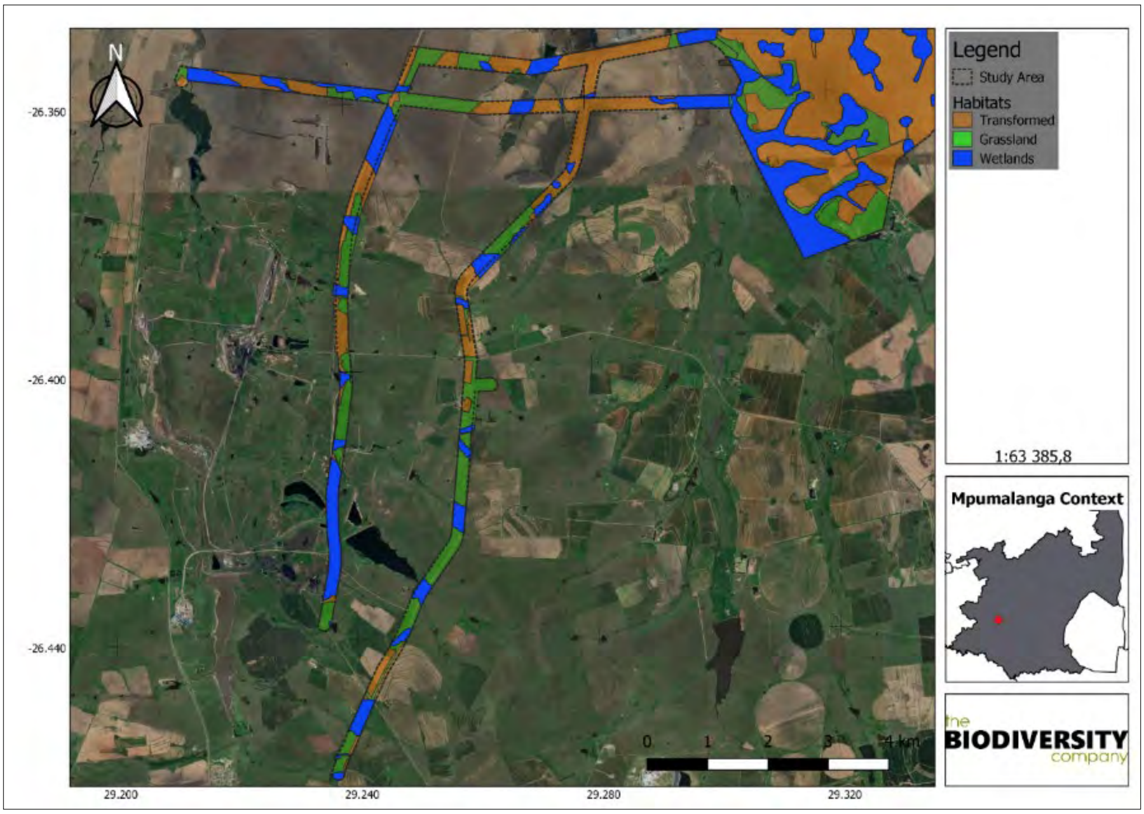


Figure 10-39: **Habitats identified along the Alexander linear infrastructure route (TBC, 2021c).**

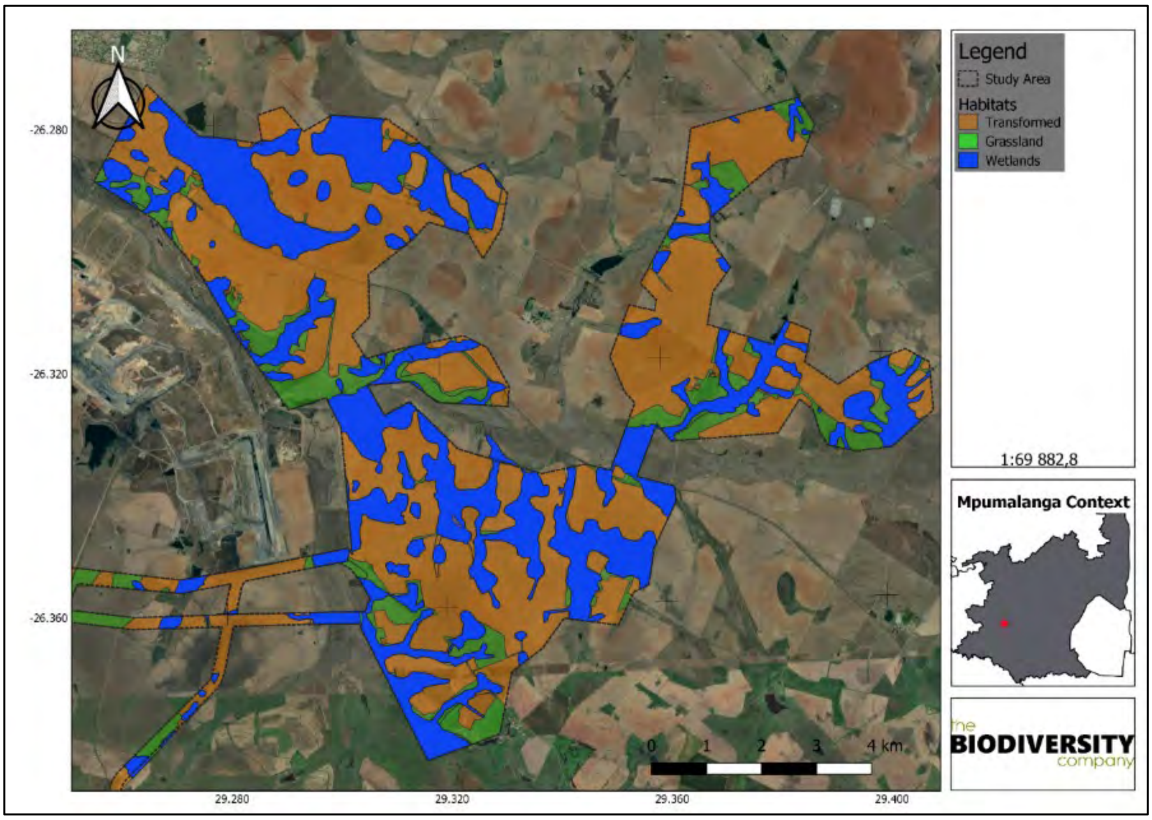


Figure 10-40: **Habitats identified for Alexander (TBC, 2021c).**

As per the Department of Forestry, Fisheries and Environment (DFFE) screening tool, the biodiversity sensitivity is considered to be Very High. The sensitivity scores identified during the field survey for each habitat were mapped as shown in **Figure 10-41** to **Figure 10-42.**

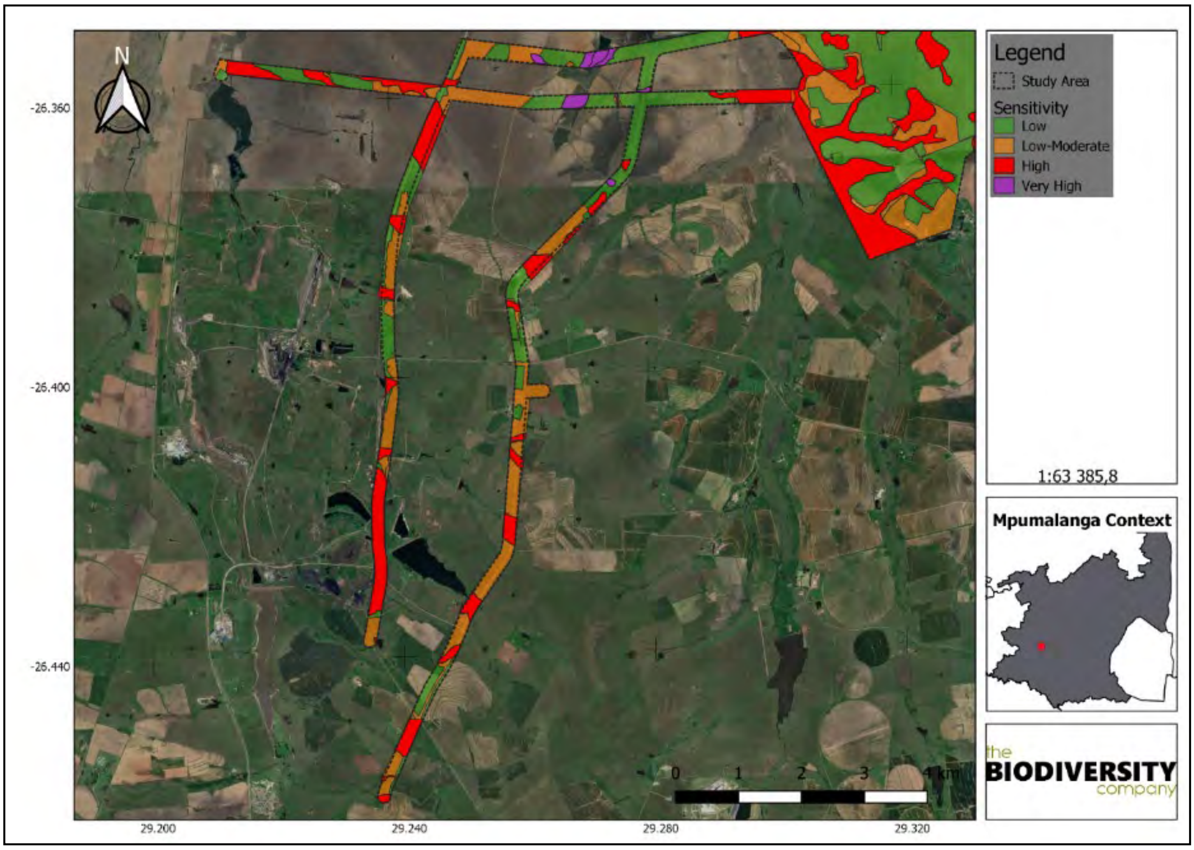


Figure 10-41: Habitat sensitivity map along the Alexander infrastructure route (TBC, 2021c).

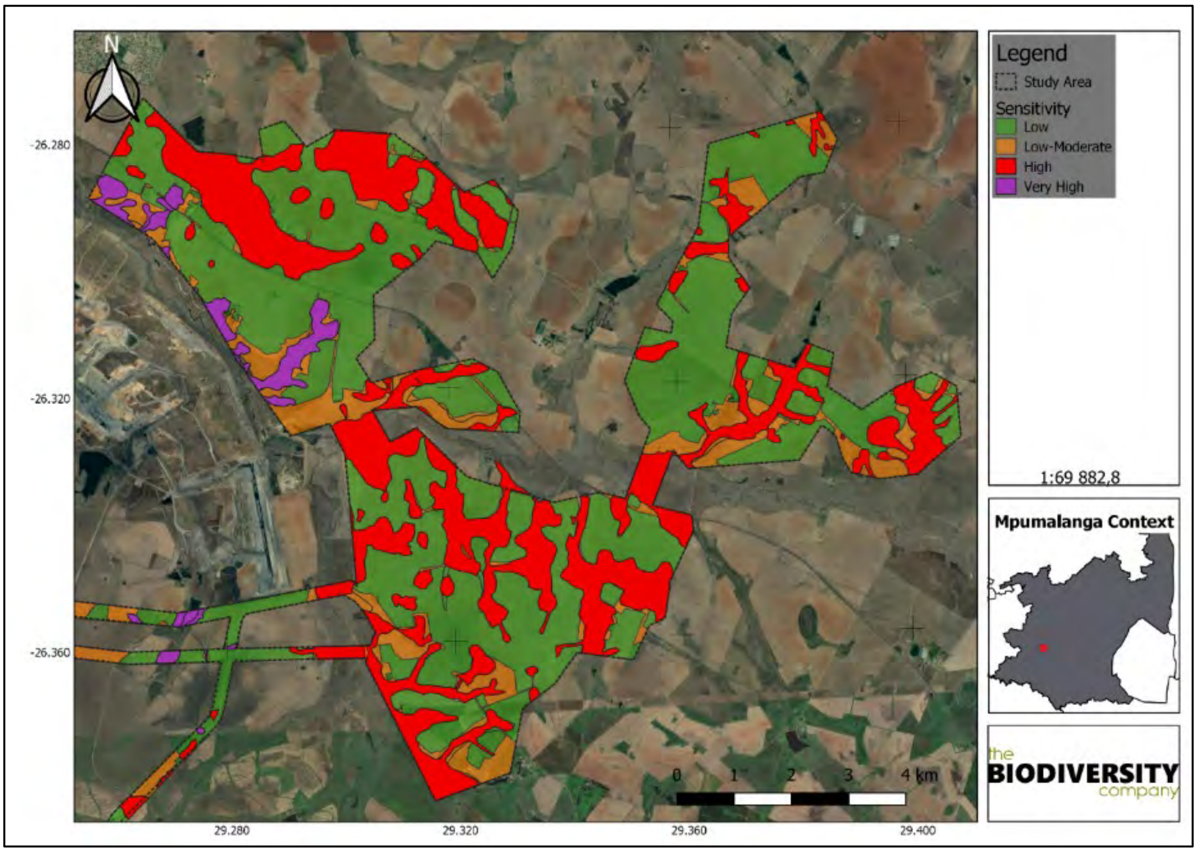


Figure 10-42: Habitat sensitivity map for Alexander (TBC, 2021c).

10.1.1.10. Socio-economic

Social setting

The Mpumalanga Province is divided into three district municipalities, which are comprised of 20 local municipalities. The proposed Alexander Mining Project is located within the ELM within the NDM; and the GMLM within the GSDM.

The southern parts of ELM form part of the precinct referred to as the Energy Mecca of South Africa, due to its rich deposits of coal reserves and power stations such as Kendal, Matla, Duvha and Ga-Nala. The southward road and rail network connect the Emalahleni area to the Richards Bay and Maputo harbours, offering export opportunities for coal reserves. It comprises Emalahleni City as the main urban centre in the municipality, with the other activity nodes/towns in the municipal area represented by Ogies, Phola, Ga-Nala, Thubelihle, Rietspruit, Van Dyksdrift and Wilge. (www.emalahleni.gov.za).

GMLM, bordering ELM to the south, is located within the GSDM. The municipality boasts both mining and manufacturing sectors that contribute significantly to the local, provincial and national Gross Domestic Product (GDP) (http://cgta.mpg.gov.za). GMLM has the most diversified economy within the GSDM, dominated by the petrochemical industry (the SASOL II and III complexes) and mining, both coal and gold mining. GMLM has the largest underground coal mining complex in the world which makes it an important strategic area within the national context.

Demographics

<u>**Population size**</u>

From 1996 to 2016, Emalahleni population has increased by 3.3% average per annum (StatsSA Community Survey, 2016). In 2016 the population of Emalahleni was recorded at 455 228 people. Using an average population growth of 3.3% per annum, the 2021 population can be estimated to approximately 536 502 people.

The population exponential growth represents numerous social challenges such as an increase of informal settlements, strain on municipal infrastructure such as water, sanitation electricity and roads. However, the expected maintenance in economic activity due to the development and operation of the Alexander Mining Project by replacing a current mine reaching the end of its productive life, it can assist in maintaining the employment rate and the households' average income in the region as well as the municipality revenue streams which in turn will allow the municipality to provide basic services. **Figure 10-43** below illustrates the population trends of Emalahleni Local Municipality from 1996 to 2021[5]

[5] From 2017 to 2021 the population number has been forecasted using 3.3% average growth per annum.

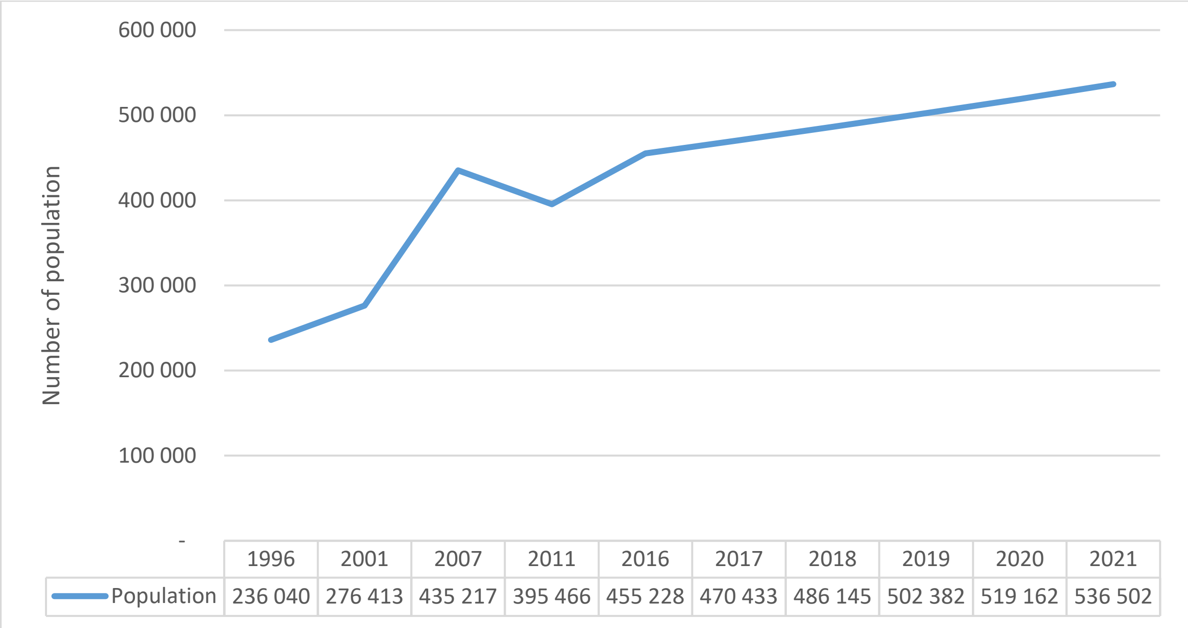
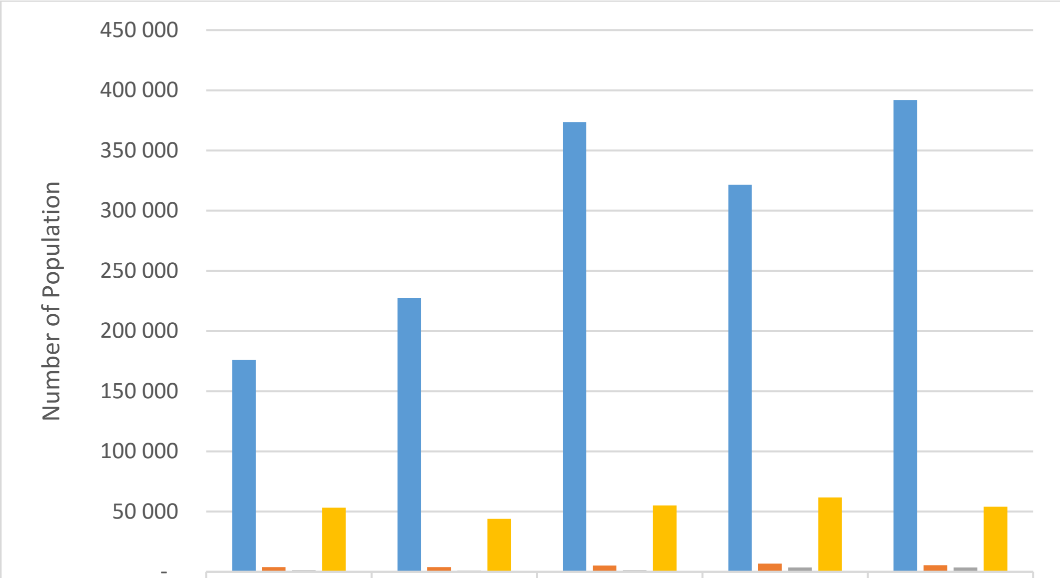


Figure 10-43: Emalahleni population trends from 1996 – 2021 (Statistics South Africa 2021 and own estimations).

<u>Population distribution</u>

This section focuses on the description of the population distribution by race groups in Emalahleni from 1996 to 2016, based on the 2016 Community Survey.

Emalahleni is composed of all racial groups based on the South African race classification. The majority of the residents are Black African with a population of 391 982 people in 2016, follow by Whites with a population of 54 033 people. Coloured and Indian are the minority communities with a population of 5 450 and 3 762 people respectively. **Figure 10-44** below depicts the population groups of Emalahleni from 1996 to 2016. It can be observed from the figure below that the Black and Indian population have more than double from 1996 to 2016. From 2011 to 2016 both the Coloured and White population have decreased by 18.9% and 12.7% respectively. In the same period both Black and Indian population have increased by 21.9% and 5.6% respectively. These changes of population groups over the years can be attributed to the migration across the province and the country due to pursue of better business opportunities, education and job opportunities. The figure below illustrates the population groups of Emalahleni in different periods over time.



	1996	2001	2007	2011	2016
Black African	176 025	227 321	373 602	321 668	391 982
Coloured	3 877	3 956	5 222	6 717	5 450
Indian/Asian	1 314	1 092	1 157	3 562	3 762
White	53 412	44 044	55 236	61 893	54 033

Figure 10-44: Population groups of Emalahleni, 1996 – 2016 (Statistics South Africa 2021*).*

Population age per category

The population of Emalahleni is predominantly young (15-34 years) at 40.3% of the total population, according to the 2011 Census. Approximately 86% of the population are below 50 years of age. The male population is predominated with 52.6% of the total population whilst the female population is 47.4%. The considerable large number of the young population can pose serious social challenges such as the provision of social infrastructure like schools, hospitals, sporting facilities and even housing. As it was mentioned previously, the development and operation of the Alexander greenfields coal mining can to some extend address those mentioned social challenges by maintaining existing job opportunities by transferring staff from the closing mine and maintaining the standard of living of the population.

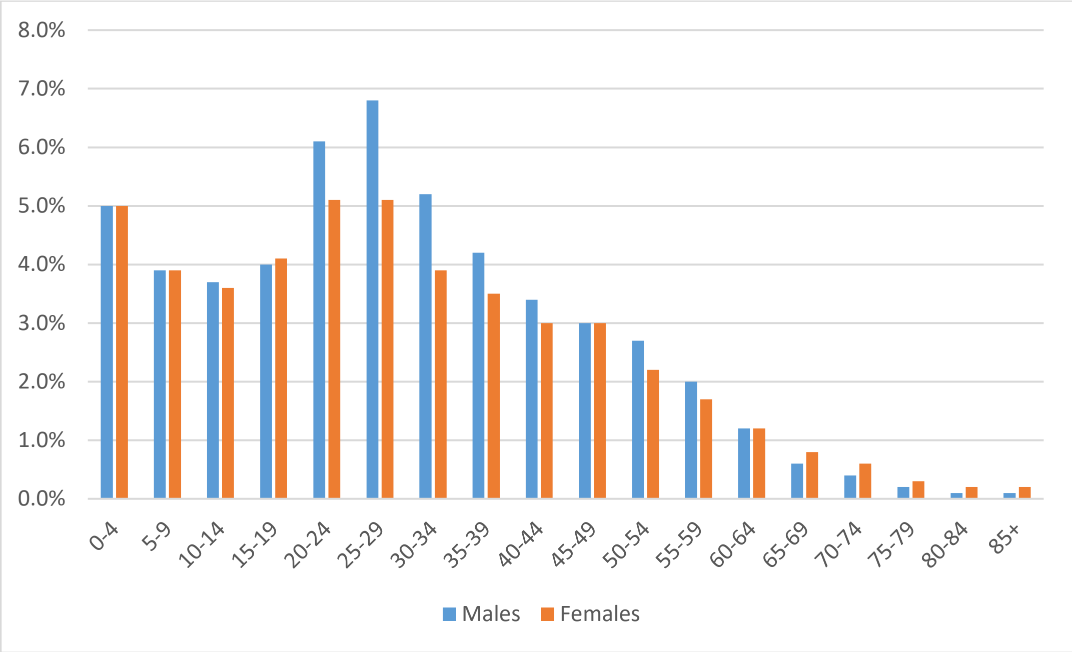


Figure 10-45: Population distribution per age category (Census 2011).

Household Infrastructure

The present section discusses the relevant aspect related to the household's challenges in terms of housing, access to piped water, flush toilet facilities and electricity.

<u>Housing challenges</u>

Figure 10-46 below illustrates the number of households in Emalahleni Local Municipality from 1996 to 2016, based on the 2016 Community Survey (IDP, 2020). The number of households had significantly increase since 1996, from 56 349 in 1996 to 150 420 in 2016, representing an increase of more than 90 000 households. This considerable increase in the number of households over the year can increase the number of informal settlements in the municipality. To address this challenge, the municipality is in the obligation to build rental accommodation or support private initiatives of building rental accommodation to accommodate the rapid increase in the number of households. According to the IDP, Emalahleni has the highest number of informal settlements in the Nkangala District. Almost a quarter of the households are living in informal settlements. The municipality has adopted Informal Settlement Upgrading Policy, which guides the process of upgrading informal settlement.

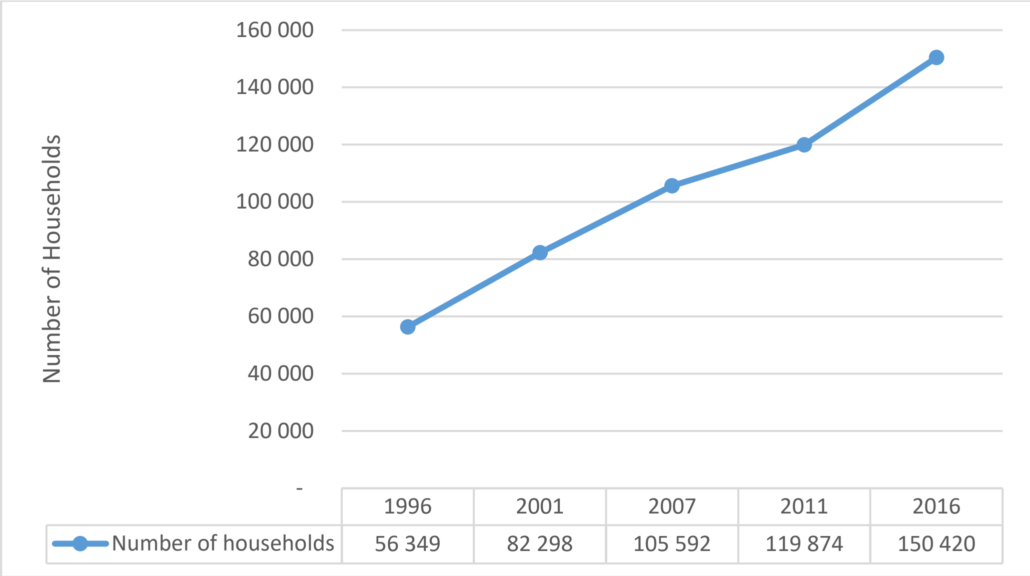


Figure 10-46: **Number of households in Emalahleni, 1996 – 2016 (Integrated Development Plan 2020)**

Access to piped water

According to the IDP, the number of households with access to piped water was 13 792, which translated to 9.2% of households without access to piped water in 2016. **Figure 10-47** illustrates the percentage of households without access to piped water in 2016 per Local Municipality.

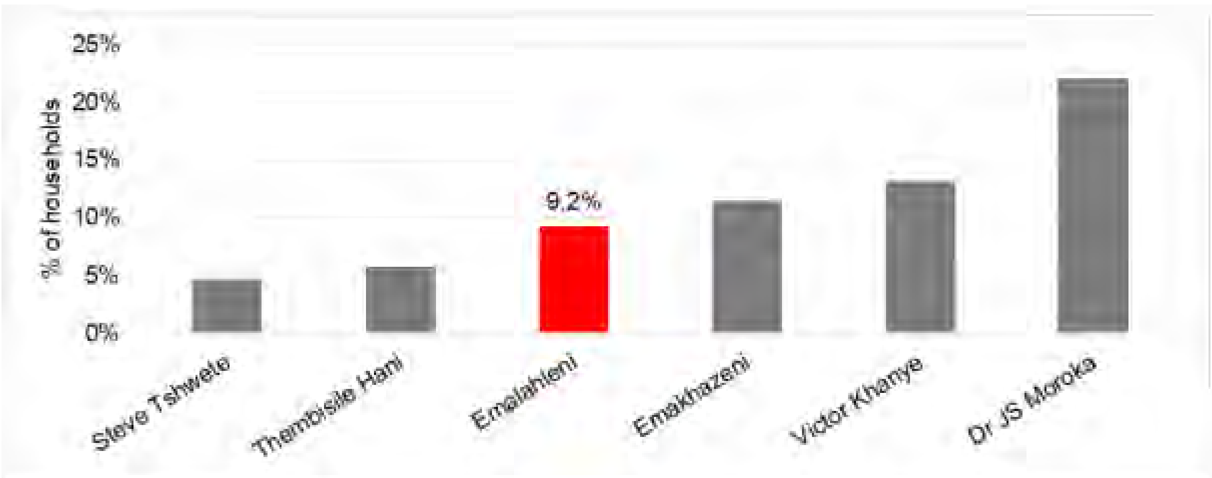


Figure 10-47: **Access to piped water (Integrated Development Plan 2020).**

Access to flush toilets

The number of households with access to flush toilets improved from 34 160 in 2011 to 41 552 in 2016. However, 2 186 households were without any toilet facilities (IDP, 2020).

Table 10-48: Access to flush toilets (Integrated Development Plan 2020).

Local Municipality area	Number of households without flush toilets		Share of total households	
	2011	2016	2011	2016
Victor Khanye	3 742	3 373	18%	14%
Emalahleni	34 160	41 552	29%	28%
Steve Tshwete	9 780	15 713	15%	18%
Emakhazeni	2 941	2 573	21%	18%
Thembisile Hani	68 022	73 411	90%	89%
Dr. JS Moroka	52 450	50 738	84%	81%

Access to electricity

Approximately 40 721 households were not connected to electricity in 2016 compared to 31 527 in 2011, which is more than a quarter of the households. This increase can be attributed to the increase in informal settlements and RDP houses that were built over the same period.

Table 10-49: Number of households connected (Integrated Development Plan 2020).

Local Municipality area	Number of households not connected		Share of total households	
	2011	2016	2011	2016
Victor Khanye	3 062	1 585	14,9%	6,5%
Emalahleni	31 527	40 721	26,3%	27,1%
Steve Tshwete	5 782	7 458	8,9%	8,6%
Emakhazeni	2 209	2 074	16,1%	14,2%
Thembisile Hani	5 673	1 636	7,5%	2,0%
Dr. JS Moroka	1 927	912	3,1%	1,5%

Health and education services

Health Services

According to Mpumalanga department of health (cited by IDP, 2020), influenza and pneumonia are the major cause of death in the province whist the Inflammatory Diseases of the Central Nervous System is the lowest cause of death in Emalahleni. This can be explained by the relatively high number of HIV prevalence rate in the municipality, which is 40.7% (latest available figure, published in 2013).

In addition to the pre-existing health challenges, there is a potential air pollution in the study area due to the operation of the Alexander coal mining in the near future. The air pollution aspect should be considered as a serious health issue. Coal contains several pollutants chemicals including carbon monoxide (CO) and CO2 that are released into the air which consistently affect human and the general ecosystem (Sabbioni et al., 1884 cited Adejoke et al., 2018). Several studies conducted in South Africa and other countries have indicated that exposure to these pollutants may be associated with various diseases such as increased respiratory ailments, reduced lung function, nervous system damage in children, cardiovascular diseases, cancer in various forms and an increased number of deaths. According to Greenpeace Africa, an estimate 2 200 premature deaths per year is reported due to emissions from coal-fired power plants. This figure includes 200 deaths of young children (Baillie, 2015 cited by Adejoke et al., 2018).

Education services

According to the Emalahleni Integrated development Plan (IDP, 2020), Emalahleni registered good improvements in education over the recent years. **Table 8-3** bellow can demonstrate the improvement in education by observing the drop in the number of people without any form of schooling over the years (from 14% in 1996 to 5% in 2016).

According the 2016 Community Survey (cited by the IDP, 2020), the population in Emalahleni aged 20 plus completed grade 12, increased from 117 021 in 2011 to 146 952 in 2016, an increase of 25.6% in the relevant period. Based on the IDP report, Emalahleni grade 12 pass rates showed declined from 81.9% in 2014 to 79.1% in 2018 and a slight increase to 81.2% in 2019. It is ranked 10th lowest in the province. The records in 2018 showed that Emalahleni had 926 bachelor’s degree, 924 diploma and 480 higher certificate achievements.

The municipality has stated that schools experience infrastructure challenges such as theft and there is preference of some of the schools than others, which underutilised and overcrowded others. Emalahleni has one satellite University, which do not absorb all those who passed grade 12. Therefore, many students leave the town for other institutions after successfully completing high school.

It is important to note that there is currently a school (Enkundleni Senior Primary) operating within the proposed Alexander Mining project area.

Table 10-50: Educational Level in Emalahleni, 1996 – 2016 (Statistics South Africa/Integrated development Plan 2020).

Year	1996	2001	2007	2011	2016
No Schooling	14%	14%	8%	6%	5%
Primary	20%	20%	20%	13%	10%
Grade 8 - grade 11	35%	33%	40%	33%	34%
Less than Matric and Certificate/Diploma	3%	1%	5%	1%	1%
Matric only	18%	24%	19%	31%	37%
NTCI/N1/NIC/V Level 2 - N6/NTC 6				5%	6%
Post matric	10%	8%	8%	10%	8%

Community safety

The municipality does participate in community programmes together with the South African Police Service (SAPS) and Department of Community Safety and liaison. Directorate Community Services is engaged in realising the provision of community services as enshrined in the Constitution of the Republic of South Africa, 1996, with specific reference section 152 of chapter 7. The Directorate is also ensuring the protection of environment and animals (Emalahleni Local Municipality, 2020). Furthermore, the municipality established Security Section with the intention to protect and save guard Municipal assets and property as well as enforcement of municipal by laws. In addition to the existing crime levels, there is a possibility of an increase in crime activities during the construction period of the required surface infrastructure due to additional movement of people and vehicles. This should be a serious concern for the local authorities and should be anticipated.

The Community Services Department provides the following services to the community:

- Emergency and disaster management services;
- Registration and licensing services;
- Traffic and security services;
- Arts and culture; and
- Social services.

Local labour force

According to the 2011 Census, 49% of the labour force were employed of which 77% were absorbed in the formal sector whilst 11% were absorbed in the informal sector, 10% in the private household and 2% unspecified. These statistics can demonstrate that maintaining the economic activities in the local municipality, due to the development and operation of the Alexander Mining Project, will result in maintaining the number of labour force absorbed in the formal sector. This will in return maintain the revenue base of the local municipality and improve the standard of living of the residents.

Figure 10-48 below depicts the population of Emalahleni by employment status.

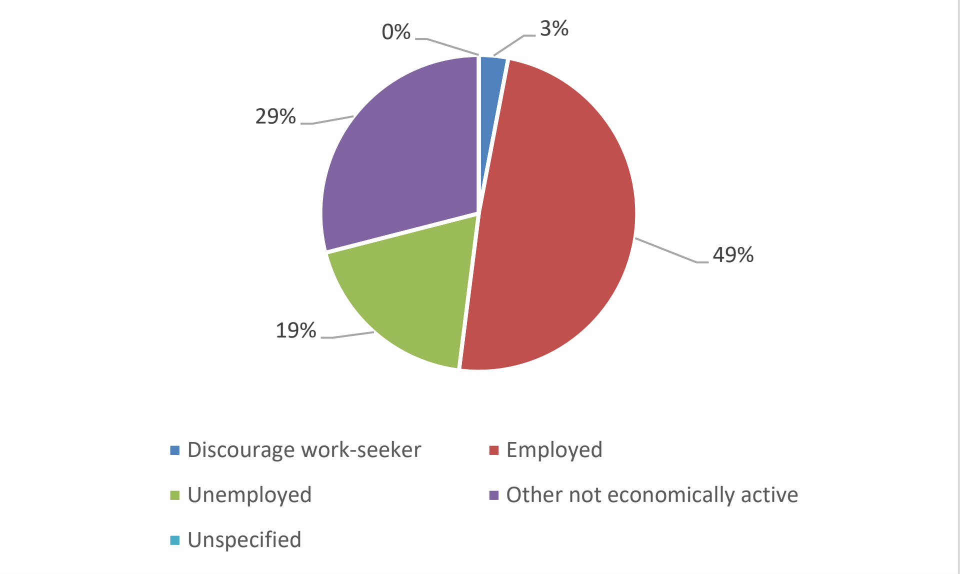


Figure 10-48: Population by employment status (Census 2011*).*

Household income

Based on 2011 Census, the Emalahleni Local Municipality's annual household income were approximately R57 300, which is about double the amount in Nkangala and Mpumalanga as a whole. About 33% of the households earned between R 150 000 and R 600 000 in 2011, identifying a very important middle-class group in the local municipality. It can be assumed that there is a very high changes that the development and operation of the Alexander Mining Project will results in maintaining the economic activities in the local municipalities giving the household income and purchasing power.

Figure 10-49 below depicts the annual household income distribution in Emalahleni based on 2011 Census.

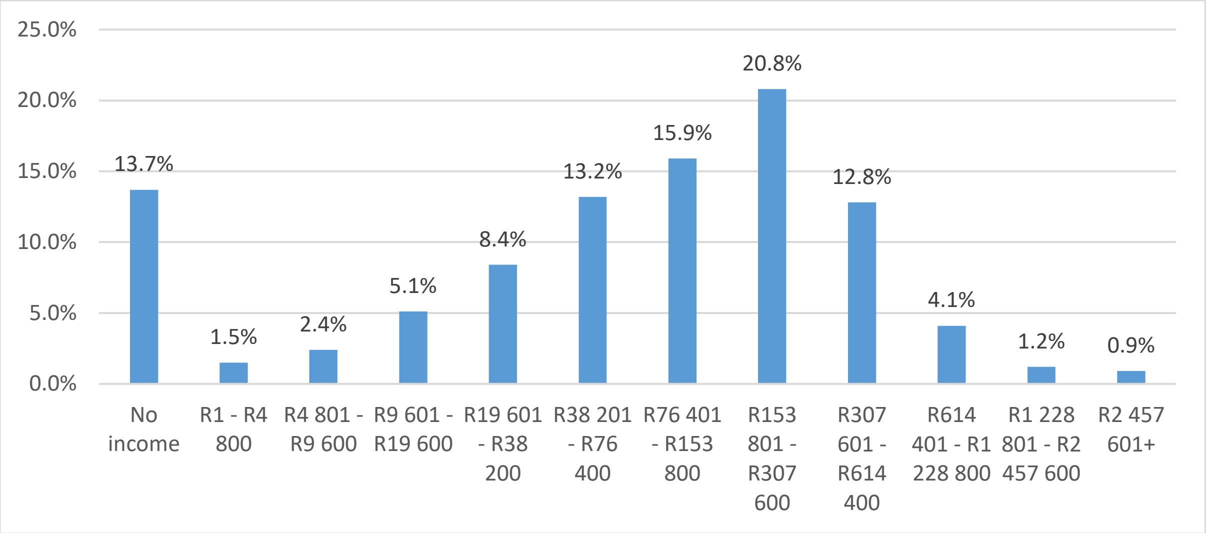


Figure 10-49: Annual household income distribution in Emalahleni (Census 2011).

Agriculture Baseline

The most prevalent land use in the rural areas of GMLM and ELM is commercial agriculture. Though soils in parts of the study area are not ideally suited for arable agriculture, vast areas are being utilized for dry land crop cultivation (crops such as maize, soybeans, and Eragrostis hay production). Unimproved grasslands are used for cattle and sheep grazing. Improvements on the commercial farms mostly include the farmsteads (farmer's house, yard, farm stores, etc.) and labourer's quarters (Conningarth Economists, 2021).

The commercial agricultural activities reflected in **Table 10-51** below were determined by means of satellite images and the visit to the area to confirm some of the observations or deductions made from satellite images. The cultivated dry land and irrigation areas were provisionally determined by the use of satellite images of the area to establish the area in hectares. The total annual turnovers were determined by the average yield per hectare multiplied by the expected price again multiplied with the number of hectares on a crop basis (Conningarth Economists, 2021).

Table 10-51: Main agricultural land use on Alexander (2020 prices) (Conningarth Economists, 2021).

Land use	Hectares	Percentage	Annual Turnover Rand mil.	Percentage
Maize – Dryland	3 962	37.7%	R 81.11	61.2%
Soya Beans - Dryland	2 558	24.3%	R 33.50	25.3%
Irrigated Grazing	90	0.9%	R 4.01	3.0%
Eragrostis Hay	277	2.6%	R 7.02	5.3%
Livestock & Game Grazing	3 622	34.5%	R 6.93	5.2%
Total	10 509	100.0%	R132.58	100%

From the above it is clear that dry land farming and grazing are the predominant farming activities, with limited irrigation in the area. However, although livestock occupies 34.5% of the area it only contributes 5.2% to the total income of the area with dryland maize and soya beans contributing 86.5% of the total average turnover based on 2020 prices.

Local Economic Baseline Activities

The economy around Ga-Nala (Kriel) is largely based on electricity production. Kriel Power Station is one of the largest coal fired power station in Sub-Saharan Africa. However, mining and trade are the dominant economic contributors in the local economies whilst agriculture is the least contributor. Mining activity is scattered throughout the regions and as such has historically been in competition for land with agricultural production. Given the location of coal deposits within the Mpumalanga region and the resultant large amount of coal mines, it is unsurprising that the local economies have been driven by the coal mining sector for a number of decades with continued strong growth and expansion evident (Conningarth Economists, 2021).

It is anticipated that the proposed development will have the greatest effect on Ga-Nala (Kriel), in terms of aspects such as employment, residential development, retail demand, etc., which is located closest to the development site and the fact that employment opportunities will be retained possibly for the next 30 years if the necessary licenses are issued.

Mining is the largest employment provider in both the local municipalities involved. Of the 62.1% economically active residents of Ga-Nala, 74.6% are employed and 25.4% unemployed. **Figure 10-50** below illustrates the major of economic activities in Emalahleni based on 2017 figures.

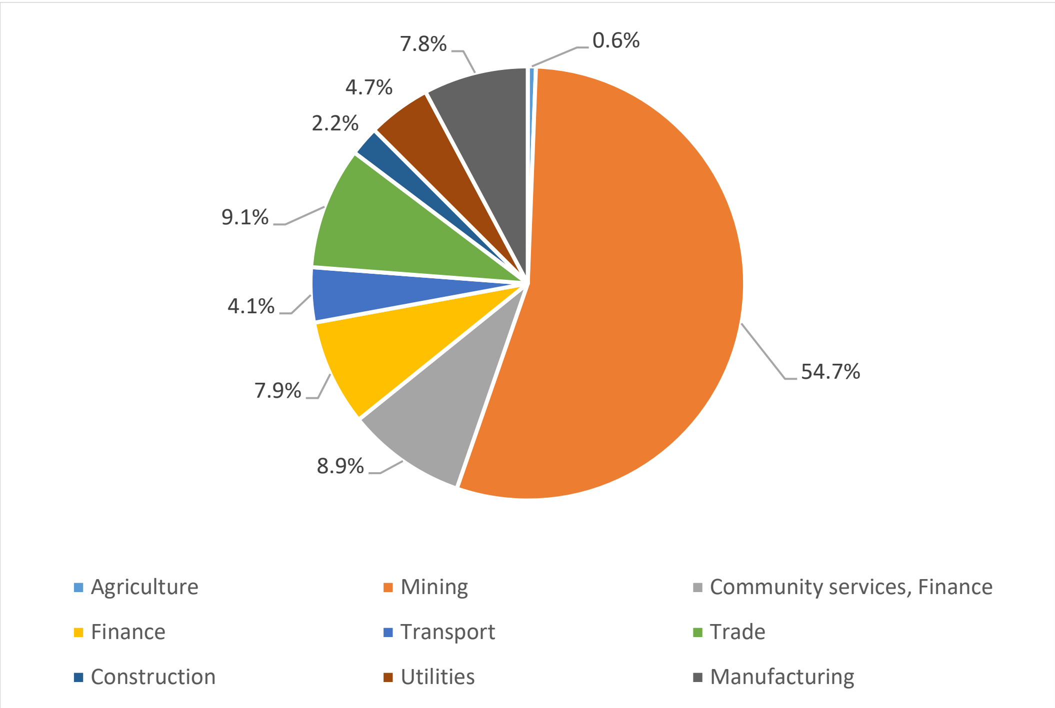


Figure 10-50: Major economic activities in Emalahleni (Integrated Development Plan 2020).

10.1.1.11. Visual Aesthetics

The land use of the study area is dominated by open grasslands (47%) and cultivated commercial fields (37%) that make up 84% of the total land use in the Mining Rights Area (MRA). The minor land uses include wetlands, water, urban areas (mostly Evander), Mines and their dams (Syferfontein, Thubelilsha and Isibonelo), woodlands, shrubland and plantations. A very small portion of degraded eroded and bare land was also observed (J&W, 2021a).

Generally, the farming activities in the area have a low impact on the natural visual environment (J&W, 2021a). However, land degradation from over-grazing is evident in some areas. Prominent visual features resulting from farming activities typical of the region include windmills, powerlines, cattle kraals, homesteads, fences and occasional clusters of shade trees.

Most infrastructure present in the greater study area stems from mining activities (Sasol Mining and Anglo American) and is concentrated around the towns of Secunda, Evander and Kriel. The main road in the area is the N17 Highway, connecting Gauteng with Mpumalanga. In addition, the Sasol plant in Secunda and the Kriel and Matla power stations provide further industrial impact. These activities have an industrial visual character and result in a more pronounced impact on the natural character of the landscape. Additionally, prominent Eskom powerlines cross the landscape to and from the Sasol plant and the two power stations (J&W, 2021a).

Visually there are no sensitive features or no-go areas on the site itself. In the surrounding area the following are considered to be visually sensitive (J&W, 2021a):

- Topographic Features
  - None
- Surrounding homesteads
  - The area around the site has several farmsteads overlooking the proposed mining area.
- Towns/urban areas
  - The towns of Secunda, Trichardt, Evander, Kinross and Kriel are located within the project area.
  - The proposed infrastructure should not be visible from any towns/urban areas.
- Roads
  - The proposed project will be located mostly north of the N17, the main highway connecting Secunda, Bethal and Ermelo with Gauteng.
  - The R545 traverses through the Alexander MRA.

The viewshed of the proposed Alexander mining project extends some 15 km in a north-west, and western direction, with limited views to the east and south due to topographical features (**Figure 10-51**).

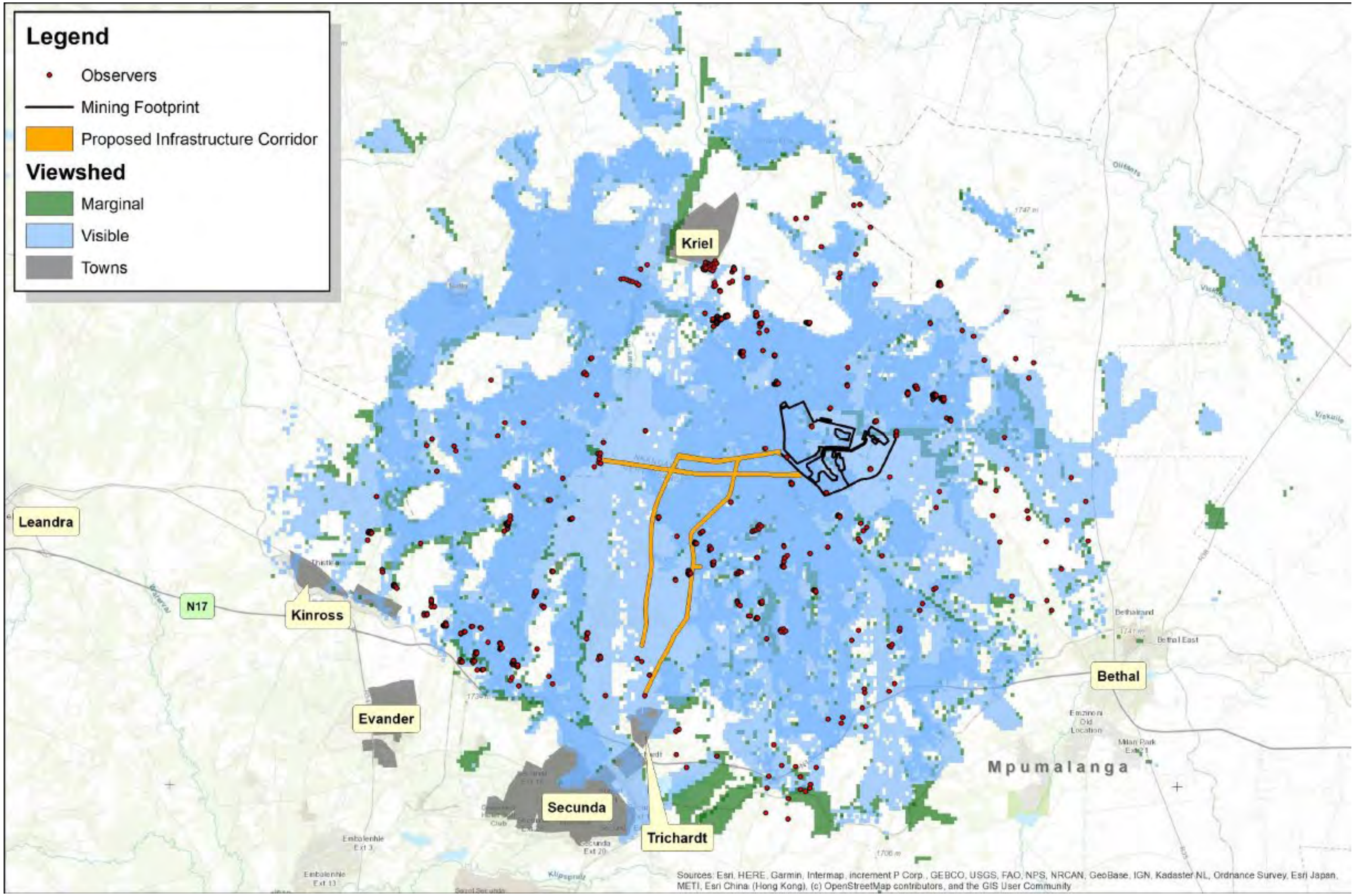


Figure 10-51: Viewshed of the proposed Alexander mining area and associated infrastructure (J&W, 2021a).

10.1.1.12. Noise

Noise sensitive receptors

Noise sensitive receptors generally include places of residence and areas where members of the public may be affected by noise generated by mining, processing and transport activities.

The impact of an intruding industrial/mining noise on the environment rarely extends over more than 5 km from the source. The closest residential developments to the proposed project consist of Kriel village to the northwest and Bethal to the southeast. Individual farmsteads also surround the project area (**Figure 10-52**) (Airshed, 2021b).

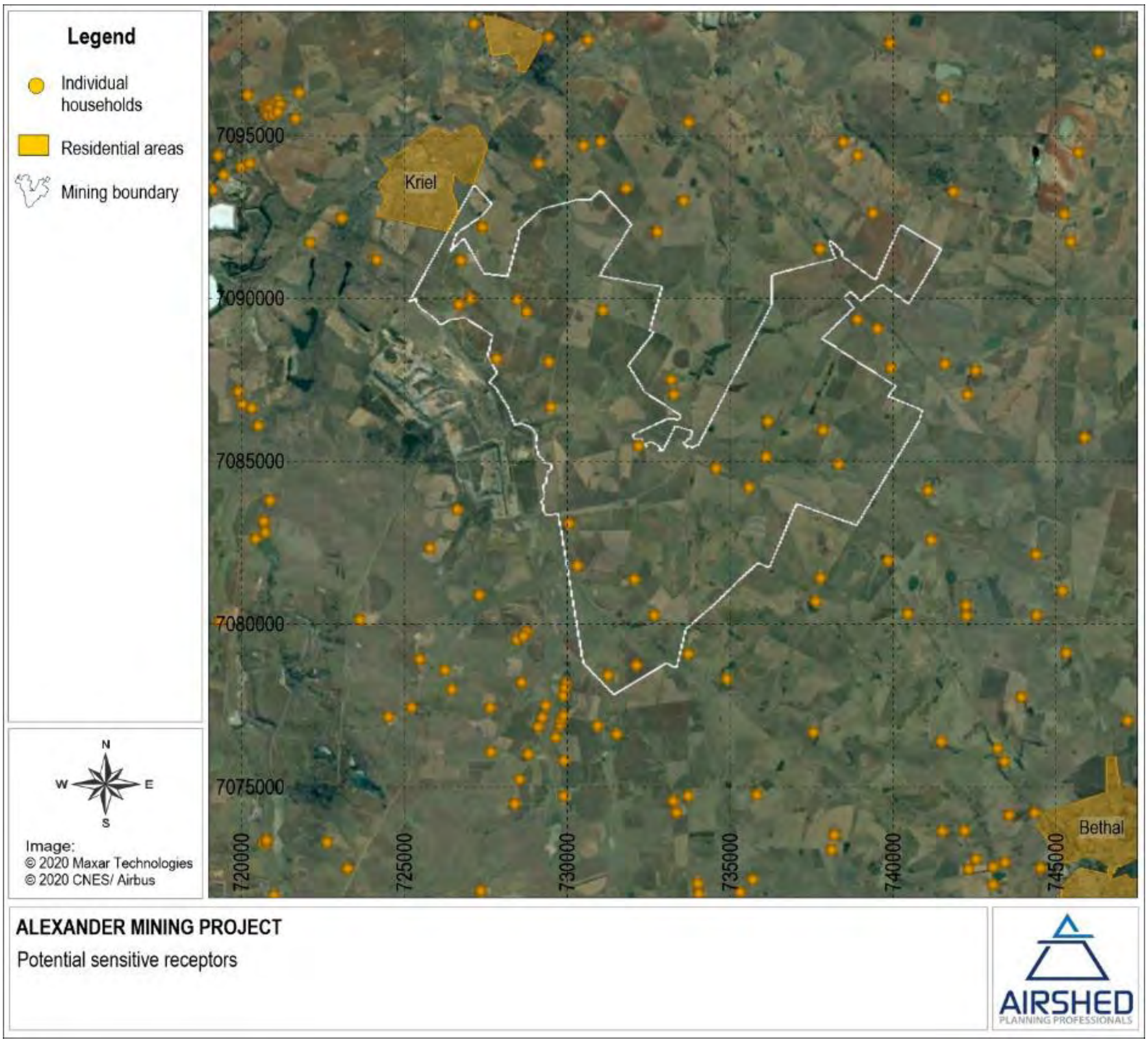


Figure 10-52: Location of potentially sensitive receptors in relation to the project (Airshed, 2021b).

Environmental Noise Propagation and Attenuation potential

Many factors affect the propagation of noise from source to receiver. The most important of these are:

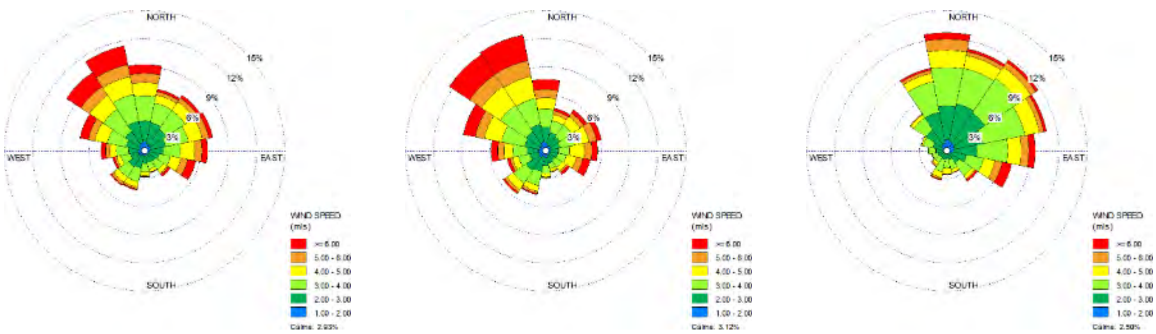
- The type of source and its sound power (LW);
- The distance between the source and the receiver;

- Atmospheric conditions (wind speed and direction, temperature and temperature gradient, humidity etc.);
- Obstacles such as barriers or buildings between the source and receiver;
- Ground absorption; and
- Reflections.

The main meteorological parameters affecting the propagation of noise include wind speed, wind direction and temperature. These along with other parameters such as relative humidity, air pressure, solar radiation and cloud cover affect the stability of the atmosphere and the ability of the atmosphere to absorb sound energy.

Wind speed increases with altitude. This results in the ‘bending’ of the path of sound to ‘focus’ it on the downwind side and creating a ‘shadow’ on the upwind side of the source. Depending on the wind speed, the downwind level may increase by a few dB but the upwind level can drop by more than 20 dB (Brüel & Kjær Sound & Vibration Measurement A/S, 2000). It should be noted that at wind speeds of more than 5 m/s, ambient noise levels are mostly dominated by wind generated noise.

Data from WRF data for the period 2018 to 2020 was used for the assessment. The modelled data set indicates wind flow primarily from the northwest (**Figure 10-53**). At night, wind shifted to be mostly from the north easterly sector. On average, noise impacts are expected to be more notable southeast during the day and south west of the project activities during the night (Airshed, 2021b).



(a) Period average wind rose

(b) Day-time wind rose (06:00 – 22:00)

(d) Night-time wind rose (22:00 – 06:00)

Figure 10-53: Wind rose for WRF data, 1 January 2018 to 31 December 2020 (Airshed, 2021b).

Sampling points were selected based on proposed project activities, position of sensitive receptors and previous survey locations. Survey results for the campaign undertaken on the 28 and 29 May 2018 are visually presented in **Figure 10-54** (day-time results) and **Figure 10-55** (night-time results).

Baseline noise survey results

The following is noted (Airshed, 2021b):

- Measurements were conducted on 28 and 29 May 2018.
- Weather conditions:
    - o During the day weather conditions had less than 5% cloud and sunny, with temperatures between 20 ºC and 23ºC. Slight to moderate wind

conditions with wind speeds between 1 and 4 m/s mostly from the northwest and northerly directions, prevailed.

- At night, skies were clear with temperatures between 10ºC and 12ºC. Slight wind conditions with wind speeds between 1 and 2 m/s mostly from the north-westerly direction, prevailed.

- Through subjective observations during measurements and frequency analysis of recorded 3rd octave frequency spectra, it was determined that pure tones were not present during any of the measurements.
- Day-time baseline noise levels:
  - Measurements indicate day-time ambient noise levels that are comparatively quite but influenced by occasional noisy incidents such as vehicle pass-bys.
  - LAeq's ranged between 43 dBA and 57 dBA which is considered typical of rural to urban areas according to SANS 10103.
  - Recorded LAeq's during the day were within IFC guidelines for residential, institutional and educational receptors (55 dBA) with the exception of Site A4 (57 dBA).
- Night-time baseline noise levels:
  - Measurements indicate night-time ambient noise levels that are quiet but influenced by occasional noisy incidents such as vehicle pass-bys.
  - Mining activities were clearly audible at Site A1, Site A5 and Site A6 during the night.
  - On-site LAeq's ranged between 30 dBA and 52 dBA which is considered typical of rural to urban areas according to SANS 10103.
  - Recorded LAeq's during the night were within IFC guidelines for residential, institutional and educational receptors (45 dBA) with the exception of Site A1 (49 dBA) and Site A6 (52 dBA).

Ambient baseline noise levels for all noise sampling surveys conducted in the study area is provided in **Figure 10-56**.

Table 10-52: Project baseline environmental noise survey results summary (Airshed, 2021b).

	Date and time	Duration	L_{AFmax} (dBA)	L_{AIeq} (dBA)	L_{Aeq} (dBA)	L_{A90} (dBA)	Observations
Day-time							
Site A1 Evander	28/05/2018 12:03	00:30:00	70.24	55.04	53.33	47.3	Near R546 and Aukland Road
Site A2 Kinross	28/05/2018 12:49	00:30:00	61.14	45.58	43.07	35.57	Near R547
Site A3 Secunda	28/05/2018 16:40	00:30:00	71.48	59.15	52.57	44.1	Short to long grass, suburban noise (including leaf blower), traffic from nearby road
Site A4 Farm Vosstoffel Boerdery	28/05/2018 13:42	00:30:00	77.8	58.49	57.04	36.92	Long grass, bluegum trees, moderate wind
Site A5 Weltevreden Farm	28/05/2018 15:41	00:30:00	73.3	48.81	45.21	35.83	Short to long grass, mielie fields, livestock, trees
Site A6 Farm house	28/05/2018 14:40	00:30:00	62.6	48.39	46.34	35.66	Road activity
Night-time							
Site A1 Evander	28/05/2018 23:10	00:10:00	64.66	50.71	48.85	32.28	Mining activities audible
Site A2 Kinross	28/05/2018 22:39	00:12:46	61.64	45.55	43.26	28.49	Traffic audible
Site A3 Secunda	29/05/2018 1:29	00:13:12	59.71	41.6	34.66	22.4	Traffic audible
Site A4 Farm Vosstoffel Boerdery	28/05/2018 23:48	00:10:00	57.96	39.89	29.64	20.54	Cattle
Site A5 Weltevreden Farm	29/05/2018 2:22	00:10:00	57.73	47.24	41.01	36.04	Mining activities and cattle audible
Site A6 Farm house	29/05/2018 0:17	00:20:00	79.29	54.71	51.87	34.63	Mining activities audible

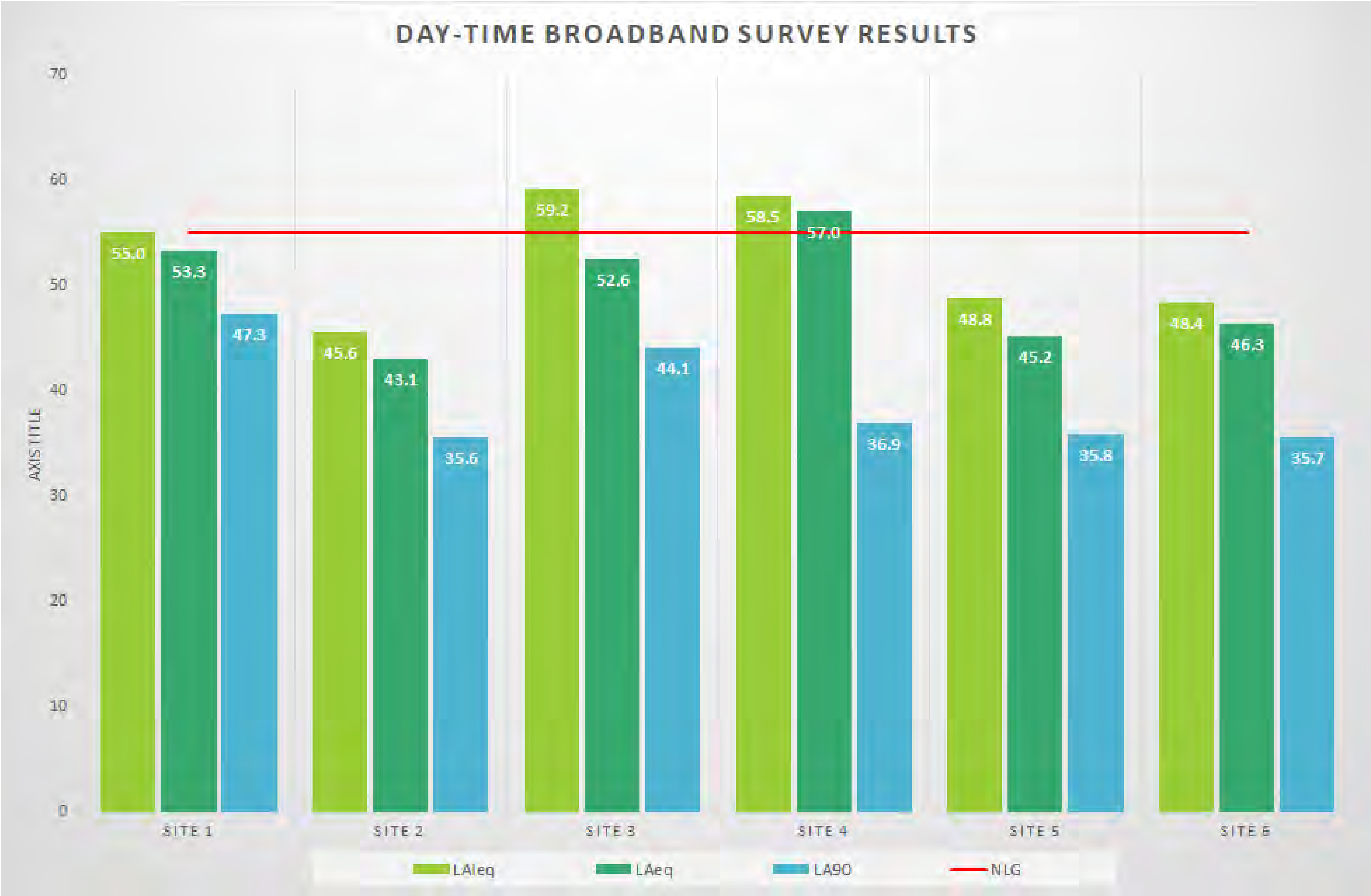


Figure 10-54: **Day-time broadband survey results (Airshed , 2021b).**

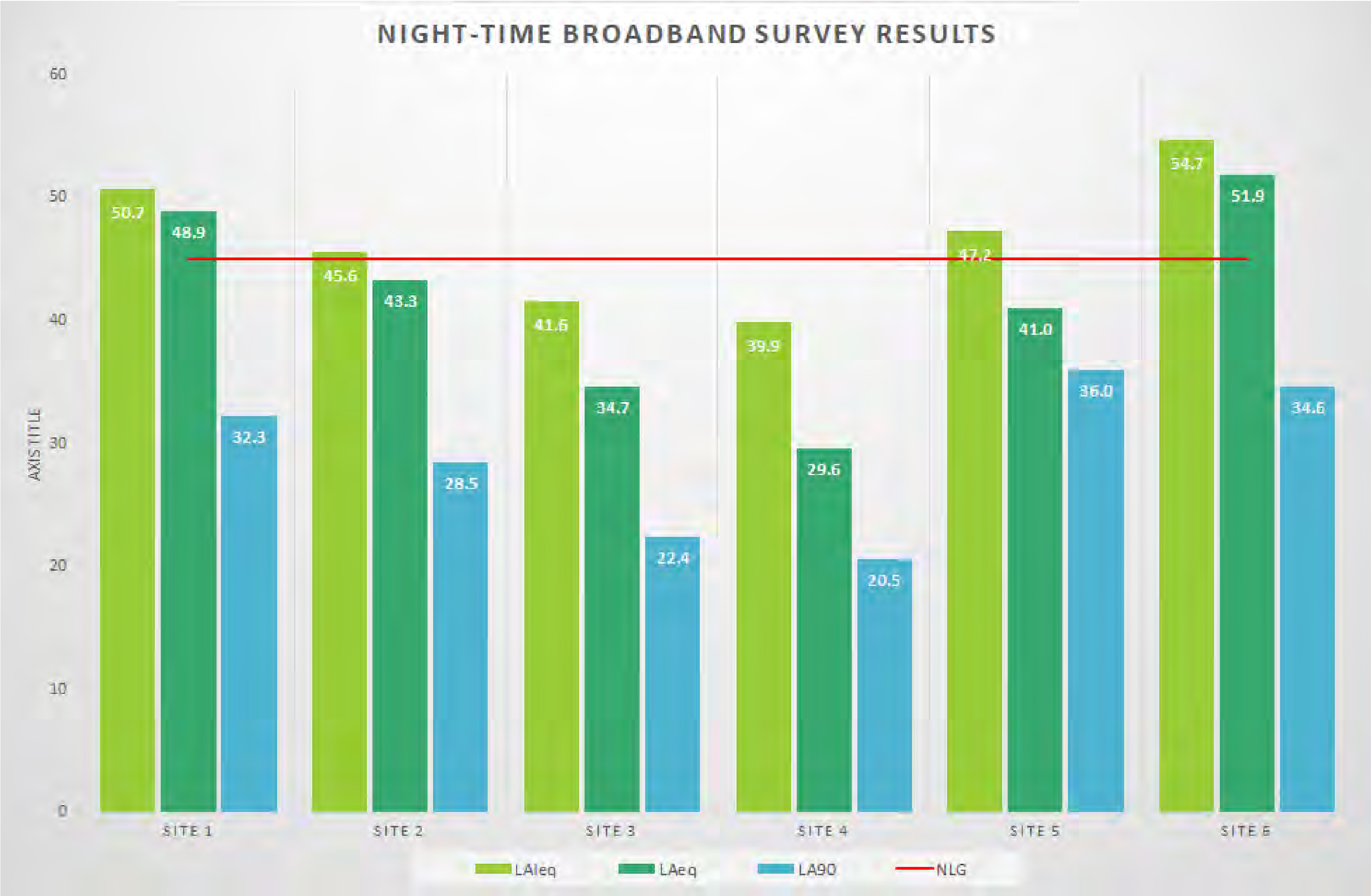


Figure 10-55: **Night-time broadband survey results (Airshed, 2021b).**

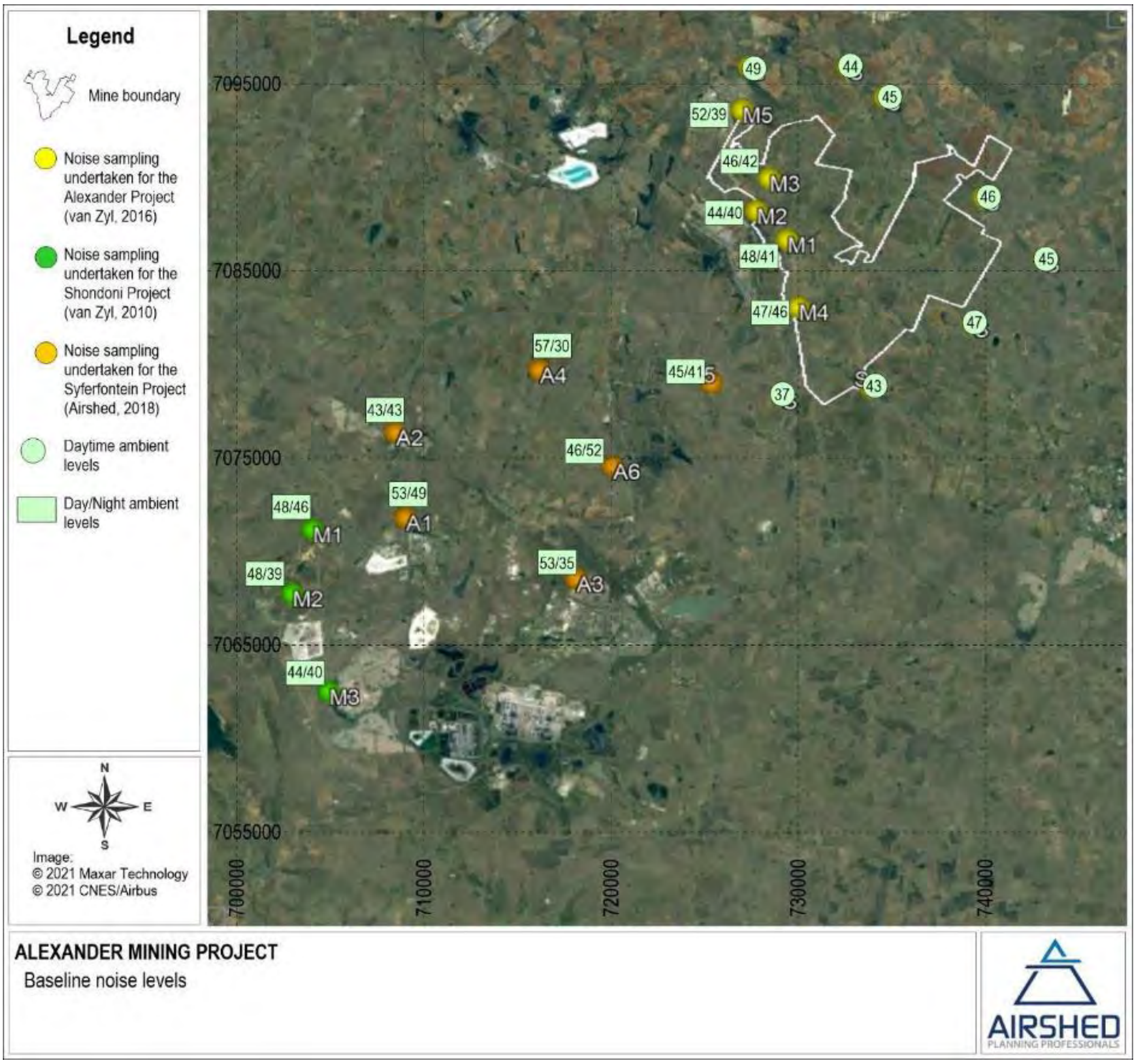


Figure 10-56: Baseline noise levels (Airshed, 2021b).

10.1.1.13. Air quality

Effect of Dust on Vegetation, Animals and Susceptible Human Receptors

Since plants are constantly exposed to air, they are the primary receptors for both gaseous and particulate pollutants of the atmosphere. In terrestrial plant species, the enormous foliar surface area acts as a natural sink for pollutants especially the particulate ones. Vegetation is an effective indicator of the overall impact of air pollution particularly in context of particulate matter (PM) (Rai, 2016).

According to the Canadian Environmental Protection Agency (CEPA), generally, air pollution adversely affects plants in one of two ways. Either the quantity of output or yield is reduced, or the quality of the product is lowered. The former (invisible) injury results from pollutant impacts on plant physiological or biochemical processes and can lead to significant loss of growth or yield in nutritional quality (e.g. protein content). The latter (visible) may take the form of discolouration of the leaf surface caused by internal cellular damage.

Inhalation of confinement-house dust and gases produces a complex set of respiratory responses. An individual or animal’s response depends on characteristics of the inhaled components (such as composition, particle size and antigenicity) and of the individual’s susceptibility, which is tempered by extant respiratory conditions (Davidson et al., 2005). Most studies concurred that the main implication of dusty environments is the stress caused to animals which is detrimental to their general health. However, no threshold levels exist to indicate at what levels these are having a negative effect. In this light it was decided to use the same screening criteria applied to human health, i.e. the South African Standards and SANS limit values.

The impact of particles on human health is largely depended on (i) particle characteristics, particularly particle size and chemical composition, and (ii) the duration, frequency and magnitude of exposure. The nasal openings permit very large dust particles to enter the nasal region, along with much finer airborne particulates. These larger particles are deposited in the nasal region by impaction on the hairs of the nose or at the bends of the nasal passages. The smaller particles (PM10) pass through the nasal region and are deposited in the tracheobronchial and pulmonary regions (CEPA, 1998; Dockery and Pope, 1994).

Highveld Priority Area

The Highveld Airshed Priority Area (HPA) was declared by the Minister of Environmental Affairs at the end of 2007, requiring the development of an Air Quality Management Plan for the area. The plan (HPA, 2011) includes the establishment of emissions reduction strategies and intervention programmes based on the findings of a baseline characterisation of the area. The implication of this is that all contributing sources in the area will be assessed to determine the emission reduction targets to be achieved over the following few years.

Sources of air pollution

The ambient monitoring stations within the study area are located at Kriel Village and Elandsfontein (Eskom operated monitoring stations). Data were obtained for the period January 2018 to October 2020 and is provided in **Table 10-53**.

Table 10-53: Summary of the ambient particulate concentrations within the study area (Airshed, 2021c).

Pollutant	Period	Availability (%)	Daily Concentrations (µg/m³)				Annual Average	No of recorded daily exceedances
			Max	99th Percentile	90th Percentile	50th Percentile		
Eskom: Elandsfontein								
PM_{10}	2018	86.3	54.9	50.7	36.1	19.3	20.6	0
	2019	41.6	48.1	36.1	24.6	15.0	15.6	0
	2020 (Jan-Oct)	0.0						
$PM_{2.5}$	2018	84.0	61.0	48.7	33.3	18.0	19.3	11
	2019	74.7	49.5	36.6	28.2	15.8	17.3	1
	2020 (Jan-Oct)	96.9	43.2	36.9	27.9	15.3	18.5	2
Eskom: Kriel Village								
PM_{10}	2018	98.6	143.3	109.9	86.1	45.5	50.6	69
	2019	80.7	201.6	175.8	121.7	60.5	67.5	117
	2020 (Jan-Oct)	69.1	168.9	153.5	108.7	63.5	66.3	80
$PM_{2.5}$	2018	75.3	66.2	54.9	33.6	20.0	21.6	15
	2019	84.3	52.4	49.8	40.2	25.3	25.0	33
	2020 (Jan-Oct)	65.4	57.7	52.1	36.9	23.4	23.7	14

Monthly variation of PM10 and PM2.5 shows a typical Highveld signature of elevated concentrations during winter months due to the greater contribution from domestic fuel burning, dust from uncovered soil and the lack of the settling influence of rainfall.

Existing sources of emissions in the study area include (Airshed, 2021c):

- Vehicle Tailpipe Emissions
- Agricultural Sources
- Fugitive Dust Sources
- Biomass burning
- Industrial emissions

Possible sensitive receptors

The NAAQS are based on human exposure to specific criteria pollutants and as such, possible sensitive receptors were identified where the public is likely to be unwittingly exposed. NAAQS are enforceable outside of project operational boundaries and therefore the sensitive receptors identified include the residential areas within a 5 km radius of the proposed project (as indicated in **Figure 10-52**). Potential impacts from the proposed project will be assessed at these sensitive receptors and screened against NAAQS.

10.1.1.14. Climate change

The Greenhouse Effect

Greenhouse gases (GHGs) are those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulfur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (IPCC, 2007). Human activities since the beginning of the Industrial Revolution (taken as the year 1750) have produced a 40% increase in the atmospheric concentration of carbon dioxide, from 280 ppm in 1750 to 415 ppm in early September 2021 (NOAA, 2021). This increase has occurred despite the uptake of a large portion of the emissions by various natural "sinks" involved in the carbon cycle (NOAA, 2021). Anthropogenic CO_2 emissions (i.e., emissions produced by human activities) come from combustion of fossil fuels, principally coal, oil, and natural gas, along with deforestation, soil erosion and animal agriculture (IPCC, 2007).

South African National Climate Change Response Policy 2011

The National Climate Change Response White Paper stated that in responding to climate change, South Africa has two objectives: to manage the inevitable climate change impacts and to contribute to the global effort in stabilising GHG emissions at a level that avoids dangerous anthropogenic interference with the climate system. The White Paper proposes mitigation actions, especially a departure from coal-intensive electricity generation, be implemented in the short- and medium-term to match the GHG trajectory range. Peak GHG emissions are expected between 2020 and 2025 before a decade long plateau period and subsequent reductions in GHG emissions.

The White Paper also highlighted the co-benefit of reducing GHG emissions by improving air quality and reducing respiratory diseases by reducing ambient particulate matter, ozone and sulfur dioxide concentrations to levels in compliance with NAAQS by 2020. To achieve these objectives, the DFFE established a national GHG emissions inventory that reports through the South African Atmospheric Quality Information System (SAAQIS).

Nationally Determined Contribution

The first South African Nationally Determined Contribution (NDC) submission was completed in 2016. This was undertaken to comply with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC). An update of the first NDC was published and submitted to the UNFCCC on the 27th September 2021 in preparation for the 26th Conference of the Parties (held in Glasgow, Scotland in November 2021). This document describes South Africa's NDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions with updated revisions to the adaptation goals and mitigation targets.

As part of the mitigation portion the following have been, or can be, implemented at National level:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer (IPP) projects as part of a Renewable Energy Independent Power Producer Procurement Programme (REIPPP).
- A “Green Climate Fund” has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.
- Carbon Capture and Sequestration (or Carbon Capture and Storage) (CCS).
- To support the use of electric and hybrid electric vehicles.
- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar photovoltaic (PV); wind power; CCS; and advanced bioenergy.
- Updated targets based on revised 100-year global warming potential (GWP) factors (published in the Annex to decision 18/CMA.1 of the Intergovernmental Panel on Climate Change’s (IPCC) 5th assessment report) and based on exclusion of land sector emissions arising from natural disturbance. The updated NDC mitigation targets, consistent with South Africa’s fair share, are presented in **Table 10-54**.

Table 10-54: South Africa’s NDC mitigation targets

Year	Target	Corresponding period
2025	South Africa’s annual GHG emissions will be in a range between 398 - 510 Mt CO_2-e.	2021-2025
2030	South Africa’s annual GHG emissions will be in a range between 398 - 440 Mt CO_2-e.	2026-2030

Greenhouse Gas Emissions Reporting

Regulations pertaining to GHG reporting using the NAEIS were published on 3 April 2017 (GN 257 in Government Gazette 40762). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only. The three broad scopes for estimating GHG are:

- Scope 1: All direct GHG emissions.
- Scope 2: Indirect GHG emissions from consumption of purchased electricity, heat or steam.
- Scope 3: Other indirect emissions, such as the extraction and production of purchased materials and fuels, transport-related activities in vehicles not owned or controlled by the reporting entity, electricity-related activities not covered in Scope 2, outsourced activities, waste disposal, etc.

The South African Greenhouse Gas Emission Reporting System (SAGERS) web-based monitoring and reporting system is used to collect GHG information in a standard format for comparison and analyses. The system forms part of the national atmospheric emission inventory component of South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP).

The DFFE is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC’s default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors. Technical guidelines for GHG emission estimation have been issued.

Also, the Carbon Tax Act (Act 15 of 2019) includes details on the imposition of a tax on the CO2-e of GHG emissions. Certain production processes indicated in Annexure A of the Declaration of Greenhouse Gases as Priority Pollutants (GN 710 in GG 40966, 21 July 2017) with GHG in excess of 0.1 Mt, measured as CO_2-e, are required to submit a pollution prevention plan to the Minister for approval. The proposed project will be required to report CO_2-e emissions but will not be required to prepare a pollution prevention plan, unless directed by the minister.

South African Energy Supply

Coal provides in the order of 70% of the primary energy supply to the SA economy, with more than 90% of the electricity being generated from coal combustion. South Africa is thus regarded as having a carbon-intensive energy economy.

The 1998 White Paper on the Energy Policy of the Republic of South Africa covered both supply and demand of energy for the next decade and made specific provision for independent suppliers of energy to enter the market. No additional capacity ensued during the decade 1998 to 2008, leading to the 'load shedding' of 2008 and the subsequent short-term interventions to ensure stability of supply. The 2011 Integrated Resource Plan (IRP; DOE, 2011) provided a planning basis for the period up to 2030 and made provision for the supply of energy - including renewable energy - by independent producers, as well as 9 600 MW of nuclear energy over that period. An update of the IRP was gazetted on the 18th of October 2019 (Government Gazette No 42784) where it accounts for electricity capacity development changes since the 2011 IRP. The draft IRP updates attracted considerable criticism regarding the cost and greenhouse gas implications as part of the public participation process, including a report by the CSIR arguing for a much larger use of renewable sources. Although the planning period is unchanged (2010 to 2030), the updated IRP includes increased capacity allocations to solar PV and wind, alongside a decrease in gas and diesel and the inclusion of nuclear and storage capacity (DMR, 2019).

As of March 2020, 112 renewable energy IPP projects have been approved and several others are being deliberated as part of a REIPPP where 4 201 MW of renewable electricity generating capacity has been connected to the grid (DFFE, 2021).

GHG Inventories

<u>National GHG Emissions Inventory</u>

South Africa is a global climate change contributor and is undertaking steps to mitigate and adapt to the changing climate. DFFE is categorised as the lead climate change institution and is required to coordinate and manage climate related information such as development of mitigation, monitoring, adaption and evaluation strategies. This includes the establishment and updating of the National GHG Inventory. The National Greenhouse Gas Improvement Programme (GHGIP) has been initiated; it includes sector specific targets to improve methodology and emission factors used for the different sectors as well as the availability of data.

The 2000 to 2017 National GHG Inventory was prepared using the 2006 IPCC Guidelines (IPCC, 2006). According to the draft 4th Biennial Update Report to the UNFCCC (DFFE, 2020), the total GHG emissions in 2017 were estimated at approximately 574.696 million metric tonnes CO_2-e (excluding Forestry and Other Land Use (FOLU)). This was a 27.9% increase from the 2000 total GHG emissions (excluding FOLU). FOLU is estimated to be a net carbon sink which reduces the 2017 GHG emissions to 532.173 million metric tonnes CO_2-e. The assessment (excluding FOLU) showed the main sectors contributing to GHG emissions in 2017 to be the energy industry, contributing 79.8% to the total GHG emissions (excluding FOLU), this increased by 2.9% from 2000.

The DFFE is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC default emission figures may be used to populate the SAAQIS GHG emission factor database. The country specific emission factors, when developed, will replace some of the default IPCC emission factors.

GHG Emission Inventory for the Sector

The proposed Alexander Mining Project would be categorised in the "Energy" category for both the global GHG inventory and for the national GHG inventory. According to the World Resources Institute – CAIT Climate Data Explorer the 2017 global GHG emissions from the Energy category were approximately 34 901.6 Mt CO_2-e; 78% of the total anthropogenic GHG emissions (excluding FOLU). The South African Energy sector contributed represented 1.3% of the global emissions from the Energy sector; contributed approximately 437.8 Mt CO_2-e to global emissions in 2017.

Physical risks of climate change on the region

In 2017 the South African Weather Services (SAWS) published an updated Climate Change Reference Atlas (CCRA) based on Global Climate Change Models (GCMs) projections (SAWS, 2017). It must be noted that as with all atmospheric models there is the possibility of inaccuracies in the results because of the model's physics and accuracy of input data; for this reason, an ensemble of models' projections is used to determine the potential change in near-surface temperatures and rainfall depicted in the CCRA. The projections are for to 30-year periods described as the near future (2036 to 2065) and the far future (2066 to 2095). Projected changes are defined relative to a historical 30-year period (1976 to 2005). The Rossby Centre regional model (RCA4) was used in the predictions for the CCRA which included the input of nine GCMs results. The RCA4 model was used to improve the spatial resolution to 0.44° x 0.44°- the finest resolution GCMs in the ensemble were run at resolutions of 1.4° x 1.4° and 1.8° x 1.2°.

Two trajectories are included based on the four Representative Concentration Pathways (RCPs) discussed in the IPCC's fifth assessment report (AR5) (IPCC, 2013). RCPs are defined by their influence on atmospheric radiative forcing in the year 2100. RCP4.5 represents an addition to the radiation budget of 4.5 W/m2 as a result of an increase in GHGs. The two RCPs selected were RCP4.5 representing the medium-to-low pathway and RCP8.5 representing the high pathway. RCP4.5 is based on a CO2 concentration of 560 ppm and RCP8.5 on 950 ppm by 2100. RCP4.5 is based on if current interventions to reduce GHG emissions being sustained (after 2100 the concentration is expected to stabilise or even decrease). RCP8.5 is based on if no interventions to reduce GHG emissions being implemented (after 2100 the concentration is expected to continue to increase).

RCP4.5 Trajectory

Based on the median, for the region in which the proposed project is situated, the annual average near surface temperatures (2 m above ground) are expected to increase by between 1.5°C and 2.0°C for the near future and between 2.5°C and 3.0°C for the far future. The seasonal average temperatures are expected to increase for all seasons, in the same order as the annual average increases, with slightly larger temperature increases in spring (September – November). The total annual rainfall is expected to decrease by between 5 mm and 10 mm for the near future and up to 30 mm in the far future. Seasonal rainfall is expected to decrease in summer (December to February) in the near- and far future, while other seasons are in line with the annual changes (Airshed, 2021c).

RCP8.5 Trajectory

Based on the median, the region in which the project and receptors are situated, the annual average near surface temperatures (2 m above ground) are expected to increase by between 2.0°C and 2.5°C for the near future and between 4.0°C and 4.5°C for the far future. The seasonal average temperatures are expected to increase for all seasons in similar ranges to the annual average temperature, with slightly higher increases in spring. The total annual rainfall change is likely to increase by between 10 and 20 mm, while for the far future a potential decrease between 20 and 30 mm. Seasonal rainfall changes could see an increase of 10 to 20 mm in summer in the near future, in the remaining seasons the rainfall changes are similar to the projected annual changes (Airshed, 2021c).

Water Stress and Extreme Events

South Africa is known to be a water stressed country where the Kriel-Bethal-Secunda area currently rated with a high risk (**Figure 10-57**). Climate change, through elevated temperatures, is likely to increase evaporation rates, which together with reduced annual rainfall volumes, will decrease water volumes available for dryland and irrigated agriculture (Davis-Reddy & Vincent, 2017). Commercial agriculture (irrigated, dryland, and stock farming) is the predominant agricultural land-use in the vicinity of the project (Mpumalanga Tourism and Parks Agency, 2021), where the vegetation is of the Eastern Highveld Grassland type (Airshed, 2021c).

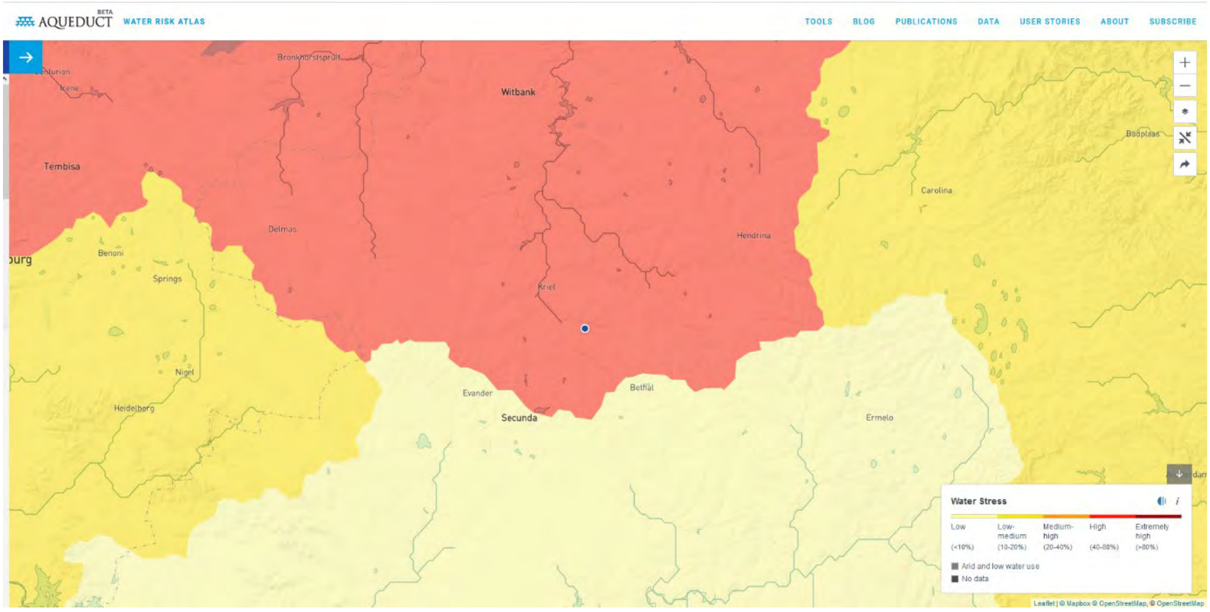


Figure 10-57: **Water stress for the project area (Hofste, et al., 2019) (blue dot indicates project location).**

Extreme weather events affecting southern Africa, including heat waves, flooding due to intensified rainfall due to large storms, and drought, have been shown to increase in number since 1980 (Davis-Reddy & Vincent, 2017). Projections indicate (Davis-Reddy & Vincent, 2017):

- with high confidence, that heat wave and warm spell duration are likely to increase while cold extremes are likely to decrease, where up to 80 days above 35°C are projected by the end of the century under the RCP4.5 scenario;
- with medium confidence, that droughts are likely to intensify due to reduced rainfall and/or an increase in evapotranspiration;
- with low confidence, that heavy rainfall events (more than 20 mm per 24 hours) will increase, especially in the eastern parts of southern Africa.

10.1.1.15. Heritage and Paleontological setting

Heritage

The source material used to develop the baseline dates from 2003 to 2017. Relevant sources are listed in the reference list in Chapter 8 of the Heritage Report (Digby Wells, 2021).

Four pre-disturbance surveys considering the changes in mine plans were undertaken and tracklogs recorded as displayed on **Figure 10-58**. The first was undertaken on 19 and 20 July 2018 where the focus was on the proposed Alexander mining area and the then proposed Tweedraai long-wall footprint (which is no longer applicable). The survey was primarily vehicle-based with pedestrian surveys of select areas considered to comprise higher likelihoods for heritage resources to exist. The survey also ground-truthed / verified certain previous heritage resources. A second pedestrian survey was completed on 16 January 2019 that focussed on the then proposed ventilation shafts footprint area (no longer applicable). This survey was completed by Johan Nel and Dr Heidi Fourie (palaeontologist). This survey verified that the Vryheid Formation underlies the development footprint area. A third survey was completed on 12 November 2020 that focussed on added linear infrastructure footprints. A final survey was done on 8 February 2021 to survey revised linear infrastructure footprints. Documentation of identified heritage resources included GPS points, photographs, and written records.

Identified heritage resources are assessed in terms of criteria outlined in section 3 of the NHRA to provide a statement of the cultural significance of individual, groups, or categories of heritage resources. The methodology aims to provide as objective rankings as possible based on research that informed the baseline assessment.

The criteria are based on a resource’s value in terms of one or more of the following:

- Aesthetic importance;
- Historical importance;
- Social importance; and
- Scientific importance.

Each resource is further assessed in terms of its integrity (i.e., current physical state of conservation and restoration potential), rarity and sensitivity to change.

Local study area

The cultural landscape of the local study area comprises five heritage resources categories. These include Stone and Iron Age remains, historical structures and graves, as well as fossils (Digby Wells, 2021).

Most heritage resources comprise burial grounds and graves, which combined with historical built environment resources accounts for 84% of identified heritage.

Archaeological heritage only accounts for less than 14% of the total number of identified sites, whilst resources described as cultural landscapes, geological sites or palaeontological resources are less than 1%. Refer to **Table 10-55** below for a summary of these findings.

Several factors influence these statistics. The relatively high visibility, local knowledge and historical settlement notably contribute to the abundance of burial grounds and historical built environment resources. Similarly, the relative scarcity of archaeological resources speaks to the lower visibility, lack of knowledge and infrequent Late Iron Age settlement. Low visibility, scarcity, and a near absence of knowledge results in the very low palaeontological heritage identified (Digby Wells, 2021).

This section of the report provides an overview of the cultural landscape in the following sequence:

- Geology and palaeontological potential;
- Stone Age;
- Iron Age; and
- Historical.

Table 10-55: Summary of Recorded Heritage Resources in Local Study Area (Digby Wells, 2021).

Heritage Resources Category	Number of Recordings	Percentage of Total
Palaeontology	1	0.33%
Cultural landscape	2	0.66%
Geological features	2	0.66%
Archaeology	42	13.91%
Historical Built Environment	112	37.09%
Burial Grounds & Graves	143	47.35%
Grand Total	**302**	**100.00%**

<u>Historical overview</u>

Recorded historical heritage includes 143 burial grounds and graves, and 112 structures. Only two instances of landscapes or natural features with possible cultural significance exist (Digby Wells, 2021).

The Historical period is usually defined as dating from the early 19th century with the advance of European immigrants such as the Voortrekkers who entered and settled in the region from the 1840s. Some of the earliest Historical period European heritage includes Voortrekker, and later Boer, farmsteads, and burial grounds. This settlement on the eastern Highveld led to a unique vernacular stone architecture established in the late 19th century. The general scarcity of trees precluded extensive timber use in construction or as fuel to fire clay bricks. Construction therefore made use of locally quarried stone (Pistorius, 2010; van Vollenhoven, 2010).

The early European settlements were largely agrarian, but farmers mined coal on a small, domestic scale. As early as 1868, Thomas Baines mentioned farmers mining coal in the Bethal area. However, coal mining was only truly commercialised after the discovery of diamonds in Kimberley in 1867 and gold on the Witwatersrand in 1886. By 1899, at least four collieries operated in the Middelburg-Witbank district.

The increased demand also led to the establishment of several small towns, including Bethal in 1880 (Digby Wells, 2021).

The Mpumalanga Highveld also represents a significant Anglo-Boer War / South African War landscape. Several battles and skirmishes took place in the general region. Notable events and places occurred at Bakenlaagte (30 October 1901), Oshoek (4 December 1901), Trigaardsfontein (10 December 1901), Witbank (11 January 1902) and Nelspan (26 January 1902) (Van Vollenhoven, 2010).

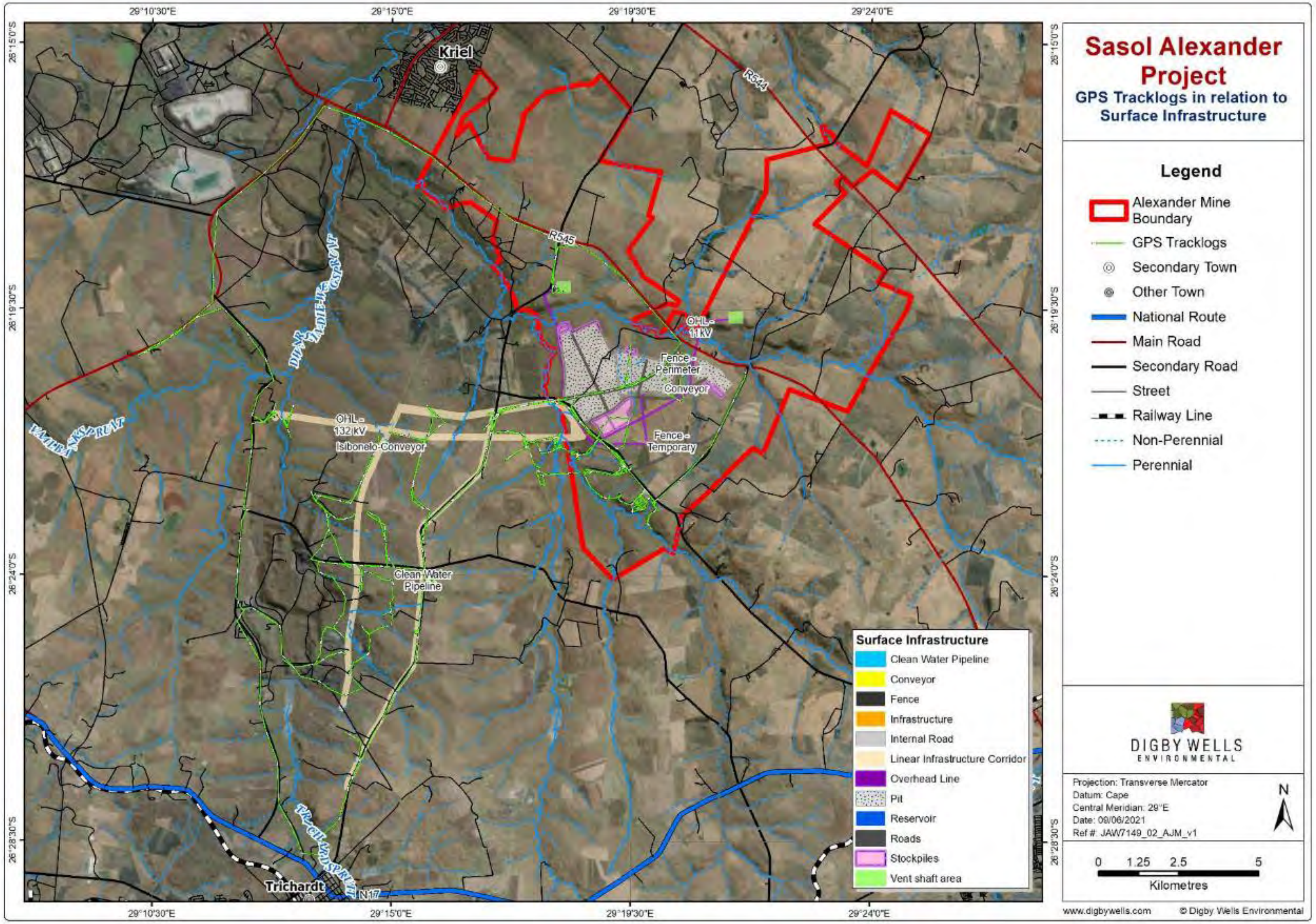


Figure 10-58: GPS Tracklogs of Pre-disturbance Surveys in relation to Surface Infrastructure (Digby Wells, 2021).

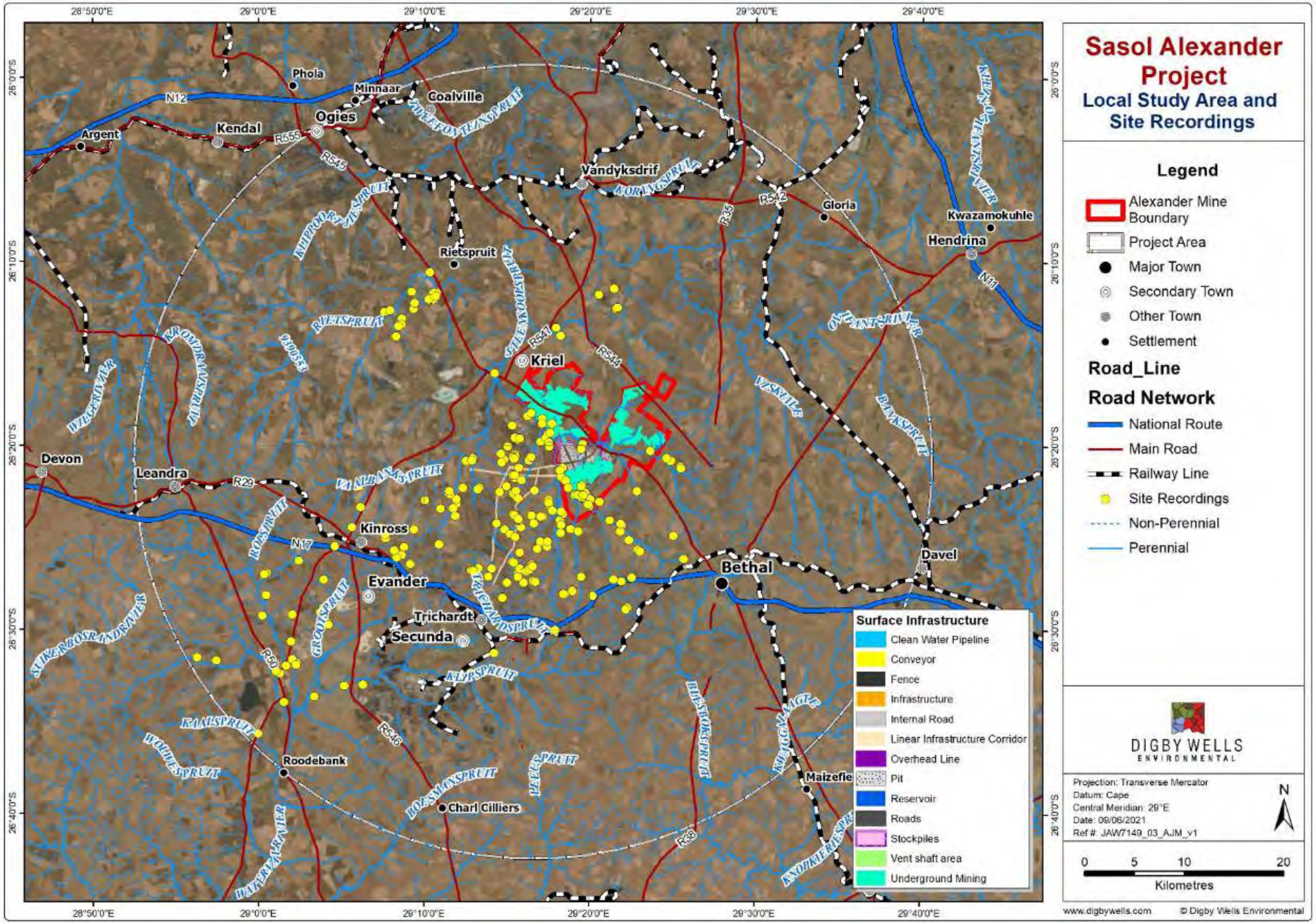


Figure 10-59: Local Study Area for the Alexander Mining Project indicating Site Recordings (Digby Wells, 2021).

Site-specific and development footprint study areas – Alexander Mining Project

The Alexander Mining Project site specific study area includes five heritage resources categories constituting 66 individual records.

Table 10-56 and **Figure 10-60** provides a summary of these resources and depict the locations of recorded heritage resources in relation to surface infrastructure footprints.

Table 10-56: Summary of Recorded Heritage Resources within the Alexander Mining Project Area (Digby Wells, 2021).

Heritage Resource Category	No. Recordings	% of Total Recordings
Geological features	1	1.52%
Palaeontology	1	1.52%
Archaeology	17	25.76%
Burial Grounds & Graves	21	31.82%
Historical Built Environment	26	39.39%
	66	**100.00%**

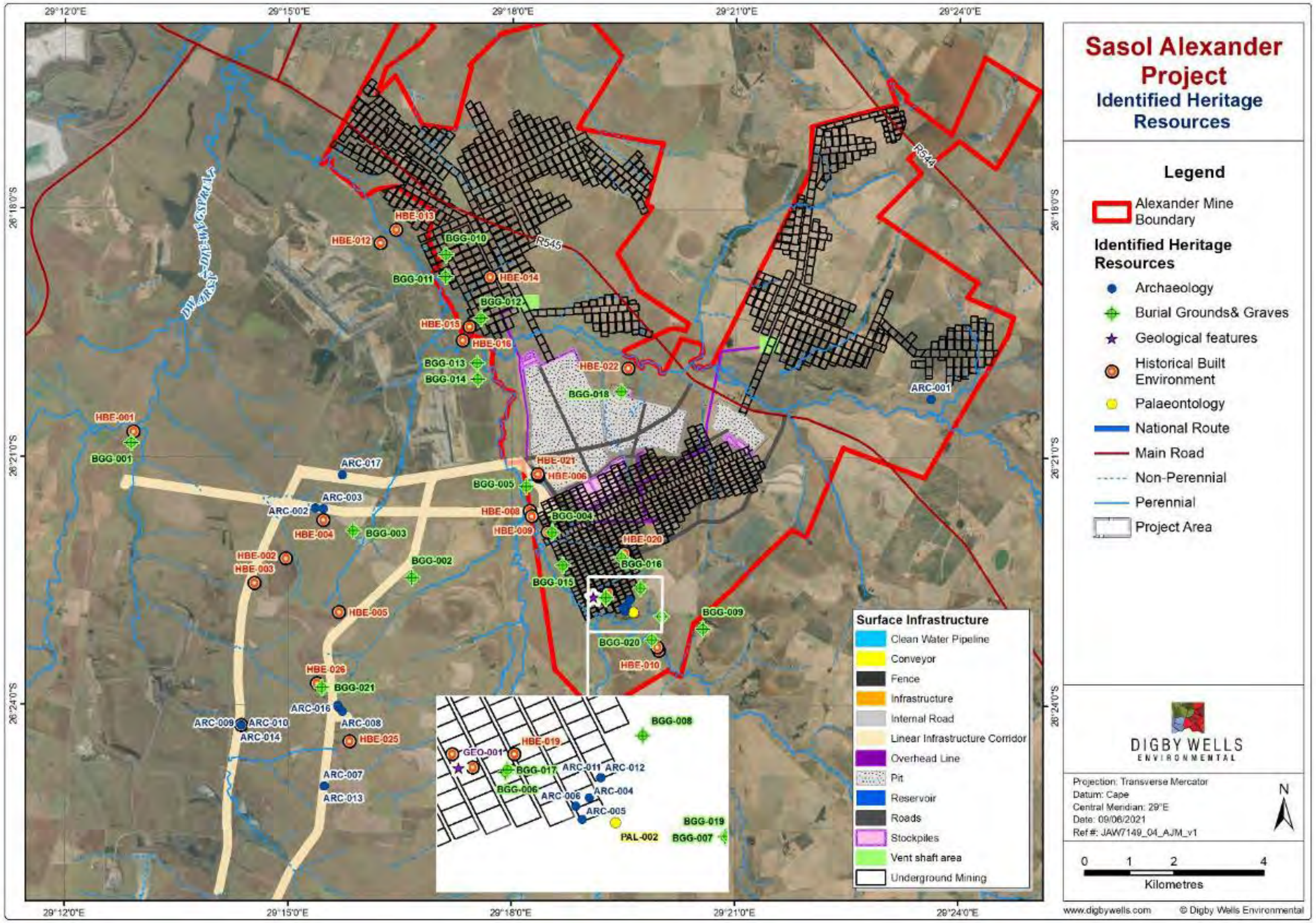


Figure 10-60: **Identified Heritage Resources in Relation to the Alexander Mining Project and Associated Linear Infrastructure (Digby Wells, 2021)**

Palaeontology

The Phase 1 PIA Field Study was undertaken in January 2019 in the summer in hot and dry conditions and the following is reported:

The Karoo Supergroup is renowned for its fossil wealth. The Vryheid Formation (Pe,Pv), Ecca Group is rich in plant fossils such as the *Glossopteris* flora represented by stumps, leaves, pollen and fructifications. This formation is early to mid-Permian (Palaeozoic) in age and consists of sandstone, shaly sandstone, grit, conglomerate, coal and shale. Coal seams are present in the Vryheid Formation within the sandstone and shale layers. Fossils are mainly present in the grey shale which is interlayered between the coal seams (Kent 1980, Visser 1989). Borehole logs in the coalfields show the following layers; soil, shale and sandstone, shale and sandstone interbedded, sandstone, coal, conglomerate reworked diamictite, Dwyka Tillite, and the Pre-Karoo Basement.

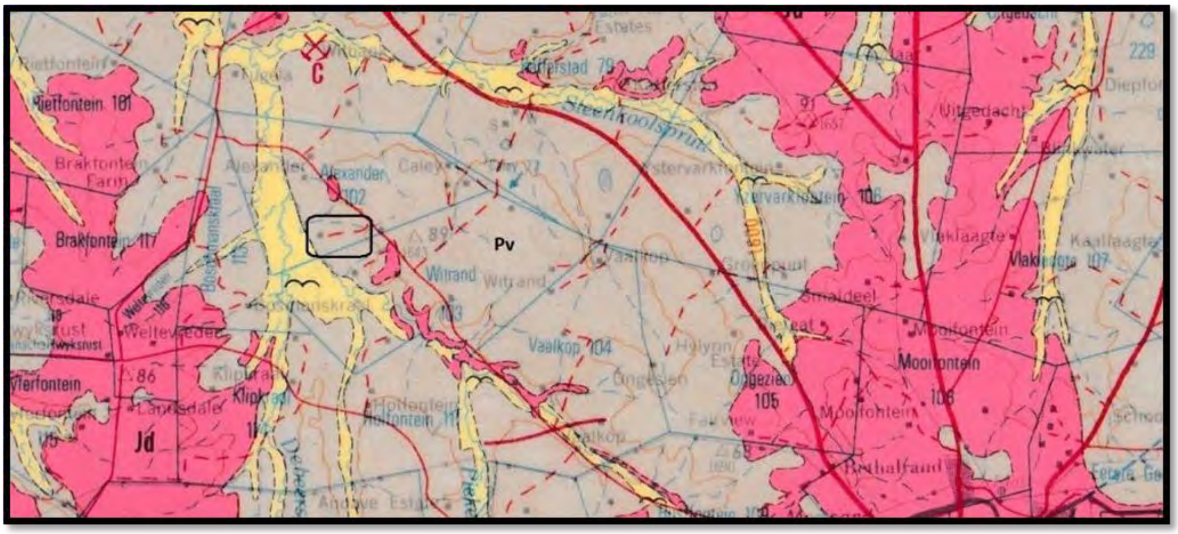


Figure 10-61: **Geological map indicating the Alexander Mining Project area (Fourie, 2019).**

Legend to map and short explanation	
M	(yellow) Alluvial deposits. Quaternary.
Jd	(pink) Jurassic dolerite.
Pv	(brown) Sandstone, shaly sandstone, grit, shale, conglomerate and coal near base and top. Vryheid Formation, Ecca Group, Karoo Supergroup. Permian.
……	(blue) Lineament (Landsat, aeromagnetic).
------	Concealed geological boundary.
⊥12	Strike and dip of bed.
□	Proposed development.

The palaeontological sensitivity of the Alexander Mining Project area is very high, as depicted in **Figure 10-62** (Fourie, 2019). All five coal seams occur in the Alexander Mining Project area. Seam numbers 5, 4 and 2 are relatively thick, whilst 1 and 3 are very thin. Sandstones and mixed sandstones and shales characterise the strata between the coal seams. Only two shale and siltstone bands with a likelihood of fossils occur: between seams 5 and 4 and above seam 2. However, the distribution of fossils in these bands is “patchy and unpredictable.” The intruding Karoo dolerite dykes to the south of the proposed mining area would have destroyed any fossiliferous material. Although the Alexander Mining Project area’s palaeontological sensitivity is very high, one palaeontologist maintains that there are no records of fossil flora from this area due to the depth of the deposits. Surface activities will not significantly affect palaeontological heritage. Fossils, if any, may only be identified when excavations and mining commence. Although this palaeontologist did not recommend site visits, the pre-disturbance survey undertaken for the current project identified an imprint of a fossilised mollusc (possibly a clamshell) in a sandstone outcrop on Portion 25 of Witrand 103 (Fourie, 2019).

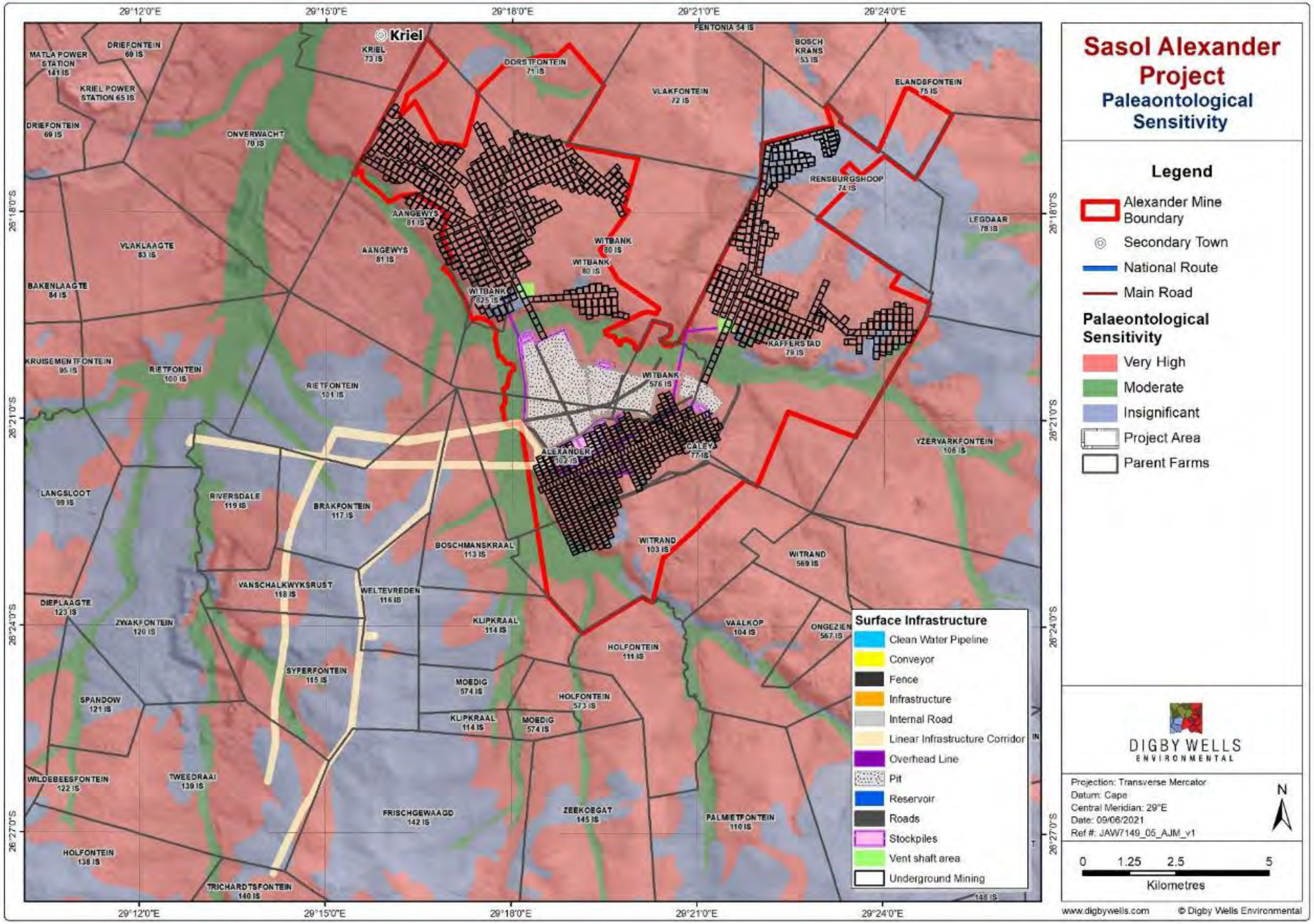


Figure 10-62: Palaeontological Sensitivity of Alexander Mining Project Area (Digby Wells, 2021).

10.1.1.16. Blasting and Vibrations

Sensitivity of project area

A review of the project and the surrounding areas is done before any specific analysis is undertaken and sensitivity mapping is done, based on typical areas and distance from the proposed mining area. This sensitivity map uses distances normally associated where possible influences may occur and where influence is expected to be very low or none. The Alexander Mining Project area was identified as an opencast pit in this regard (BMC, 2021):

- A highly sensitive area of 500 m around the pit option 1 area. Normally, this 500 m area is considered an area that should be cleared of all people and animals prior to blasting. Levels of ground vibration and air blast are also expected to be higher closer to the vent shaft areas.
- An area 500 m to 1 500 m around the pit option 1 area can be considered as being a medium sensitive area. In this area, the possibility of impact is still expected, but it is lower. The expected level of influence may be low, but there may still be reason for concern, as levels could be low enough not to cause structural damage but still upset people.
- An area greater than 1 500 m is considered low sensitivity area. In this area it is relatively certain that influences will be low with low possibility of damages and limited possibility to upset people.

Figure 10-63 shows the sensitivity mapping with the identified POIs in the surrounding area for the proposed Alexander Mining Project (BMC, 2021).

Influence from blasting operations

Blasting operations are required to break rock for excavation to access the development of the opencast pit area. Explosives in blast holes provide the required energy to conduct the work. Ground vibration, air blast and fly rock result from the blasting process. Based on the regulations of the different acts consulted and international accepted standards these effects are required to be within certain limits. There are no specific South African ground vibration and air blast limit standards.

The possible impacts associated with blasting operations will be assessed during the EIA Phase.

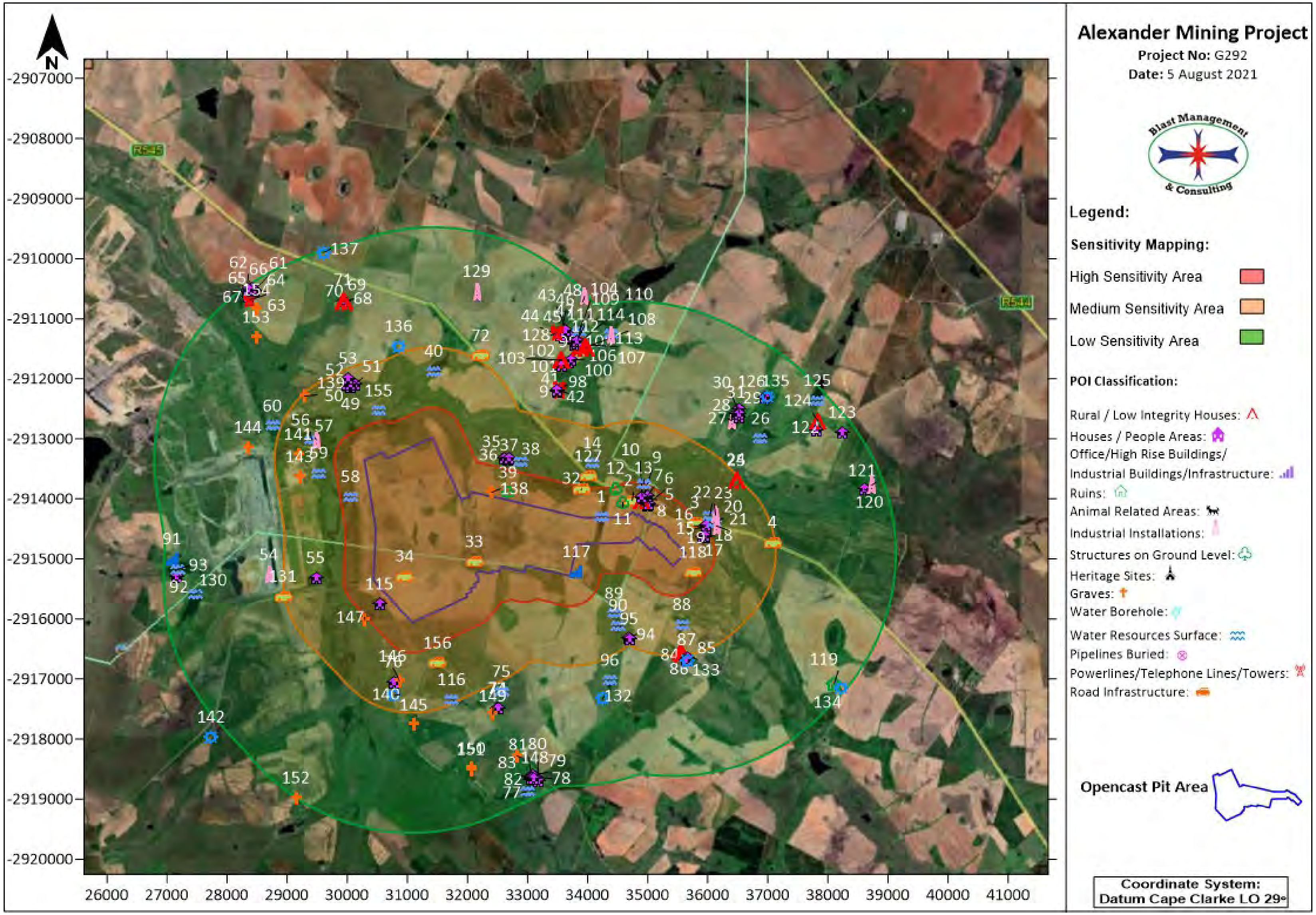


Figure 10-63: Identified sensitive areas for the Pit Area (BMC, 2021)

10.1.1.17. Traffic

As part of the baseline assessment, a site visit was previously held on Wednesday, 29 November 2017, and the intersections at which traffic counts are required were confirmed (WSP, 2021). The latest site inspection was held on Wednesday, 16 September 2020, to observe and confirm the layouts of the existing road geometry; existing pavement conditions; signage; public transport and non-motorised transport (NMT) facilities; as well as other transport-related elements. Based on the overall condition of the road network, the roads are deemed in a generally fair condition.

An electronic traffic count was conducted by Unitraf and Infratrans at critical intersections identified during the site visit, and the collected traffic data was analysed by means of SIDRA 7 software in order to determine the baseline traffic conditions. From the traffic counts, a common peak hour was determined (the busiest hour) for each counted period, refer to **Table 10-57** below.

Table 10-57: Intersections Counted (WSP, 2021).

No:	INTERSECTION	DATE SAMPLED	GROWTH RATE	PEAK HOURS OCCURING AT:	
				AM PEAK	PM PEAK
1.	D618 and R545(P52/3)	Tuesday, 29 September 2020	3%	05:00 – 06:00	16:30 – 17:30
2.	D620 and R545(P52/3)	Tuesday, 29 September 2020	3%	05:00 – 06:00	16:30 – 17:30
3.	D618 and N17 on-ramp	Friday, 25 May 2018	3%	05:00 – 06:00	16:30 – 17:30
4.	D503 and N17	Wednesday, 16 September 2020	3%	06:00 – 07:00	17:00 – 18:00
5.	D503 and Pump Station	Wednesday, 16 September 2020	3%	06:00 – 07:00	16:15 – 17:15

Trip generation and distribution

Access to the mine will be provided from the provincial road R545 (P52/3) via the district road D620. Access to the mine from Secunda/Trichardt can also be obtained from the gravel district roads D618 and D450. The Alexander opencast mining operation will necessitate the deviation of the D618 district road to provide continued access to R545. It is proposed to deviate the traffic from district road D618 (southern approach movements of intersection D618 & R545) to district road D450 and the new gravel road of D620. This, therefore, means additional traffic to the intersection D620 & R545 is expected (WSP, 2021).

District road D620 will be re-routed to provide access to the mine and link up again with district road D450. District Road D620's proposed new alignment is indicated with the green and magenta lines in **Figure 10-64**. The existing portions of D620 and D450 indicated in yellow will remain and access can still be obtained to the surrounding farm dwellings and lands (WSP, 2021).

Trip assignment

Local re-assignment of traffic will result from the proposed deviation and the closure of district road D618 from the regional road R545 up to the intersection with district road D450 (red line in **Figure 10-64**).

Traffic from district road D618 (upgraded gravel road, orange line in **Figure 10-64**) will be deviated to bypass the Block 2 surface mining operation to access the Provincial Road R545 via District Road D620's new alignment.

District road D450 will also be closed for a section and re-routed in order to accommodate the footprint of the mine (red line in **Figure 10-64**).

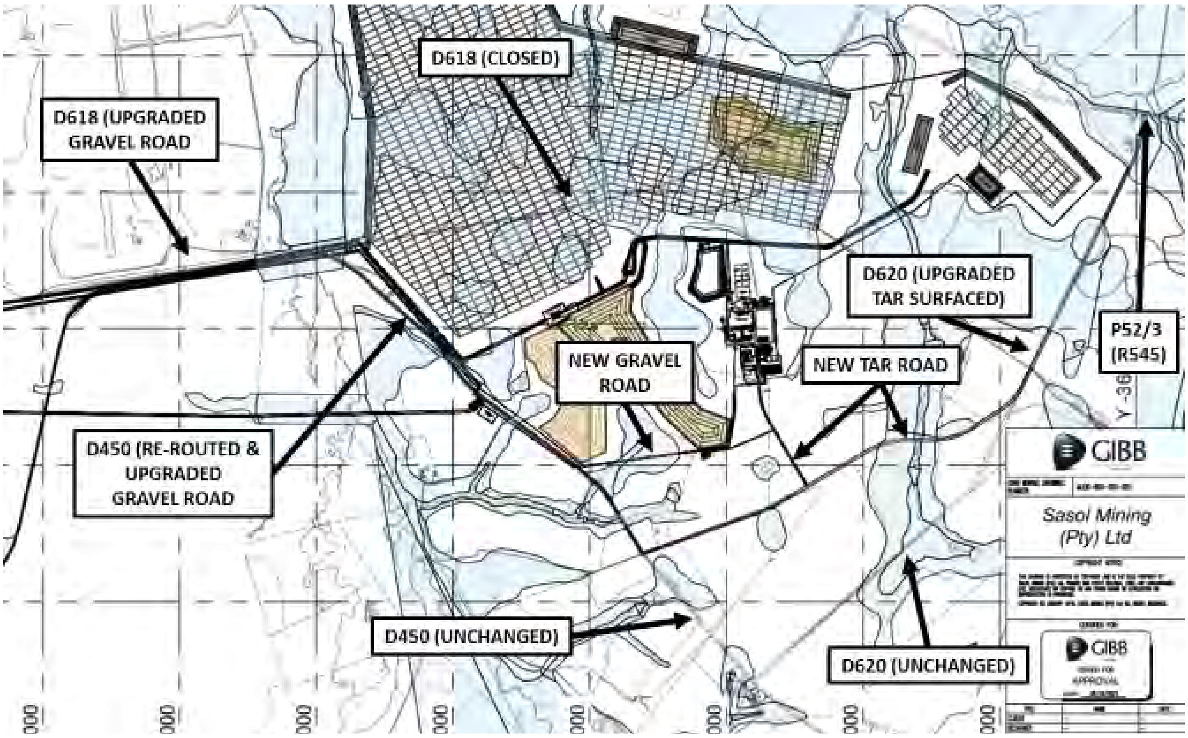


Figure 10-64: Proposed Combined Road Works (GIBB, 2021).

10.1.2 Description of the current land uses

The dominant land use within the Alexander Mining Project area is cultivated fields.

The minor land uses include wetlands, water, urban areas, mines and their dams (Syferfontein and Isibonelo), woodlands, shrubland and plantations. A very small portion of degraded eroded and bare land was also found (J&W, 2021d).

10.1.3 Description of specific environmental features and infrastructure on the site

10.1.3.1. Environmental features

As can be seen from the baseline description in **Section 10.1.1**, the Alexander Mining project area is characterised by various sensitive environmental features, most prominently the priority floodplain wetland systems associated with the Steenkoolspruit, Debeerspruit and Piekespruit.

Wetlands. The wetlands within the project area provide important indirect regulating and supporting services relating to flood attenuation, streamflow regulation, sediment trapping and nutrient and toxicant removal. Of all the HGM units, the floodplains provide the highest levels of ecosystem services due to their large size, high channel sinuosity, abundance of depressions and largely intact vegetation cover.

Groundwater. The groundwater vulnerability is described as having medium vulnerability (30 to 60%). The natural factors provide some protection to shield groundwater from contaminating activities at the land surface, however based on the contaminant toxicity mitigation measures will be required to prevent any surface contamination from reaching the groundwater table.

Geology. Rocky ridges and outcrops were identified within the study area by various specialists. The areas that classify as either conservation, or wilderness land are associated with the shallow rocky soils that were mapped in association with the ridge slope positions that are defined by the less resistant dolerite dykes that have intruded into the sediments. These areas are confined predominantly to the southern portion of the area mapped.

Land use. Arable land dominated the study area as 50% of the Alexander area is comprised thereof. The areas that classify as grazing land are generally confined to the shallower and more structured soil forms that are moderately well drained comprising 19% of the Alexander area.

Biodiversity. The study area is associated with various terrestrial CBAs, ESAs, and ONAs, aquatic ESAs and ONAs, and has an ecosystem threat status of VU (vulnerable). The wetland threat status is described as CR (critical) in some areas due to the large floodplains. Eight (8) plant species were recorded that are protected by the Mpumalanga Nature Conservation Act 10 of 1998: Schedule 11. Three (3) bird SCC were recorded during the survey, namely Blue Korhaan (*Eupodotis caerulescens*), Secretarybird (*Sagittarius serpentarius*) and African Grass-owl (*Tyto capensis*). Based on the various wetland habitats encountered in the study area, the likelihood that other bird SCCs occur there is rated as high. Four (4) mammal SCC were recorded in the study area. There appears to be healthy populations of Cape Clawless Otters (*Aonyx capensis*) along the wetland areas and in the dams within the study area and adjacent to it. Serval (*Leptailurus serval*) occurred throughout the study area. Brown Hyaena (*Parahyaena brunnea*) were observed in the forested rocky ridge within the Alexander study area.

Sensitive receptors. Sensitive receptors in the area include the closest residential developments being the Kriel village to the northwest and Bethal to the southeast.

Individual farmsteads also surround the project area. Most notably, the Enkundleni Senior Primary school is located within the project area. Various sensitive points of interest were likewise identified within the blast area of the proposed Alexander Mining Project.

Heritage and palaeontology. The Alexander Mining Project site specific study area includes five heritage resources categories constituting 66 individual records. The palaeontological sensitivity of the Alexander Mining Project area is very high.

Traffic. As part of the Alexander Mining Project, it is proposed to deviate the traffic from district road D618 (southern approach movements of intersection D618 & R545) to district road D450 and the new gravel road of D620. This, therefore, means additional traffic to the intersection D620 & R545 is expected.

10.1.3.2. Existing infrastructure

Existing infrastructure within the Alexander Mining Project area includes the following:

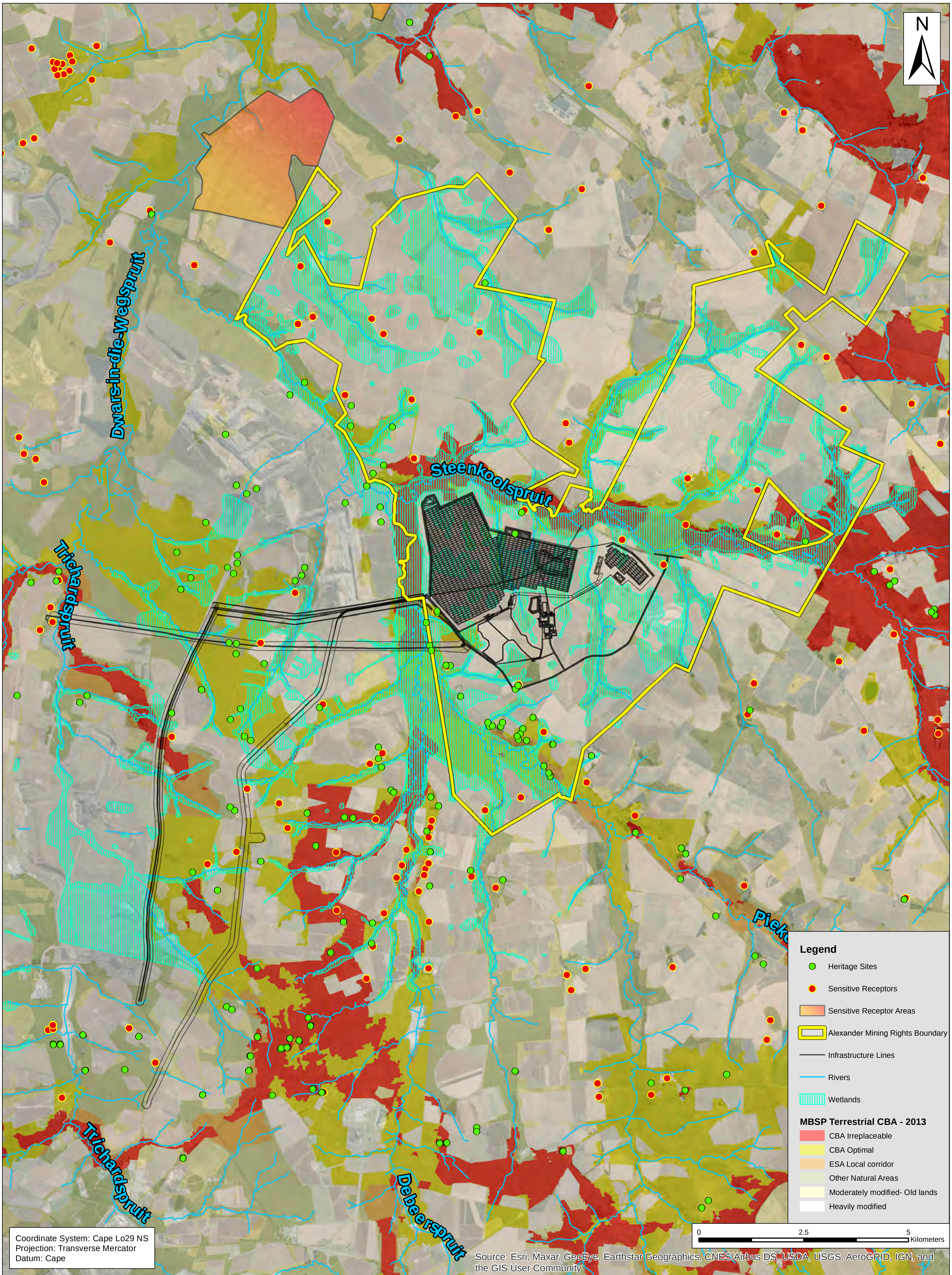
- Residential developments (Kriel village to the northwest and Bethal to the southeast)
- Individual farmsteads
- Enkundleni Senior Primary school
- Various secondary farm roads, minor tar roads (R547, R545, R29 and R580), and a national highway (N17) which runs along the southern portion of the project area
- Isibonelo conveyor belt
- Powerlines
- Farm dams & man-made dams
- Telephone lines
- Agricultural homesteads
- Urban dwellings

10.1.4 Environmental and current land use map

The proposed Alexander Mine will be located on a greenfields site. The current land use in the project area is mainly open grasslands and cultivated commercial fields.

A number of watercourses and wetlands are present in the study area. As discussed in **Section 8.1**, several alternatives were considered to avoid and mitigate impacts where possible.

The environmental sensitivities are shown in **Figure 10-65**.



Jones & Wagener
Engineering & Environmental Consultants

Sasol Mining (Pty) Ltd
Alexander Mining Project IRP
Environmental sensitivities

Job No: G292-55

Figure 10-65

11. IMPACTS IDENTIFIED

The proposed Alexander Mining Project is anticipated to impact on various biophysical aspects and socio-economic aspects. The potential impacts identified during the Scoping Phase are summarised in **Table 11-1**. These impacts and any additional potential impacts identified by the specialists will be further investigated during the Impact Assessment Phase of the project.

Table 11-1: Potential environmental impacts to be investigated in the impact assessment phase

Environmental aspect	Potential environmental impact
Topography and land use	- The proposed mining development will alter the topography and land use of the project area.
Soil and land capability	- Due to topsoil stripping, soil stockpiling, soil compaction, and nutrient leaching, it is likely that the soils and land capability may be impacted by the proposed mining development - Hydrocarbon spills during construction and operation may impact soil quality.
Surface water	- Water quality may be negatively impacted due to pollutants entering surface resources. - Water quantity of the surrounding water courses may be negatively impacted due to the catchment losses to opencast pits and the removal of water from the opencast pits for the continuation of mining activities.
Wetlands	- Activities occurring within or near wetlands may impact on wetland functioning, condition, and ecosystem services.
Aquatics	- Contaminated runoff resulting from the proposed activities may enter watercourses, thereby impacting on the condition and functioning of watercourses.
Hydrogeology	- Water quality may be negatively impacted due to pollutants entering groundwater resources. Likewise, should the mine decant, this will have a negative impact on water quality. - Water quantity may be negatively impacted by the removal of water from the opencast pits for the continuation of mining activities.
Terrestrial biodiversity	- Construction activities will result in the clearing of vegetation and possible destruction of habitat.
Socio-economic	- Blasting may result in ground vibration, air blast, fly rock and fumes, impacting on nearby infrastructure and sensitive receptors. - An increase in noise, air quality, and visual disturbance may have a negative impact on the quality of life for any local communities and homesteads. - The potential for job creation and job availability may not be in line with stakeholder expectations.
Visual	- The development of the mine (including dumps and stockpiles) and construction of the linear infrastructure may have an additional visual impact in the project area.
Noise	- Excessive noise associated with mainly construction activities may disturb humans and animals near the project area.

Environmental aspect	Potential environmental impact
Air quality	- Dust generation caused by construction and operational activities may have a direct impact on the health and wellbeing of people in the area.
Climate change	- Coal mining activities may result in carbon dioxide equivalent emissions entering the atmosphere, thereby contributing to climate change
Heritage resources and palaeontological findings	- Existing heritage resources in or near the project area (such as graves), palaeontological findings, and historic buildings may be damaged or destroyed due to construction/operational activities and blasting.

12. METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF ENVIRONMENTAL IMPACTS

Potential environmental impacts will be identified by means of determining what activities will be undertaken as part of the proposed Alexander Mining Project. Changes in the status quo of an aspect/attribute as a result of the activities being undertaken as part of the proposed activities, will indicate a potential environmental impact, be it positive or negative.

In order to ensure uniformity, a standard risk assessment methodology has been utilised so that a wide range of impacts can be compared. A qualitative risk assessment has been used to describe the risk. Risk will be expressed in terms of a combination of the ***impact significance*** of an event and the associated ***probability*** on the following 7x7 matrix.

4	3	3	2	1	1	1	**I7**	**Significance**
4	3	3	2	2	1	1	**I6**	
5	4	3	3	2	2	2	**I5**	
6	5	4	4	3	3	3	**I4**	
6	5	5	4	4	3	3	**I3**	
6	6	6	5	5	4	4	**I2**	
6	6	6	6	6	6	6	**I1**	
P1	**P2**	**P3**	**P4**	**P5**	**P6**	**P7**		
Probability								

12.1 Impact significance

In identifying the significance of an impact, Sasol Limited's Risk Impact Rating Table has been utilised, with impact categories and impact ratings for each of these categories (**Table 12-1**).

The relevant categories are assessed for the type of impact, in terms of the consequence that impact could have on those aspects. Scale and severity are incorporated in the descriptions of impact significance. For the purposes of this assessment, the impact categories of Community and Environment are most relevant. The Sasol business-specific categories have not been assessed.

Table 12-1: Description of the impact significance rating scale.

RATING	Financial Impact (Rand - EBIT)	Employee Safety & Health	Community & customers	Government Relations	Environment	Reputation / Brand	Legal Impact	Human Resources	Operations
I7	>R4500m (>15% of risk Tolerance)	More than 10 fatalities	More than 3 public fatalities	Breakdown in relations with governments on an international scale resulting in international political pressure and operating licenses being revoked	Very serious irreversible impact on national scale	Prolonged international and national condemnation that is difficult to defend and manage resulting in long term damage to reputation with a potential for a prolonged drop in share price (>5 years)	International legal/class action (e.g. anti-competitive practices) that may alter business model and reduce market share; complete breach of Sasol's protected intellectual property	International and national strike action and/or serious deterioration in workforce morale that is expected to last for the foreseeable future; inability to recruit appropriately qualified staff resulting in project failure	Total loss of production
I6	R1500m-R4500m (5% -15% of risk Tolerance)	3 to 10 fatalities	1 to 2 public fatality	Breakdown in relations with government causing local licenses being revoked	Serious reversible impact on a national scale	International & national critics resulting in a medium term drop in share price (<5 years)	National legal action resulting in significant alteration to business practices and significant fines that may impact cash flow; partial breach of Sasol's intellectual property	Strikes at several facilities and difficulty in attracting appropriately qualified staff resulting in project delays; deterioration in workforce morale that lasts for up to 5 year	Future operations untenable
I5	R300m-R1500m (1% -5% of risk Tolerance)	1 to 2 fatality	Hospitalisation or multiple press articles regarding complaints e.g. smell	Breakdown in relations limited to specific government departments	Serious reversible impact at Regional scale	Serious negative critici's limited to one geographical area resulting in short term drop in share price before recovery (<1 years)	Legal action resulting in loss of operating permit and causing a business interruption and potentially impacting cash flow: potential breach of Sasol's intellectual property	Strike at one facility or deterioration in workforce morale that lasts for up to 1 year	Future operations at site seriously affected. Loss of production > 6 months; total breakdown in supply chain lasting longer than 6 months
I4	R150-R300m (0,5% -1% of risk Tolerance)	Serious irreversible or disabling injury	Local public asked to take shelter indoors or to evacuate or adverse public local publicity	Breakdown in relationship at local government level	Moderate reversible impact on local scale	Adverse national media public attention with a limited impact on share price	Severe legal fines with a limited impact on cash flow	Disputes /marches / organised stay aways	Major damage to facility. Loss of production < 6 months; disruption to supply chain resulting in delays to obtaining materials and significantly higher cost of materials
I3	R30m-R150m (0,1% -0,5% of risk Tolerance)	Lost workday case	Complaints from public e.g. smell	N/A (I3)	Moderate reversible impact off-site	Local attention from media/ NGO/ public - no impact on share price	Legal fines	Isolated employees grievances	Moderate damage to equipment and/or facility; loss < 1week; limited disruption to supply chain
I2	R3m-R30m (0,01% -0,1% of risk Tolerance)	Medical treatment / restricted workday case	N/A (I2)	N/A (I2)	Minor impact extending beyond plant boundary	Minor adverse local/public/media attention and complaints	Reportable incident	Complaints/ dissatisfaction amongst the workforce	Minor/ superficial damage to equipment; no loss of production
I1	<R3m (<0,01% of risk Tolerance)	First aid injury	N/A (I1)	N/A (I1)	Minor impact within plant boundary	Public concern restricted to local complaints	N/A (I1)	N/A (I1)	Easily addressed or rectified

12.2 Probability Assessment

The qualitative descriptors for the probability of an event occurring are described in **Table 12-2** below.

Table 12-2: Description of the probability rating scale.

RATING		DESCRIPTION	%
P7	Almost certain	The event is expected to occur or occurs regularly.	>80%
P6	Likely	The event will probably occur (significant chance).	50 - 80%
P5	Possible	The event may occur (realistic chance).	20 - 50%
P4	Low	The event could occur (moderate chance).	10 - 20%
P3	Very Unlikely	The event may occur in certain circumstances (remote chance).	5 - 10%
P2	Highly Unlikely	The event may occur in exceptional circumstances (very remote chance).	1 - 5%
P1	Unforeseen	The event is not foreseen to occur.	0 - 1%

12.3 Risk rating

A risk rating is determined by plotting the significance of an impact against the probability of that impact occurring. The resulting risk is classified according to six classes as described in **Table 12-3**.

Table 12-3: Risk Ratings.

RISK RATINGS	DESCRIPTION - NEGATIVE	DESCRIPTION - POSITIVE
6	Very Low	Very Low
5	Low	Low
4	Moderate	Moderate
3	High	High
2	Very High	Very High
1	Unacceptable	Unacceptable

An example of how this rating is applied is shown below:

ACTIVITY	ASPECT	IMPACT	CRITERIA		RISK RATING
Servitude preparation	Terrestrial Ecology	Clearing of vegetation will result in loss of faunal and floral species	*Significance (including scale and severity)*	*I2*	Environment: 4 (Moderate, negative)
			Probability	*P7*	

	Unforeseen	Highly unlikely	Very unlikely	Low	Possible	Likely	Almost certain		Environment
	P1	P2	P3	P4	P5	P6	P7		
	4	3	3	2	1	1	1	I7	Very serious irreversible impact on national scale
	4	3	3	2	2	1	1	I6	Serious reversible impact on a national scale
	5	4	3	3	2	2	2	I5	Serious reversible impact at Regional scale
	6	5	4	4	3	3	3	I4	Moderate reversible impact on local scale
	6	5	5	4	4	3	3	I3	Moderate reversible impact off-site
	6	6	6	5	5	4	4	I2	Minor impact extending beyond plant boundary
	6	6	6	6	6	6	6	I1	Minor impact within plant boundary

13. <u>THE POSITIVE AND NEGATIVE IMPACTS THAT THE PROPOSED ACTIVITY (IN TERMS OF THE INITIAL SITE LAYOUT) AND ALTERNATIVES WILL HAVE ON THE ENVIRONMENT AND THE COMMUNITY THAT MAY BE AFFECTED</u>

Alternatives were considered for the mining method, as well as the infrastructure layout (refer to **Section 8.1** for a detailed discussion on alternatives). Since the Scoping Report has not yet been subjected to public review, any concerns raised by affected parties have not yet been addressed. A full Impact Assessment will be done in the EIR phase to determine the positive and negative impacts associated with the proposed activity.

14. THE POSSIBLE MITIGATION MEASURES THAT COULD BE APPLIED AND THE LEVEL OF RISK

This section will be finalised once specialist impact assessments have been finalised during the EIR phase.

15. THE OUTCOME OF THE SITE SELECTION MATRIX. FINAL SITE LAYOUT PLAN

(Provide a final site layout plan as informed by the process of consultation with interested and affected parties)

This section will be finalised with comments and contributions from I&APs when the public participation process has commenced and will be included in the EIR.

16. MOTIVATION WHERE NO ALTERNATIVE SITES WERE CONSIDERED

Not applicable. Alternatives were considered (refer to **Section 8**). Since alternatives have been evaluated in detail, going forward only the preferred alternative and no-go alternative will be assessed.

17. STATEMENT MOTIVATING THE PREFERRED SITE

(Provide a statement motivation the final site layout that is proposed)

The preferred site of the proposed Alexander Mining Project is limited in terms of its necessity to be located within the Alexander mining rights acquired from AAIC. Many alternatives have gone through various iterations during the pre-feasibility and planning phase, which have been discussed in **Section 8**. The preferred location, mining method, mine plan, and project layout of the mining development and associated infrastructure was determined based on the potential impacts on environmental, social and economic aspects, as well as the operational and financial implications.

The assessment of the preferred site will be provided in more detail during the impact assessment phase, the results of which will be discussed in the EIR.

18. PLAN OF STUDY FOR THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

18.1 Description of alternatives to be considered including the option of not going ahead with the activity

Please refer to **Section 8.1** for details regarding the alternatives considered, as well as the consideration of the No-Go option.

18.2 Description of the aspects to be assessed as part of the environmental impact assessment process

The aspects to be assessed include:

- Soils, land use and land capability;
- Surface water (quality and quantity);
- Wetlands;
- Regional wetland assessment;
- Reserve determination;
- Aquatic ecosystem;
- Groundwater (including geochemistry and hydrogeology);
- Terrestrial biodiversity (flora and fauna);
- Heritage and cultural resources;
- Socio-economic;
- Visual impacts;
- Noise;
- Air quality;
- Blasting and vibration;
- Post-closure end land use;
- Stability assessment; and
- Financial Provision reporting.

18.3 Description of aspects to be assessed by specialists

The above-mentioned aspects will be assessed by independent specialists. The terms of references for the assessments are contained in the following section.

18.4 Proposed method of assessing the environmental aspects including the proposed method of assessing alternatives

The Scoping Phase investigations have identified several potential environmental impacts associated with the proposed Alexander Mining Project. From these preliminary investigations, a shortlist of potentially significant environmental impacts was identified for specialist investigations during the Impact Assessment Phase.

The specialist investigations (refer to **Section 18.2**) to be conducted during the Impact Assessment Phase of this project will consist of the following studies:

The findings from these investigations will be reflected in the EIR/EMPr. The proposed Terms of References (ToR) for all these specialist studies are indicated in **Table 18-1** below[6].

Table 18-1: Proposed terms of References for the specialist studies

Specialist investigations	Terms of References
Soils, Land Use and Land Capability Investigation	Baseline Assessment - Desktop review of soils, land use, and land capability reports

[6] Please note, the baseline assessment components have been undertaken already, as summarised in **Section 10**.

Specialist investigations	Terms of References
	- Undertake a baseline assessment of the proposed Alexander mining area inclusive of soils, land use, and land capability Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of soils, land use, and land capability using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Surface Water Impact Assessment	Baseline Assessment - Desktop review of existing surface water reports - Characterise the surface water regime at the site and the catchments in terms of surface water quantity and quality. - Determine the floodlines for the project area Impact Assessment - Compile a life of mine (LoM) water balance in GoldSim and design water flow diagrams. - Assess the potential impacts and cumulative impacts from the proposed activities in terms of surface water aspects (quality and quantity) using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Wetlands Assessment	Baseline Assessment - Desktop review of wetland reports and existing data; - Undertake site visits to delineate wetlands in accordance with the DWAF guidelines - Assess goods and services using WET-EcoServices and wetland health using WET-Health Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of wetlands using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Reserve Determination	Phase 1 (Intermediate Wetland Reserve Determination) - Review of available information; - Specialist Workshops with surface and groundwater hydrologists, wetland specialists, and aquatic ecologists; - Measure continuous in-stream flow for a 12-month period. - Development of a Draft SoW template (DWS template) and Intermediate Reserve Determination proposal; - Presentation and sign off of the Draft SoW template and Intermediate Reserve Determination proposal by the DWS.
Regional Wetland Assessment	- Collation and review of available information - Identification of study area. - Desktop delineation and classification of wetlands - Brief field investigation

Specialist investigations	Terms of References
	- Desktop biodiversity assessment: o Compile list of species list of conservation important mammals, avifauna and herpetofauna o Compile list of species list of conservation important flora o Description of the possible vegetation units within the study area (Desktop Based) o Description of Mpumalanga Sector Plan data for the study area o Brief field investigation to verify key habitats identified and familiarise with the surrounding environment. - Desktop assessment of the Present Ecological State of the wetlands - Desktop assessment of the wetland functionality using the WET–EcoServices tool - Desktop assessment of the Ecological Importance and Sensitivity of the wetlands
Aquatic Ecosystem Assessment	Baseline Assessment - Desktop review of aquatic ecosystem reports and existing data; - Undertake site visits to characterise the aquatic ecosystems in terms of stressors, habitats, and response indicators Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of the aquatic ecosystem using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Hydrogeological Impact Assessment	Baseline Assessment - Desktop review of existing hydrogeological information and reports - Compile a conceptual groundwater model and a numerical groundwater flow and transport model. Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of hydrogeology using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Terrestrial Ecological Assessment	Baseline Assessment - Desktop review of terrestrial ecology reports and existing data; - Undertake baseline surveys (flora and fauna) for ground truthing Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of terrestrial ecology using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Heritage & Palaeontological Impact Assessment	Baseline Assessment - Undertake documentary research and literature review - Ground truthing to verify heritage resources identified; - Conduct a gap analysis in terms of the minimum requirements contained in the NHRA and SAHRA Minimum Standards for Heritage Impact Assessments. - Produce a map indicating the locations of heritage resources, graves, etc.

Specialist investigations	Terms of References
	Impact Assessment - Conduct a pre-disturbance survey; - Assess the cultural significance of identified heritage and palaeontological resources; - Assess the potential impacts and cumulative impacts from the proposed activities in terms of heritage and palaeontological resources using the Sasol impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Socio-economic Impact Assessment	Baseline Assessment - Desktop review of existing socio-economic data and reports - Undertake a baseline assessment of the proposed Alexander mining area in terms of socio-economic aspects Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of soils, land use, and land capability using the approved impact assessment methodology - Undertake an econometric model to attain a full picture of the current socio-economic activities in the identified project area - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Visual Impact Assessment	Baseline Assessment - Desktop review of baseline information (contours, vegetation, proposed mining dimensions etc) - Determine the viewshed and observation sites of the proposed activities Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of visual aspects using the approved impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases
Noise Impact Assessment	Baseline Assessment - A site visit to collect baseline noise data - Baseline noise measurements will be conducted according to the South African National Standards (SANS 10103:2008) 'The measurement and rating of environmental noise with respect to annoyance and to speech communication'. Measurements will be conducted during the day and night at locations representative of the noise climate and at sensitive receptors. Measurement time intervals will be so chosen that the results are representative of the noise climate, taking into account variations in weather conditions and variations existing noise levels. Impact Assessment - Noise emissions from the project's operational phases will be estimated. The propagation of noise from the project will be calculated according to SANS 10357:2004, 'The calculation of sound propagation by the Concawe method'. The Concawe method makes use of the International Organisation for Standardization's (ISO) air absorption

Specialist investigations	Terms of References
	parameters and equations for noise attenuation as well as the factors for barriers and ground effects. In addition to the ISO method, the Concawe method facilitates the calculation of sound propagation under a variety of meteorological conditions. Data representative of conditions in the study area and obtained from the air quality study will be applied in the calculations. - Noise impacts will be calculated both in terms of total ambient noise levels as a result of the project as well as the effective change in ambient noise levels. Impacts will be calculated and assessed according to guidelines provided by the International Finance Corporation (IFC). - The findings of the above components informed recommendations of noise management measures, including mitigation and monitoring (if necessary).
Air Quality Impact Assessment	Baseline Assessment - Identification of existing air pollution sources - Identification of air quality-sensitive receptors, including any nearby residential dwellings and proposed receptors in the vicinity of the Project; - Collection of local weather conditions either from local weather station sources or by modelled MM5 data; o Preparation of three years of raw meteorological data. The required meteorological data includes hourly average wind speed, wind direction and temperature data. - Simulation of wind field, mixing depth and atmospheric stability. - The legislative and regulatory context, including emission limits and ambient air quality standards. - Assessment of baseline air pollutant measurements (from available information). Impact Assessment - Quantification of all sources of atmospheric emissions associated with the proposed project. - Formatting of meteorological data for input to the dispersion. - Obtain and process topographical data for input into the dispersion model (if required) - Dispersion simulation of ground level pollutants due to routine emissions from the project, reflecting highest hourly, highest daily and annual average concentrations. The US EPA approved AERMOD model will be used - Analysis of dispersion modelling results - Evaluation of potential for human health and environmental impacts - Recommend mitigation measures and monitoring program for the site - Quantification of level 1 Green House Gas emissions for the proposed project
Blasting and Vibrations Impact Study	Baseline Assessment - Undertake a site visit to obtain all relevant information onsite and offsite of the proposed mining area - Review of the site considering the various installations in and around the proposed blasting area - Definition of existing structure and review of possible concerns Impact Assessment - Assess the potential impacts and cumulative impacts from the proposed activities in terms of blasting (ground vibration, air blast, fly-rock, and noxious fumes) using the approved impact assessment methodology - Recommend practical mitigation measures for the potential impacts, or suggest alternatives should the impact be unacceptable post-mitigation - Compile an impact assessment report covering the construction, operational, closure and post-closure phases

Specialist investigations	Terms of References
Financial Provision Reporting	Compilation of the Financial Provision Reports in terms of GNR1147: - Undertake information review and gap analysis to identify required information for compilation of the three Financial Provision reports – o An Annual Rehabilitation Plan; o A Final Rehabilitation, Decommissioning and Mine Closure Plan ('Closure Plan'); o An Environmental Risk Assessment Report

18.5 The proposed method of assessing duration significance

The impact assessment methodology to be utilised in the project is discussed in detail in **Section 12**.

18.6 The stages at which the competent authority will be consulted

A pre-application consultation meeting was requested with the DMRE, however the DMRE informed the EAP that a meeting will only be requested if necessary.

The CSR is being provided to the DMRE, with the application form (**Appendix 8**), for review (as well as to commenting authorities and I&APs). Following the review, the document will be updated to an FSR, taking into account all comments received from the competent authority, commenting authority and I&APs.

Following the DMRE review of and decision on the FSR, the Consultation/Draft EIR and associated documents will be compiled and submitted to the DMRE for review (as well as to commenting authorities and I&APs). Again, following the review, the document will be updated to a Final EIR and associated documents, taking into account all comments received from the competent authority, commenting authority and I&APs. The DMRE will then make a decision on whether to grant Environmental Authorisation.

18.7 Particulars of the public participation process with regard to the Impact Assessment process that will be conducted

18.7.1 Steps to be taken to notify interested and affected parties

Please refer to **Section 9** for details regarding the public participation process.

18.7.2 Details of the engagement process to be followed

Please refer to **Section 9** for details regarding the public participation process.

18.7.3 Description of the information to be provided to Interested and Affected Parties

Interested & Affected Parties (I&APs) will be engaged throughout the project where information relating to the project (project background, CSR, FSR, EIR and EMPr, etc.), will be shared as follows:

- Project announcement and CSR review:
    - Background Information Documents (BIDs) and comment sheets, as well as notification emails/ letters, will be prepared and sent to the Interested & Affected Parties (I&APs) i.e. stakeholders on the stakeholder database.

  - Site notices will be placed at strategic points in the project's area of influence.
  - Advertisements announcing the project, availability of the CSR and associated documents (EMPr), and the public review period (30 days) will be placed in local newspapers.
  - I&APs will also be notified of the public review period (30 days) of the CSR and associated documents via emails/telephone.
  - 30-day public review period of the CSR and associated documents.
  - A Comments and Response Report (CRR) will be compiled with I&AP comments and concerns. This document will be updated throughout the project.
  - A public meeting and / or one-on-one consultations / focus group meetings will be held during the public review period.
- Final Scoping Report:
  - The CRR will be updated with comments from the public review of the CSR and associated documents. The CSR will be updated to an FSR.
  - I&APs will be notified of the availability of FSR and associated documents.
- Consultation Environmental Impact Report review:
  - Advertisements announcing the availability of the Consultation/Draft EIR and associated documents, and the public review period (30 days) will be placed in local newspapers.
  - I&APs will also be notified of the public review period (30 days) of the Consultation/Draft EIR and associated documents via emails/telephone.
  - 30-day public review period of Consultation/Draft EIR and associated documents.
  - A public meeting and / or one-on-one consultations / focus group meetings will be held during the public review period.
- Final Environmental Impact Report
  - The CRR will be updated with comments from the public review of the Consultation/Draft EIR and associated documents. The Consultation/Draft EIR will be updated to a final EIR.
  - I&APs will be notified of the availability of final EIR and associated documents.
  - Environmental Authorisation announcement:
- I&APs will be notified of the authority decision via email and in newspaper advertisements.

Please refer to **Appendix 6** for documents provided to I&APs as part of the public participation process.

18.8 Description of the tasks that will be undertaken during the environmental impact assessment process

The following tasks will be undertaken

Application and Scoping

An environmental authorisation application form has been compiled for submission to the DMRE.

A CSR has been compiled and made available to all commenting authorities, as well as I&APs from 24 August 2022 to 23 September 2022.

Following comments and issues received by I&APs, the Final Scoping Report will be compiled and submitted to the DMRE. A decision on the acceptance or refusal of the application will be issued by the DMRE.

Compilation of EIR and EMPr

The Consultation EIR and EMPr will be prepared with information and issues identified during the Scoping Phase activities, comments from I&APs, commenting authorities and the findings from the specialist studies.

The Impact Assessment Phase comprises of:

- The completion of the specialist studies and reports;
- The finalisation of the impact assessment;
- The compilation of the Consultation EIR and EMPr;
- The public review of the Consultation EIR and EMPr and possible extended public review period, at the discretion of the competent authority (DMRE);
- The compilation of the Final EIR and EMPr; and
- The submission of the Final EIR and EMPr.

The Consultation EIR and EMPr includes:

- The details of the EAP who prepared the report;
- A detailed description of the proposed development and alternatives;
- A description of the environment that may be affected by the activity and the way physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed development;
- A description of the methodology of the stakeholder engagement process;
- The comments and response report and stakeholder database;
- A description of the need and desirability of the proposed development and the identified potential alternatives to the proposed activities;
- A summary of the methodology used in determining the significance of potential impacts;
- A description and comparative assessment of all alternatives identified during the EIA process;
- A summary of the findings of the specialist studies;
- A detailed assessment of all identified potential impacts;
- A list of the assumptions, uncertainties and gaps in knowledge;

- An opinion by the consultant as to whether the development is suitable for approval; and
- Once the Consultation EIR and EMPr have been placed on public review, comments received from stakeholders will be documented and considered in the Final EIR and EMPr which will be placed on public review and simultaneously submitted to the DMRE for approval.

Since this is an integrated application, the Consultation and Final EIR/EMPr will also address all the information requirements in support of a WML application as required in terms of NEM:WA and relevant regulations.

19. MEASURES TO AVOID, REVERSE, MITIGATE, OR MANAGE IDENTIFIED IMPACTS AND TO DETERMINE THE EXTENT OF THE RESIDUAL RISKS THAT NEED TO BE MANAGED AND MONITORED

A summary of the potential impacts and preliminary mitigation measures to address the impacts is provided in **Table 19-1** below. More comprehensive impacts and mitigation measures will be assessed in detail during the Impact Assessment phase and will be included in the EIR.

Table 19-1: Preliminary list of mitigation measures

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	MITIGATION TYPE	POTENTIAL FOR RESIDUAL RISK
Clearing of vegetation	• Loss of habitat; • Dust generation; • Soil erosion leading to sediments in surface water resources • Loss of agricultural potential & impacts to local farming activities	• Control by only clearing the area required for the proposed development; • Control by diverting clean water around construction areas; and • Control erosion and implement dust control measures.	Moderate
Blasting during opencast mining	• Loss of habitat • Vagrant flyrock and airblasts damaging existing infrastructure and heritage resources • Dust generation	• Control by only blasting areas where required • Control by determining areas of exclusion for blasting activities • Control by meticulously managing onsite blasting activities	Low
Clean water pipeline	• Loss of habitat	• Control by only clearing the area required for the proposed development • Control by implementing surface water management, erosion control, and dust control practices	Low
Dirty water pipelines	• Loss of habitat Potential spills leading to: • Soil, surface and groundwater contamination	• Control by implementing surface water management. • Control by developing and implementing maintenance plan • Control by limiting surface disturbance and vegetation clearing; • Control by ensuring the proper design, construction, and maintenance of the infrastructure.	Low
Infrastructure within 32 m of a watercourse	• Surface water contamination (including wetlands) • Loss of habitat • Loss of natural soil structure via compaction.	• Control by limiting the area to be as small as possible; • Control by demarcating watercourses and no-go areas; • Control by diverting clean water around areas and managing clean and dirty water separately, as well	Low

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	MITIGATION TYPE	POTENTIAL FOR RESIDUAL RISK
		as containing and managing dirty water in line with acceptable standards; • Control erosion and implement dust control measures; • Control by constructing infrastructure in the dry season, if possible.	
Sewage treatment plant	Potential spills leading to: • Soil, surface and groundwater contamination	• Control by ensuring the proper design, construction, and maintenance of the infrastructure.	Low
Reservoirs and post-closure stormwater dam	• Loss of habitat	• Control by limiting the area of disturbance	Low
Pollution Control Dam	• Loss of habitat • Groundwater and surface water contamination through seepage	• Control by providing barrier systems as required; • Control by providing facility with adequate size; and • Control by operating with sufficient freeboard.	Low
Mine complex (including sumps)	• Loss of habitat • Soil, surface and groundwater contamination.	• Control by limiting the area of disturbance; • Control by ensuring the proper design, construction, and maintenance of the infrastructure • Control by implementing an approved rehabilitation design	Moderate
Opencast mining	• Loss of wetland habitat • Dust generation • Noise-related nuisance impact to locals and fauna • Reduction in groundwater and surface water quantity • Potential loss/impact to heritage resources • Increased traffic on public roads • Greenhouse gas emissions • Influx of jobseekers	• Control by limiting the area of disturbance; • Control by ensuring the proper design, construction, and maintenance of the infrastructure • Control by implementing an approved rehabilitation design • Control by compiling and implementing a decant management plan • Stop by relocating graves that may be impacted • Control by demarcating and enforcing no-go areas • Control by upgrading roads where required • Control by maintaining open channels of communication with I&APs and managing stakeholder expectations	Moderate
Conveyors and dirty water channels	• Potential spills leading to soil, surface and groundwater contamination	• Control by limiting the area of disturbance; • Control by ensuring the proper design,	Low

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	MITIGATION TYPE	POTENTIAL FOR RESIDUAL RISK
		construction, and maintenance of the infrastructure in order to prevent spillages.	
New haul roads, upgrading of existing roads, and a road diversion	• Loss of habitat • Dust generation • Traffic disruptions	• Control by limiting the area of disturbance; • Remediate by removing and storing all utilizable soil; • Remediate by protecting the area from erosion, compaction and contamination; • Control by implementing dust control measures. • Control by upgrading roads where required	Low
Topsoil stockpiles	• Loss of soil potential (nutrient leach and erosion) • Dust generation	• Control erosion by implementing erosion control measures; • Control by implementing recommendations by soil specialist with regarding to height and management of stockpiles.	Low
Overburden stockpiles (hards and contaminated)	• Soil, surface and groundwater contamination • Impact to visual aesthetics in the area	• Control by providing barrier systems using a risk-based approach; • Control by separating clean and dirty storm water, as well as collecting and containing dirty runoff and seepage • Control by undertaking concurrent rehabilitation where feasible	Moderate
ROM tip	• Soil, surface and groundwater contamination • Greenhouse gas emissions	• Control by ensuring that all facilities with the potential to generate dirty storm water runoff, effluent or washdown water are located within the designated dirty water area; • Control by diverting clean runoff around the designated dirty areas by means of cut-off canals, sized to accommodate at least the 1:50 year peak flow event. • Control by investigating carbon offset strategies	Low
Storage of chemicals within the Explosives magazine	• Soil, surface and groundwater contamination	• Control by ensuring the proper design, construction, and maintenance of the infrastructure.	Low

ACTIVITY whether listed or not listed	POTENTIAL IMPACT	MITIGATION TYPE	POTENTIAL FOR RESIDUAL RISK
Storage of fuel and chemicals within the mine complex workshops		• Control by implementing proper management measures for the storage and handling of fuels and chemicals.	
Dust suppression using mine impacted water	• Soil, surface and groundwater contamination	• Control by only using mine-impacted water in dirty water management areas with appropriate dirty water management measures; • Control by limiting dust suppression to a minimum to prevent excessive runoff.	Low

20. OTHER INFORMATION REQUIRED BY THE COMPETENT AUTHORITY

Compliance with the provisions of sections 24(4) (a) and (b) read with section 24 (3) (a) and (7) of the National Environmental Management Act (Act 107 of 1998). The EIA report must include the following:-

20.1 Impact on the socio-economic conditions of any directly affected person

(Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any directly affected person including the landowner, lawful occupier, or, where applicable, potential beneficiaries of any land restitution claim, attach the investigation report as Appendix 2 and confirm that the applicable mitigation is reflected herein)

The anticipated socio-economic impacts will be assessed during the EIA Phase to determine the required mitigation measures. The detailed outcome of socio-economic impact assessment will be provided in the EIR.

20.2 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

(Provide the results of Investigation, assessment, and evaluation of the impact of the mining, bulk sampling or alluvial diamond prospecting on any national estate referred to in section 3(2) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) with the exception of the national estate contemplated in section 3(2) (i) (vi) and (vii) of that Act, attach the investigation report as Appendix 2 and confirm that the applicable mitigation is reflected herein)

The anticipated heritage and palaeontological impacts will be assessed during the EIA Phase to determine the required mitigation measures. The detailed outcome of socio-economic impact assessment will be provided in the EIR.

20.3 Other matters required in terms of sections 24(4) (a) and (b) of the Act.

(the EAP managing the application must provide the competent authority with detailed, written proof of an investigation as required by section 24(4)(b)(i) of the Act and motivation if no reasonable or feasible alternatives, as contemplated in sub-regulation 22(2)(h), exist. The EAP must attach such motivation as Appendix 5)

Various alternatives relating to the Alexander Mining Project were investigated as detailed in **Section 8**, therefore, no motivations are required for no reasonable or feasible alternatives.

21. UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I _Gina Martin____ herewith undertake that the information provided in the foregoing report is correct, and that the comments and inputs from stakeholders and Interested and Affected parties have been correctly recorded in the report.

____

Signature of the EAP

DATE: _15/08/2022_______

22. UNDERTAKING REGARDING LEVEL OF AGREEMENT

I _ Gina Martin_____ herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with interested and Affected Parties and stakeholders has been correctly recorded and reported herein.

____

Signature of the EAP

DATE: _15/08/2022_______

23. REFERENCES

Airshed Planning Professionals (2021a): Alexander Mining Project: Baseline Noise Survey Report. Report number: 17JAW03

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APPENDIX 1

QUALIFICATION AND CV OF EAP

APPENDIX 2

SOCIO-ECONOMIC CONDITIONS OF DIRECTLY AFFECTED PERSON(S) AND HERITAGE ASSESSMENT

To be included in the Environmental Impact Report

APPENDIX 3

LOCALITY MAP

APPENDIX 4

MAP OF LISTED AND SPECIFIED ACTIVITIES

APPENDIX 5

MOTIVATION FOR NOT CONSIDERING ALTERNATIVES

Not applicable

APPENDIX 6

PUBLIC PARTICIPATION

APPENDIX 6 - Table of Contents

Appendix 6.1

I&AP DATABASE

Appendix 6.2

BID AND REPLY SHEET

Appendix 6.3

STAKEHOLDER NOTIFICATION

To be included in the Final Scoping Report.

Appendix 6.4

ADVERTISEMENT

Appendix 6.5

SITE NOTICE BOARD

Appendix 6.6

COMMENTS AND RESPONSE REPORT

To be included in the Final Scoping Report.

Appendix 6.7

PUBLIC MEETING DOCUMENTATION

To be included in the Final Scoping Report.

Appendix 6.8

LANDOWNER CONSENT LETTERS

Not included in public review copies to remain compliant with the Protection of Personal Information Act. The landowner consent letters have been included in the submission to the DMRE only.

APPENDIX 7

NEM:WA INFORMATION

To be included in the Environmental Impact Report

APPENDIX 7 - Table of Contents (all to be included in EIR)

APPENDIX 8

APPLICATION FORM AND EIA SCREENING TOOL REPORT