Lukisa Ryst Kuil Project:

Environmental Impact Assessment and Environmental Management Programme Report for the Ryst Kuil application area

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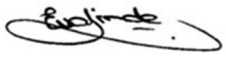	E. van der Linde; M.EM; EAPASA (2247/2020)	Aquatox Consulting Pty Ltd	July 2025
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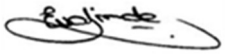

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mineral resources

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REPUBLIC OF SOUTH AFRICA

ENVIRONMENTAL IMPACT ASSESSMENT REPORT and ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

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).

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Appendix 3 Air Quality Assessment Report

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Appendix 5 Heritage Impact Assessment Report

HIA Includes: Palaeontological, Built Environment, Archaeological and Visual Impact Assessment Reports

Appendix 6 Noise Assessment Report

Appendix 7 Radiation Safety Assessment Report

Appendix 8 Socio-Economic Impact Assessment Report

Appendix 9 Soil, Land Use and Land Capability Impact Assessment Report

Appendix 10 Traffic Impact Assessment Report

Appendix 11 Surface Water

Appendix 12 Groundwater Reports

Appendix 13 Geochemistry

Appendix 14 Screening Report

Appendix 15 Aquatic fresh water biodiversity

GLOSSARY OF ACRONYMS, TERMS AND UNITS

µg/m^3	Micrograms per cubic meter
µSv	10^{-6} Sievert (one millionth of a Sievert)
AEL	Atmospheric Emission Licence
ALARA	As Low As Reasonably Achievable
AMAD	Activity Median Aerodynamic Diameter
AQA	National Environmental Management: Air Quality Act (No. 39 of 2004)
AMD	Acid Mine Drainage
ARD	Acid Rock Drainage
ASD	Advance strike drives
Bq	Becquerel
Bq/L	Becquerel per litre
Bq/m^2	Becquerel per square metre
CBA	Critical Biodiversity Area
CMA	Catchment Management Agency
COR	Certificate of Registration
CPP	Central Processing Plant
CPP	Central Processing Plant
DCF	Dose Conversion Factor, the dose per unit radioactivity of a radionuclide taken into the body
DEA	Department of Environmental Affairs
DWS	Department of Water and Sanitation
DMR	Department of Mineral Resources
EAP	Environmental Assessment Practitioner
ECA	Environment Conservation Act (Act 78 of 1989)
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
Emission	The direct or indirect release of substances, vibrations, heat or noise from individual or diffuse sources in an installation into the air, water or land.
EMP	Environmental Management Plan
EMPr	Environmental Management Programme Report
EMS	Environmental Management System
ESA	Ecological sensitive area
FEL	Front End Loader
FEPA	Fresh water Ecosystem Priority area
GHG	Green House Gas
GPS	Global Positioning System
ha	Hectare
HIA	Heritage Impact Assessment
HEC	Heritage Eastern Cape
HWC	Heritage Western Cape
IAEA	International Atomic Energy Agency
IAPs	Interested and Affected Parties
ICRP	International Commission on Radiological Protection
km	kilometre

LRP	Karoo Uranium Project
LAeq,I dB(A)	A-weighted equivalent sound level using the 'I' (Impulse) dynamic response characteristic as recommended in SANS 10103:2008
LAMin dB(A)	The minimum A-weighted sound level recorded during the period of measurement
LHD	Load Haul Dumper
LL-alpha	Long-lived alpha activity, and in the context of this report mainly the radio-isotopes U-238, U-234, Th-230, Ra-226, and Pb-210
LOM	Life of Mine
LP	low profile
m	Meters (measurement of distance)
m^2	Square meter
m^3	Cubic meter
mamsl	Meters above mean sea level
mBq	10^{-3} Bq (one thousandth of a Becquerel)
mbgl	Meters below ground level
mg/m^3	Milligrams per cubic meter
mg/m^3	milligrams per cubic metre
MPRDA	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
mSv	10^{-3} sievert (one thousandth of a sievert)
NAAQS	National Ambient Air Quality Standard
NCR	Noise Control Regulations (under section 25 of the ECA)
NEMA	National Environmental Management Act (No. 107 of 1998)
NHRA	National Heritage Resources Act
NNR	National Nuclear Regulator
NORM	Naturally Occurring Radioactive Material
NPAES	National Protected Areas Expansion Strategy
PCD	Pollution control dam
PM_{10}	Particulate matter with a diameter of less than 10 microns
$PM_{2.5}$	Particulate matter with a diameter of less than 2.5 microns
PPE	Personal Protective Equipment
PPP	Public Participation Process
R%	Relative humidity
ROM	Run of Mine, the uranium ore delivered for processing and extraction of the uranium product
SABS	South African Bureau of Standards
SANS	South African National Standard
SCC	Species of Conservation Concern
SHEQ	Safety Health Environment and Quality
Sv	Sievert
T°C	Temperature in degrees Celsius
TME	Trackless Mining Equipment
TLD	Thermoluminescent dosimeter
TSP	Total suspended particulates
UTM	Universal Transverse Mercator

W m/s	Maximum wind speed measured
WHO	World Health Organisation

1 IMPORTANT NOTICE

In terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended), the Minister must grant a 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, as amended, 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 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.

The footprint area as presented in this document poses the worst-case scenario. Any changes to the mine work programme and engineering designs, that would result in affecting areas outside of defined parameters would require a Section 102 amendment application in terms of the of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 as amended).

2 OBJECTIVE OF THE ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The objective of the environmental impact assessment process is to, through a consultative process—

(a) determine the policy and legislative context within which the activity is located and document how the proposed activity complies with and responds to the policy and legislative context;
(b) describe 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 the location of the development footprint within the preferred site based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;

(d) determine the—-

i. nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and

ii. degree to which these impacts—

(aa)can be reversed;

(bb)may cause irreplaceable loss of resources, and

(cc)can be avoided, managed or mitigated;

(e) identify the most ideal location for the activity within the preferred site based on the lowest level of environmental sensitivity identified during the assessment;

(f) identify, assess, and rank the impacts the activity will impose on the preferred location through the life of the activity;

(g) identify suitable measures to manage, avoid or mitigate identified impacts; and

(h) identify residual risks that need to be managed and monitored.

PART A

SCOPE OF ASSESSMENT AND ENVIRONMENTAL IMPACT ASSESSMENT REPORT

3 Contact Person and correspondence address

3.1 Details of the EAP

Name of The Practitioner	E. van der Linde
Tel No.	083 441 0239,
Fax No.	086 716 5576
e-mail address	erika@atox.co.za

3.1.1 Expertise of the EAP

The qualifications of the EAP

Erika obtained Master degree in Environmental management from the University of the Free State in 2002 (see Appendix 1).

Summary of the EAP's past experience

1990-2002: Free State Education Department

Teaching at Secondary and High Schools.

Subjects: Biology, Physiology, Mathematics, Science (Physics & Chemistry), Computer Science, Computer literacy.

January 2003 - December 2023: Ferret Mining and Environmental Services Pty Ltd

Duties: Environmental Consultant

July 2018 – current: Aquatox Consulting Pty Ltd

Director, Senior Environmentalist; Office management including computer maintenance.

My duties, as an when projects are allocated, include but are not limited to:

- Environmental consulting,
- Specialist contributions to environmental projects, i.e. ecology & biology,
- Compilation of Environmental Management Programme Reports, Environmental Management Plans, Environmental Impact Assessments and Environmental impact reports, EMP performance assessments,
- Compiling feasibility studies,
- Environmental due diligence,
- Water use license applications and water use registration,
- Liaison with authorities for acquisition of mining and prospecting permits and licences,

- Environmental monitoring programmes,
- Mining & Prospecting right applications,
- Compliance evaluation,
- Training: General awareness, job-specific, ISO 14001:2004 & 2015
- Development and Implementation of ISO 14001 compliant EMS,
- Auditing of ISO 14001 based Environmental management systems (Audit log available on request).

The nature of my responsibilities at Atox includes the finding of solutions to environmental pollution problems, development of environmental management systems, environmental auditing, compiling feasibility studies, environmental impact assessment (EIA), environmental management programmes (EMPr) and mining and environmental related licence and permit applications as well as monitoring of environmental programmes.

A thorough understanding of the mitigation and management of impacts to limit environmental contamination is part of my work milieu.

Development and provision of training regarding environmental management as per legal and customer requirement to ensure effective implementation of the Environmental management plan / programmes. Training programmes I developed included ISO 14001 (2004 and the updated 2015 version) and ISO 50001:2018 awareness, implementation, and management responsibility sessions as well as related legal training.

3.2 Description of the property

Farm Names and 21-digit Surveyor General Code for each farm portion

FARMNAME	FARMNO	SUBDIVNO	21-DIGIT SG CODE
HAANE KUIL	335	RE	C00900000000033500000
HAANE KUIL	335	1	C00900000000033500001
HAANE KUIL	335	4	C00900000000033500004
HAANE KUIL	335	7	C00900000000033500007
NIEUW JAARS FONTEIN	340	1	C00900000000034000001
EERSTE WATER	349	1	C00900000000034900001
EERSTE WATER	349	3	C00900000000034900003
EERSTE WATER	349	4	C00900000000034900004
VLAK PLAATS	350	1	C00900000000035000001
RYST KUIL	351	RE	C00900000000035100000
RYST KUIL	351	2	C00900000000035100002
KAT DOORN KUIL	359	RE	C00900000000035900000
KANT KRAAL	360	RE	C00900000000036000000
KLIP STAVELS	361	RE	C00900000000036100000

	KLIP STAVELS	361	2	C00900000000036100002
	KLIPGAT	362	RE	C00900000000036200000
	FARM 394	394	RE	C00900000000039400000
Application area (ha)	68,926.2355ha			
Magisterial district	Beaufort West			
Distance and direction from nearest town	+/- 40km south-east of Beaufort West			

3.3 Locality map

The properties of the "Ryst Kuil" application (this application) are located to the south-east of the town of Beaufort West, which is situated at the north-eastern edge of the Central Karoo (Figure 3-1, Figure 3-2 and Figure 3-1).

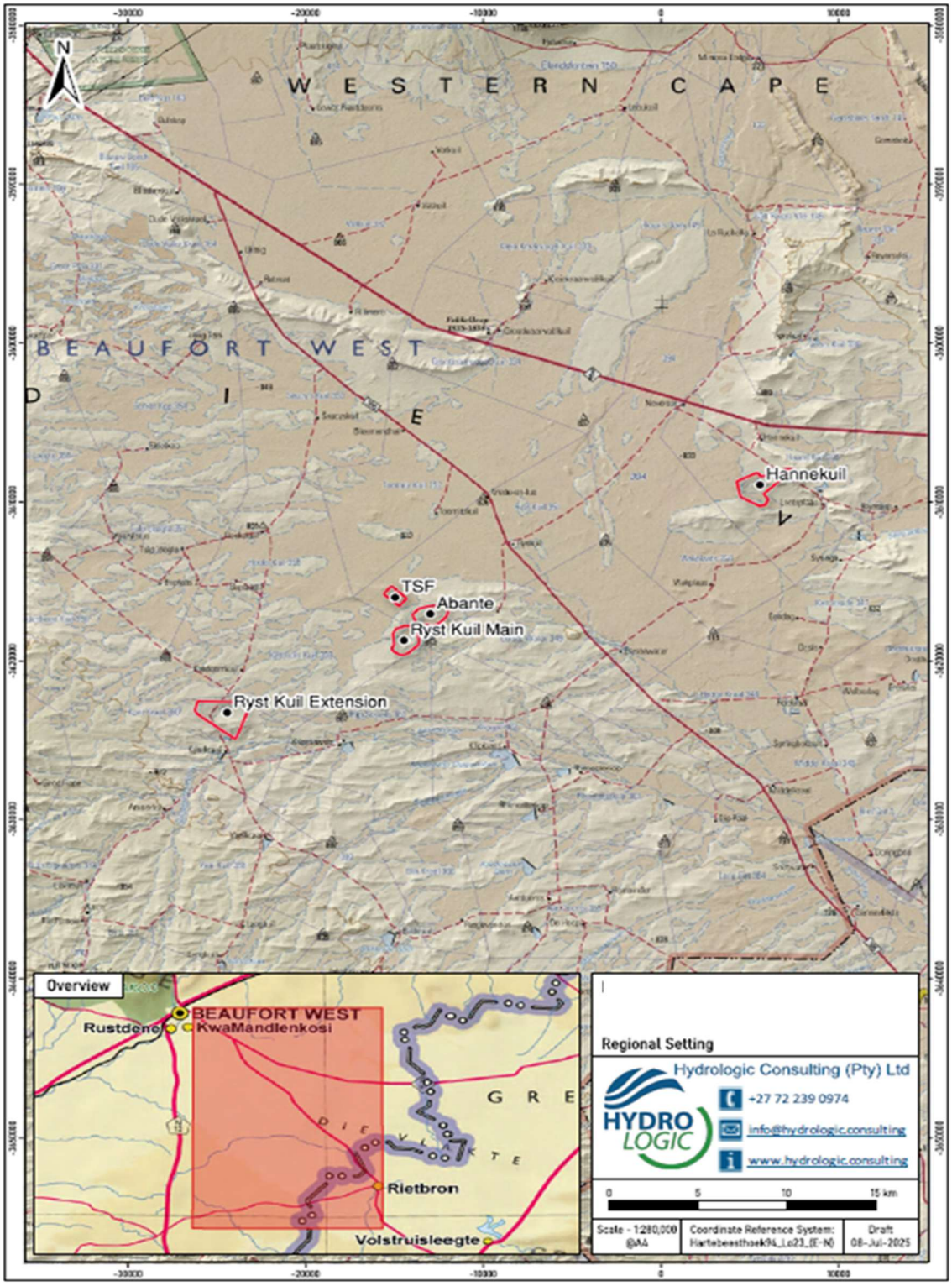


Figure 3-1. Regional setting.

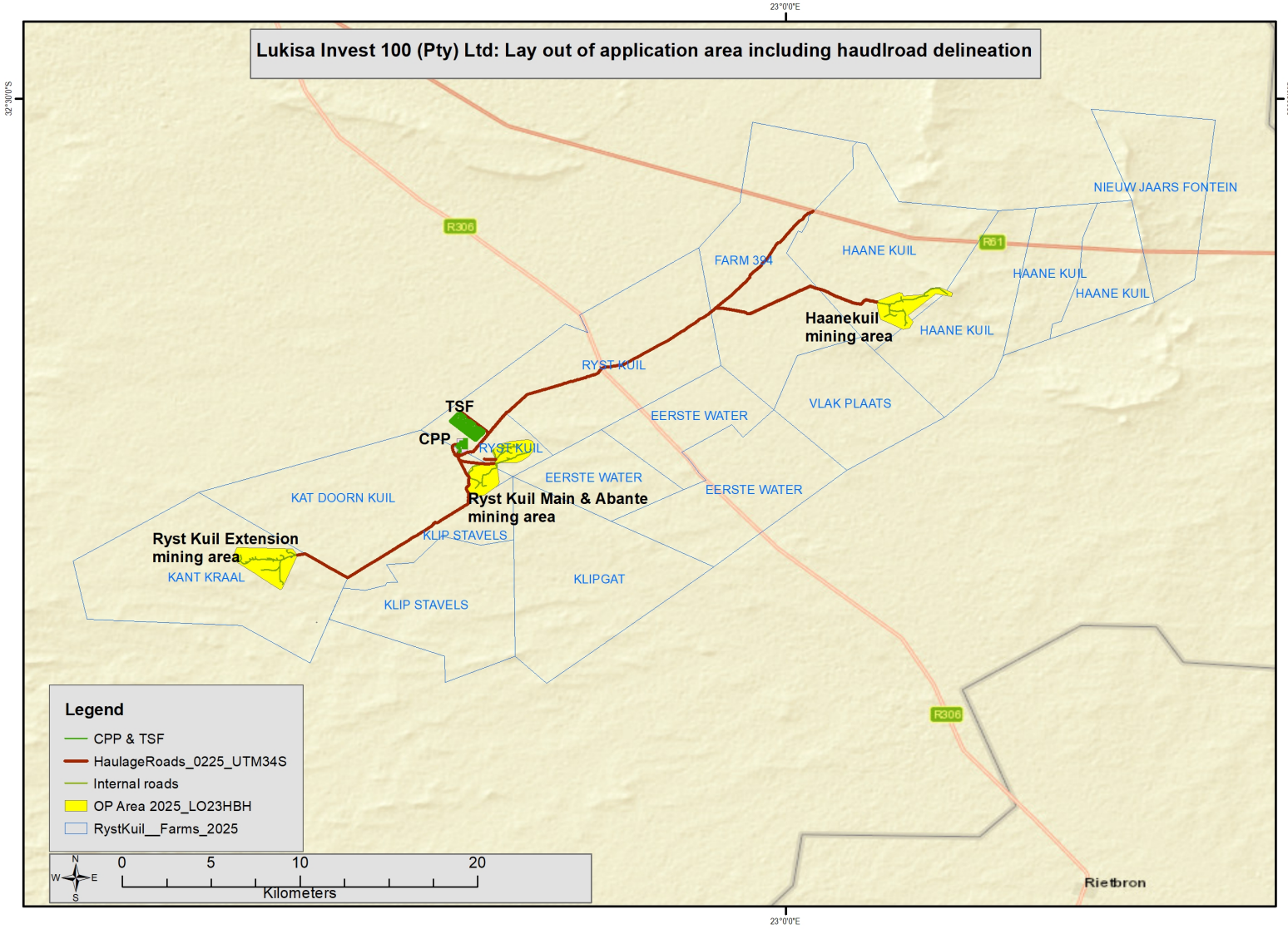


Figure 3-2. Layout of the various mining areas within the Ryst Kuil mining right application area including haul road delineations.

3.4 Description of the scope of the proposed overall activity

Lukisa Invest 100 (Pty) Ltd ("Lukisa") is the applicant for a mining rights application submitted in terms of Section 22 of the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) for uranium (U) and molybdenum (Mo) in the Karoo.

The mining right application is referred to as "Ryst Kuil". The Ryst Kuil application is in the Western Cape Province.

This document is prepared in support of the Ryst Kuil application, which is located approximately 40 km south-east of Beaufort West. Tasman Lukisa JV Company (Pty) Ltd ("LUKISA"), the previous exploration rights holder, commenced with exploration activities in 2006/2007 and evaluated historic deposits located on the property and converted them to modern resource compliance standards.

The proposed mining operation is to be known as the Lukisa Ryst Kuil Project and will be operated as a single entity, with multiple mining areas feeding a central processing plant (CPP) to be located near the main orebody in the Ryst Kuil area. Operations within the Ryst Kuil application area would include open pit mining, underground mining, the Central Processing Plant (CPP) and the Tailing Storage Facility (TSF).

3.4.1 Listed and specified activities

NAME OF ACTIVITY	**Aerial extent of the Activity**	**LISTED ACTIVITY**	**APPLICABLE LISTING NOTICE**
(All activities including activities not listed) (E.g. Excavations, blasting, stockpiles, discard dumps or dams, Loading, hauling and transport, Water supply dams and boreholes, accommodation, offices, ablution, stores, workshops, processing plant, storm water control, berms, roads, pipelines, power lines, conveyors, etc.)	**ha or m²**	Mark with an X where applicable or affected.	2014/2017
NB: Amendments to the listed activities were promulgated on 7 April 2017. Although this change occurred after submission of the application, these changes are referenced below.			
CPP – Central Processing Plant			
Land use: Agriculture to Mining	68,926.3 ha	X	GN R983/R327 Activity 28
Chemicals at the CPP - Sulphuric Acid (24 634t) - Pyrolusite (1080t) - Flocculant (66t) - Alamine (10m^3) - Isodecanol (10m^3) - Kerosene (54m^3) - Sodium Carbonate (106t) - Ammonium Hydroxide (148t) - Burnt Lime (1038t) - Diesel (~120m^3) - Oil (~25m^3) - Hydraulic fluid (tbd)	Combined >500m^3(tbd)	X	GN R984/R325 Activity 4

NAME OF ACTIVITY	Aerial extent of the Activity	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
CPP; TSF – Tailings Storage Facility	~103ha	X	GN R984/R325 Activity 15
Mining and mining related infrastructure: CPP, TSF, Milling, Crushing, Change house, offices, lay down area, Haul road crossings, parking, weight bridge	~1161 ha	X	GN R983/R327 Activity 12 GN R983/R327 activity 19 GN R984/R325 Activity 15 GN R984/R325 Activity 17 GN R984/R325 Activity 19
Beneficiation plant	40Ha	X	GN R984/R325 Activity 6 GN R984/R325 Activity 21 GNR893 Sub-Category 4.1 GNR893 Sub-Category 7.2
Tailings Stockpile	47 + 32ha (Phase 1 and Phase 2)	X	GN R984/R325 Activity 15 GN R984/R325 Activity 6 GN R 632 & GN R633 (Category B(11)
ROM Stockpiles;	10ha	X	GN R984/R325 Activity 15 GN R984/R325 Activity 6
Water storage-reservoir; Silt traps; Pollution control dam; Return water dam; Raw water dam; Process water dam; Potable water tank	Vol 1900m^3 Vol variable Vol 10,000m^3 Vol 42,000m^3 Vol 5,000m^3 Vol 10,000m^3 Vol 150m^3	X	GN R983/R327 Activity 12 GN R983/R327 Activity 13 WULA
Service roads (Mining operation **not** for public use)	2.9km	X	GN R984/R325 Activity 15 GN R984/R325 Activity 17
Ryst Kuil pit complex (RKA – Ryst Kuil Abante): Excavation, blasting, loading, sorting, hauling, berms, crushing.			
Pit RKA1; RKA 2; RKA 3; RKA 4; RKA 5; RKA 6; RKA 7.	2.41ha; 3.81ha; 7.96ha; 8.22 ha; 2.7ha; 2.61ha; 21.71ha.	x	GN R984/R325 Activity 15 GN R 983/R327 Activity 21 GN R984/R325 Activity 15 GN R984/R325 Activity 17 GN R984/R325 Activity 21
Back fill of most pits	~50ha	X	GN R984/R325 Activity 6 WULA
3 x stockpiles	19.5ha; 6.4ha; 3.5ha	X	GN R984/R325 Activity 6 Category B(11)
Water storage-reservoir; silt traps; Pollution control dam. Pollution control dams Concrete lined collection channels Concrete lined drainage channels Clean cut-off berms and channels	500 m^2	X	GN R983/R327 Activity 12
Internal haul roads (Mining area only, **not** for public use)	6151m	X	GN R984/R325 Activity 17
Kat Doorn Kuil ptn RE: (RKM – Ryst Kuil Main): Excavation, blasting, loading, sorting, hauling, equipment storage, berms, crushing, underground mining, change house, diesel storage (<60m^3).			
Pit RKM1; RKM 2; RKM 3	4.63ha; 3.16ha; 13.86ha;	x	GN R983/R327 Activity 21 GN R984/R325 Activity 15 GN R984/R325 Activity 17 GN R984 Activity 21
Back fill of most pits	~20ha	X	GN R984/R325 Activity 6

NAME OF ACTIVITY	Aerial extent of the Activity	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
			WULA
Water storage-reservoir; silt traps; Pollution control dam. Pollution control dams Concrete lined collection channels Concrete lined drainage channels Clean cut-off berms and channels	1350 m^3	X	GN R983/R327 Activity 12
1 x stockpiles	36.8ha	X	GN R984/R325 Activity 15 GN R984/R325 Activity 6 Category B4(11)
Underground mining access through one pit high wall, potentially ventilation shaft	1ha	X	GN R984/R325 Activity 17
Internal haul roads (Mining area only, **not** for public use)	5272m	X	GN R984/R325 Activity 17
Kant Kraal ptn RE: (RKE – Ryst Kuil Extension): Excavation, blasting, loading, sorting, hauling, Equipment storage, berms, crushing, underground mining, change house, diesel storage (<60m^3).			
Pit RKE1; RKE 2; RKE3; RKE4; RKE5; RKE6; RKE7; RKE8; RKE9; RKE10; RKE11; RKE12	1.58ha; 3.29 ha; 1.43 ha; 1.87 ha; 1.94 ha; 6.99 ha; 4.4 ha; 2.7 ha; 2.19 ha; 1.7 ha; 2.61 ha; 2.61 ha.	x	GN R983 Activity 12 GN R 983 Activity 21 GN R984/R325 Activity 15 GN R984/R325 Activity 17 GN R984/R325 Activity 19 GN R984/R325 Activity 21 GN R985 Activity 14
Back fill of most pits	~33ha	X	GN R984/R325 Activity 6 WULA
5 x stockpiles	9.3ha; 5.6ha; 4.2ha; 13ha; 13ha.	X	GN R984/R325 Activity 15 GN R984/R325 Activity 6 Category B4(11)
Water storage-reservoir; silt traps; Pollution control dam. Pollution control dams Concrete lined collection channels Concrete lined drainage channels Clean cut-off berms and channels	1350 m^3	X	GN R983/R327 Activity 12
Underground mining access through one pit high wall and Ventilation shaft	1ha	X	GN R984/R325 Activity 17
Internal haul roads (Mining area only, **not** for public use)	8188m	X	GN R984/R325 Activity 17
Haanekuil (HNK – Haanekuil): Excavation, blasting, loading, sorting, hauling, Equipment storage, berms, crushing, underground mining, Change house, diesel storage (<60m^3).			
Pit HNK 1 (Ptn 7); HNK2 (Ptn 7); HNK3 (Ptn 7); HNK4 (Ptn 7 & RE); HNK5 (Ptn 7 & RE); HNK6 (Ptn 7);	2.57ha; 6.11ha; 11.22ha; 1.01ha; 1.55ha; 2.98ha;	X	GN R 983 Activity 21 GN R984/R325 Activity 17 GN R984/R325 Activity 21

NAME OF ACTIVITY	Aerial extent of the Activity	LISTED ACTIVITY	APPLICABLE LISTING NOTICE
HNK7 (Pnt RE);	1.79ha;		
Waste rock stockpiles (Ptn 7)	52.3ha	X	GN R984/R325 Activity 6 Category B4(11)
Back fill of most pits	~26ha	X	GN R984/R325 Activity 6 WULA
Underground mining access through pit high wall	1ha	X	GN R984/R325 Activity 17
Water storage-reservoir; silt traps; Pollution control dam. Pollution control dams Concrete lined collection channels Concrete lined drainage channels Clean cut-off berms and channels	1200 m^3	X	GN R983/R327 Activity 12
Internal haul roads (Mining area only, **not** for public use)	7299m	X	GN R984/R325 Activity 17
Transportation road			
Development (4.5m x 57.84km) and widening (by 1.5m) and upgrade (57.36km) of tracks to roads, with potential road diversion at Haanekuil and Ryst Kuil Extension.	24.66 ha Diversions: Haanekuil 434m RK Ext 564m	X	GN R983/R327 Activity 19

3.4.2 Description of the activities to be undertaken

Currently open cast mining and underground mining are planned within the Ryst Kuil application area. While in-situ leach recovery is an effective method of extraction, accounting for roughly 48% (World Nuclear Association) of world uranium production, the geology of the Karoo uranium deposits is ***not suited to this method*** mainly because the primary porosity of the host sandstone is extremely low and virtually impermeable to fluids (Cole, Geological Survey, 1980).

Any change to the mine plan to include underground mining will only occur following approval by the Department of Mineral Resources (DMR) upon submission of an update to the Mine Works Programme and Environmental Management Programme. Processing of ore and storage of tailings is planned within this application area.

3.4.2.1 Open Pit Mining

Open pit mining at the various satellite sites will be carried out using traditional blasting and loading from an open pit, which requires the removal of overburden and waste rock before accessing the ore material.

Topsoil (if any) will be removed to a maximum depth of 30 cm where possible from all open pit and dump areas. This will be done by bulldozing the material onto windrows, loaded by an excavator and trucked to a topsoil

stockpile for storage. No vegetation will be removed prior to this operation. All vegetation will be stockpiled together with the topsoil.

The hard overburden will be mined in benches of 10 m with a maximum slope angle of 65°. The benches will be drilled and blasted prior to an excavator and truck fleet loading and hauling to an appropriate dump site. The waste rock stockpile consists of ex-pit overburden dumps adjacent to the open pit and old mined-out open pits from which no mining is taking place or are planned to take place in future. Overburden on the last bench above the ore will only be drilled and blasted down to the ore/waste contact. Ore and overburden will not be drilled and blasted together.

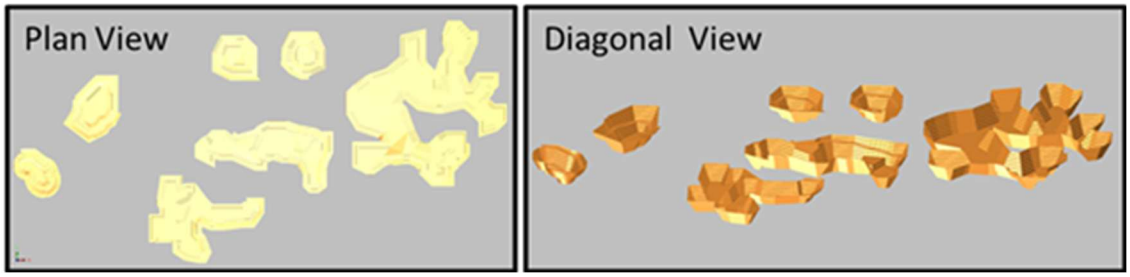


Figure 3-3. An example of open pit designs from one of the planned mining areas.

Due to the thin tabular nature of the ore deposit and the small size of the various open pits, virtually all the overburden will have to be mined before any ore production from any given pit will be possible. Because no clear visual distinction is identified between the ore and waste material, strict grade control measure will need to be implemented using radiometric measurements by the production geological department. All mined ore will be loaded by an excavator or front-end loader onto a truck and transported directly to the processing plant run of mine (ROM) tip.

Mined ore will be transported from the satellite operation to the CPP at Ryst Kuil. No ore will be processed at the satellite sites. Internal roads will connect the mining pits, waste rock laydown area, temporary change house and temporary office complex. Access to and from the site will be regulated through a security access point on a road connecting the site to the CPP. Transportation routes are in the Western Cape.

Table 3-1. Open pit dimensions

Ryst Kuil Main		
Open Pit	**Size (ha)**	**Depth(mbgl)**
OP 1	4.63	109
OP 2	3.16	70
OP 3	13.86	110
Total	**21.65**	
Ryst Kuil Abante		
Open Pit	**Size (ha)**	**Depth(mbgl)**
OP 1	2.41	69
OP 2	3.81	74
OP 3	7.96	54
OP 4	8.22	69
OP 5	2.70	68
OP 6	2.61	67
OP 7	21.71	70
Total	**49.42**	

Ryst Kuil Extension		
Open Pit	**Size (ha)**	**Depth(mbgl)**
OP 1	1.58	50
OP 2	3.29	48
OP 3	1.43	51
OP 4	1.87	57
OP 5	1.94	55
OP 6	6.99	51
OP 7	4.4	51
OP 8	2.7	54
OP 9	2.15	53
OP 10	1.7	54
OP 11	2.61	47
OP 12	2.61	52
Total	**33.27**	
Haanekuil		
Open Pit	**Size (ha)**	**Depth (mbgl)**

OP 1	2.57	53
OP 2	6.11	35
OP 3	11.22	67
OP 4	1.01	22
OP 5	1.55	33
OP 6	2.98	44
OP 7	1.79	35
Total	**27.23**	

3.4.2.2 Underground Mining

3.4.2.2.1 Mining Method Selection

The Karoo uranium underground orebody is exceptionally complex and scattered in nature. Dissimilar to the familiar average tabular orebody structure being mined across South Africa. It is best described as a flat-dipping, lens-like deposit. The average thickness is mostly 1.2 m with some areas at 1.8 – 3m and occasionally up to 6.0m thick. Depth to seam is mostly 35 – 80m with a few deeper areas up to 110m.

In general, the orebody characteristics appear to be ideally suited for Bord and Pillar mining using low profile (LP) trackless mining equipment (TME). In narrower mineable portions, other mining methods, deploying more conventional methods, had to be considered. This is necessitated mainly due to the excessive dilution factor associated with a higher trackless mining height.

The most appropriate alternate mining method is an on-reef hybrid stoping method. The method still uses the same TME fleet for on reef access development, and cleaning, hand-held rock drills is used for face drilling and waterjets for in-stope ore cleaning LHD's will load the stoping production tonnes jetted into the on-reef drives, haul and dump it on the designated belt tipping points.

3.4.2.2.2 Development – Access Methodology

Development layout for the Karoo uranium deposits will consist of high-wall access roadways from the floor of mined out open pits. It is suggested that the portal positions be finalised early in the life of each pit that will host an underground decline and that the wall geometry is altered to provide safe access to the declines. This is to be achieved, in the following manner:

- Increase the bench width on the bench above the level into which the portal will be created to allow sufficient space to place a substantial catch berm along the crease of the bench to prevent any scaling from upper benches to report to the portal / decline level;
- Ensure that the bench into which the portal will be established is of sufficient height to leave at least 4m brow of solid, fresh rock above the decline hanging wall;
- Prior to excavating the portal entrance (start the decline development):
- A 50mm thick layer of shotcrete is to be applied to the whole bench wall around the portal entrance, to at least 5.0m on either side of the planned excavation;
- Two rows of 4.5m long cable anchors (full column grouted) be installed into the brow above the planned decline portal on a 2m x 2m pacing and horizontally orientated (8 anchors).

A crown pillar of 20m wide will be left around the open pit to ensure slope stability during the underground LOM. The twin access roadway will serve as a conveyor and a men and material roadway. These two drives

will also act as main ventilation intake airways, returning through dedicated return airways (either through holing's in the high-wall or raise drilled ventilation holes). The ventilation intakes (conveyor roadways) will be configured in a manner that the airflow can be short circuited to the return airways in case of fire.

Production sections will be established off the twin roadway system as development progresses. A development section consists of two roadways which are 5m wide by a minimum of 2m high. Skin to skin pillar spacing will be 6m according to the rock engineering design as per report. The length of the pillar between the roadways will be dictated by tip and belt positions with a maximum of 75m long. The holings between the roadways will be 5m wide.

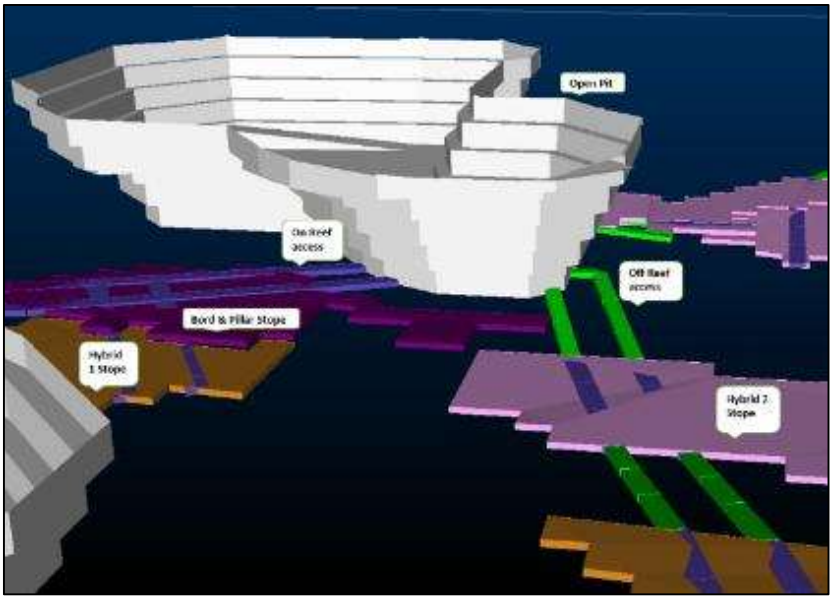


Figure 3-4. Schematic of a twin decline system established from an open pit bottom.

During the initial development phase, rock will be loaded at the face by 5t low profile load haul dumpers (LHDs) and trammed to the nearest in pit waste dump. Once the development has advanced to a point where the conveyor belt system is installed, ore will be loaded on the face by the LHDs and trammed to a dedicated conveyor tipping point for each section. The tipping point for the development section will be located in the dedicated belt decline. The tipping points for the stoping sections will be in the strike drive with a maximum distance of 150m from the face to limit the overall LHD return trip tramming distance to 300m.

Once the development section has completed the on-reef development through a targeted deposit the stoping method best suited to the orebody width will be applied. This approach is required to ensure that the minimum mining dilution is maintained.

The mining methods selected for underground mining are the following:

- Bord and Pillar stoping
- Hybrid stoping

The identified methods are flexible and allow uncomplicated changing between the methods.

1. Bord and Pillar Stoping

Trackless mechanised Bord and Pillar sections will operate on an 11-day-fortnight two shift cycle. Each standard stoping section will consist of 9 bords and in some cases the geometry of the mining area will dictate smaller

sections. For this method, 6m wide bords with a minimum mining height of 1.8m would be developed alongside 6m x 6m pillars. The mining sequence will be performed in the following manner:

- Face drilling will be carried out by drilling crews using low profile diesel driven single boom electrohydraulic, drill rigs;
- Rock bolt installation: All support holes will be drilled using Auto rock support frames fitted with conventional rock drills;
- The cleaning of the blast will be carried out using low profile load haul dump (LHD) vehicles. LHD's will load the blasted rock at the face and transport it to the dedicated in section tipping points from where it will be conveyed to surface by means of a series of conveyor belts;
- Face charging: All shot holes will be charged with pumpable emulsion explosives. Explosive vehicles with emulsion tanks and pumping units will be used for charging-up operations. A shock tube detonating system will be used to detonate the blast;
- Blasting operations will be done twice daily at the end of each shift with an hour re-entry period allowed after each blast;
- Construction and services installation: Utility vehicles will be used for general purpose construction and services installation work.

The declines are positioned to optimise strike length and minimise conveyor belt construction requirements in each of the stoping sections. In some instances, single-sided mining is necessitated to make this possible. Smaller stoping sections created in this manner will not have conveyor belt systems installed. They will be extracted at reduced rates due to the increased tramming distances to tipping points.

The equipment selected limits the practical mining cut to a minimum of 1.8m high. The extraction ratio, based on the bord and pillar design specifications issued by the geotechnical report is 85%. A further 10% minable inventory loss allowance was made for geological losses. The overall extraction ratio for the bord and pillar sections is 75%.

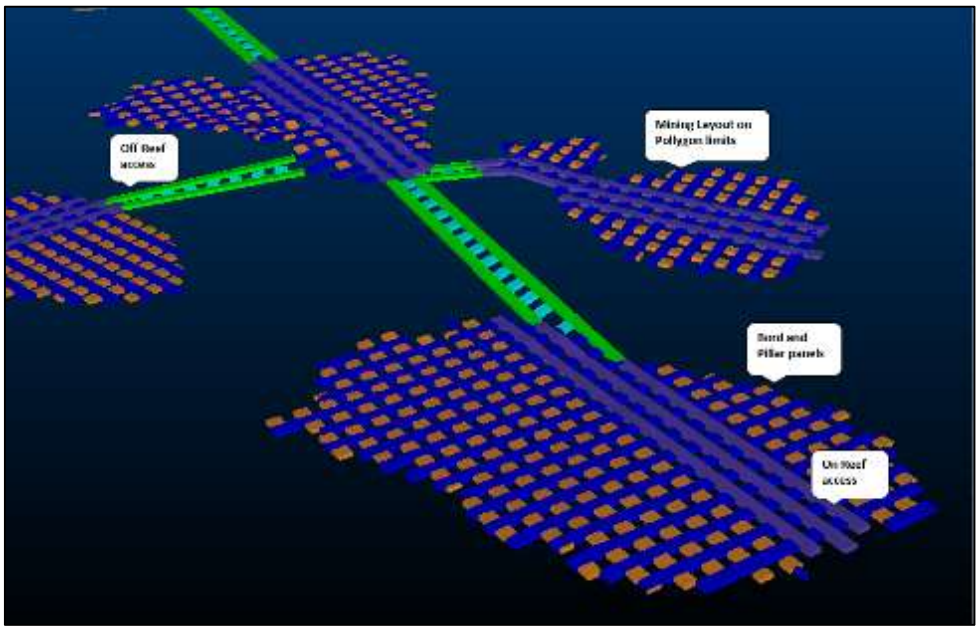


Figure 3-5. Bord and Pillar mining layout.

2. Hybrid Stoping

Access to the hybrid stoping or reef extraction areas are affected by a twin drive system. One drive serves as the conveyor belt roadway. Advance strike drives (ASD's) are developed outwards from the leading twin access drives. The ASD is developed on the down dip side of the hybrid stoping panel, where it will act as a free breaking point for the panel over the life of that panel. The ASD has the same purpose as a conventional advance strike gully (ASG) in the conventional mining section. The difference is that it will be developed by LP trackless mobile machinery and cleaning is done with low profile LHD's.

Strike pillars (indicated in yellow below), which is not continuous, will be left on the up- dip side of each panel. The holings between the strike pillars allows for the flow of ventilation between panels. The ventilation holings are 2m wide and are mined in an up- dip direction from the panel towards the ASD above until holing is affected.

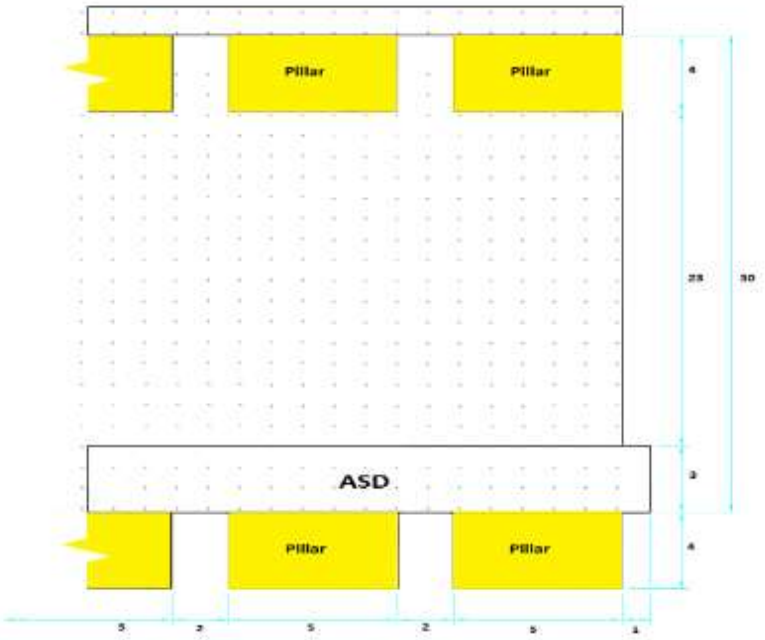


Figure 3-6. Hybrid stoping panel layout.

3.4.2.3 Exploration and Drilling

Although commonly seen as part of the prospecting process prior to mining, near-mine exploration work and drilling (also referred to as "minex") is an integral part of the overall mining process throughout the life of mine. As a project transitions from prospecting to mining, drilling continues within the planned mining areas as infill drilling and later grade control drilling to increase the confidence levels and understanding of the resource before and during mining. Exploration drilling outside the planned mining areas is also undertaken to identify additional resources for potential project expansion. Resource expansion drilling is key to maximising the potential life of a mining project. The description of infill drilling, grade control drilling and resource expansion drilling, as applicable, is provided in greater detail below.

Other exploration activities that may precede drilling include desktop studies, remote sensing, surface mapping & sampling and ground-based or airborne geophysical surveys (e.g. radiometric, magnetic, LiDAR, etc.).

Drilling within in the application area will be required in three scenarios, namely:

- Mining area resource/reserve upgrade in-fill drilling prior to mining production;
- Mining area open pit blast and grade control drilling during mining production;
- Resource expansion exploration drilling along the channel trend outside of the currently defined mining areas, at any stage of the mining project.

3.4.2.3.1 Resource/Reserve In-fill Drilling

This phase of drilling is required mainly prior to the operational stage to increase the confidence level of geostatistical resource/reserve estimation to a level sufficient for accurate mine designs. A combination of mainly reverse circulation and/or percussion drilling and, to a lesser extent, diamond core drilling will be utilised to attain a minimum grid drill-spacing of 25m (average depth of approximately 65m). Drilling will be only be focused on areas identified for mining development (brown open pits or orange underground areas) within the areas currently assessed by the Biodiversity Study (green outline) as indicated on the series of the maps below.

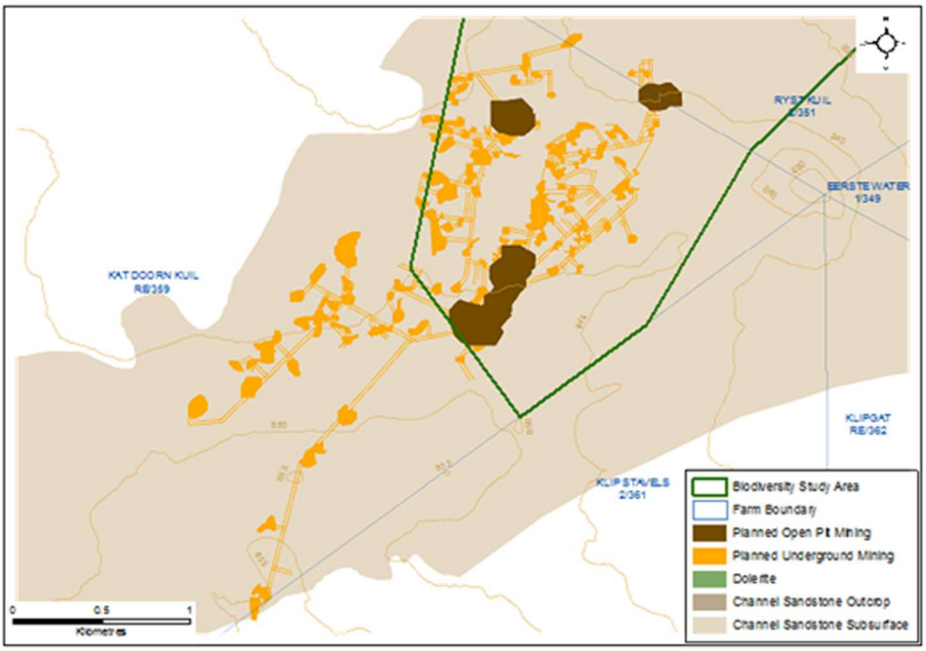


Figure 3-7. Ryst Kuil Main planned open pit (brown) and underground (orange) in-fill drilling areas with current Biodiversity study area (green) outline.

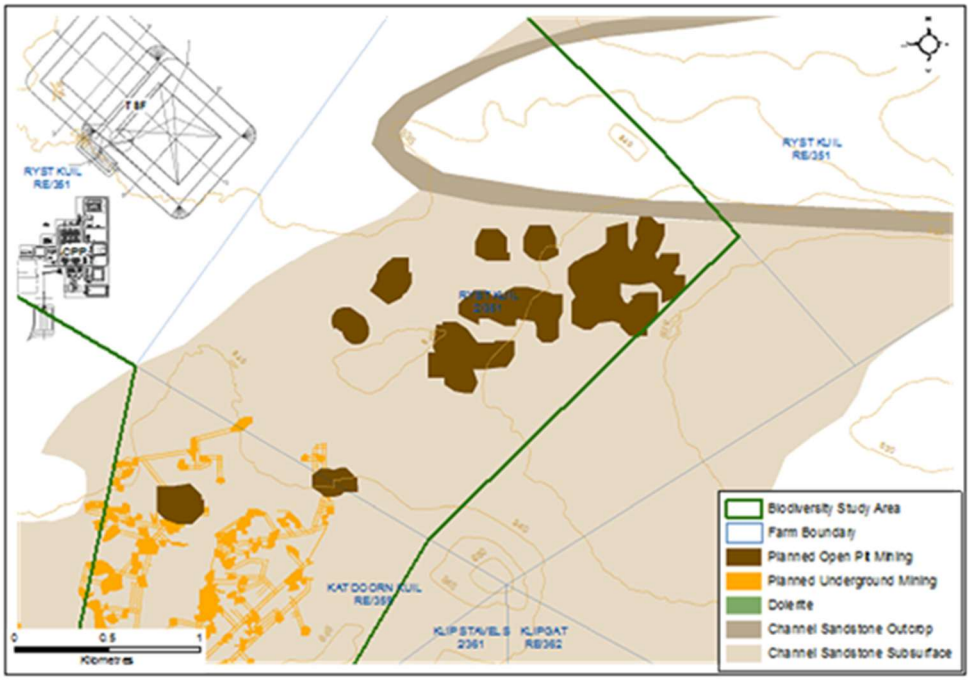


Figure 3-8. Ryst Kuil Abante planned open pit (brown) in-fill drilling areas with current Biodiversity study area (green) outline.

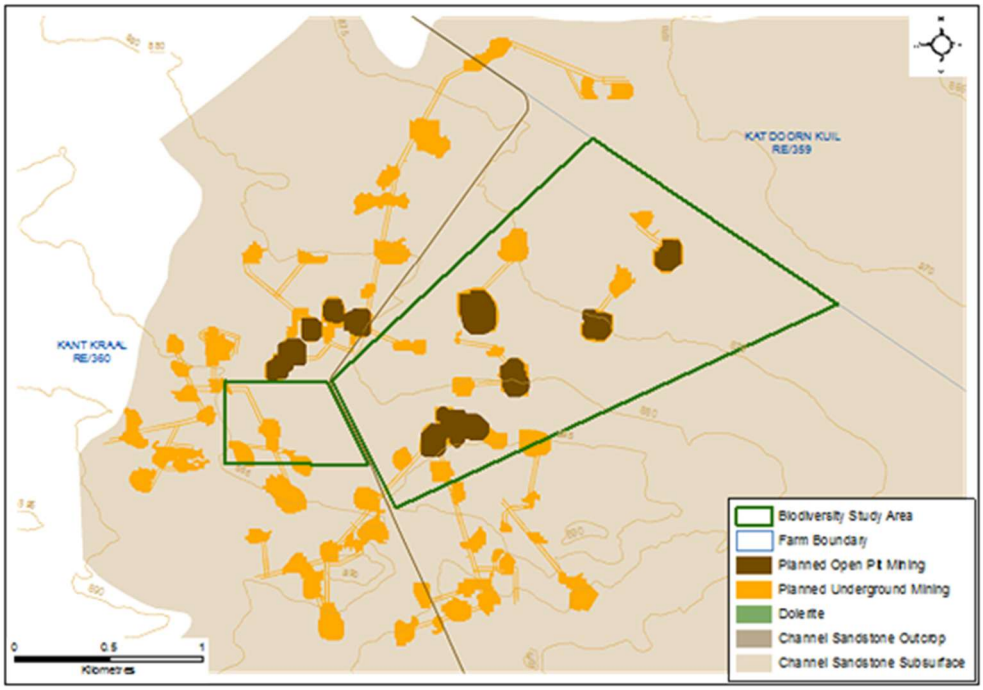


Figure 3-9. Ryst Kuil Extension planned open pit (brown) and underground (orange) in-fill drilling areas with current Biodiversity study area (green) outline.

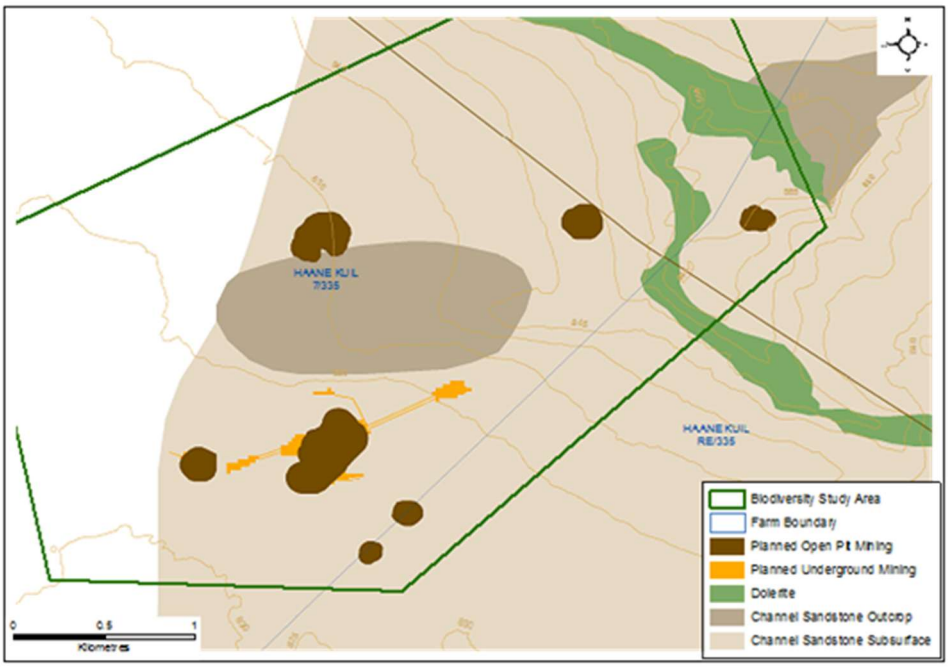


Figure 3-10. Haanekuil planned open pit (brown) and underground (orange) in-fill drilling areas with current Biodiversity study area (green) outline.

3.4.2.3.2 Open Pit Blast and Grade Control Drilling

This type of drilling is only required during the operational stage in the open pit areas to design the blast and grade control grid pattern during mining production along the planned mining benches. In this instance, percussion drilling will be utilised to attain a grid drill-spacing of 5.0m x 2.3m (10.5m depth) for waste and 2.5m x 2.3m (1.5m depth) for ore along benches of 4m wide x 10m high prior to each blasting round.

3.4.2.3.3 Exploration Drilling

Exploration drilling outside of the currently planned mining areas along the interpreted palaeo-channel trend will be required at any stage of the project to investigate the potential for additional resources that may be added to the mineable reserve base at a later stage, if successful. The palaeo-channel trend exploration areas are based on the geological knowledge of the deposit.

A combination of mainly reverse circulation and/or percussion drilling and, to a lesser extent, diamond core drilling will be utilised initially on a 400m x 800m reconnaissance grid along the interpreted channel trend (expected average depth of 65m, but may extend to 120m or more in some locations). Successive phases of closer spaced grid (in-fill) drilling will only focus on areas with positive potential depending on the success of the previous phase as illustrated in the diagram below.

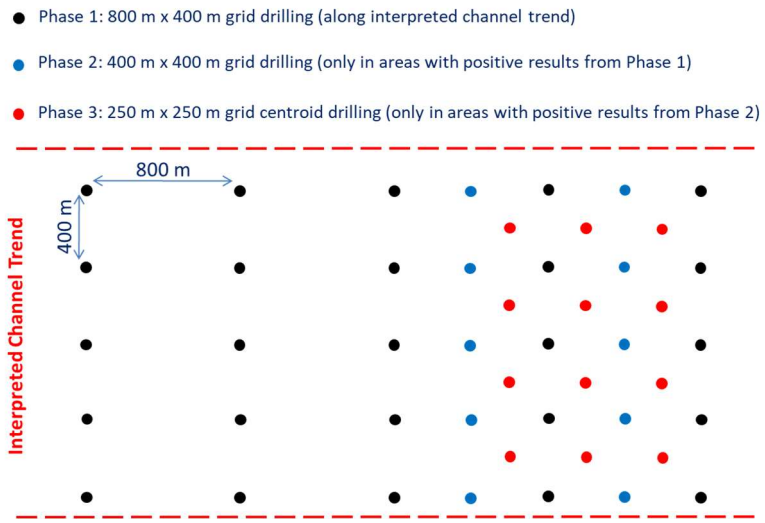


Figure 3-11. Schematic diagram of a drilling grid pattern for Exploration drilling.

3.4.2.3.4 Environmental Management Plan implications

Prior to the initiation of any exploration drilling, an EMP addendum will be submitted to the DMR which will include the proposed drill hole grid along the interpreted channel trend and a biodiversity and landscape sensitivity assessment. No exploration drilling will commence outside of areas not covered by the current biodiversity study areas without the authorisation from the DMR. No additional submissions to the DMR will be required for resource in-fill drilling and in-pit grade control drilling as these activities fall within the existing assessed mining area.

3.4.2.4 Infrastructure

3.4.2.4.1 Satellite sites:

The office complex will include a pre-fabricated/mobile office, change house with septic tank and French drain, bunded areas for 60m^3 diesel storage, oils, hydraulic fluid, emulsion silo, security access, lay-down area, wash bay, maintenance workshop. Chemical toilets will be added at the relevant pit areas.

3.4.2.4.2 CPP*:*

3.4.2.4.2.1 Milling and Processing

Conventional processing technology will be applied with a mill where the ore is crushed and ground to liberate the mineral particles, then passed through a sulphuric acid leach circuit to dissolve the uranium oxides. The solution is then processed to recover the uranium

Most of the material mined consists of barren rock or other minerals which remain undissolved in the leaching process. These solids or 'tailings' are separated from the uranium-rich solution, usually by allowing them to settle out. The remaining solution is filtered and the uranium is recovered in some form of ion exchange (IX) or solvent extraction (SX) system.

Schematic Flow Diagram for the preferred sulphuric acid leach process:

- The ore is crushed to maximum particle size of 125 mm and then milled to 145 µm particle size after which a pre-leach thickener is added.
- The ore is then sent to a leach circuit using concentrated sulphuric acid. Leached slurry is pumped to a post leach thickener to recover solution which is recycled back to leach for upgrading pregnant leach solution tenors.
- Underflow from the post leach thickener is pumped to a counter-current decantation (CCD) circuit composed of six stages required to wash entrained solutions from the barren solids. The final CCD underflow is neutralised with slaked lime and pumped to the tailings storage facility (TSF). Return water is pumped from the TSF to the return/process water dam for storage and distribution within the plant.
- The slurry is then sent through a series of tanks for molybdenum precipitation and finally a clarified pregnant leach solution is pumped to a uranium solvent extraction (SX) circuit. Uranium is precipitated as an ammonium diuranate which is pumped to a thickening and wash circuit to remove deleterious impurities present in the product prior to drying and final packaging.
- The product is pumped to a dewatering, drying and packaging circuit which is a highly integrated and automated plant. The product is dewatered using a centrifuge and the solids are then fed into an electrically heated horizontal rotary drier. The final dried product is deposited in 210L drums and sealed for dispatch.

Washing Ammonium diuranate (ADU) is processed in a fully automated dewatering, drying, and packaging system. The product is first dewatered using a centrifuge to 60–65% solids, then dried in a rotary dryer to reduce moisture to below 1%. The dried U_3O_8 product is packed into 210L drums using a pre-assembled, secure Drum Packing Plant Module.

This module, built to prevent dust escape and allow for easy cleaning, automates all steps—filling, sampling, washing, weighing, lidding, and labeling—minimizing operator exposure and increasing safety. Safety standards include EN/ISO 13849-1 Category 3 PLr d and IEC 62061 SIL 3. Operator involvement is limited to loading empty drums and unloading labeled full ones, allowing for 24/7 or 8-hour shifts with minimal supervision.

The plant can pack up to 8 drums per hour, each containing 300–454 kg of U_3O_8, depending on the product's bulk density.

CPP Ancillary infrastructure

The following associated plant buildings have been allowed for:

- Plant laboratory including store room, tea room, male and female toilets and offices
- Plant admin offices storage rooms, kitchen, boardroom and male and female toilets
- change houses
- Main store including issuing and receiving portals, offices, male and female toilets and kitchen
- Plant workshop with 1.5t crawl

- Plant control room including lunch room, kitchen, male and female toilets, office and engineering room
- Sodium hydroxide pearl, lime and flocculants store
- Laundry and store
- Weighbridge control room
- Security guardhouse including control room, access turnstiles, induction room and search area

Tailings Storage Facility (TSF)

An approximately 8.0Mm^3 TSF capacity is required. Development of the TSF is proposed in 2 phases, the combination of which will provide storage of ~8.3Mm^3. The TSF and RWD footprint covers an area of 78ha, and the maximum TSF embankment wall height is 25m.

The TSF will be constructed from waste rock sourced from open pit mining areas. The factor of safety (FoS) of the TSF waste rock walls has been calculated by SRK at ~2.1 (against an industry norm of 1.5). This means that the TSF wall integrity is (conservatively) 100% overdesigned (industry norms requiring a 50% overdesign, equating to a FoS of 1.5).

As the TSF will be constructed of waste rock, the TSF walls are extremely unlikely to be impacted by erosion. Many TSFs do not have the benefit of being constructed with waste rock, and walls are often constructed with the tailings material itself – in the case of this project, using waste rock to construct the TSF walls provides a high degree of confidence that the TSF facility will not fail.

Liner requirements are based on the Type 3 tailings waste classification, thus requiring a double HDPE liner (one of these replacing the mandated clay liner as no clay is available on the site), and incorporating a leakage detection system. Waste rock classification indicates that the waste rock marginally classifies as a Type 3 waste. However, it is evident that the waste rock will not produce a significant leached contaminant stream, nor pose any risks to the receiving environment. The assumption taken is therefore that the impoundment walls will not require a liner.

3.4.2.4.2.2 Satellite site office complex infrastructure

Various operational sites are planned as part of the mining operations in the Ryst Kuil application area. These include:

- Ryst Kuil Extension (RKE)
- Ryst Kuil Main (RKM)
- Ryst Kuil Abante (RKA)
- Haanekuil (HNK)

A temporary office complex consisting of the below mentioned infrastructure would be erected for the duration of the operations at the operational sites:

- 15 m x 12 m Maintenance area
- 12 m x 4 m Refuelling bay and oil trap
- Three high mast area light bases
- 8 m x 9 m Waste collection pad for skip waste bins

- 3 m x 6 m Container store
- 12 m x 3 m Container office
- Covered meeting area
- 3 m x 6 m male / female container ablutions
- Three 3 m x 6 m Shade net car ports
- Security guardhouse
- One 10 000 l JoJo potable water tanks, and
- Chemical toilets or alternative.

3.4.2.4.3 Operational schedule

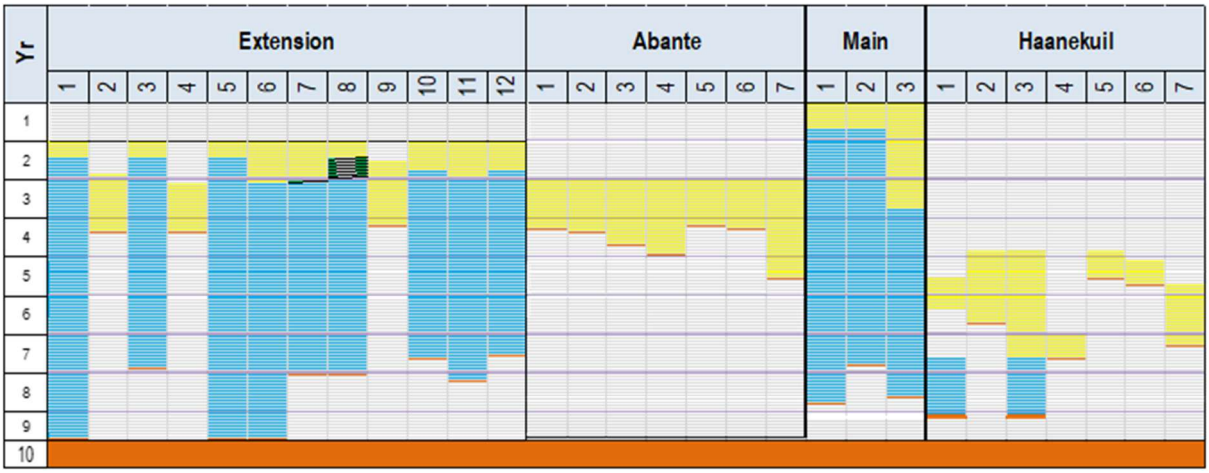
The proposed operational schedule is provided in Table 3-2.

Table 3-2. Operational schedule

Key:

Open Pit	**OP**
Underground	**UG**
Pit available for Backfill	
Sorting Operations Only	

Period Name: Y = Years; Q = Quarters; (Q1 = Jan-Mar; Q2 = Apr-Jun; Q3=Jul-Sep; Q4=Oct-Dec)



No drilling or blasting would occur at night (18h00 to 8h00).

3.5 Policy and Legislative Context

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
Constitution of South Africa (No. 108 of 1996)	Section 24 of the Constitution of RSA addresses the Duty of Care. This Section of the legislation is not specifically referenced in the EIA/EMP or its supporting studies.	Although this Section of the legislation is not specifically referenced in the EIA/EMP or its supporting studies, the principles of environmental protection which underpin the mitigation

		methods described are at the heart of our Duty of Care as South African's.
National Environmental Management Act (NEMA) (Act No 107, 1998)	Section A (above) of this EIA/EMP addresses the listed activities that are triggered by this proposed project in accordance with the NEMA EIA Regulations. Sections 2, 23, 24, 24O, and 28.	The principle of environmental protection and environmental authorization are primary to the purpose of this EIA/EMP. The listed activities according to the NEMA EIA Regulations which are triggered by the proposed mining operations are included in Section A of this report.
National Environmental Management: Biodiversity Act (NEM:BA) (No 10 of 2004); Assessment Protocal (March & October 2020); Western Cape Biodiversity Bill 2019; Western Cape Biodiversity Sector Plan 2023	The NEMBA is referenced in the Biodiversity Specialist Study conducted by The Biodiversity Company and is attached in Appendix 4. The relevant content from this study is incorporated into this EIA/EMPr.	The protection of species and ecosystems that warrant protection
National Environmental Management: Air Quality Act, (Act 39 of 2004) (AQA)	The NEMAQA is referenced extensively in the Air Quality Impact Assessment which is attached in Appendix 3.	The legislated requirements to maintain dust emissions within the maximum allowable exceedance level forms the basis of the recommended mitigation measures for dust abatement.
Environmental Conservation Act (Act 73 of 1989) (ECA)	The legislation is included in the Noise Baseline Assessment which is attached in Appendix 6 of this EIA/EMP.	Empowers the Minister to make regulations regarding noise. In terms of Section 25 of ECA, the Noise Control Regulations were promulgated (GNR154 in Government Gazette 13717 10 Jan 1992).
SANS 10103:2008 Measurement and Rating of Environmental noise SANS 10210:2004 Calculating and predicting road traffic noise SANS 10328:2008 Methods for Environmental Noise Impact Assessment SANS 10357:2004 Calculation of Sound propagation by the Concave method	The legislation is included in the Noise Baseline Assessment which is attached in Appendix 6 of this EIA/EMP.	The implementation of these National Standards is intended to address and minimise the impacts of environmental noise for the planned mining project.
Mineral and Petroleum Resource Development Act (MPRDA) (Act 28 of 2004)	This legislation is the primary enabling legislation under which a mining right application may be made to the competent government authority, the Department of Mineral Resources. The MPRDA is referenced numerous times within this EIA/EMP.	The MPRDA is applicable to the issuing of a mining right which is the purpose of this mining right application process.
National Water Act, 39 of 1998 (NWA)	The NWA is references in both the Biodiversity Specialist study (Appendix 4) as well as the Surface	The anticipated water uses for this proposed project include section 21: (a) Borehole abstraction

	and Ground Water Specialist Study (Appendix 11)	(b) – Storage of potable water (c) & (i) – crossing of drainage channels (e) Irrigation for dust suppression and crop cultivation. (g) – Return water dams, PCD, French drain septic tank combination, Bio-disk sewage plant, Dust suppression, Stockpiles, back-fill of pits, Tailings storage facility; (j) – Dewatering pit These water uses require a Water Use License (WUL) which must be issued by the DWS prior to the initiation of mining.
Government Notice (GN) 704, of Government Gazette 20119 of the 4th of June 1999 Section 4 Section 10	Section 4.1.6	
Water Use License Application in terms of the National Water Act, 1998 (Act No. 36 of 1998). Department of Water and Sanitation (DWS) Listed activities in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) EIA Regulations (2014), as amended. Department of Environmental Affairs and Development Planning (DEA&DP)		
SANS 310 and ASIB requirements • SANS 10287 • SABS 0287 • SABS 0100-1 & 2 • SABS 064:1979 • SABS 801 • SABS 763		Potable water tank and fire water tank inspections
National Environmental Management Waste Act (NEMWA) (Act No 59, 2008) & GN 921 of 29November 2013 as amended	Waste related listed activities are listed in Section A of this EIA/EMP report	The back-filling of pits as well as the safe management of the waste rock dump and the TSF are governed under the NEMWA. Residue stockpile management in the form of the waste rock stockpiles.
National Heritage Resources Act, Act 25 of 1999)	The NHRA is referenced extensively in the Heritage Impact Assessment Report in Appendix 5.	Since the Ryst Kuil application area falls inside the borders of the Western Cape, the Western Cape Provincial Heritage Resources Authority (WCPHRA) was first contacted on 29th June 2015 at the

		start of the EIA process. A single report, were submitted and evaluated.
Beaufort West Municipality: Integrated Development Plan, 2022-2027.		The IDP clearly states that the rail transport and agricultural sectors are in a decline in terms of economic opportunities. The town has, however, managed to maintain a minimal level of growth due to high volume of passing road traffic.
National Nuclear Regulator Act (1999)	The NNR Act is referenced in the Air Quality Impact Assessment (Appendix 3) but is the primary legislation governing the Radiation Assessment Report (Appendix 7).	The mining of NORM is regulated by the NNR Act and a Certificate of Registration (COR) must be issued by the National Nuclear Regulator (NNR) before such NORM mining can take place.

Socio-economic assessment

The socio-economic assessment was performed according to the policies and based on strategic guidelines developed for South Africa. The following six initiatives were considered:

- The National Spatial Development Framework 2050 (NSDF) has implications for Beaufort West Municipality. It was approved in 2022, and is South Africa's first national spatial plan, aimed at achieving a peaceful, prosperous, and transformed society. The NSDF builds on the Freedom Charter, RDP, and NDP 2030, with a national spatial vision and five strategic Sub-Frames.
- Draft Karoo Regional Spatial Development Framework (KRSDF). The KRSDF is the first Regional Spatial Development Framework developed. It covers 40% of South Africa's land area, including the Central Karoo District and Beaufort West Municipality. It supports the Arid-Agri Innovation Region concept from the NSDF.
- Western Cape Provincial Spatial Development Framework (PSDF) (2014). Beaufort West Town is identified as a Regional Centre. The N1 and N12 highways are classified as key Regional Connector Routes. This aligns with the NSDF and draft KRSDF. The core elements of the PSDF includes four spatial themes, namely resources, space economy, settlement and spatial governance.
- Central Karoo District Spatial Development Framework (CKDM SDF) 2020. Karoo National Park is designated as a Core Area (SPC Category 1), making it a statutory conservation area. Key Alignment Requirements, include: Protect the area's biodiversity, promote eco-tourism and allow for planned, controlled outdoor recreation.
- Draft Beaufort West Municipal Spatial Development Framework (2023). Spatial vision of Beaufort West Municipality: To work together to develop Beaufort West into a thriving Regional Development Anchor that is the economic, tourism and transport gateway to the people, mountains, and plains of a resilient Central Karoo.
- Beaufort West Municipality: Local Economic and Tourism Strategy, Final Draft (2024).

Due to concerns regarding the accuracy of the Census 2022 population figures, particularly at the local municipality level, a decision was made not to rely solely on these figures. Instead, the Mid-Year Population

Estimates (MYPE) from Stats SA, along with other relevant data sources, were used to provide a more balanced and informed perspective (See socio-economic specialist report).

Aquatic Biodiversity

In line with the protocol for the specialist assessment and minimum report content requirements for environmental impacts on freshwater biodiversity, as per Government Notice 320 published in terms of NEMA, dated 20 March 2020: "Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes in terms of Sections 24(5)(a) and (h) and 44 of the National Environmental Management Act, 1998, when applying for Environmental Authorisation" , the following has been assumed:

- An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of:
    - "very high sensitivity" for aquatic biodiversity, must submit an Aquatic Biodiversity Specialist Assessment.

In accordance with General Notice (GN) 4167 of 2023 as it relates to the NWA (1998), a regulated area of a watercourse for Section 21 (c) and 21 (i) of the NWA, 1998 means the outer edge of the 1 in 100 year flood or where no flood line has been determined it means 100 m from the edge of a watercourse or a 500 m radius from the delineated boundary (extent) of any wetland or pan. Listed activities in terms of the NEMA (1998), (Act 107 of 1998) EIA Regulations as amended in April 2017 must be taken into consideration if any infrastructure is to be placed within the applicable zone of regulation, which in this case is a 32 m zone of regulation. The proposed boundaries overlap and/or are proximal to ephemeral drainage areas and pans, and therefore the project falls within the NEMA Act 107 and DWS GN 4167 regulated zones.

Air quality

The National Environmental Management: Air Quality Act (Act No. 39 of 2004)

NEMAQA provides the legislative norms and standards for air quality-specific controls, particularly for licensing of major activities and ambient air quality standards. These controls are related to project activities and the air quality impact assessment.

Atmospheric emission licence (AEL)

Mining, and the storage of ore on a mine site are not Listed Activities as classified in terms of NEMAQA (DEA, 2013a). An AEL application does not need to be submitted as part of the project development stage for these two activities.

However, the processing of ammonium diuranate (ADU) takes place in a fully automated dewatering, drying, and packaging system. The product is first dewatered using a centrifuge to 60 - 65% solids, then dried in a rotary dryer to reduce moisture to below 1%. The dried U_3O_8 product is packed into 210L drums using a pre-assembled, secure Drum Packing Plant Module.

This module, built to prevent dust escape and allow for easy cleaning, automates all steps, filling, sampling, washing, weighing, lidding, and labelling, minimizing operator exposure and increasing safety. Safety standards include EN/ISO 13849-1 Category 3 PLr d and IEC 62061 SIL 3. Operator involvement is limited to loading empty drums and unloading labeled full ones, allowing for 24/7 or 8-hour shifts with minimal supervision.

The plant can pack up to 8 drums per hour, each containing 300 - 454 kg of U_3O_8, depending on the product's bulk density. However, this capacity of the fully automated system, exceeds the guideline for items and activities undet category 4, the metallurgical Industry, Subcategory 4.1, Drying and Calcining. Facilities with capacity of more than 100 tons/month product, require an Atmospheric Emission Licence (AEL). An application for such a licence has been initiated and is in progress. Although ~50% of the moisture is dispeled by centrifugal force technique, the remaining product is dried to levels below 1% using a thermal source, which trigger the necessity of an AEL.

Ambient air quality standards and guidelines

The effects of air pollutants on human health occur in a number of ways with short-term, acute, chronic, or long-term effects. Different groups of people are affected differently, depending on their level of sensitivity, with the elderly and young children being more susceptible. Factors that link the concentration of an air pollutant to an observed health effect are the level and the duration of the exposure to that particular air pollutant.

The National Ambient Air Quality Standard (DEA, 2009 and 2012) criteria pollutants consist of a limit value and a permitted frequency of exceedance. The limit value is the fixed concentration level aimed at reducing the harmful effects of a pollutant. The permitted frequency of exceedance represents the tolerated exceedance of the limit value and accounts for high concentrations as a result of process upsets and meteorological variation. Compliance with the ambient standard therefore implies that ambient concentrations are below the limit value and the frequency of exceedance does not exceed the permitted tolerance. Being a health-based standard, ambient concentrations below the standard imply that air quality is acceptable and poses little or no risk to human health; while exposure to ambient concentrations above the standard implies that there is a risk to human health, particularly for sensitive individuals. The National Ambient Air Quality Standards for pollutants typically associated with and from mining are listed in Table 3-6. The ambient standard for PM¬10 was published in 2009, and for PM2.5 in 2012. A transitional standard is in force for PM2.5 currently and will be replaced by the final, more stringent standard in 2030.

Table 3-3. Ambient standards for PM10 and PM2.5 (DEA, 2009 and 2012*)

	Exposure period	Limit value ($\mu g/m^3$)	Number of permissible exceedances per annum
PM10	Daily	75	4
	Annual	40	0
PM2.5*	Daily	40 (25)[1]	0
	Annual	20 (15)[1]	0

[1] 1 Jan 2030

The Minister also published the National Dust Control Regulations which applies to the proposed mine (DEA, 2013b). The regulation states that no person may conduct any activity in such a way as to give rise to dust in such quantities and concentrations that:

- The dust, or dust fall, has a detrimental effect on the environment, including health, social conditions, economic conditions, ecological conditions or cultural heritage, or has contributed to the degradation of ambient air quality beyond the premises where it originates; or
  - The dust remains visible in the ambient air beyond the premises where it originates; or
  - The dust fall at the boundary and beyond the boundary of the premises where it originates exceeds:
    - 600 mg/m^2/day averaged over 30 days in residential or light commercial areas measured using reference method ASTM D1739; or
    - 1200 mg/m^2/day averaged over 30 days in areas other than residential and light commercial areas measured using reference method ASTM D1739.

Radiation

The International Framework for Radiation Protection

The international framework for ionising radiation protection is provided in the various recommendations and extensive international publications produced by the International Commission on Radiation Protection (ICRP) and the International Atomic Energy Agency (IAEA). These publications form the bases for regulatory control of almost all countries in the world, including South Africa. Three important publications that provide recommendations and guidance for public radiation protection are:

- The 2007 Recommendations of the International Commission on Radiological Protection ICRP Publication 103. These revised Recommendations for a System of Radiological Protection formally replace the Commission's previous 1990 recommendations. The revised recommendations update, consolidate, and develop the additional guidance on the control of exposure from radiation sources issued since 1990. They maintain the Commission's three fundamental principles of radiological protection, namely justification, optimisation, and the application of dose limits, clarifying how they apply to radiation sources delivering exposure and to individuals receiving exposure.
- IAEA International Basic Safety Standards describing the principles of radiological protection, recommended by the International Commission on Radiological Protection.
- An IAEA publication titled "Safety Guide on the Regulatory Control of Discharges" describe the general principles governing the regulatory control of discharges to the environment [8]. A mine that can control its effluent and discharges to the environment in an optimised manner and following best international environmental practice should be able to keep the dose to the public and the radiological impact on the public as low as reasonably achievable, economic and social factors being taken into account.

South African Radiation Related Legislation

Radiation Protection Criteria

Regulatory controls of NORM mining industries such as gold, copper, heavy mineral sands, as well as uranium, became much more formalised in South Africa in the 1990's. Regulatory control is exercised by the National Nuclear Regulator through the National Nuclear Regulatory Act. This act and its regulations are aligned with the various recommendations and extensive publications on radiation safety produced by the International Commission on Radiation Protection (ICRP) and the International Atomic Energy Agency (IAEA).

Section 6(1)(c) of the National Nuclear Regulator Act provides to minimise the duplication of functions between the National Nuclear Regulator (NNR) and other organs of state and as such the review of radiological environmental impact assessments falls within the ambit of the NNR. This impact assessment will form part of a single application to the NNR for a Certificate of Registration (COR) and to be approved prior to commencement of mining. The radiological impact assessment report that will be submitted as part of the COR application to the NNR has been included in this EIA/EMPr.

The primary responsibility of the National Nuclear Regulator (NNR) is to provide for the protection of persons, property, and the environment against nuclear damage through the establishment of safety standards and regulatory practices. The NNR exercises regulatory control related to nuclear installations and other actions involving radioactive material. Regulations supporting the act are provided in "Regulations on Safety Standards and Regulatory Practices" (SSRP). The SSRP contains the principal radiation protection and nuclear safety requirements. It requires a prior safety assessment, also referred to as a prospective safety assessment.

As part of a regulatory nuclear authorisation process, a Certificate of Registration (COR) must be issued by the NNR prior to mining. Most gold mines in South Africa operate under the conditions of a COR because of uranium associated with the gold reefs. A COR provides written permission for a mine to carry out activities that are specified in the COR. The COR is the principal mechanism connecting the legal framework of the regulatory system with the responsibilities of the principal parties; namely, the regulator and the mine operator. The conditions in a COR cover aspects of radiation protection, such as the following:

- radiation hazard assessments for workers;
- operational radiation protection of the workforce;
- prospective and operational safety assessments to determine the impact on public health and the environment;
- radioactive waste management;
- transportations of radioactive material;
- physical security;
- occurrences and emergency planning;
- operational limitations; and
- a radiation protection quality management system.

The occupational exposures of workers and members of the public have to be controlled so that the regulatory limits are not exceeded. These limits are listed in Table 3-7.

Table 3-4. Dose Limits in Planned Exposure Situations

Type of radiation dose limit	Occupational	Public
Effective dose	20 mSv/yr, averaged over defined periods of 5 years	1 mSv/yr
Annual equivalent dose in:		
• Lens of the eye	150 mSv	15 mSv
• Skin	500 mSv	50 mSv
• Hands and feet	500 mSv	–

The annual effective dose limit for a member of the public of 1 mSv per year is in addition to the existing background radiation dose. The total effective dose (ET) to a person is calculated according to the following formula:

$$E_T = H_p(d) + \sum e(g)_{j,ing} I_{j,ing} + \sum e(g)_{j,inh} I_{j,inh}$$

where Hp(d) is the personal dose equivalent from exposure to penetrating gamma radiation during the year; e(g)j,ing and e(g)j,inh are the committed effective dose per unit intake by ingestion and inhalation for radionuclide j by the group of age g; and Ij,ing and Ij,inh are the intakes via ingestion or inhalation of radionuclide j during the same period.

An important aspect of NNR legislation pertains to release of potentially contaminated land following closure. Contaminated areas will be part of the mine's footprint at the end of operations. Proper design and operational practices optimised in respect of environmental impact should result in a radioactive footprint at the time of mine closure with less financial and environmental liabilities to a company than would be the case otherwise.

Transport of Radioactive Material

It will be necessary to transport the uranium oxide concentrate as well as low-level radioactive waste or contaminated equipment on public roads. The transport of radioactive material in the public domain will be subject to the requirements of the IAEA Regulations for the Safe Transport of Radioactive Material and any applicable international convention.

Other Relevant Legislation

This report deals exclusively with elevated levels of NORM associated with uranium mining and therefore the NNR Act is the applicable legislation in terms of public and environmental impact. However, mines also use sealed radioactive sources with a very high specific radioactivity content, e.g. density meters on plant process pipelines. The applicable legislation for these radiation sources is the Hazardous Substances Act, Act No. 15 of 1973. The Hazardous Substances Act provides for the control of Group IV hazardous substances (radioactive material not at nuclear installations or not part of the nuclear fuel cycle, for example fabricated radioactive sources like medical isotopes) and Group III hazardous substances (involving exposure to ionising radiation emitted from equipment). Radioactive waste arising from activities authorised under this Act falls under the regulation of the Department of Health's Directorate of Radiation Control.

3.6 Need and desirability of the proposed activities.

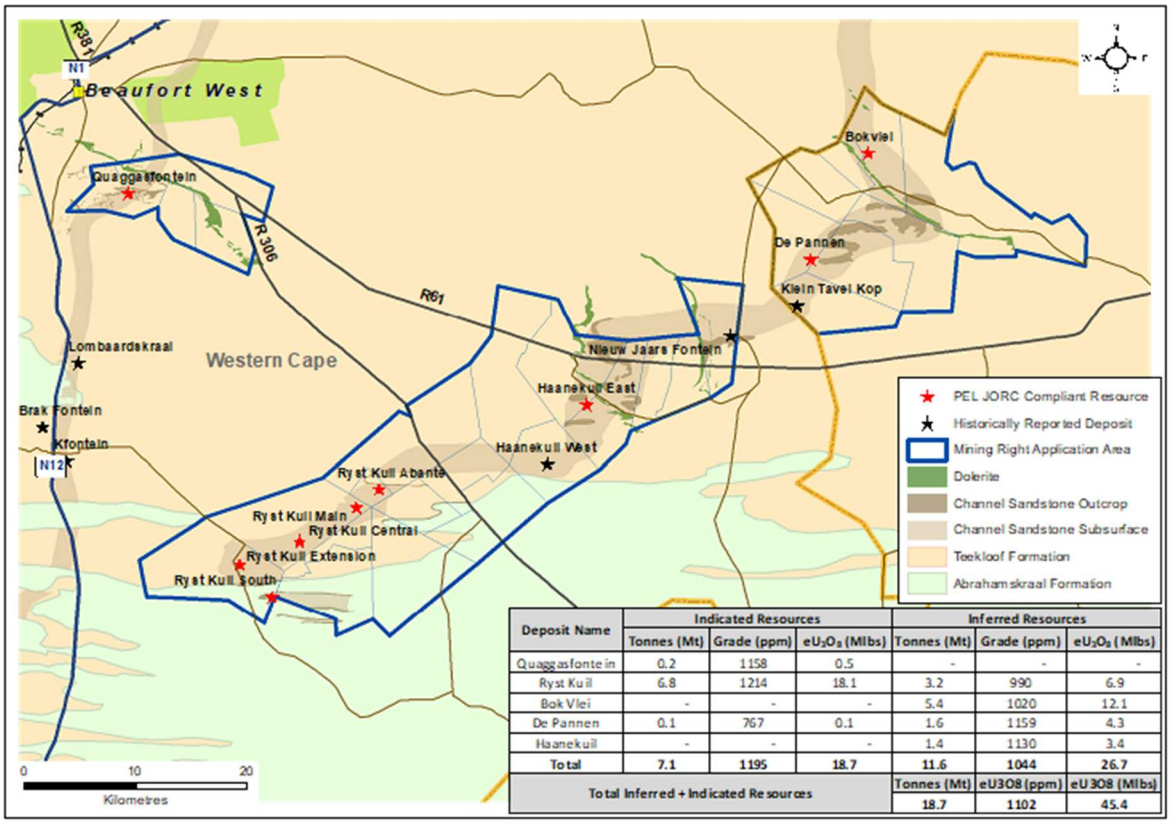
When evaluating an application for Environmental Authorisation (EA), the competent authority must adhere to Section 24O of the National Environmental Management Act (NEMA), No. 107 of 1998. This entails considering any relevant guidelines issued under Section 24J of the Act, as well as meeting all prescribed minimum information requirements, including the Guideline on Need and Desirability.

3.6.1 Mineral Resources

Various studies have determined that potentially economic quantities of uranium and molybdenum mineralisation is hosted in fluvial channel sandstone deposits in the western and central parts of the Main Karoo basin within the Adelaide Subgroup and to a much lesser extent, the Molteno and Elliot formations of the Permian-Triassic Beaufort Group (Karoo Supergroup). The occurrences are epigenetic, tabular and sandstone-

hosted with the thickest sandstone bodies tending to contain the highest proportion of mineralisation (Woodford, 2002).

The map with table below (Figure 3-12) indicates the position and size of estimated resources and historic mineralisation areas within the mining right applications of Lukisa Invest 100 (Pty) Ltd. At this stage only the Ryst Kuil resource areas, as indicated, have been assessed for mining activities and will form the basis of the initial mining operations. Additional known or potential resource areas, the black star positions (historic mineralisation) and areas in between along the trend, will be evaluated while initial mining operations are underway to expand the resource/reserve base and extend the life of mine beyond the initial mining stages.



Deposit Name	Indicated Resources			Inferred Resources		
	Tonnes (Mt)	Grade (ppm)	eU_3O_8 (Mlbs)	Tonnes (Mt)	Grade (ppm)	eU_3O_8 (Mlbs)
Quaggasfontein	0.2	1158	0.5	-	-	-
Ryst Kuil	6.8	1214	18.1	3.2	990	6.9
Bok Vlei	-	-	-	5.4	1020	12.1
De Pannen	0.1	767	0.1	1.6	1159	4.3
Haanekuil	-	-	-	1.4	1130	3.4
Total	**7.1**	**1195**	**18.7**	**11.6**	**1044**	**26.7**
Total Inferred + Indicated Resources				**Tonnes (Mt)**	**eU3O8 (ppm)**	**eU3O8 (Mlbs)**
				18.7	**1102**	**45.4**

Figure 3-12. Mining Right application areas, including previous application areas, mineral resources and historic mineralisation.

More detailed views of the resources at Ryst Kuil Block (this application) are provided in Figure 3-13 to Figure 3-15.

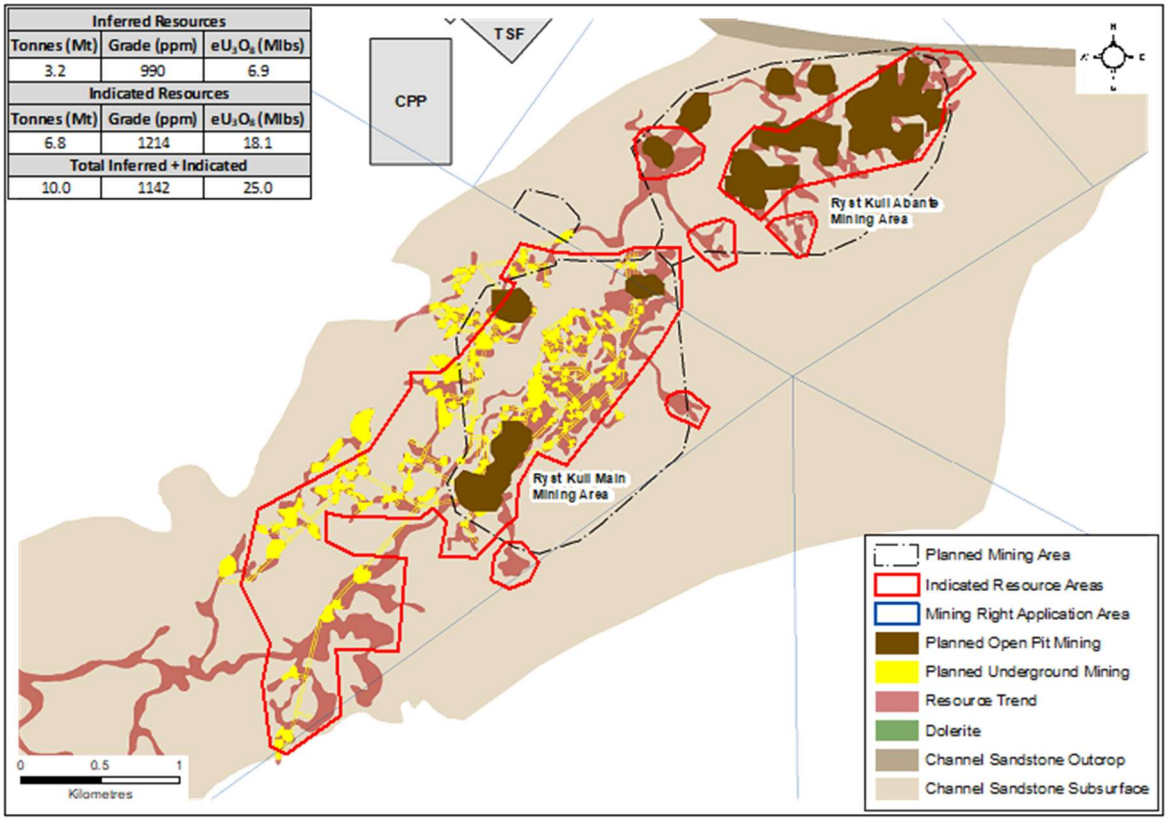


Figure 3-13. Ryst Kuil Main & Abante mining area mineral resources.

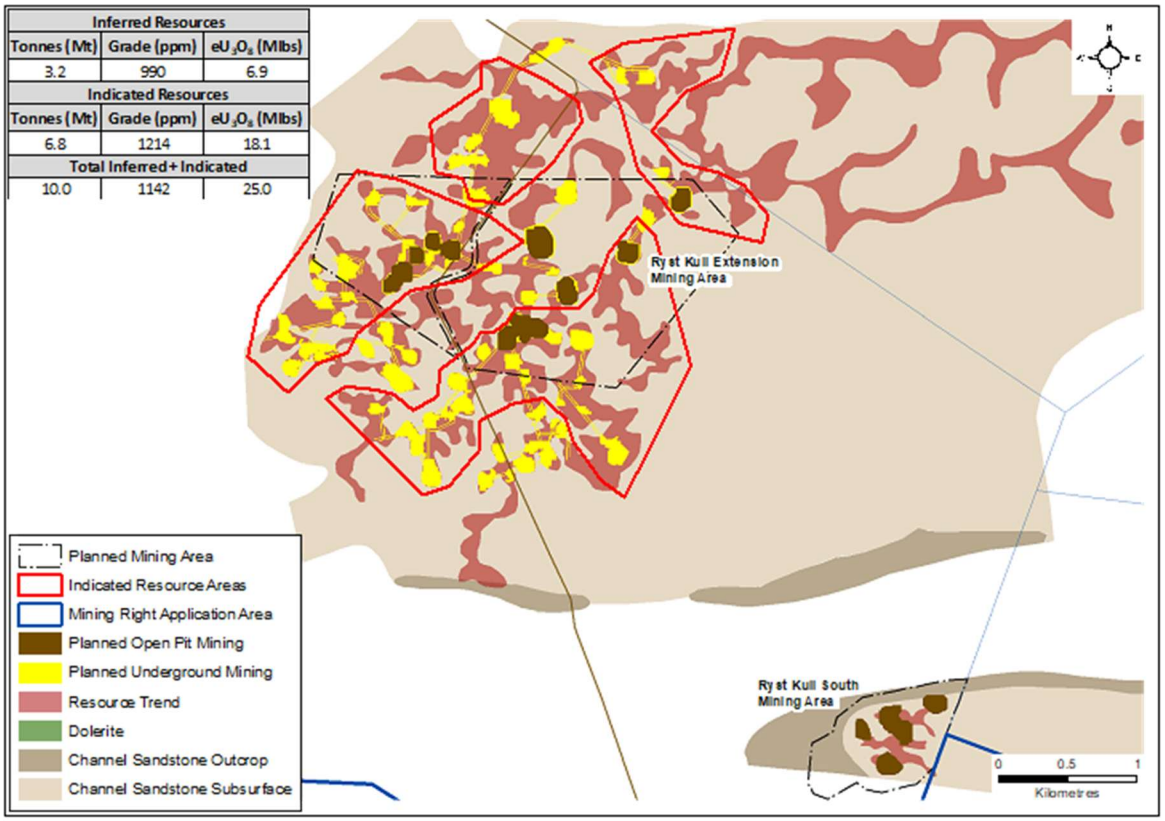


Figure 3-14. Ryst Kuil Extension mining area mineral resources.

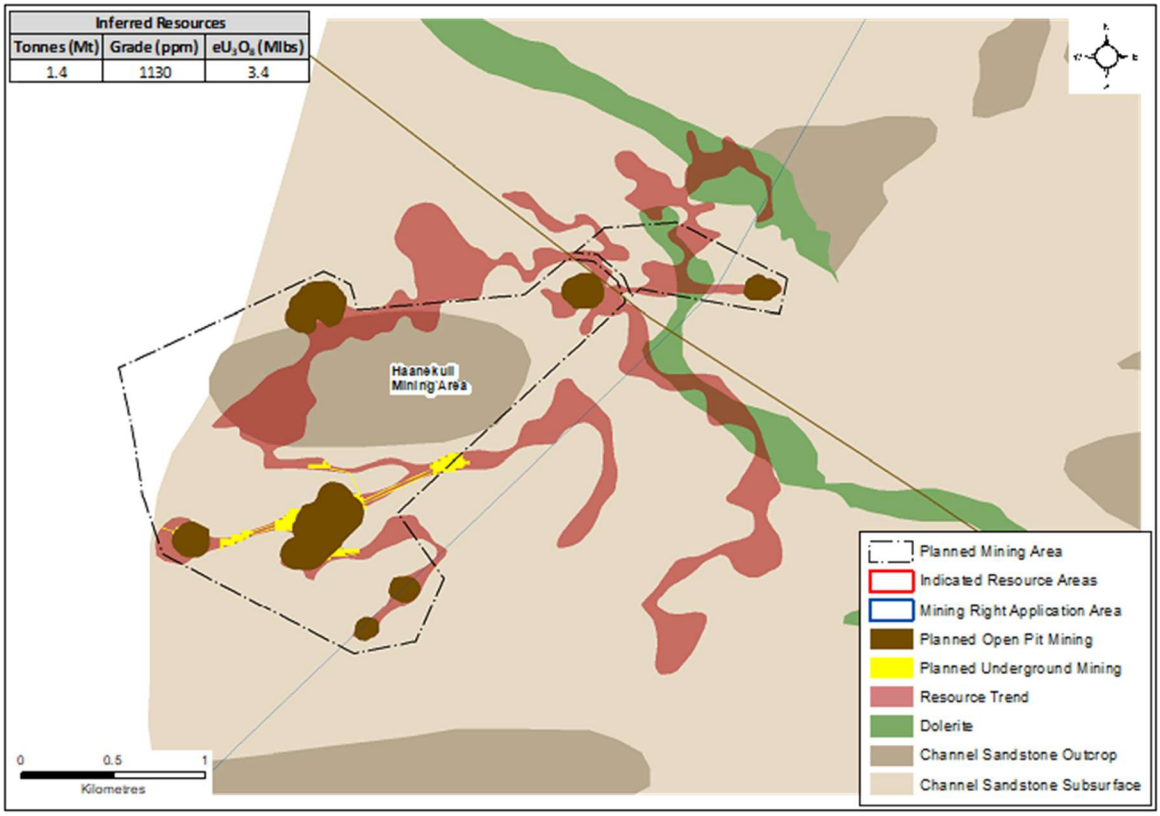


Figure 3-15. Haanekuil mining area mineral resources.

The Mineral Resources attributable to the Ryst Kuil application area are:

Table 3-5. Ryst Kuil application area mineral resource tabulation (this mining application, 600 ppm eU_3O_8 Cut-off)

Deposit Name	Indicated Resources			Inferred Resources		
	Tonnes (Mt)	Grade (ppm)	eU_3O_8 (Mlbs)	Tonnes (Mt)	Grade (ppm)	eU_3O_8 (Mlbs)
Ryst Kuil	6.8	1214	18.1	3.2	990	6.9
Haanekuil	-	-	-	1.4	1130	3.4
Total	**6.8**	**1214**	**18.1**	**4.6**	**1033**	**10.3**
Total Inferred + Indicated Resources				**Tonnes (Mt)**	**eU3O8 (ppm)**	**eU3O8 (Mlbs)**
				11.4	**1141**	**28.4**

The Mineral Resources attributable to the combined mining right application areas (including this one) have been estimated and classified in accordance with the Australasian Code for Reporting of Identified Mineral Resources and Ore Reserves, 2012 (the JORC Code). Mineral resources as at February 2014, reported above 600ppm eU_3O_8 cut-off, are listed below.

Table 3-6. LRP mineral resource tabulation (all mining applications, 600 ppm eU_3O_8 Cut-off)

01-Feb-14						
KAROO JORC RESOURCES (February 2014 Estimate, 600 ppm cut-off)						
Deposit Name	**Indicated Resources**			**Inferred Resources**		
	Tonnes (Mt)	**Grade (ppm)**	**eU_3O_8 (Mlbs)**	**Tonnes (Mt)**	**Grade (ppm)**	**eU_3O_8 (Mlbs)**
Ryst Kuil	6.8	1214	18.1	3.2	990	6.9

3.6.2 Uranium Market

In 2007, South Africa declared uranium a strategic mineral, recognizing its significance in electricity generation, medical isotope production, and naval propulsion. South Africa holds about 6% of the world's uranium resources.

Uranium demand fluctuates with global energy needs, new reactor development, and reactor longevity. Recent years have seen declining mobile inventories, influenced by COVID-19-related production drops, increased buying by the Sprott Physical Uranium Trust (SPUT), and acquisitions by junior mining firms.

Geopolitical instability, particularly unrest in Kazakhstan and Russia's invasion of Ukraine, has heavily impacted the uranium market, causing price surges and shifting utilities' focus to long-term supply contracts. As inventories decline and past production cuts take effect, the market is becoming production-driven, aligning prices with production costs.

Producers are restarting idle mines, and Kazakhstan is increasing output. UxC forecasts a 32% rise in uranium demand by 2035, from 192 million pounds U_3O_8 in 2024 to 253 million pounds, driven by growing nuclear power capacity. However, geopolitical risks in major producing regions threaten supply stability.

As of mid-2025, uranium futures in the U.S. are trading at around $77.50/lb. Globally, there are 440 operational reactors, 61 under construction, and 108 planned, with nuclear power currently supplying about 10% of the world’s electricity.

In this EIA, mining of uranium and molybdenum is assessed as an alternative to the current land use, which is predominantly agriculture.

3.6.3 Consideration of Alternatives

The availability and geographic location of the mineral resource that the applicant wishes to exploit dictates the preferred location to a large degree. The location of the open cast pits and underground shafts are determined by the location of the mineral resource. Although the location of the minerals cannot be altered, the impact of the infrastructure footprints associated with the mining operation are investigated as part of the EIA process.

Key criteria for consideration when identifying need, alternatives and preferred location include practicability, feasibility, relevance, reasonability and viability. Lukisa propose to follow the most pragmatic mining method to extract the mineral resource, but also commits to reducing the environmental impact footprint as far as possible, as well as rehabilitate or remediate the affected areas as best possible once mining ceases.

Assessment of alternatives would include a comprehensive comparison of all potential impacts, both direct, indirect and cumulative, on the environment. The goal of evaluating alternatives is to find the most effective way of meeting the need and purpose of the project either through enhancing the environmental benefits of the proposed activity, or through reducing or avoiding potentially significant negative impacts. Mining will always have a negative impact on the environment. The challenge lies in optimally managing the expected impacts as best possible.

Determining baseline environmental conditions would enable a truthful means for comparison, identifying both opportunities and potential negative impacts, as well as proposing methods to reduce expected negative impacts arising from the proposed development.

In addition to environmental impacts, an EIA also assesses socio and economic aspects, which also need to be considered in terms of need and desirability. The positive socio-economic impacts of the proposed LRP project should be considered as a significant driver of the need and desirability of this project.

Tourism is seen as an alternative to stimulate economy and create job opportunities. Between Aberdeen and Beaufort West, 70 accommodation service providers have been identified, representing a combined capacity of 1,334 beds, this includes campsites and caravan parks. The majority of these accommodation service providers (52 representing 1080 beds) are situated within a 2km radius of the Beaufort West town centre. There are 10 accommodation establishments, leaving 120 tourist beds in Aberdeen. Using the total number of beds and the average occupancy determined from the primary research combined with secondary sources, the total number of tourist bed-nights sold per annum over 2008 is calculated to be ~98. From this analysis, it was apparent that the split between local and international visitors staying in paid accommodation is 69.6% to 30.4%, 23.5% visit the area for business purposes while 76.5% are holiday travellers. The average occupancy of accommodation establishments is calculated to be ~16%, taking into consideration that rooms with multiple beds are often occupied by single business travellers. The proposed mining development may increase the occupancy rate which could be seen as positive for turnover. However, this could also lead to squeezing out other forms of occupancy such as holiday travellers. This may lead to increased demand for accommodation.

Continued agriculture as an alternative land use to mining. A carrying capacity of 7.3 small stock units per hectare is assumed, the directly impacted area of 1 300 hectares equates to a grazing loss of 178 sheep per annum. If all of these sheep are assumed to be ewes the resulting loss in lamb production will be approximately 143 lambs per annum (factor 0.8 applied), which, assuming an average price of R1,100 per Karoo lamb will equate to a loss of income of R157 300per annum. If the 10 ewes are assumed to produce 4.5 kg of wool each with a market price of R120 per kg, the annual loss of income will be approximately R96 120. Twenty-four farm workers are employed on the seven farms covered by the Ryst Kuil mining righ application. If these 24 workers were to lose their income, which will not to be the case, as farming activities can still be undertaken on the areas not directly impacted by mining, and, assuming the monthly salary and other benefits value of R4 500 per worker, the annual loss of income to the 24 farmworkers will amount to R1 296 000. Adding a contingency of 20% to all of the values calculated, the total income generated by the 1 300 hectares over a 10-year period in real terms will amount to R18 593 040. Over a period of 60 years the cumulative income generated by current land use, in real terms, will therefore amount to R111 558 240.

If mining is considered as an alternative to current land use, local business opportunities created (all of which relate to the Ryst Kuil application area only) from the transportation of employees (R42.6 million) and transportation of ore (R69.3 million) over a period of approximately 10 years matches the cumulative income that current land use will generate over a 60-year period.

Similar to agriculture, mining projects such as the LRP are aligned with South Africa's strategic development objectives, as contained in the National Development Plan (NDP), drafted by the National Planning Commission. In this plan, the Government has set as target the creation of 11 million jobs by 2030 through promoting employment in labour-absorbing industries and boosting exports and competitiveness.

"Transforming the economy and creating sustainable expansion for job creation means that the rate of economic growth needs to exceed 5 percent a year on average. To bring this about we propose: Increasing exports, focusing on those areas where South Africa already has endowments and comparative advantage, such as mining, construction, mid-skill manufacturing, agriculture and agro-processing, higher education, tourism and business services" (National Planning Commission, 2013).

It is well documented that South Africa is at risk of not reaching the development targets contained in the NDP. During the February 2017 Presidential State of the Nation address, emphasis was placed on the focus areas of the "Nine-Point Plan" to reignite the economy. These focus areas include industrialisation, mining and beneficiation, agriculture and agro-processing, energy, small, medium and micro enterprises (SMMEs), managing workplace conflict, attracting investments, growing the oceans economy and tourism. It is recognized that, although a mining project such as the Lukisa Ryst Kuil Project, will make significant direct contributions to many these focus areas, such as industrialisation, energy, the promotion of small, medium and micro enterprises and attracting investment, in doing so it competes with, and may negatively impact on, other focus areas such as agriculture and tourism.

A primary objective of the SADC's (Southern African Development Communities) programme is to stimulate local and foreign investment in the mining sector through the assimilation and dissemination of data, prospecting activities, and participation in professional forums. The objectives of the SADC include:

- Achieve development and economic growth, alleviate poverty, uplift standard and equality of life;
- Promote and maximise productive employment and utilisation of resources of the region;
- Achieve sustainable utilisation of natural resources and effective protection of the environment;
- The progressive removal of barriers to the movement of goods, services, people and the promotion of cross-border investment.

One of the Western Cape Government's Provincial Strategic Goals (2016) includes: "Create opportunities for growth and jobs", which entail creating an enabling environment to attract investment, grow the economy and create jobs by supporting high growth economic sectors.

The gross domestic product (GDP) of the Western Cape, as percentage of the national GDP, has declined. This was a result of a lack of mining activities, which caused the province not to benefit from rapid increase in metal prices from 2003-2011 (The Real Economy Bulletin, 2016).

Mining plays an important role in re-addressing South Africa's historical inequity through ownership participation in existing or future mining, prospecting, exploration and beneficiation operations with transformation objectives such as:

- Participation in or control of management of such operations;
- Development of management, scientific, engineering or other skills of historically disadvantaged South Africans;
- Involvement of or participation in the procurement chains of operations;
- Integrated socio-economic development for mine workers, host communities, major labour sending areas and areas that due to unintended consequences of mining are becoming ghost towns, by mobilising all stakeholder resources.

As an alternative to current land use, the Lukisa Ryst Kuil Project will contribute to the transformation objectives above. Based on current land use, the impacted areas are unlikely to match this contribution.

The potential exists within the Central Karoo District Municipality (CKDM) for sound and sustainable economic growth with more equitable benefits and opportunities. Although potential lies in the tourism, transport, manufacturing and agricultural sectors, mining opportunities in the area may also enable further development.

The potential increased demand for services within the town of Beaufort West is also an important consideration in terms of the municipalities ability or capacity to service additional persons.

In terms of water supply to surrounding towns (Beaufort West and Rietbron), the proposed Ryst Kuil mining area will not impact in any way on these towns existing and future ground water supply.

The impacts on sensitive natural and cultural areas can be summarised as follows:

- The sensitive landscape features of the Ryst Kuil application area are principally driven by the topographical features and associated episodic drainage lines. These features also influence ecological factors that have been considered and addressed in detail by the specialist team. No ecological factors have been identified that cannot be mitigated adequately through design change, engineering and/or administrative mitigation measures.
- No significant impacts on the cultural/heritage or built environment have been identified.

The impact of the proposed Ryst Kuil mining area on the general wellbeing of residents of Beaufort West and surrounds are low and the most significant mitigation factor is the large distances between the proposed mining sites and sensitive receptors/inhabitants. Noise, visual impact and changes to the sense of place have all been addressed by the heritage practitioner and other specialists.

The cumulative impact assessment has addressed the proposed uranium mining operation along with agriculture, electricity distribution, wind energy and solar energy. Although long term scenarios were discussed with the various stakeholders associated with these other projects, no significant long term cumulative impacts have been identified. This is described in greater detail in the cumulative impact assessment in the EIA.

The most significant long term visual impact is associated with the tailings storage facility (TSF) and final waste rock dumps. These would form part of the final landscape features however mitigation through maximum elevation reduction has been implemented by the applicant. The view shed analysis of these features is illustrated in the EIA.

Nationally, and internationally uranium plays an important role in reducing carbon emissions through reducing the dependency on fossil fuels in the generation of electricity. According to the 2014 Intergovernmental Panel on Climate Change (IPCC), the global warming potential of selected electricity sources in terms of their cradle to grave emissions (life cycle CO_2 equivalent, including mining of the raw materials) were compared. Nuclear energy contributes the second lowest on the medium and maximum scale of current commercial technologies.

There is no viable project alternative road delineation since Lukisa is considering the only economically and technically viable mining methods to extract the commercially viable uranium and molybdenum deposits.

The only other realistic alternative to the proposed mining activity is livestock farming, which is the current activity on the farms.

It can be concluded that the specialist team and EAP responsible for this EIA and EMP have identified no “red flags” that would constitute a recommendation for a negative record of decision (ROD) from the competent authority subject to the effective implementation of all recommended mitigation measures.

3.6.4 No go

Visual Opportunities

- Retaining the existing wide open Karoo sense of place that does add to reginal tourism economy.

Visual Constraints

- Limited economic benefit at the regional or national level.
- National energy security is not supported.

The no-go option would ensure the continued protection of the region's biodiversity, ecological processes, and sensitive habitats. It would avoid the introduction of new, potentially significant environmental risks associated with uranium mining, and maintain the ecological integrity of the Gamka-Karoo landscape.

The Gamka-Karoo vegetation type, which is largely intact and only minimally transformed by current land uses, would remain undisturbed by additional mining activities. Sensitive habitats including rocky and stony communities, drainage lines, and areas supporting species of conservation concern would be preserved in their current state. This would help maintain the region's ecological connectivity, species diversity, and ecosystem services.

2030 Background Traffic Conditions

- A growth rate of 3 percent per annum was applied to the existing traffic volumes to determine the 2030 background traffic conditions.
- The road network will continue to operate at acceptable levels-of-service in the future during the worst peak hours of the year without the proposed development.
- The surface conditions of some of the gravel roads will continue to deteriorate without proper maintenance.
- The gravel surfaces of the Provincial Main Roads are in fair condition and these roads can accommodate the expected growth in traffic volumes on these roads in the year 2030 Background conditions.

3.7 Motivation for the preferred development footprint within the approved site including a full description of the process followed to reach the proposed development footprint within the approved site

Open pit mining

The locations of the open cast pits are dictated by the mineral resource. No alternative location could be considered for the open cast pits. Open cast pits are planned to be developed at the various operational areas. The approximated depths of the pits range from 22-110m (Table 3-1). The surface areas of the pits are indicated on Table 3-1.

Waste rock dump and pollution control dam

The waste rock dump and pollution control dam have been placed to avoid significant impacts on surface water flow patterns, such as non-perennial streams. The waste rock dump and PCD have also been placed to be central in relation to the associated infrastructure, specifically the open cast pits. The waste rock dumps will not exceed a height of 20m. This will reduce the visual impact on the 'sense of place' and 'landscape character'. The surface area of the waste rock dump and PCD:

- Ryst Kuil Extension (RKE) – ~346 385m^2 (34.6ha)
- Ryst Kuil Main (RKM) - ~298 210m^2 (29.8ha)
- Ryst Kuil Abante (RKA) – ~278 666m^2 (27.9ha)
- Haanekuil (HNK) – ~274 974m^2 (27.5ha).

Crushing and sorting plant

Mobile crushing and sorting units will be used for sorting of low-grade ore at satellite open pit mining areas. The crushing and sorting unit is planned to be located near the operational open cast pit at the time of mining. No permanent location for the crushing and sorting unit is planned.

Central Processing Plant (CPP)

The CPP planned at Ryst Kuil represents primary processing of the uranium and molybdenum ore. The proposed LRP is neither feasible nor reasonably practicable without a primary processing facility. The selected location of the CPP is based on various factors. These factors include centralized proximity to the various mining production/operational areas. In addition, the sensitivity analysis generated by the various specialists also informed the location selection.

The planned maximum storage capacity and type of chemicals anticipated for use at the CPP include:

Chemicals at the CPP

- Sulphuric Acid (24 634t)
- Pyrolusite (1080t)
- Flocculant (66t)
- Alamine ($10m^3$)
- Isodecanol ($10m^3$)
- Kerosene ($54m^3$)
- Sodium Carbonate (106t)
- Ammonium Hydroxide (148t)
- Burnt Lime (1038t)
- Diesel (~$120m^3$)
- Oil (~$25m^3$)
- Hydraulic fluid (tbd).

Tailing Storage Facility (TSF) and Return water dam (RWD)

A necessary part of the primary processing of uranium and molybdenum ore is a facility for the safe disposal of tailings material from the CPP. The selected location of the TSF is based on various factors. These factors include reasonable proximity to the CPP taking into consideration the zone of influence of the TSF as per SABS 0286:1998. The relatively flat topography of the selected site was also an important decision-making factor from a civil engineering perspective. In addition, the sensitivity analysis generated by the various specialists also informed the location selection. The groundwater specialist team also recommended that the TSF not be located within the boundaries of the sandstone channel.

The design drivers related to the locality of the TSF are as follows:

- The TSF is to be located near the proposed plant;
- It is desirable to have the RWD nearer to the plant (i.e. on the western side of the TSF);
- Critical Biodiversity Areas (CBAs) are to be avoided;
- The TSF Zone of Influence should be taken into account;
- The footprint should not straddle sandstone dominated lithology (i.e. paleochannels) as these areas have higher permeability than surrounding geological units;

- The TSF should be located on the site of a proposed open pit, as overburden material (waste rock) is required for construction of the TSF embankments.

Haul Roads

The haul roads have been placed to ensure accessibility to each of the associated mining infrastructures. The haul roads form the primary means of transportation within the proposed operations, as well as linkage to the existing transportation routes. The haul roads within the various operational areas (internal roads) will not exceed 10m width, and will have a combined length of approximately 28,221m (Extension: 8,673m; Main: 6,192m; Abante: 6,057m; Haanekuil: 7,299m). The haul road sections linking the various operational areas to the CPP comprise mainly existing roads or farm tracks (~59km) and new (~10km) roads all to be upgraded to a 4.5m wide route.

HAUL ROAD	**Length**
Ryst Kuil Extension	13.0
Ryst Kuil Main	3.2
Ryst Kuil Abante	2.1
Haanekuil	24.0
CPP	1.1
TSF	1.8
ESKOM Yard Access	0.08
TOTAL	**115.2**

Three alternative haul road alignments were considered. The alternative posing least impact on the environment and public traffic are suggested herein.

Laydown area:

The laydown area at each mining area has been selected to be near access roads, as well as to accessible to all mining components. The laydown surface area will be approximately 0.4ha. No permanent concrete foundations are planned within the proposed satellite operations and foundations will only be temporary.

Underground operations

Extraction of deeper uranium and molybdenum ore is planned to use bord and pillar and hybrid stoping underground mining methods as described above. Underground mining is planned for Ryst Kuil Extension, Ryst Kuil Main and Haanekuil production areas. Access to underground operations would be via adits in the high walls of the applicable open pits. Raised bore ventilation shafts are planned in accordance with the underground ventilation engineering plans.

3.7.1 Details of the development footprint alternatives considered

Mining Areas

The siting of open cast pit and underground operations is dictated by the geological resource.

- The siting of the proposed infrastructure was initially based on both the proximity to the mining operations to reduce haulage time and therefore reduce diesel consumption as well as on the topography of the specific areas. Rocky ridges, sloping topography and drainage channels (episodic drainage lines) were avoided where possible. The biodiversity maps included in Appendix 4 were generated using existing GIS data. On site assessment by the biodiversity specialist team determined final recommended site locations for associated infrastructure. In addition, the input from the surface water, ground water, soil, heritage, paleo- and other specialists. However, the CBA information considered in the design criteria have been changed post design.
- The plant will be situated close to the historic underground decline (Cameron shaft) and crusher/sampler unit is situated.

Infrastructure Areas

a) The siting of the proposed infrastructure was initially based on both the proximity to the mining operations to reduce haulage time and therefore reduce diesel consumption as well as on the topography of the specific areas. Rocky ridges, sloping topography and drainage channels (episodic drainage lines) were avoided where possible.

Activities	Initial Proposed Layout	Final Layout
Operational area	Ryst Kuil Extension ~298ha Ryst Kuil Main & Abante = ~1,111ha Haanekuil = ~1070ha CPP = ~ 34ha TSF = ~192ha	Ryst Kuil Extension ~298ha Ryst Kuil Main = ~218 Ryst Kuil Abante = ~196ha Haanekuil = 353ha CPP = ~ 40ha TSF = ~ 79ha
Stockpiles	Ryst Kuil Extension =~53ha Ryst Kuil Main = ~18ha Ryst Kuil Abante = ~26ha Haanekuil = ~114ha	Ryst Kuil Extension ~34.6ha Ryst Kuil Main ~ 29.8ha Ryst Kuil Abante ~ 27.8ha Haanekuil ~27.4ha
Road alignment	Road alignment 1 ~ 133.5km Alignment 2 = ~108.8km Alignment 3 = ~143.6km Alignments 1, 2 & 3 will cross drainage line;	Alignment 1 selected as the preferred option as it mostly follows the existing roads and track, with fewest drainage line crossings.
Diesel storage	Various Diesel storage tanks at the various pits	Central storage facility at the office complex
Ablution facilities	Ablution facilities at all pits	Change house at the office complex with Chemical toilets at the pits.
Operational pits	Ryst Kuil Extension ~40.6ha Ryst Kuil Main ~31.3ha Ryst Kuil Abante ~59.2ha Haanekuil ~63.4ha	Ryst Kuil Extension ~33.27ha Ryst Kuil Main~ 21.65ha Ryst Kuil Abante ~49.42ha Haanekuil ~ 27.23ha
Pit dewatering / Water management infrastructure	Collection in pit- sump and pumped to standard lined PCD	Collection in pit-sump pumped to 1.9ML steel tank with rubber lining.

b) The most appropriate mining and processing technology for the type of deposit is planned to be utilized by the applicant. Technologies that improve efficiencies have and will continue to be investigated and where feasible such will be implemented.

Conventional open cast mining methods will be applied in a way that ensures both optimal extraction of the mineral resource, and has the lowest possible environmental impact. The equipment/processes to be used includes:

- Bulldozer;
- Drilling machines;
- Blasting;
- Excavators;
- Front-end loader;
- Trucks;
- Crushing and screening (mobile unit).

c) Operational alternatives include the following:

- Selecting the shortest haul route calculation and ramp positioning to reduce diesel consumption.
- Roll over rehabilitation wherever possible to reduce double handling.

- Placement of overburden and ROM stockpiles to minimize additional handing and/or hauling.
- Reduction of road traffic through bussing employees to the relevant mining site. No mineral processing is planned at Ryst Kuil Extension, Ryst Kuil Main, Ryst Kuil Abante or Haanekuil.
- Access to underground operations at Ryst Kuil Extension, Ryst Kuil Main and Haanekuil will be gained through the open pit high walls. No vertical shafts with head gear would be developed.

d) Should this proposed mining activity not be implemented, the following will occur:

- Existing historical mining legacy (if any) will remain the responsibility of the South African government to rehabilitate;
- Potential additional revenue provided to the South African fiscus through royalties and taxes will be lost;
- Potential job creation from the planned mining activities will be lost;
- Potential economic stimulus for Beaufort West town and the regional area from the planned mining activities will be lost.

3.7.2 Details of the Public Participation Process (PPP) Followed

A description of the project Public Participation Process is provided below. Evidence of the various facets of the Public Participation process is provided in Appendix 2.

The LRP has included a long consultation process for the initial mining right applications submitted in 2014 and 2015 (which were later withdrawn) until the previous 2016 mining right applications that were finalised in 2017. A new consultation process was launched for the current application in February 2025. Many IAP's registered over this time have asked whether they have to re-register for each application area (various mining right and prospecting right applications) or if their comments can be seen as applicable to the project at a whole. The EAP considered this the best option since the LRP should be viewed from a holistic perspective. The comments related to the various mining applications over the current application area was incorporated into the various revision processes of the specialist reports and the final EIA/EMP.

The public consultation process for the LRP has been conducted as a single process for the mining right application (i.e. Ryst Kuil). IAP's registered through any aspect of the consultation process have been included in all LRP public notices, unless previously registered IAPs requested to be removed from the database.

3.7.2.1 SCOPING PHASE

3.7.2.1.1 Project inception

The PPP commenced on the 24th of February 2025 with an initial call to register notification. Notification during this initial consultation was given in the manner described below. The following activities were undertaken during the project initiation and inception:

- Identification of I&APs -

An initial I&AP database was compiled based on the previous project in the area and Windeed searches were conducted to obtain the contact details of the surrounding landowners. The I&APs contained in this PPR include:

- Pre-identified and registered landowners and surrounding landowners;
- Pre-identified and registered key stakeholders;
- Regulatory authorities;
- Specialist interest groups; and
- All I&APs who responded to the initial notifications and requested to be registered.

Efforts to pre-identify key I&APs involved various avenues such as consultation with the proponent and known landowners within the study area, review of related previously conducted studies, and identification of key interest groups and authorities within the vicinity of the study area and municipality. Refer to PPP Appendix 1 for the Key Stakeholder/I&AP Database in Appendix 2 of this document.

3.7.2.1.2 Announcement of the project

The PPP commenced on the 24th of February 2025 with an initial call to register notification. Notification during this initial consultation was given in the manner described below.

3.7.2.1.3 Notification of directly affected land owners

Notification letters (in English and Afrikaans) were distributed to pre-identified I&APS through either faxes, SMSs, registered mail and/or emails on 24 of February 2025.

The notification documents included the following information:

- Authorisations required;
- Sufficient detail of the proposed development to enable I&APs to assess/surmise what impact the development will have on them or the use of their land;
- The purpose of the proposed project;
- Details of the application processes associated with proposed activities;
- Details of the affected properties;
- Details of the South African environmental legislation that must be adhered to;
- Scoping Report Availability details;
- Contact details of the EAP.

Advertisements (in English and Afrikaans) describing the proposed project and EIA process were placed in the Die Courier Newspaper with circulation in and around the study area on 21 February 2025. The Gazette Notice was placed in the Western Cape Provincial Gazette published on the 21st of February 2024. The newspaper and Gazette Notice adverts included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity;
- Legislative requirements;
- Scoping Report Availability details; and
- Relevant EIMS contact person for the project.

Please refer to PPP Appendix 3 for proof of the advert and gazette notice placed, Appendix 2 of this document.

Twenty (20) A1 Correx site notices and 1 A3 poster (in English and Afrikaans) were placed at 21 locations around the proposed project study area on 25 of February 2025. The on-site notices included the following information:

- Project name;
- Applicant name;
- Project location;
- Map of proposed project area;
- Project description;
- Legislative requirements;
- Scoping Report Availability details; and
- Relevant EIMS contact person for the project.

Please refer to PPP Appendix 4 for proof of site notice distribution, Appendix 2 of this document.

Table 3-7. Summary of Public Participation Opportunities

Action	Description	Publication/Place	Date
Call to register and notification of availability of the scoping report for review and comment	Notification of landowners, occupiers, and other key I&APs.	Affected landowners and key I&APs were notified via email, fax, SMSs and/or post.	24 February 2025
	Placement of site notices.	Twenty (20) A1 Correx site notices and 1 A3 Notice (in English, and Afrikaans) were placed at 21 locations along the proposed project study area.	25 February 2025
	Newspaper advertisement and Gazette Notice.	Advertisements (in English, and Afrikaans) describing the proposed project and EIA process were placed in the Die Courier Newspaper. The Gazette Notice was placed in the Western Cape Provincial Gazette.	21 February 2025 (Newspaper) 21 February 2025 (Gazette Notice)
	Placement of hard copy Scoping Report.	One (1) hard copy of the Scoping Report was submitted to the Beaufort West Public Library, where it is accessible to all members of the public.	21 February 2025
	Placement of Scoping Report electronic copy.	An electronic copy of the report will be placed on the Aquatox website.	25 February 2025

3.7.2.1.4 Announcement of availability of Draft Scoping Report

Notifications (in English, and Afrikaans) regarding the availability of the Scoping Report for public review and comment were provided to pre-identified and registered I&APs as part of the initial notification. The notifications were distributed through the channels indicated above (i.e.: email, faxes, SMSs, registered mail, site notices, and local newspaper and provincial Gazette notices). Contact details were provided to I&APs to facilitate correspondence and assistance in accessing the information or require copies of the reports. Hard copies of the Scoping Report were made available for public review and comment for a period of 30 days at the Beaufort West Public Library.An electronic copy of the Scoping Report was placed on the Aquatox website accessible to all Interested and Affected Parties: www.atox.co.za. No I&AP's requested a specific meeting to review the Scoping Report contents.

3.7.2.1.5 Comment and Response Report

Comments on the proposed project were solicited from pre-identified and registered I&APs and key stakeholders. To date, the following highly summarised types of comments have been received:

- Requests for I&AP registration.
- Request for further information such as project description, and locality map.
- Objections to the proposed project based on various risks and impacts identified by I&APs.
- Support for the project due to potential job creation.

All comments and/or queries received to date are included in this report and presented in PPP Appendix 5, appendix 2 of this document.

3.7.3 Summary of issues raised by I&APs

All data related to IAP interaction is provided in the Consultation Report in Appendix 2.

LRP Aspect	**Overview of Comments received**
Note: This overview of issues raised seeks to summarise the most common questions and comments that have been raised by IAP's. This overview does not seek to summarise responses as they are too varied and numerous. All responses are captured in the Comment and Response Report in Appendix 2	
Affected Landowners	Directly affected landowners have been involved in the LRP project for several years. Contracts have been drawn up with some of these landowners and consultation with them has been extensive.
Roads	Just a small number of comments and questions were received relating to roads. This included the potential impacts of mining related activities on existing paved and unpaved roads, the size of the proposed haul roads and the carrying capacity of the existing roads.
Air Quality	Although not many written submissions relating to dust have been received, the topic has received considerable attention during the various public meetings. Main concerns involve fugitive dust generated by trucks on unpaved mine and public roads as well as the potential of radioactive dust and the impact this could have on people, stock and the general environment.
Biodiversity	Concern about the delicate living balance. Protected *Pleiospilos bolusii* and *Gonialoe variegata*, occur in the area
Radiation	The concept of the proposed open cast and underground uranium mining naturally results on many questions and comments related to radiation related risks. Most questions and comments are related to the potential impacts of radiation and/or uranium on ground water, surface water and biota. The potential impact of radiation on receptors such as farmsteads and other locations within or near to the proposed operations. Some IAP's have also submitted questions regarding the impacts of radiation on employees of the mine.
Land capability, Land use and Soil	This related primarily to the short and long terms impacts of the proposed mining on local farming and even the potential impact on a regional scale should meat and mohair/wool products be contaminated.

Surface Water	Issues raised relating to surface water are primarily limited by the lack of surface water within the region however numerous questions and comments included the impacts of dust and radiation on surface water bodies have been raised.
Ground Water	The primary concern raised by Interested and Affected Parties (IAPs) relates to the region's reliance on groundwater. Submissions mainly focus on two areas: the quantity of water use and the risk of contamination. IAPs are particularly worried about the Karoo's arid conditions and whether it can sustain the proposed mining operations. They also highlight the potential negative effects of groundwater depletion and contamination on agriculture and related industries.
Heritage	Not many heritage related comments have been received from IAP's however those that have been received are predominantly related to the potential impact of the proposed mining on the sense of place of the Karoo and its wide-open spaces.
Noise	Not many noise related comments have been received but those that were received mostly related to the potentially intrusive noise impacts of mining in a quiet wild space.
Socio Economic	A variety of comments relating to socio economic impacts have been received. These include the potential impacts on tourism, jobseeker influx, agriculture, mohair and wool exports, Karoo lamb etc. In addition, numerous IAP's have raised the question of job opportunity/ availability as well as opportunities to register as contractors/suppliers to the mine.
Mining Plan	Other than some questions relating to clarity regarding the proposed mine planning no comments or concerns has been raised in this regard.
electricity	A renewable energy developer specializing in wind, solar PV and BESS systems quite active in the Beaufort West area and surrounds, indicated that existing rights to exclusively develop a wind energy facility on one of the properties identified within your exploration area - Remainder of the Farm Kant Kraal 360 (the Property) has been granted. Collaboration is discussed.
Rehabilitation	Comments on rehabilitation highlight both the importance of effective rehabilitation and the challenges of implementing it in the arid Karoo. Many concerns relate to past prospecting activities that left long-lasting impacts and were never properly rehabilitated.
Public Consultation	Most queries regarding public consultation were related to requests for information regarding the process and comment periods.
Health and Safety	Health and safety related questions and comments received were based on the potential risks to both local residents as well as employees of the proposed mine.
Water Use License	Limited water use license questions were received from IAP's. Most water related questions were submitted in terms of the summary provided for surface and ground water above.
Environmental Authorisation	Although no specific questions relating to environmental authorisations were received, numerous responses from the EAP included information related to the environmental authorisation process.
General	All other aspects not clearly identified by the categories above have been included under general. In addition, individual submissions that incorporate various aspects/topics have been recorded under general.

4 The Environmental attributes associated with the development footprint alternatives.

4.1 Type of environment affected by the proposed activity

4.1.1 Physiography of the Karoo Basin

The Main Karoo Basin covers the greater part of the central region of South Africa. Surface altitudes range from 800 to 2500 m above mean sea level. Altitudes are highest in the east decreasing gradually as the surface slopes to the west. The generally flat to undulating topography is broken by the up-warped plateau edges and the escarpment. A typical feature of the landscape of the Western Karoo Basin is the flat-topped hills, which are often capped by more resistant dolerite sills or sandstone beds, rising above the featureless and flat to undulating plains.

Outcrops are rare between hills due to the surface cover of calcrete, windblown sand, alluvium, colluvium and soil. Dolerite sills, dykes and ring-complexes are often prominent features of the Karoo landscape. These structures are easily recognized on satellite images, where they are often visible as ridges and and sub-circular saucer-like shapes, the rims of which are commonly exposed as topographic highs forming ring-like outcrops.

The general topography is characterised by gently rolling terrain with steeper terrain further away to the north and to the south. The topography is illustrated in Figure 3-1.

4.1.2 Geology

The Main Karoo Basin has been controlled and shaped by four major geodynamic events (Woodford 2002):

- Deposition of the Karoo sediments and the uplift of the Cape Fold Belt,
- Intrusion of Karoo basalt and dolerite,
- Intrusion of Kimberlite and localised mantle up-welling,
- Modern geomorphology, deposition of recent sediments, uplift, cessation of regional tectonics.

The geology of the Main Karoo Basin is summarized by Woodford (2002). The present-day Main Karoo Basin is in-filled with sedimentary strata which are capped by a 1.4 km thick unit of basaltic lava. Major lithostratigraphic units of the Karoo Supergroup are shown in Figure 4-1.

The lithostratigraphic units of the Karoo Supergroup outcrop concentrically around the Main Karoo Basin. Lateral facies changes, particularly in the lower half of the succession, have given rise to inter-tonguing of lithologies in various parts of the basin. No major regional unconformities are known to exist within the basin, except for one at the base of the Molteno Formation (Woodford 2002).

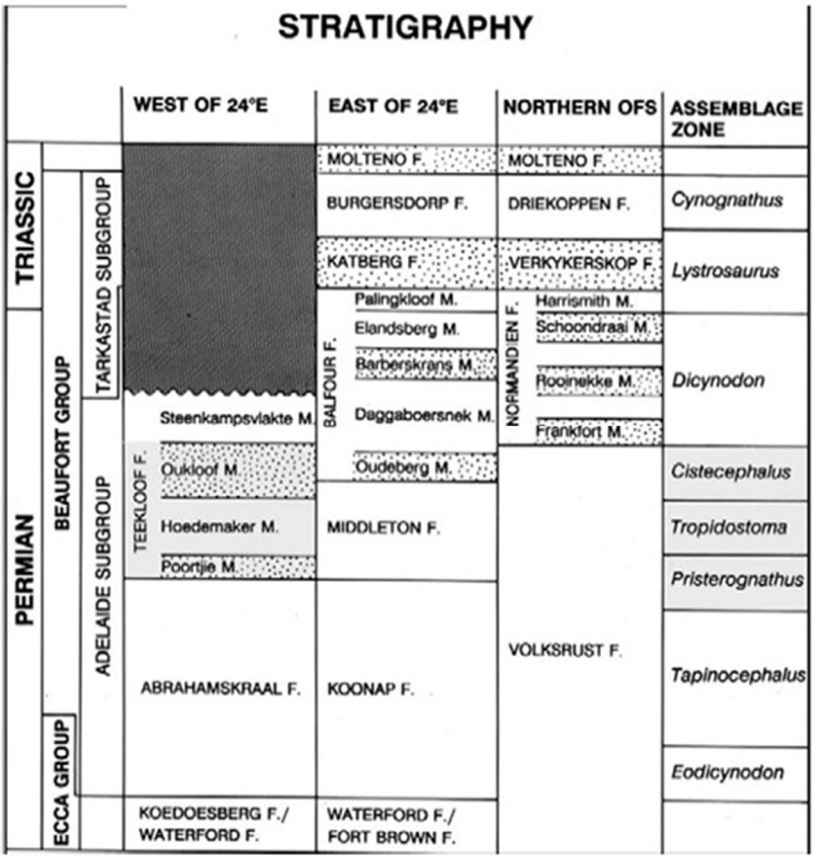


Figure 4-1. Major lithostratigraphic units of the Karoo Supergroups (Woodford. 2002).

The uranium and molybdenum deposits of the south-western Karoo basin are mainly contained within channelised palaeo-river deposits of the Beaufort Group, which is described here.

The Beaufort Group sediments are comprised of the Adelaide and Tarkastad Subgroups.

- The Adelaide Subgroup in the west comprises the Abrahamskraal, Teekloof and Balfour Formations.
- The Adelaide Subgroup comprises predominantly mudstone. The Teekloof Formation is characterised by a greater relative abundance of red mudstone compared to the underlying and overlying units, in practise the boundaries are linked to specific sandstone-rich marker units (members). The arenaceous Poortjie and Oudeberg Members constitute the base of the Teekloof and Balfour Formations, respectively. In the western basin the Abrahamskraal and Teekloof Formations attain thicknesses of 2,500 and 1,400 metres, respectively. The Balfour Formation attains a maximum thickness of 2,000 metres.
- The Tarkastad Subgroup in the central basin is characterised by a greater abundance of both sandstone and mudstone when compared to the Adelaide Subgroup. The subgroup has a maximum thickness of 2,000 metres and comprises a lower, sandstone rich Katberg Formation and an upper, mudstone rich Burgersdorp Formation. The sandstone and mudstone units of the Tarkastad Subgroup tend to form fining-upward cycles comparable to those of the Adelaide Subgroup.

Most of the sandstone-hosted uranium deposits occur in the lower members of the Teekloof Formation as illustrated in Figure 4-3 below:

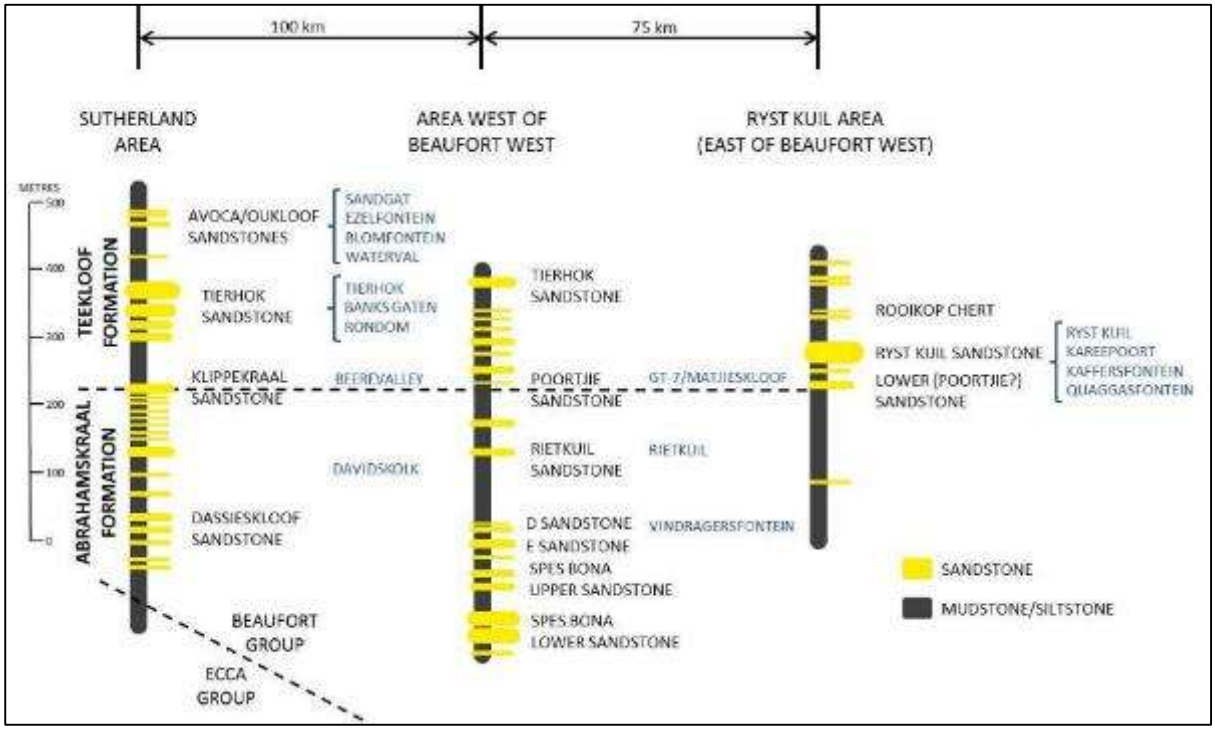


Figure 4-2. Regional stratigraphy of the south-western Karoo Basin showing the relative levels of various uranium deposits (after Esso, 1979).

The major mineralised palaeo-channel sandstones are mainly located near the base of the Teekloof Formation and can be described as *arkosic greywacke* based on mineralogy. Two main ore types are identified:

- Laminated sandstone;
- Carbonate cemented sandstone (basal), sometimes found as weathered “koffieklip” on surface.

Other “gangue” minerals include calcite (5 – 15 %), pyrite (~0.75 %) and minor arsenopyrite.

Uranium occurs mostly as coffinite [$U(SiO_4)_{1-x}(OH)_{4x}$] with minor uraninite [UO_2, U_3O_8] and is closely associated with the carbonaceous material or organics or as replacement of phytoclasts and minor coating of sand grains. Molybdenum occurs mainly disseminated as molybdenite [MoS_2] and is also closely associated with carbonaceous material or organics.

Dolerite Intrusions

The Karoo Dolerite consists of an interconnected network of dykes and sills and it is not possible to single out any intrusive or tectonic event responsible for these intrusions. It, however, appears that a very large number of fractures within the Karoo lithology were intruded simultaneously by magma and that the dolerite intrusive network acted as a shallow “stockwork-like” reservoir (Woodford 2002).

The emplacement of dykes within the Western Karoo Basin appears to be lithologically controlled (Woodford 2002) where a decrease in intrusion density is noted at the boundary between the lower and upper Ecca. This boundary corresponds to the appearance of the first sandstone units in the Karoo Basin. The bulk of the dykes

are strata bound and concentrate in the upper Ecca and Beaufort Groups (Adelaide and Tarkastad Subgroups), although some dykes are present in the lower Ecca and Dwyka Group. This indicates that the dykes propagate laterally along strike and not vertically (Woodford 2002).

4.1.3 Hydrology

4.1.3.1 Rainfall

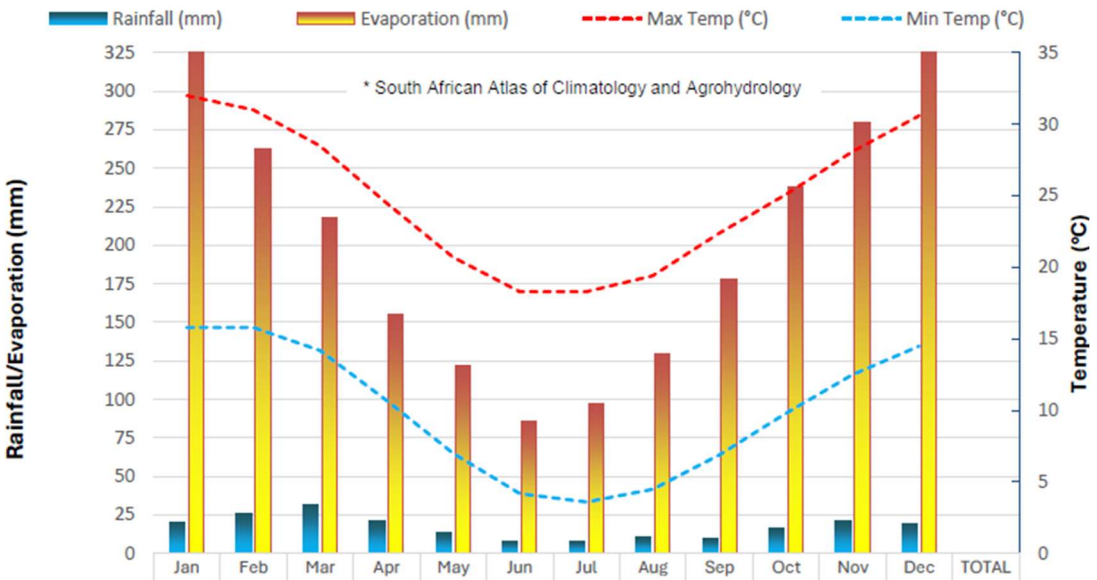
Two nearby SAWS stations provide long-term rainfall data: Klipkrans (7 km from the west side, 79 years of data, MAP 178 mm) and Verekuil (8 km from the east side, 48 years of data, MAP 207 mm). However, relying on a single station poses risks due to potential data errors and spatial variability in rainfall. Therefore, site-specific rainfall data from Pegram et al. (2016) was used instead, offering more accurate monthly averages. This data indicates a Mean Annual Precipitation (MAP) of 205 mm for the west side and 222 mm for the east side and is preferred for site planning.

Table 4-1. Average monthly rainfall distribution (mm)

Month	Rainfall (mm)	
Jan	20	22
Feb	26	29
Mar	32	35
Apr	21	22
May	13	13
Jun	8	7
Jul	8	9
Aug	10	11
Sep	10	11
Oct	16	18
Nov	21	23
Dec	19	22
Total	**205**	**222**

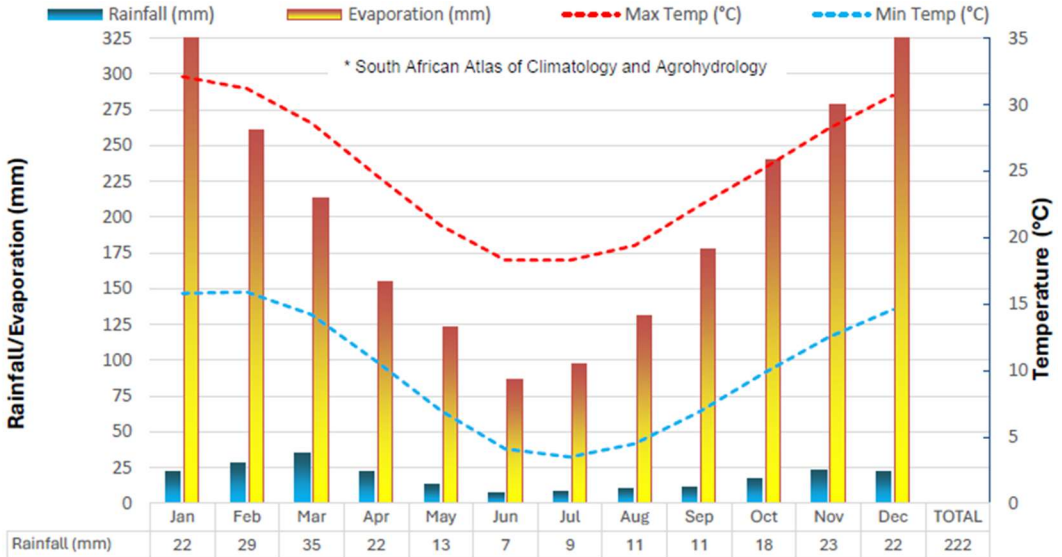
*Estimates were sourced for the points (32° 41’ 01" S, 22° 51’ 04" E and 32° 36’ 05" S, 23° 03’ 36" E)

The site’s climate, assessed using rainfall (Pegram, 2016) and evaporation/temperature data (Schulze and Lynch, 2006), is classified as a warm semi-desert, hot arid steppe climate under the Köppen-Geiger system. Both the West and East areas fall under this same classification, with minimal variation in rainfall and evaporation between them.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Rainfall (mm)	20	26	32	21	13	8	8	10	10	16	21	19	205
Evaporation (mm)	343	263	218	155	122	86	97	130	178	238	280	340	2450
Max Temp (°C)	32	31	28.5	24.5	20.7	18.3	18.3	19.4	22.4	25.1	28.1	30.6	
Min Temp (°C)	15.8	15.8	14.2	10.7	7	4.2	3.6	4.5	6.9	9.8	12.5	14.5	

Figure 4-3. Average monthly climate for the West.



	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	TOTAL
Rainfall (mm)	22	29	35	22	13	7	9	11	11	18	23	22	222
Evaporation (mm)	342	261	213	155	123	87	97	131	178	240	279	338	2444
Max Temp (°C)	32.1	31.2	28.6	24.7	20.9	18.3	18.3	19.4	22.4	25.2	28.2	30.7	
Min Temp (°C)	15.8	15.9	14.2	10.7	7	4.1	3.5	4.5	6.9	9.8	12.5	14.6	

Figure 4-4. Average monthly climate for the East.

4.1.3.2 Terrain

Figure 4-5 illustrates the terrain of the site and includes a calculation of slope (for both the site and the area of hydrological relevance) most slopes within the area of hydrological relevance are below 3% with many slopes below 1%. This reveals the particularly flat nature of the site and surroundings. The elevations over the area of hydrological relevance and site range from approximately 950 - 824 m AMSL and 882 - 826 m AMSL respectively.

4.1.3.3 Hydrology

The site lies within the quaternary catchments L11G, L12A, and L12B. Figure 4-5 presents a more detailed illustration of the site's hydrological setting. The area of hydrological relevance to the site is illustrated and covers approximately 361.1 km^2 as defined by geoprocessing of the 30m DSM.

The 1:50,000 topographical map shows several non-perennial rivers, dry watercourses, and small dams within and around the site. These features reflect the area's low rainfall and flat terrain, which result in limited runoff and poorly defined flow paths, leading to diffuse lateral flow between catchments.

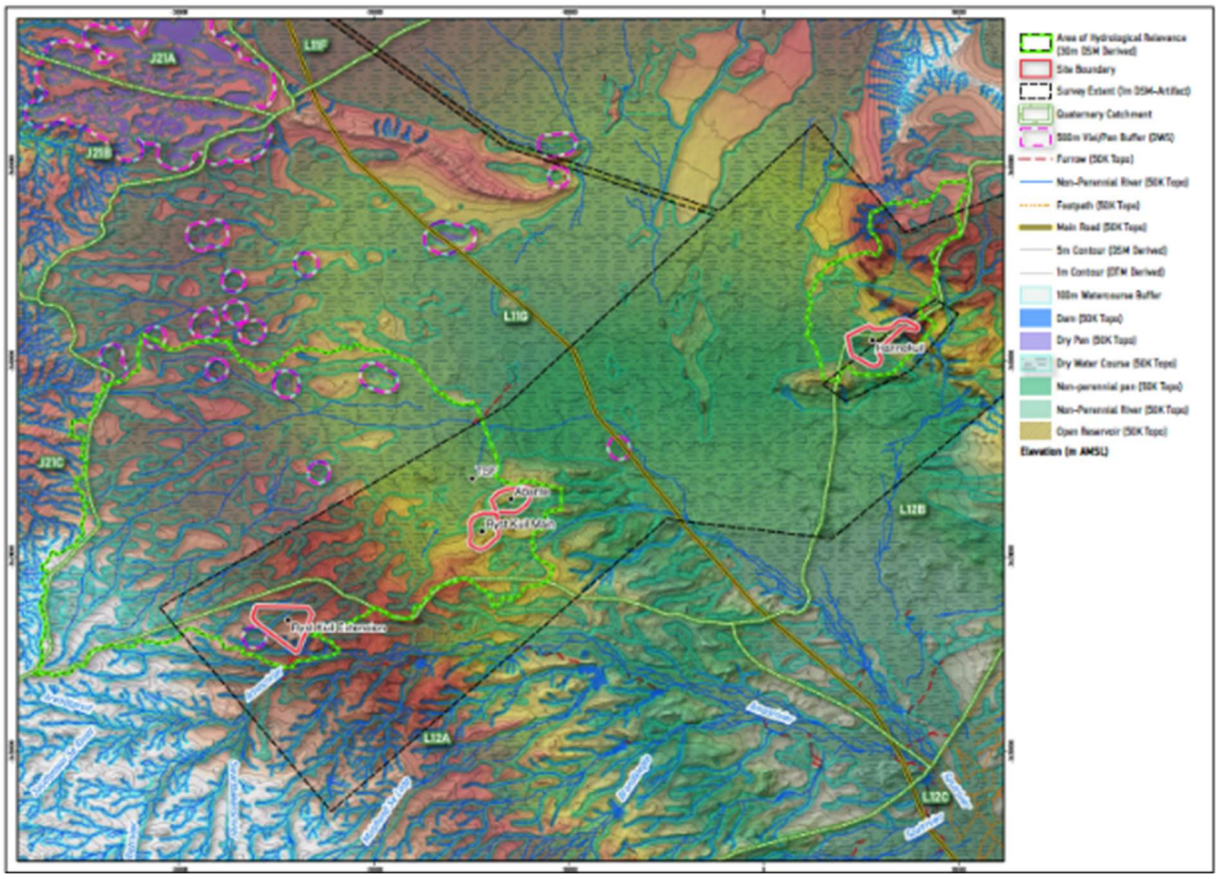


Figure 4-5. Hydrological setting of the site.

4.1.3.4 Flooding Assessment

The flood assessment used two models—a surface water flood model and a fluvial flood model—to evaluate flood risks for 1:50-year and 1:100-year recurrence intervals. The surface water model simulated rain-on-mesh flooding across the proposed development, while the fluvial model focused on the Amos non-perennial river south of Ryst Kuil Extension. Additionally, a high-level Regional Maximum Flood (RMF) assessment was done to understand flood risks from the main Sout River dividing the two sites.Since the modelling of flooding is (as undertaken) an approximation of reality, various assumptions and limitations are relevant (when considering the model results). These have been highlighted at various places in this report.

4.1.3.5 Overall Flood modelling Results

Surface water flooding differs from fluvial flooding as it occurs diffusely without defined channels, so flood lines cannot be precisely mapped. Flood depths greater than 0.2m are highlighted, with most 1:50-year and 1:100-year events showing shallow flooding under 0.5m due to the site's low slopes and lack of channels. The exception is the proposed TSF area, where depths exceed 0.5m, indicating flow concentration that requires flood protection measures. Significant deep flooding (over 2.5m) occurs along the Amos River south of the site but does not impact the site itself. Flood velocities across the development are generally low, mostly below 0.4 m/s, with some small areas up to 0.8 m/s.

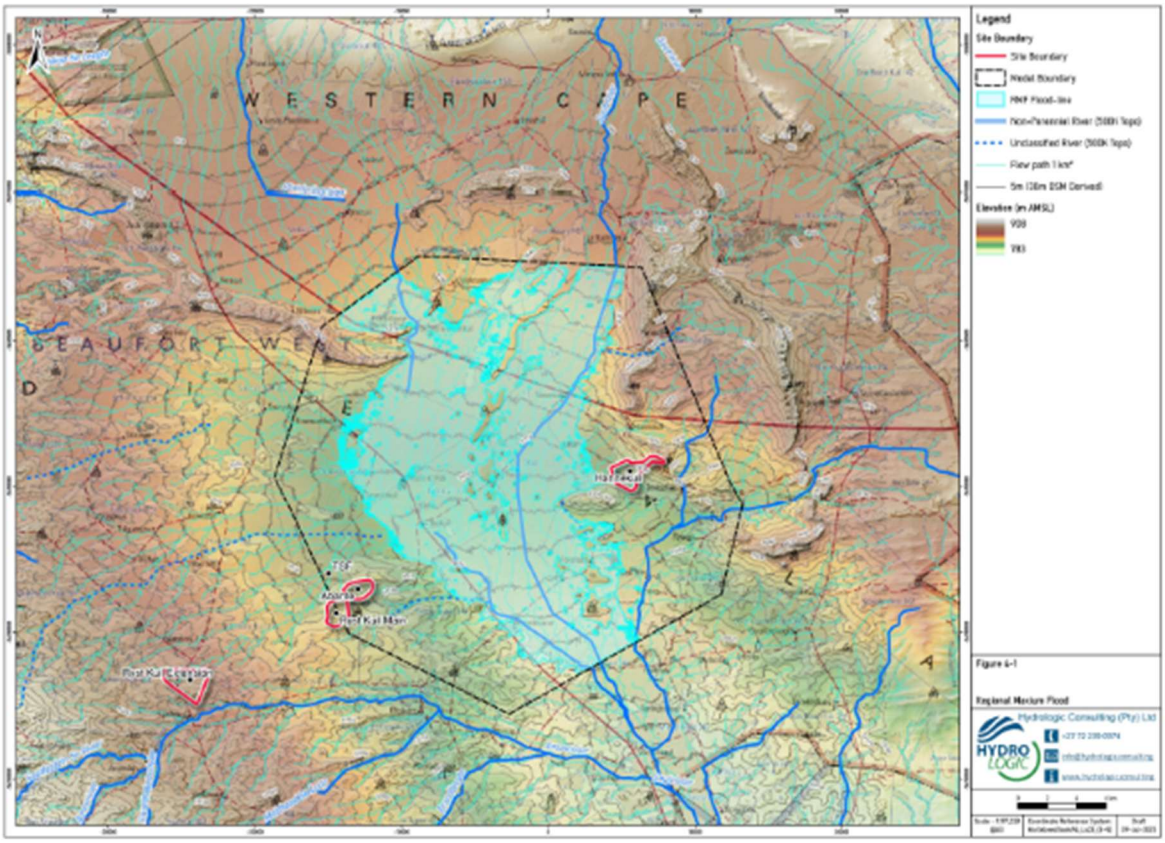


Figure 4-6. Regional maximum flood.

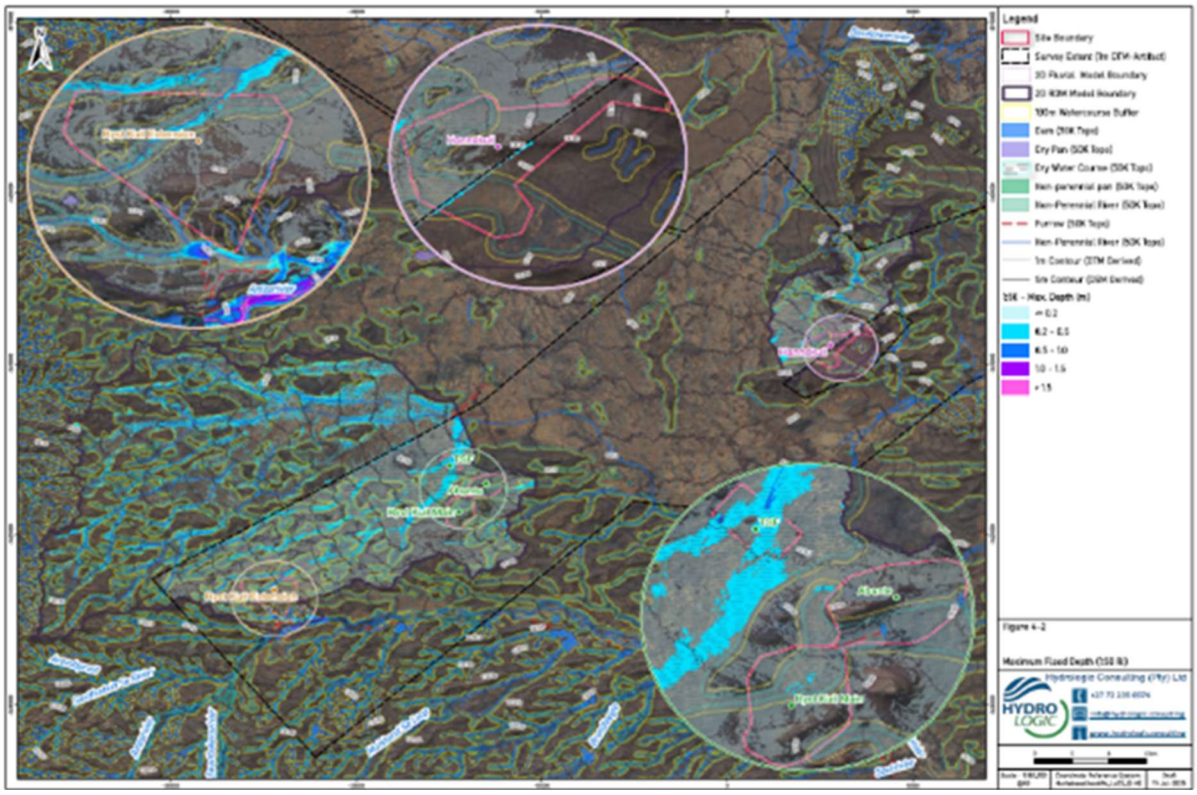


Figure 4-7. Maximum Flood Depth (1:50 RI)

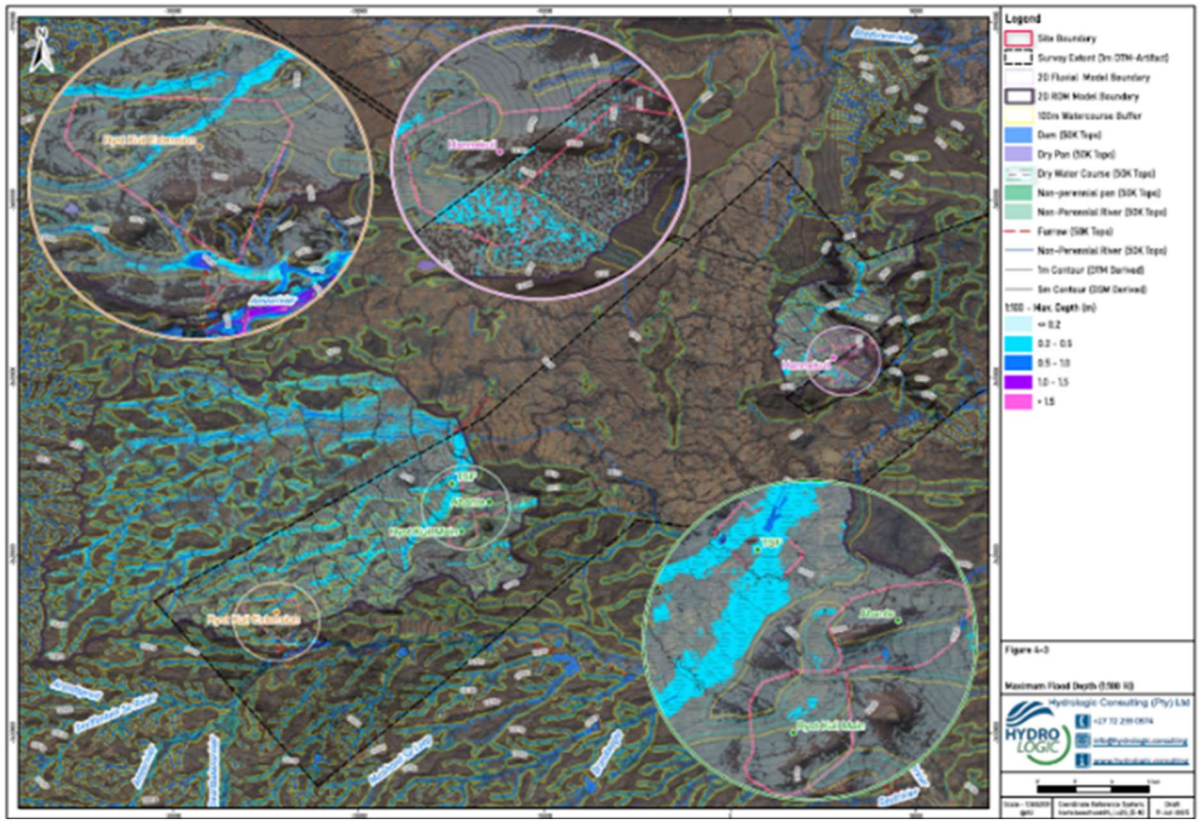


Figure 4-8. Maximum Flood Depth (1:100 RI)

4.1.4 Air Quality

No ambient air quality monitoring data is available for the region of interest so the exact state of air quality is not known. Natural sources that likely affect air quality in the region are wind-blown dust generated by the arid climatic conditions. There are few anthropogenic sources of air pollution in the district. Of interest, especially to the nearby town, Beaufort West, is emissions from vehicles sources, as it is located along the N1 highway. These emissions will include carbon monoxide, oxides of nitrogen, particulate matter and VOC emissions. Other emission sources will include fuel burning for heating and cooking in informal settlements.

4.1.4.1 Wind

The wind is represented by the annual windrose at Beaufort West (Figure 4-9). Windroses simultaneously depicts the frequency of occurrence of wind from the 16 cardinal wind directions and wind speed classes. Wind direction is given as the direction from which the wind blows, i.e., south-westerly winds blow from the southwest. Wind speed is given m/s, and each arc represents a frequency of occurrence of 250 hours. The wind direction in Beaufort West can differ significantly from the site due to the nearby mountain range. A 5-yearly average Windrose shown below.

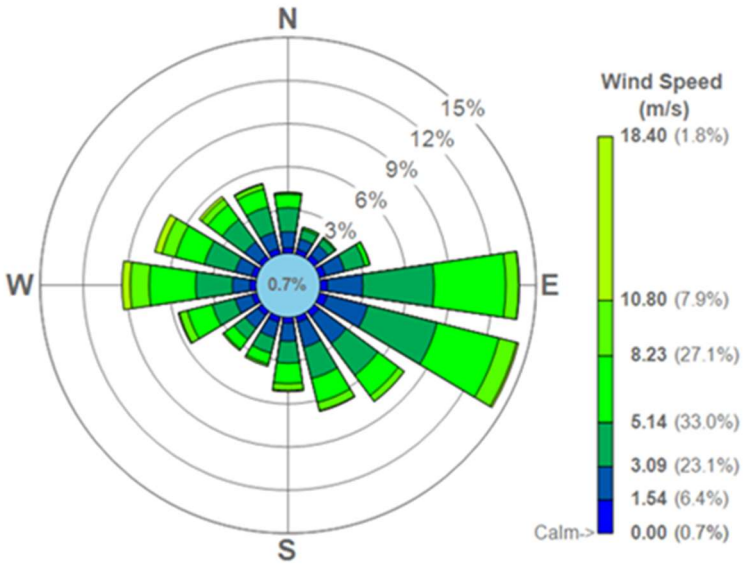


Figure 4-9. Annual wind rose for Beaufort West, depicting the frequency of occurrence of wind from the 16 cardinal wind directions and wind speed classes. Windrose at 22.88855°E, 32.63386°S.

4.1.5 Biodiversity

4.1.5.1 Desktop assessment

Ecologically Important Landscape Features are presented in Table 4-2.

Table 4-2. Summary of relevance of the proposed project to ecologically important landscape features

Desktop Information Considered	Relevance	Reasoning
Ecosystem Threat Status (RLE 2021)	Relevant	Overlaps with a 'Least Concern' ecosystem

Ecosystem Protection Level	Relevant	Overlaps with a 'Poorly Protected' Ecosystem
Provincial Conservation Plan	Relevant	HNK overlaps with a Critical Biodiversity Area (CBA) 2, Ecological Support Area (ESA) 1 and Other Natural Areas. RKM & RKA-overlaps with a (ESA) 1, ESA 2 and Other Natural Areas RKE -overlaps with a (ESA) 1, ESA 2 and Other Natural Areas
Key Biodiversity Areas (KBA)	Relevant	The PAOI overlaps with the Eastern Gamka Karoo KBA
National Freshwater Priority Area (NFEPA)	Relevant	RKM & RKA -overlaps with a non-priority wetland
Protected Areas	Irrelevant	Not within range of any relevant areas
National Protected Areas Expansion Strategy (NPAES)	Irrelevant	Does not overlap with any NPAES Priority Focus Areas
Strategic Water Source Areas (SWSA)	Irrelevant	Does not overlap with any relevant areas
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Irrelevant	Does not overlap with any relevant areas
Mining and Biodiversity Guidelines	Irrelevant	Does not overlap with any relevant areas

4.1.5.2 Red List of Ecosystems

The Ecosystem Threat Status is an indicator of an ecosystem's wellbeing, based on the level of change in structure, function or composition. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or Least Concern (LC), based on the proportion of the original extent of each ecosystem type that remains in good ecological condition. According to the Red List of Ecosystems dataset (Skowno & Monyeki, 2021) the proposed development overlaps with a LC ecosystem (Figure 4-10).

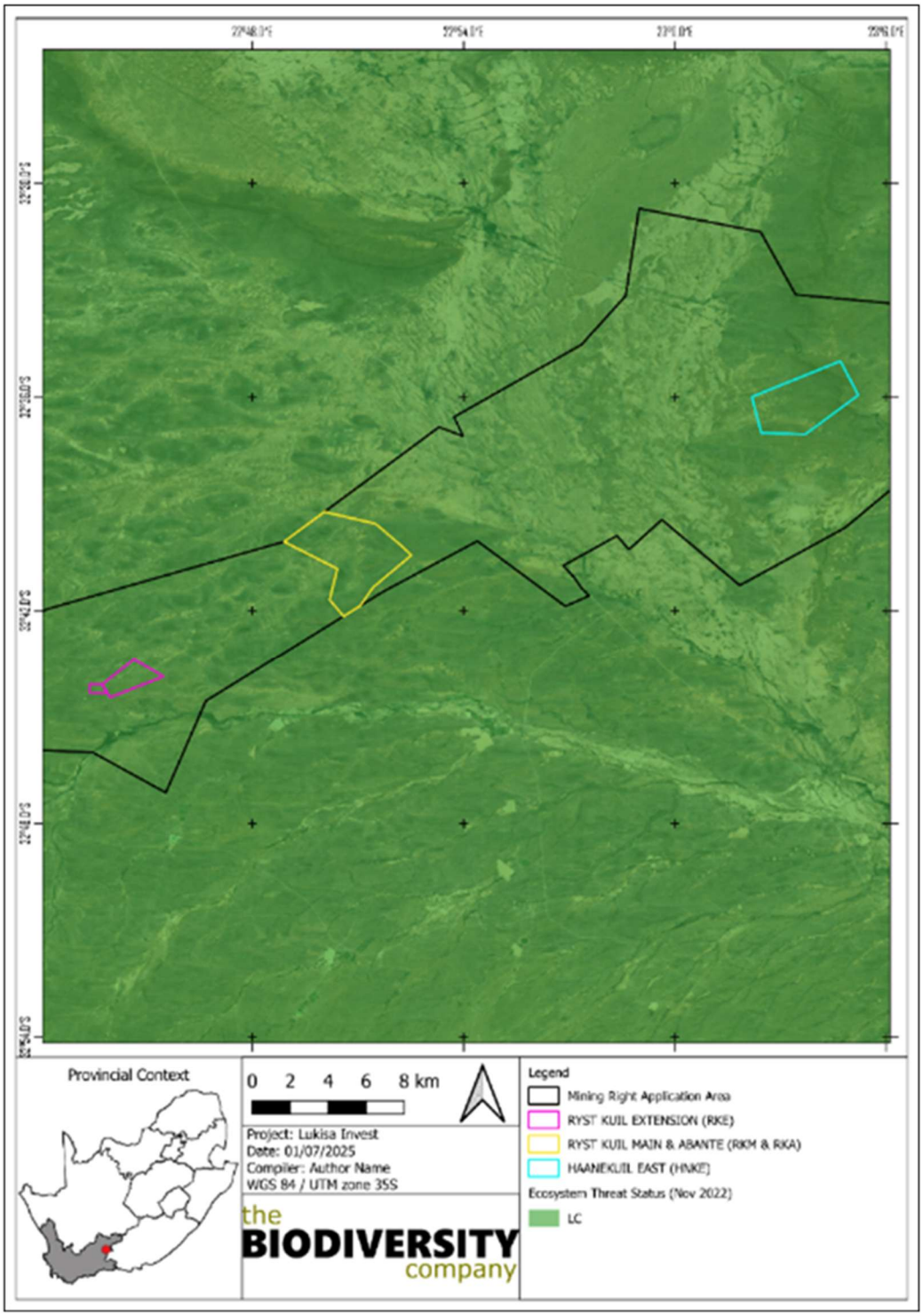


Figure 4-10. Map illustrating the ecosystem threat status associated with the PAOI.

4.1.5.3 Ecosystem Protection Level

Indicator of the extent to which ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Well Protected (WP), Moderately Protected (MP), Poorly Protected (PP), or Not Protected (NP), based on the proportion of the biodiversity target for each ecosystem type that is included within one or more protected areas. Not Protected, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. The PAOI overlaps with a PP ecosystem (Figure 4-11).

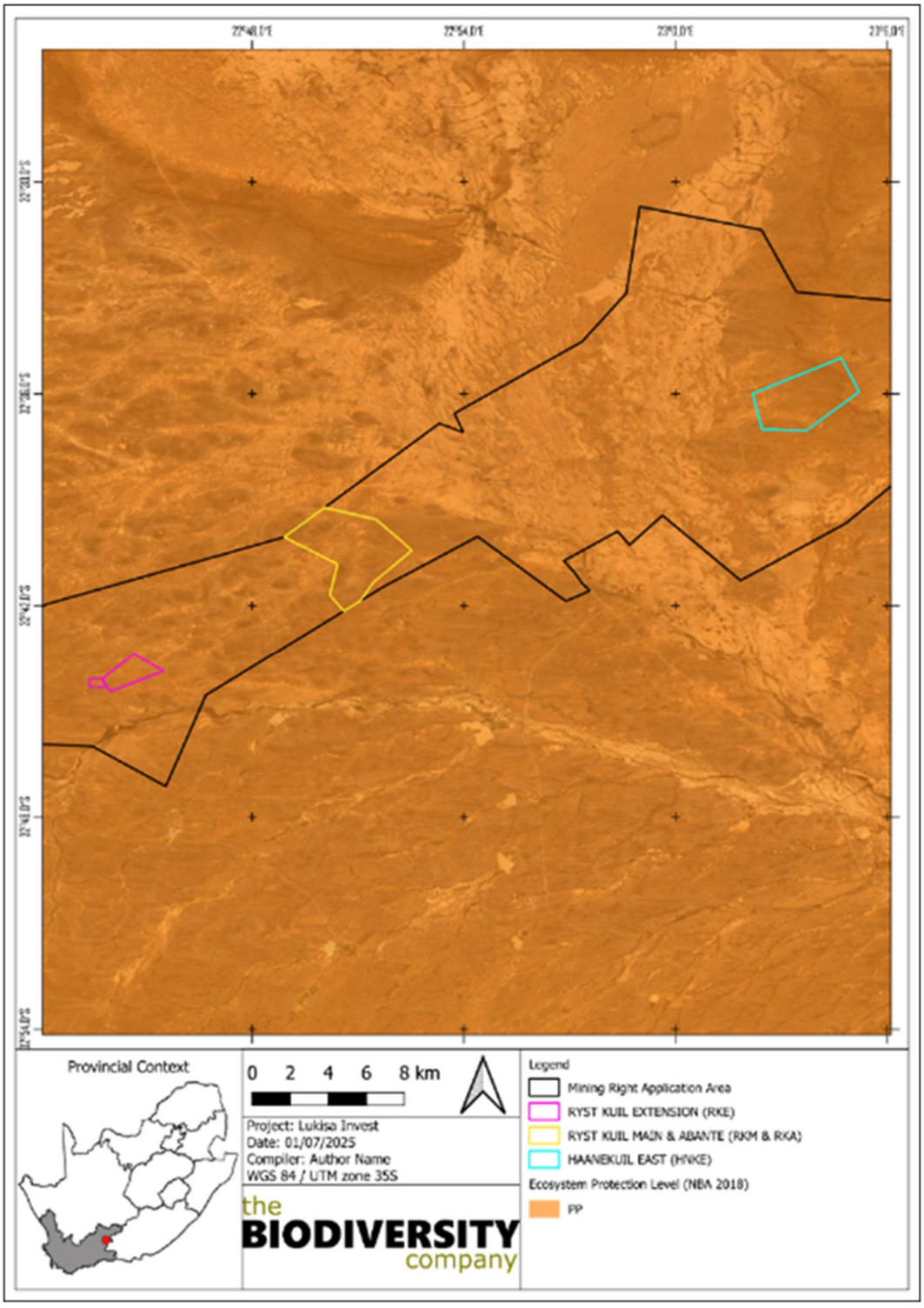


Figure 4-11. Map illustrating the ecosystem protection level associated with the PAOI.

4.1.5.4 Provincial Conservation Plan

The conservation of CBAs is crucial, in that if these areas are not maintained in a natural or near-natural state, biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity compatible land uses and resource uses (SANBI-BGIS, 2017).

The purpose of the Western Cape Biodiversity Sector Plan (BSP) (2017) is to inform land-use planning and development on a provincial scale and to aid in natural resource management. One of the outputs is a map of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These are classified into different categories, namely CBA1 areas, CBA2 areas, ESA areas and Other Natural Areas (ONAs) based on biodiversity characteristics, spatial configuration, and requirements for meeting targets for both biodiversity patterns and ecological processes.

According to the Western Cape BSP dataset, the PAOI overlaps with a CBA 1, ESA 1, ESA 2 and Other Natural Areas) (Figure 4-12).

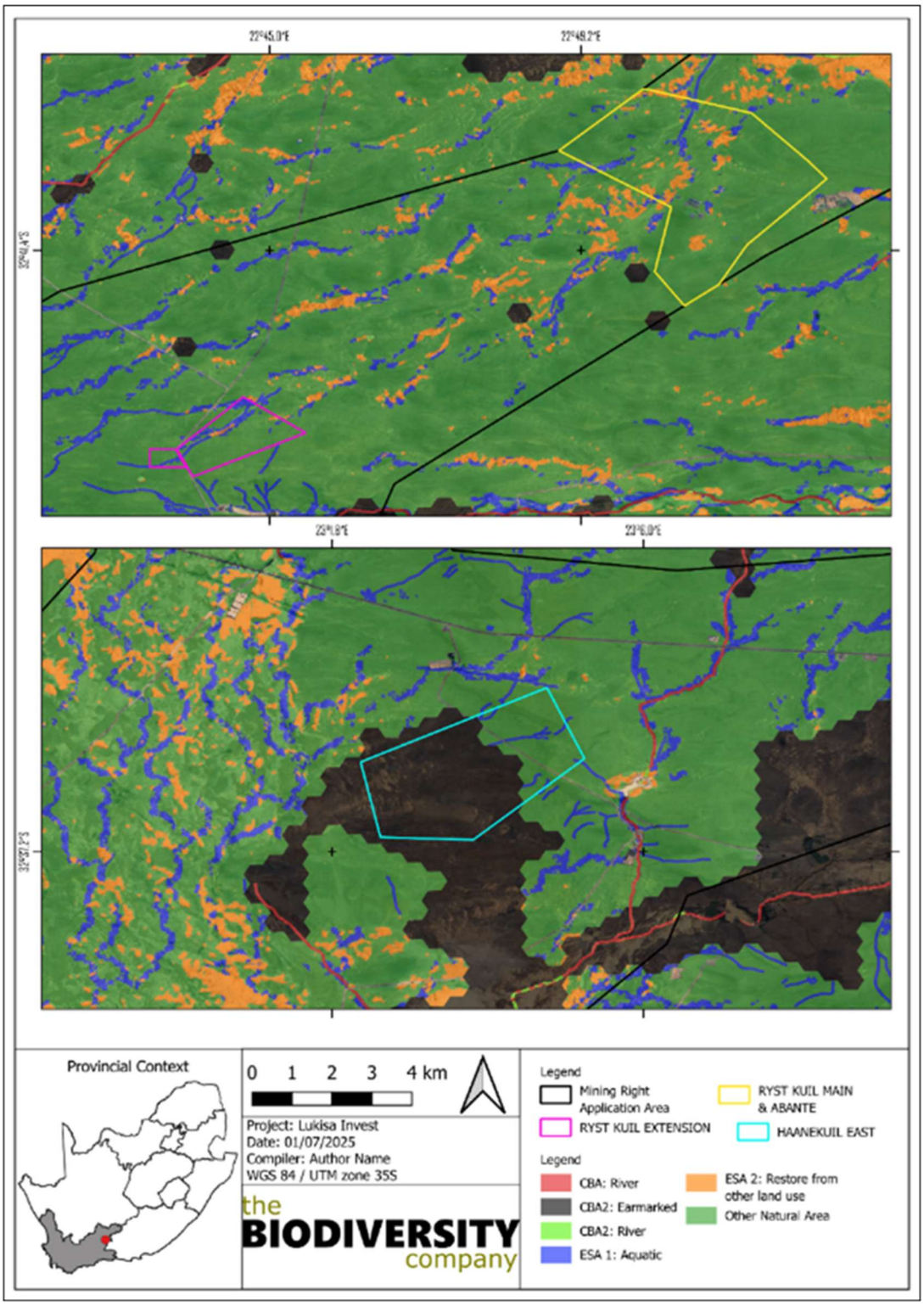


Figure 4-12. Map illustrating the PAOI in relation to the Western Cape CBA Map.

4.1.5.5 Key Biodiversity Areas

A new set of Key Biodiversity Areas (KBA) specific to South Africa has been identified using the Global Standard for the Identification of Key Biodiversity Areas version 1.2 (IUCN 2016), applied to South African species and ecosystems. KBAs are critical sites that play a vital role in maintaining global biodiversity by serving as essential habitats for species. The identification of KBAs enables governments and civil society to pinpoint key locations

crucial for species and their habitats worldwide. This understanding facilitates collaborative efforts to manage and conserve these areas, thereby safeguarding global biological diversity and supporting international biodiversity objectives.

Unlike the Important Bird Areas (IBAs), which primarily focus on birds, the KBA framework encompasses a broader spectrum of biodiversity, including mammals, amphibians, plants, and other taxa. BirdLife South Africa (BLSA), in consultation with the KBA National Coordination Group, has opted to retire IBAs and integrate KBAs into its conservation strategy. This strategic shift acknowledges the necessity of investing resources effectively to protect avian and other macroecological elements at the site level within a comprehensive framework of biodiversity conservation (KBA NCG, 2024).

According to the KBA dataset, the PAOI overlaps with the Eastern Gamka Karoo KBA (Figure 4-13). This site qualifies as a Key Biodiversity Area of international significance that meets the thresholds for 3 criteria described in the Global Standard for the Identification of KBAs. Based on current available information, 4 species meet one or more KBA.

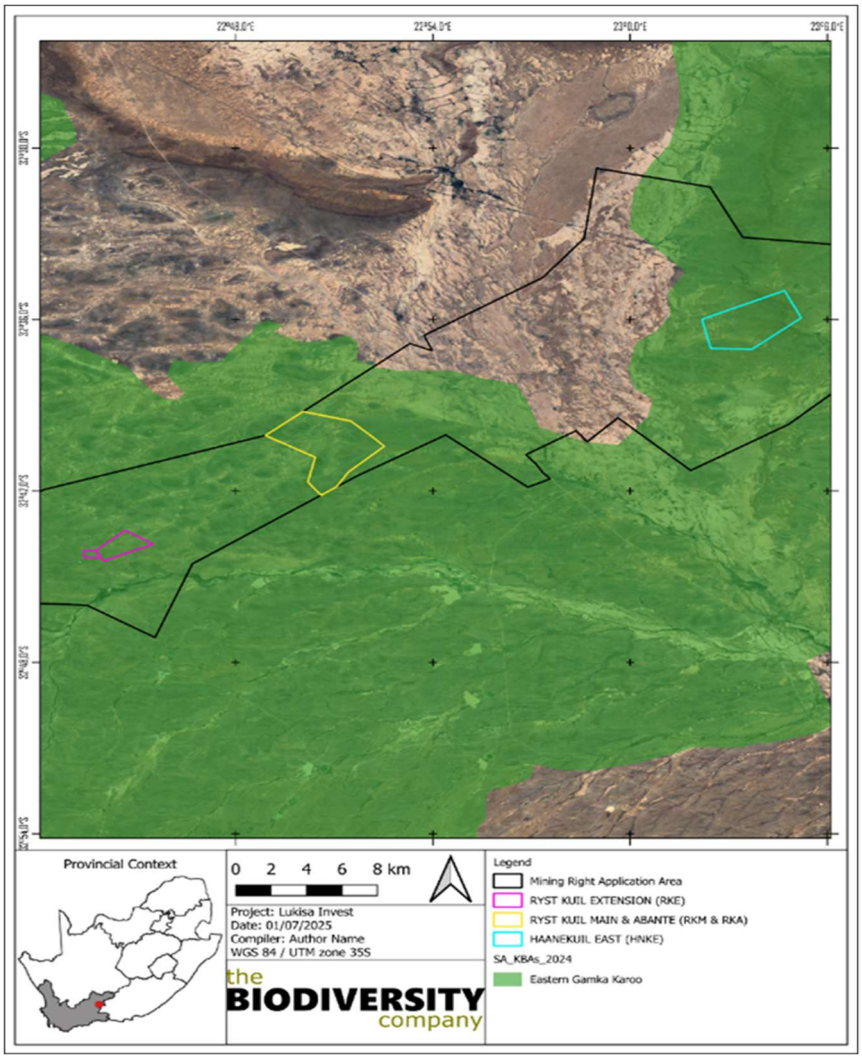


Figure 4-13. Map illustrating the PAOI in relation to the Key Biodiversity Areas dataset.

4.1.5.6 National Freshwater Ecosystem Priority Area Status

The National Freshwater Ecosystem Priority Areas (NFEPA) database forms part of a comprehensive approach to the sustainable and equitable development of South Africa's scarce water resources. This database provides guidance on how many rivers, wetlands and estuaries, and which ones, should remain in a natural or near-natural condition to support the water resource protection goals of the National Water Act (Act 36 of 1998). This directly applies to the National Water Act, which feeds into Catchment Management Strategies, water resource classification, reserve determination, and the setting and monitoring of resource quality objectives (Nel *et al*., 2011). The NFEPAs are intended to be conservation support tools and envisioned to guide the effective implementation of measures to achieve the National Environment Management Biodiversity Act's biodiversity goals (NEM: BA) (Act 10 of 2004), informing both the listing of threatened freshwater ecosystems and the process of bioregional planning provided for by this Act (Nel *et al*., 2011).

Therefore, conserving the water quality, riverine and wetland habitat and associated ecological functioning within the project area and associated catchments, will aid in the protection of riverine habitat supporting fish species occurring within the entire catchment and water quality for the aquatic and terrestrial biota downstream of the project area. The catchments in which human activities occur need to be managed to maintain water quality and prevent further degradation of local and downstream water resources in order to contribute to national biodiversity goals and support sustainable use of water resources. According to the NFEPA dataset, the PAOI does not overlap with Priority NFEPA rivers or wetlands (Nel *et al.,* 2011) (Figure 4-14).

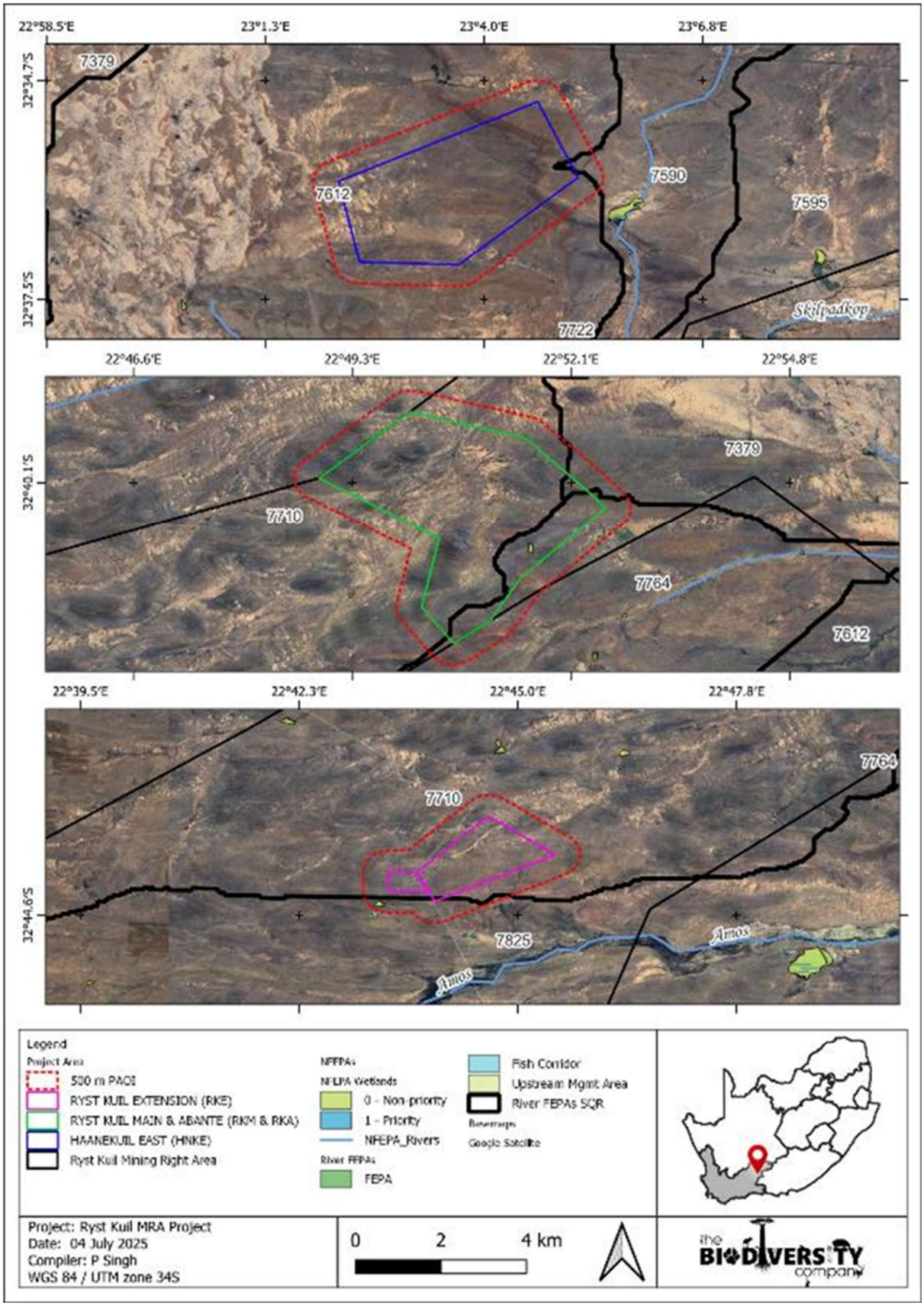


Figure 4-14. Map illustrating the PAOI in relation to the National Freshwater Ecosystem Priority Area Freshwater Ecology.

The project areas fall within the Mzimvubu_Tsitsikamma (WMA) (DWS, 2023), the Great Karoo Level 1 Ecoregion, and within the L11G, L12A and L12B quaternary catchments (Figure 4-15). Desktop information for the Sub-Quaternary Reaches (SQRs) associated with the PAOI was obtained from the DWS (2014). The PAOI falls within L11G-07710, L11G-07612, L11G-07764, L11G-07379, L12A-07825 and L12B-07590 SQRs. The Present Ecological State (PES), Ecological Importance (EI), and Ecological Sensitivity (ES) for the SQRs are summarised in Table 4-3. The SQR impacts and activities include agriculture and cultivation, cleared riparian areas, alluvium and erosion, water quality impacts, instream dams, bush encroachment and anti-erosion berms. Ultimately the receiving system from the project areas is the Sout River, which confluences with the Groot River, and finally the Gamtoos River which drains into the Indian Ocean.

Table 4-3. PES of systems and the SQR associated with the project (DWS, 2014)

Component/SQR	L11G-07710	L11G-07612	L11G-07764	L11G-07379	L12A-07825	L12B-07590
River name	-	-	-	-	Amos	-
Present Ecological Status	Largely Natural (B)	Largely Natural (B)	Moderately Modified (C)	Largely Natural (B)	Moderately Modified (C)	Moderately Modified (C)
Ecological Importance (EI)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Ecological Sensitivity (ES)	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

PES – Present Ecological State | REC – Recommended Ecological Category | TEC – Target Ecological Category

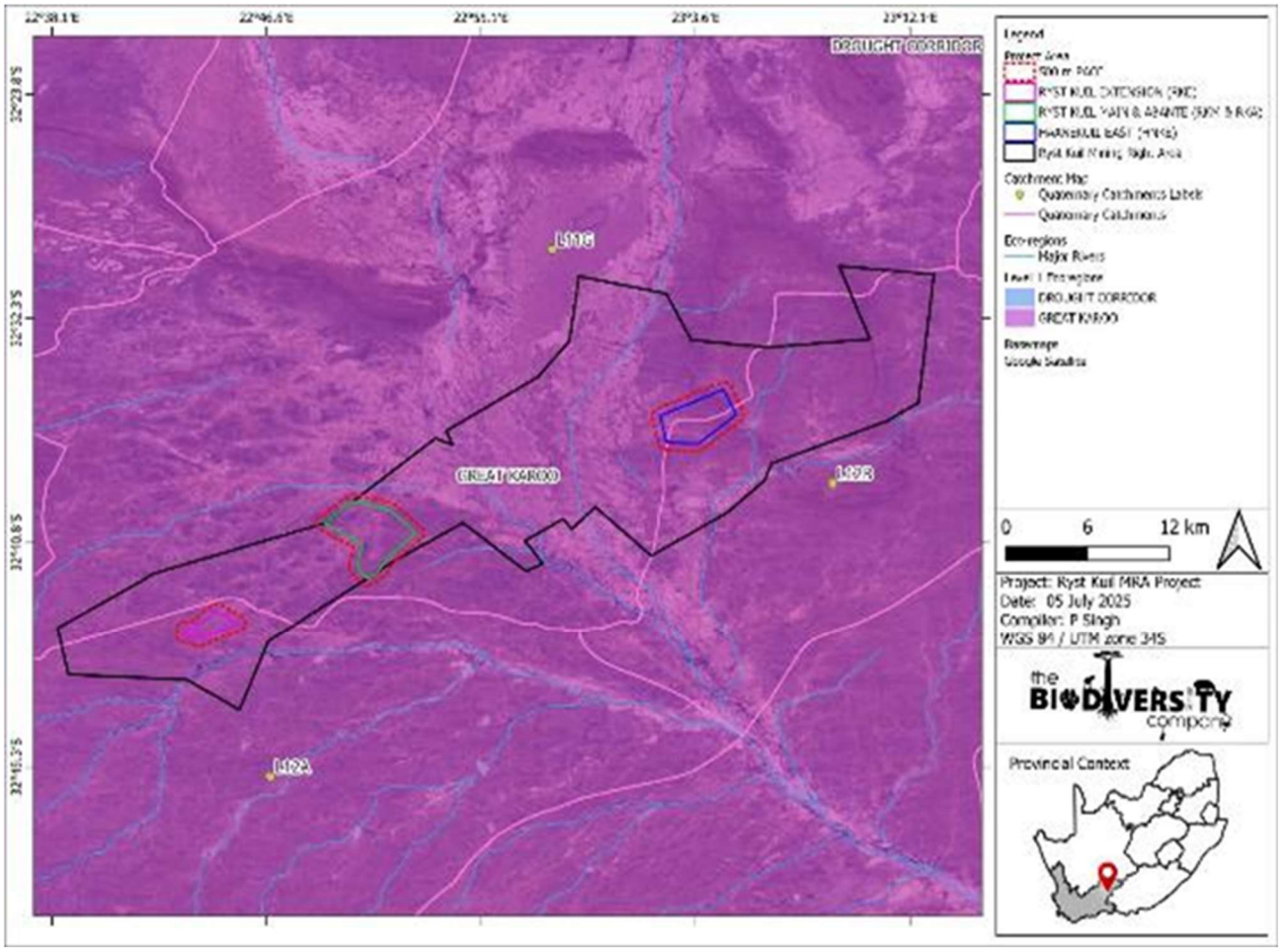


Figure 4-15. Hydrological aspects associated with the project area.

4.1.5.7 Resource Quality Objectives

The The National Water Act promotes sustainable water use and management through measures such as Resource Quality Objectives (RQOs), which define desired biological, chemical, and physical conditions for protecting water resources. RQOs guide assessments of flow, water quality, riparian habitat, and aquatic biota against required protection levels. For this assessment, the project area falls within the Mzimvubu-Tsitsikamma Water Management Area, but no specific RQOs were available for the L11G, L12A, or L12B catchments at the time of reporting.

4.1.5.8 Fresh water Survey Results

4.1.5.8.1 Investigation Sites

A single low flow survey was conducted between the 19th and 23rd of May 2025. Sampling points (Figure 4-16) were selected for the study to assess the current state of the associated watercourses and identify potential risks that may result from the project. Only watercourses at an appreciable level of risk in relation to the proposed project and related activities were considered for assessment. Site investigations were conducted on systems presenting adequate surface water to conduct biological assessments. Photographs and Global Positioning System (GPS) coordinates pertaining to the sites are presented in Figure 4-16 and Table 4-4.

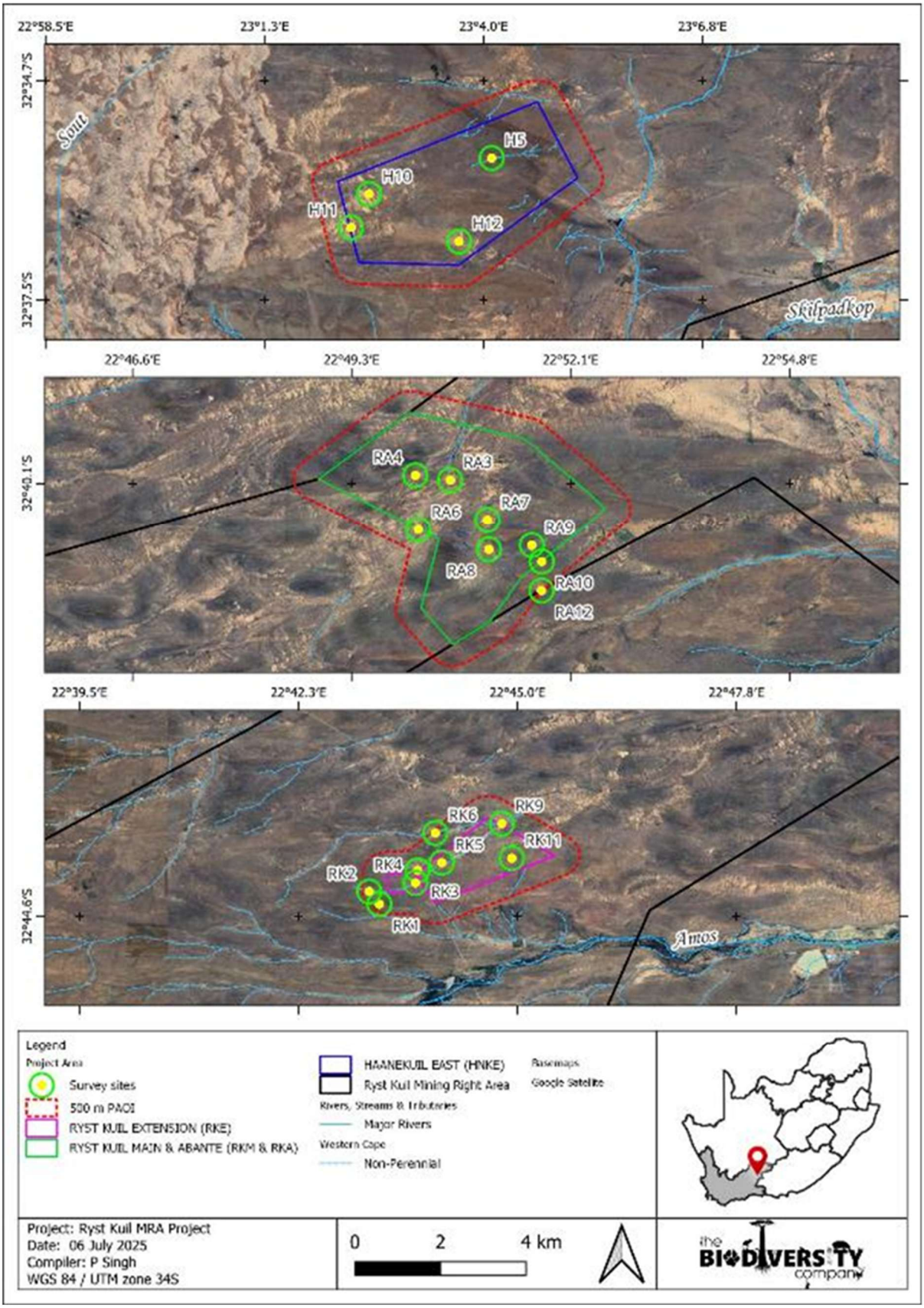
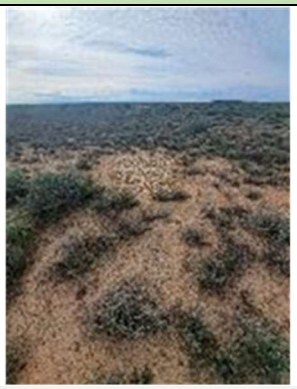


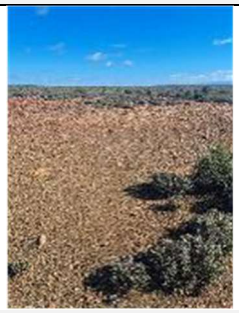
Figure 4-16. Locality map of the sampling sites within the PAOI.

Table 4-4. Photos and coordinates for the sites sampled (May 2025)

Site	Upstream View	Downstream View
Hannekuil East		
H5		
GPS	32°35'41.65"S; 23° 4'7.32"E	
H10		
GPS	32°36'8.81"S; 23° 2'34.75"E	
H11		
GPS	32°36'34.02"S; 23° 2'21.08"E	
H12		
GPS	32°36'44.58"S; 23° 3'42.76"E	

Ryst Kuil Main & Abante		
RA3		
GPS	32°40'4.26"S; 22°50'33.64"E	
RA4		
GPS	32°40'0.65"S; 22°50'7.32"E	
RA6		
GPS	32°40'41.87"S; 22°50'9.52"E	
RA7		
GPS	32°40'34.58"S; 22°51'1.82"E	
RA9		
GPS	32°40'53.82"S; 22°51'35.38"E	

RA10		
GPS	32°41'6.31"S; 22°51'42.91"E	
Ryst Kuil Extension		
RK1 (Pan 1)		
GPS	32°44'28.29"S; 22°43'16.30"E	
RK2		
GPS	32°44'18.82"S; 22°43'8.64"E	
RK4		
GPS	32°44'12.19"S; 22°43'43.67"E	
RK5		
GPS	32°43'56.92"S;22°44'3.64"E	

RK6		
GPS	32°43'34.49"S;22°43'58.68"E	
RK9		
GPS	32°43'27.32"S; 22°44'49.10"E	
RK10 (Pan 3)	No Access	No Access
GPS	32°43'29.63"S; 22°45'6.83"E	
RK11 (Pan 2)		
GPS	32°43'53.57"S;22°44'56.56"E	

4.1.5.9 Index of Habitat Integrity

Watercourse condition and aquatic biodiversity largely depend on the surrounding catchment. Intact catchments support healthy ecosystems, strong ecological functions, and high biodiversity, while modified catchments have lower ecological value, reduced services (e.g., phytoremediation), and only tolerant species persist. The Index of Habitat Integrity (IHI) assessed selected drainage reaches, showing that watercourses are part of a connected ecosystem but differ in vegetation, hydropedology, and land use. Results indicated 'Largely Natural' (Class B) habitat integrity for Haanekuil and Ryst Kuil Extension, and 'Moderately Modified' for Ryst Kuil Main and Abante, with impacts from farm tracks, crossings, agriculture, and wildlife/livestock trampling and grazing.

Table 4-5. Results for the Instream Habitat Integrity assessment for the associated reaches of the watercourses (May 2025)

Instream Criteria	Haanekuil (Drainage Areas 1-5)	Ryst Kuil Main & Abante (Drainage Areas 10-12)	Ryst kuil Extension (Drainage Areas 6-9)
Water abstraction	5	10	3
Flow modification	8	8	5
Bed modification	6	6	5

Channel modification	6	8	5
Phys-chem modification	2	2	2
Inundation	5	5	5
Alien macrophytes	0	0	0
Introduced aquatic fauna	0	0	0
Rubbish dumping	2	2	2
Instream Habitat Integrity Score	**83**	**79**	**87**
Instream Habitat Integrity Category	**B**	**C**	**B**
Riparian Criteria	**Haanekuil (Drainage Areas 1-5)**	**Ryst Kuil Main & Abante (Drainage Areas 10-12)**	**Ryst kuil Extension (Drainage Areas 6-9)**
Vegetation removal	3	8	3
Exotic vegetation	1	5	1
Bank erosion	4	6	4
Channel modification	6	8	6
Water abstraction	6	10	6
Inundation	2	5	2
Flow modification	5	3	5
Phys-chem	1	2	1
Riparian Zone Integrity Score	**86**	**76**	**86**
Riparian Zone Integrity Category	**B**	**C**	**B**

4.1.5.10 Aquatic Macroinvertrebrates

SASS5 biological assessments could not be conducted as the watercourses did not meet method requirements. Although no vernal biota were observed in the May 2025 survey, species like tadpole shrimp, fairy shrimp, clam shrimp, and seed shrimp are expected in these ephemeral systems. These organisms are adapted to seasonal wetland conditions, making the habitats ecologically sensitive. Mining activities could disrupt hydrology, remove soil, or cause contamination, leading to irreversible biodiversity loss; therefore, these wetlands should be avoided for mining.

4.1.5.11 Fish Community Structure

No ichthyofauna assessment could be done at the time of the survey due to the ephemeral nature of the project areas. Due to periodic connectivity with riverine systems and the absence of suitable habitat, no fish species are expected within the project or PAOI.

4.1.5.12 Wetland Assesment

During the May 2025 survey three (3) depression wetland (ephemeral pans) were identified within the Ryst Kuil Extension project area/PAOI only: Pan 1, Pan 2 and Pan 3. These wetlands are classified as ephemeral, only flooding/inundated during high rainfall events, and are highly sensitive to disturbance due to their slow natural recovery rates.

4.1.5.12.1 General Functional Description

Ephemeral pans are shallow, seasonally or intermittently inundated depressions, often found in arid and semi-arid regions such as the Karoo. They are a type of depressional wetland that is characterised by:

- **Temporary inundation**: Water is present only after rainfall events, often for short periods.
- **High variability**: Both the extent and duration of inundation can vary greatly between years.

- **Salinity**: Many pans are saline or brackish due to high evaporation rates and limited outflow.
- **Vegetation**: Dominated by salt-tolerant and drought-adapted species, with vegetation often forming concentric zones around the pan margin.
- **Biodiversity**: Provide critical habitat for specialized flora and fauna, including migratory birds and unique invertebrates.

It should be noted that these characteristics are representative of ideal wetland features and may not necessarily represent the characteristics of all wetlands. The functionality of wetlands and the provision of benefits is largely dependent on wetland size and influence from abiotic drivers.

4.1.5.12.2 Ecosystem Services

The ecosystem services provided by the relevant wetland units on site were assessed and rated using the WET-EcoServices method (Kotze *et al.,* 2008). The results of the assessment are presented in Table 4-6. The systems provide services with an overall moderately high and high level of benefit.

Table 4-6. Summary of the average ecosystem scores of the assessed wetland units

Project Area	Wetland Unit Name	EcoServices
Ryst Kuil Extension	Pan 1 – Ephemeral Pan	High
	Pan 2 – Ephemeral Pan	Moderately High
	Pan 3 – Ephemeral Pan	Moderately High

Ephemeral pans supply a range of ecosystem services, though these may be limited by their temporary nature. Ecosystem services are sensitive to changes in hydrology, overgrazing, and land use. Services include:

- **Biodiversity support**: Important breeding and feeding sites for birds and amphibians.
- **Water regulation**: Temporary storage of surface water, contributing to groundwater recharge.
- **Resource provision**: Grazing for livestock, especially after rain.
- **Cultural value**: Some pans have local cultural or historical significance.

4.1.5.12.3 Ecological Importance and Sensitivity

The assessed wetlands have high ecological importance and sensitivity (EIS). Both pans and valley floor depressions provide critical habitat for specialized aquatic and terrestrial species and support key hydrological functions. Their main ecosystem service is biodiversity maintenance, with additional roles in sediment trapping, erosion control, flood attenuation, natural resource provision, and serving as ecological corridors in the arid landscape. Pans feature clay-rich soils with deep cracks, surface crusts, increasing organic content with depth, and calcite. Vegetation is sparse in pan centres but more diverse along edges and drainage areas.

Table 4-7. Aspects considered in the Ecological Importance and Sensitivity assessment

Project Area	Wetland Unit Name	EIS
Ryst Kuil Extension	Pan 1 – Ephemeral Pan	High
	Pan 2 – Ephemeral Pan	High
	Pan 3 – Ephemeral Pan	High

4.1.5.13 Present Ecological Status

The Present Ecological State (PES) assessment from the May 2025 survey showed that drainage areas in Haanekuil and Ryst Kuil Extension were 'Largely Natural' (Class B), while Ryst Kuil Main and Abante were 'Moderately Modified' (Class C). Wetland pans in Ryst Kuil Extension were also Class B. All watercourses met the Recommended Ecological Category (REC) of Class C. Results reflect a single survey and should be interpreted with this limitation in mind.

Table 4-8. Present Ecological Status

Component/Aspect Assessed	Haanekuil	Ryst Kuil Main & Abante	Ryst Kuil Extension		
	Drainage Areas 1-5	Drainage Areas 10-12	Drainage Areas 6-9	Pan 1	Pan 2 & Pan 3
RIPARIAN COMPONENT					
Instream Habitat Integrity	**B**	**C**	**B**	-	-
Riparian Habitat Integrity	**B**	**C**	**B**	-	-
WETLAND COMPONENT					
Hydrology	-	-	-	**B**	**B**
Geomorphology	-	-	-	**B**	**B**
Vegetation	-	-	-	**B**	**B**
Present Ecological State	**B**	**C**	**B**	**B**	**B**
Recommended Ecological Category (DWS, 2014)	**C**	**C**	**C**	**C**	**C**
Recommended Management Objective	**Maintain**	**Maintain**	**Maintain**	**Maintain**	**Maintain**
DWS Ecostatus (DWS, 2014)	**B/C**	**B/C**	**B/C**	**B/C**	**B/C**

4.1.5.14 Watercourse Delineations and Buffer Requirements

The riparian areas along the assessed watercourses were delineated according to DWAF (2005), 5 m contour data, the SAIIAE dataset (NBA National Wetland Map, 2018), and the latest Google Earth aerial imagery (2024) as well as a site visit. The project areas include a vast drainage network that eventually drains to the Sout River. The drainage network is also associated with valley floor depression wetlands within the Ryst Kuil Extension project area (Pans 1-3). The delineated watercourses are presented in Figure 4-17 below.

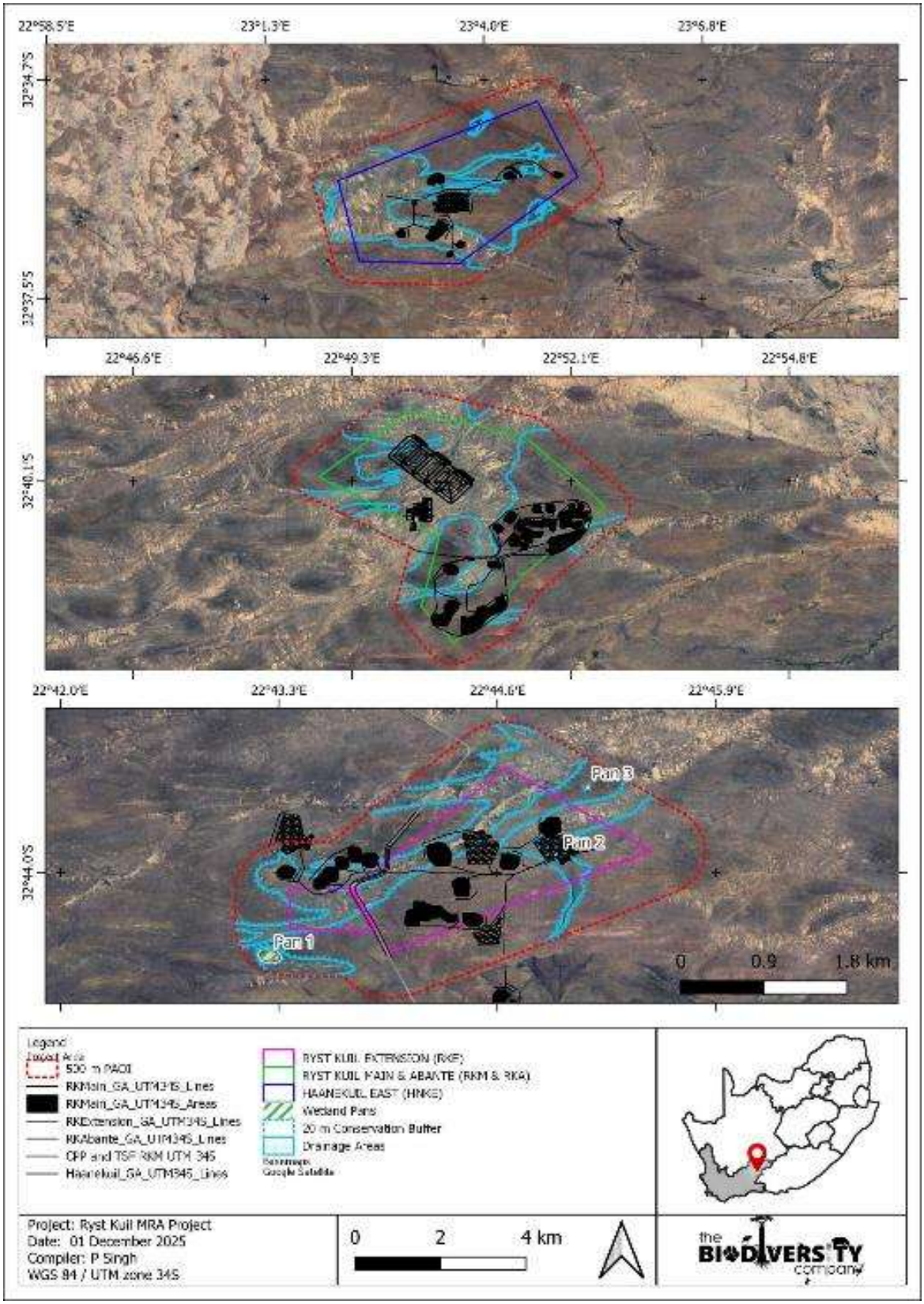


Figure 4-17. Watercourses and their assigned ecological protection buffers and ZoR with the PAOI.

4.1.5.15 General Buffer Requirements and Development Setbacks

Riparian areas are highly valuable for conservation, providing wildlife habitat, supporting livestock forage, contributing to the hydrological cycle, and stabilizing riverbanks to prevent erosion. Buffer zones are essential

to maintain ecosystem functioning and services, especially since watercourses affected by the project are sensitive to disturbance. Buffers are high-priority no-go areas, with a minimum of 32 m for rivers (NEMA) and 20 m for drainage areas and wetland pans. Maintaining these buffers enhances watercourse resilience and should guide the site development and mining plans..

4.1.5.16 Site Sensitivity Verification

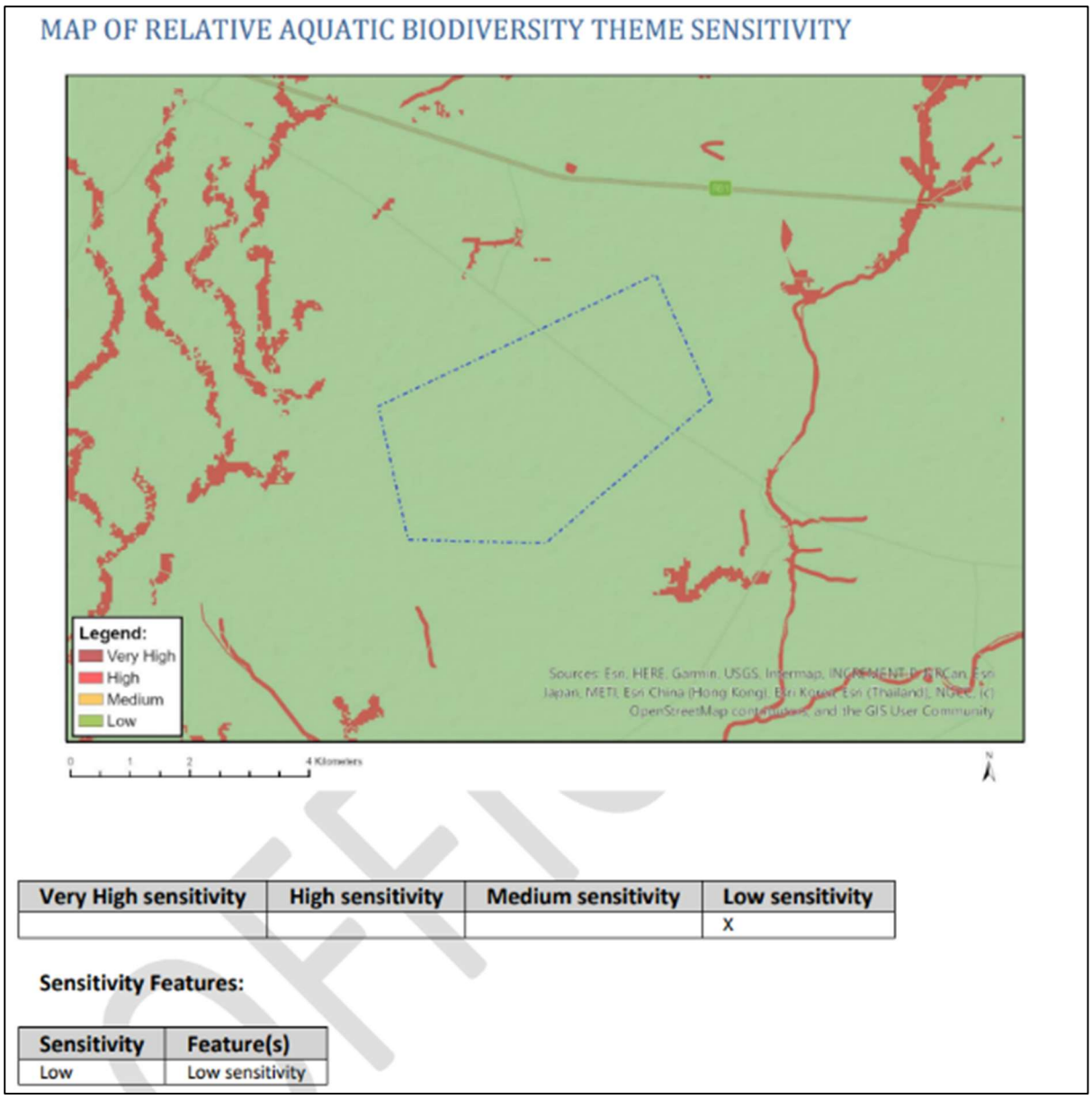
4.1.5.16.1 Ecological Sensitivity

The following is deduced from the National Web-based Environmental Screening Tool (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended) and the current assessment:

- The National Web-Based Environmental Screening Tool has characterised the aquatic theme sensitivity of the project area and the PAOI and footprint development as “Low” and “High” (Figure 4-18 to Figure 4-20).

- The desktop assessment and site visit disputed these ratings. The reaches are susceptible to further impacts, particularly on water quality and physical disturbances to instream and riparian habitat. The freshwater ecology of the immediate project area is considered sensitive to disturbance from a hydrological and biological perspective. This will include the depression adjacent to the project area, which is considered sensitive due to the ecosystem services that these watercourse features provide. The construction and operational activities must take cognizance of this and avoid any unnecessary disturbance of the watercourse and adjacent habitat.

- ‘High’ freshwater sensitivities were assigned to all delineated wetlands. ‘Medium’ sensitivities were assigned to the drainage and buffer areas, and ‘Low’ sensitivities were assigned to the remainder of the area within the PAOI. The ‘High’ sensitivity areas would be deemed ‘No go’ areas for high impact activities such as mining, whilst the ‘Low’ and ‘Medium’ sensitivity areas can be considered as mining areas in terms of aquatic sensitivity and subject to environmental authorisation and suitable mitigation (including rehabilitation). The specialist aquatic sensitivity map is provided below in Figure 4-21.



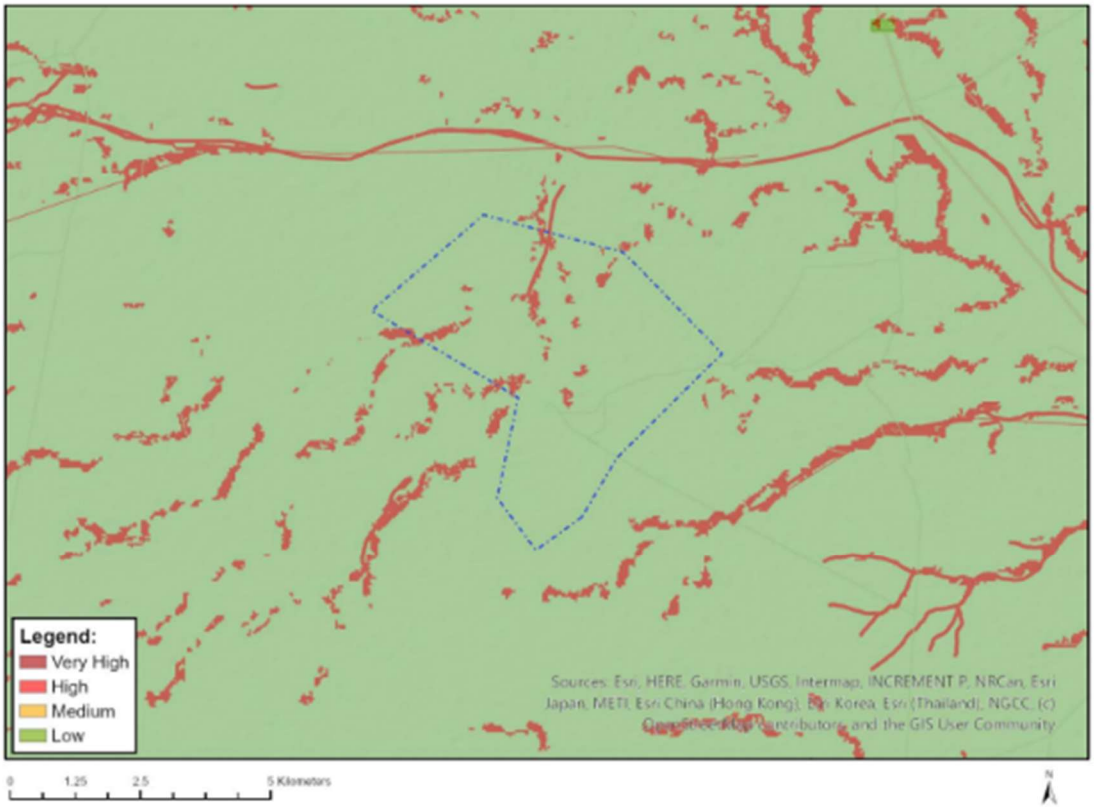
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
			X

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity

Figure 4-18. Aquatic Biodiversity Theme Sensitivity for the PAOI – Hannekuil project Area.

MAP OF RELATIVE AQUATIC BIODIVERSITY THEME SENSITIVITY

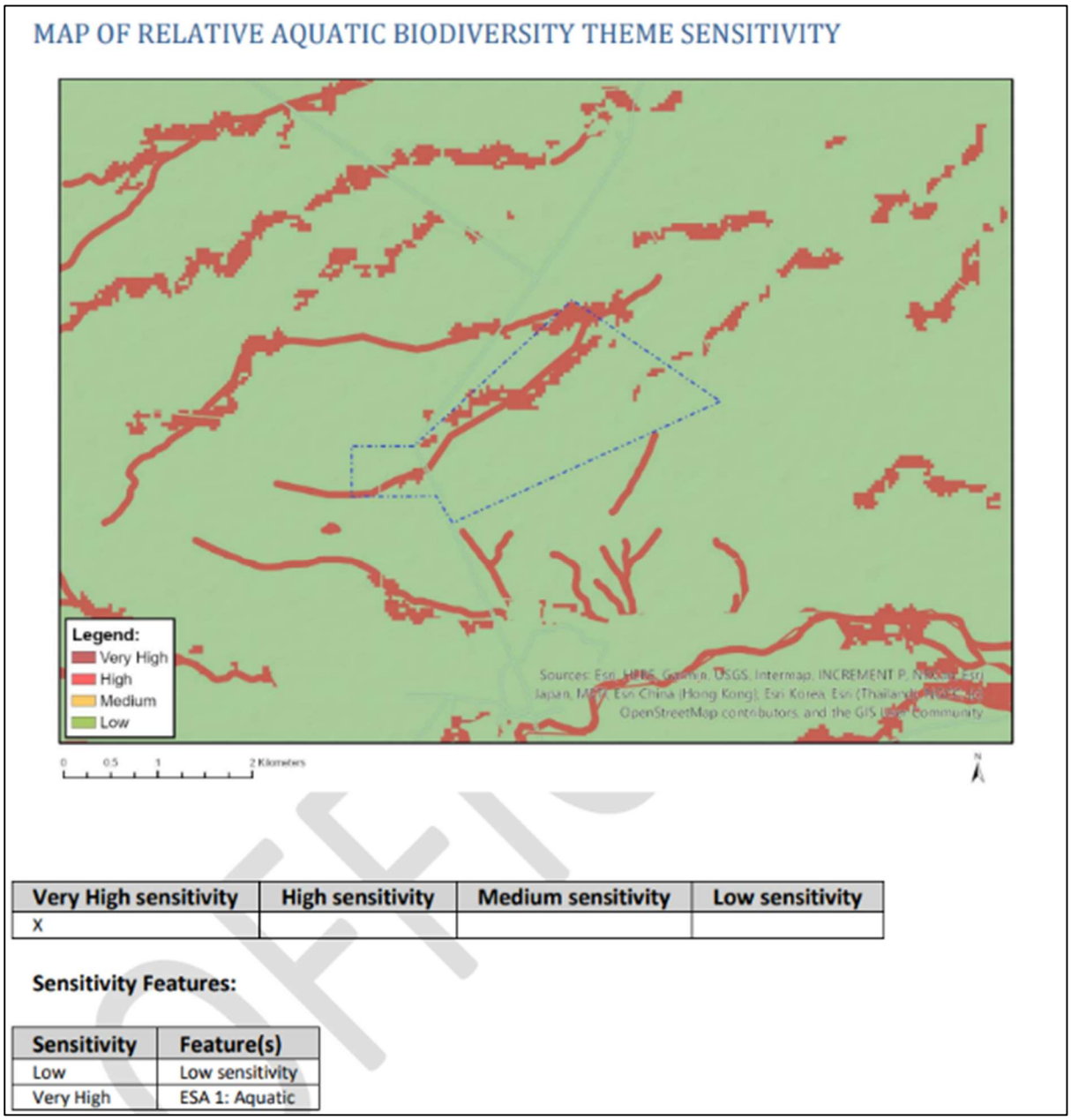


Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1: Aquatic

Figure 4-19. Aquatic Biodiversity Theme Sensitivity for the PAOI – Ryst Kuil Main and Abante project Area.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Low	Low sensitivity
Very High	ESA 1: Aquatic

Figure 4-20. Aquatic Biodiversity Theme Sensitivity for the PAOI – Ryst Kuil Extension project Area.

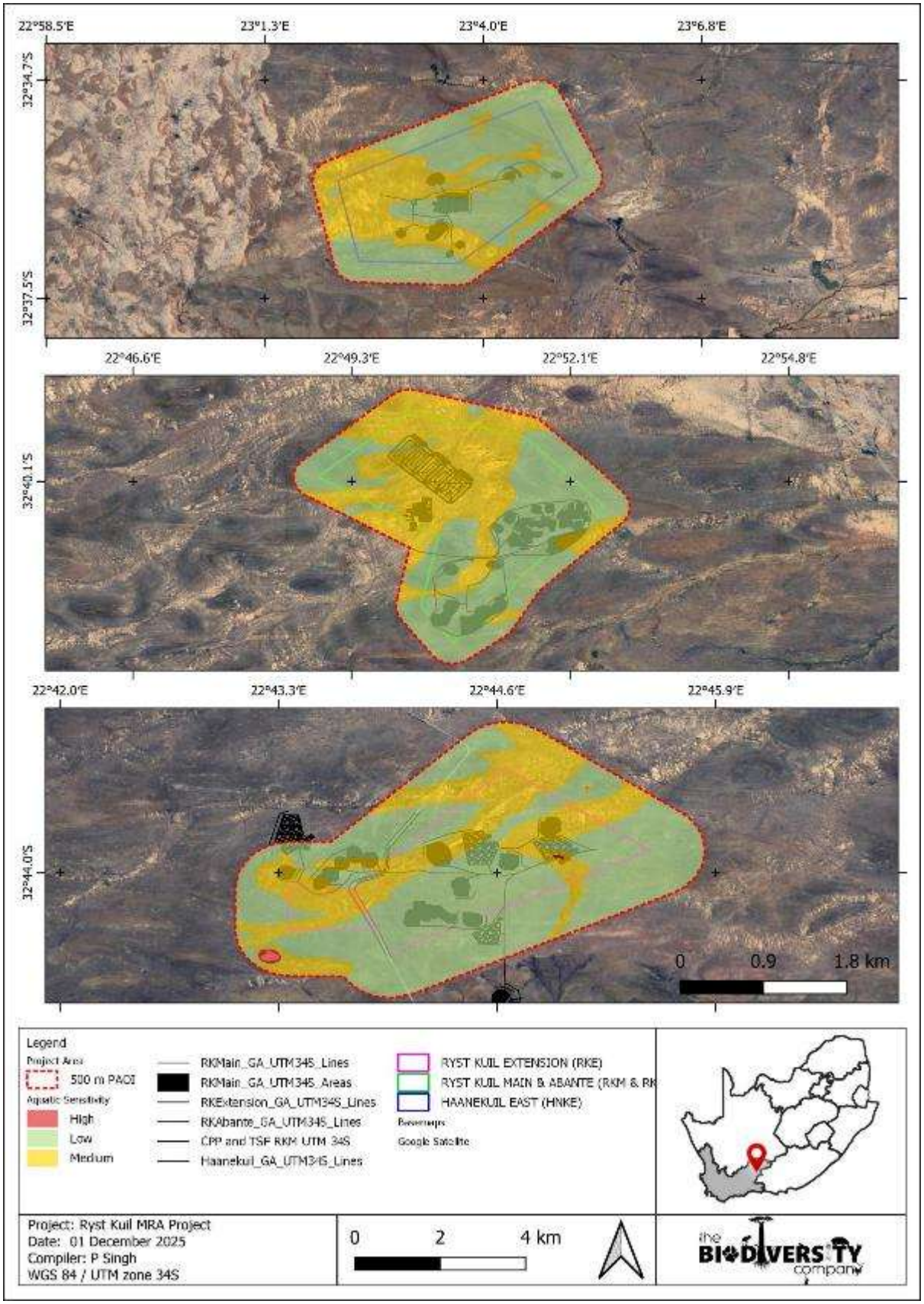


Figure 4-21. Specialist aquatic delineated sensitivity for the PAOI.

4.1.5.17 Flora Assessment

This section is divided into a description of the vegetation type expected under natural conditions and the expected flora species.

4.1.5.17.1 Vegetation Type

The PAOI falls within the Nama Karoo Biome. This biome is found in the central plateau of the western half of South Africa. The geology underlying the biome is varied, as the distribution of this biome is determined primarily by rainfall. The rain falls in summer and varies between 100 and 520 mm per year. This also determines the predominant soil type - over 80% of the area is covered by a lime-rich, weakly developed soil over rock. Although less than 5% of rain reaches the rivers, the high erodibility of soils poses a major problem where overgrazing occurs (SANBI, 2019).

The dominant vegetation is a grassy, dwarf shrubland. Grasses tend to be more common in depressions and on sandy soils, and less abundant on clayey soils. Grazing rapidly increases the relative abundance of shrubs. Most of the grasses are of the C4 type and, like the shrubs, are deciduous in response to rainfall events (SANBI, 2019).

The PAOI is situated in the Gamka Karoo vegetation type according to SANBI (2018) (Figure 4-22), which is a member of the Lower Karoo Bioregion.

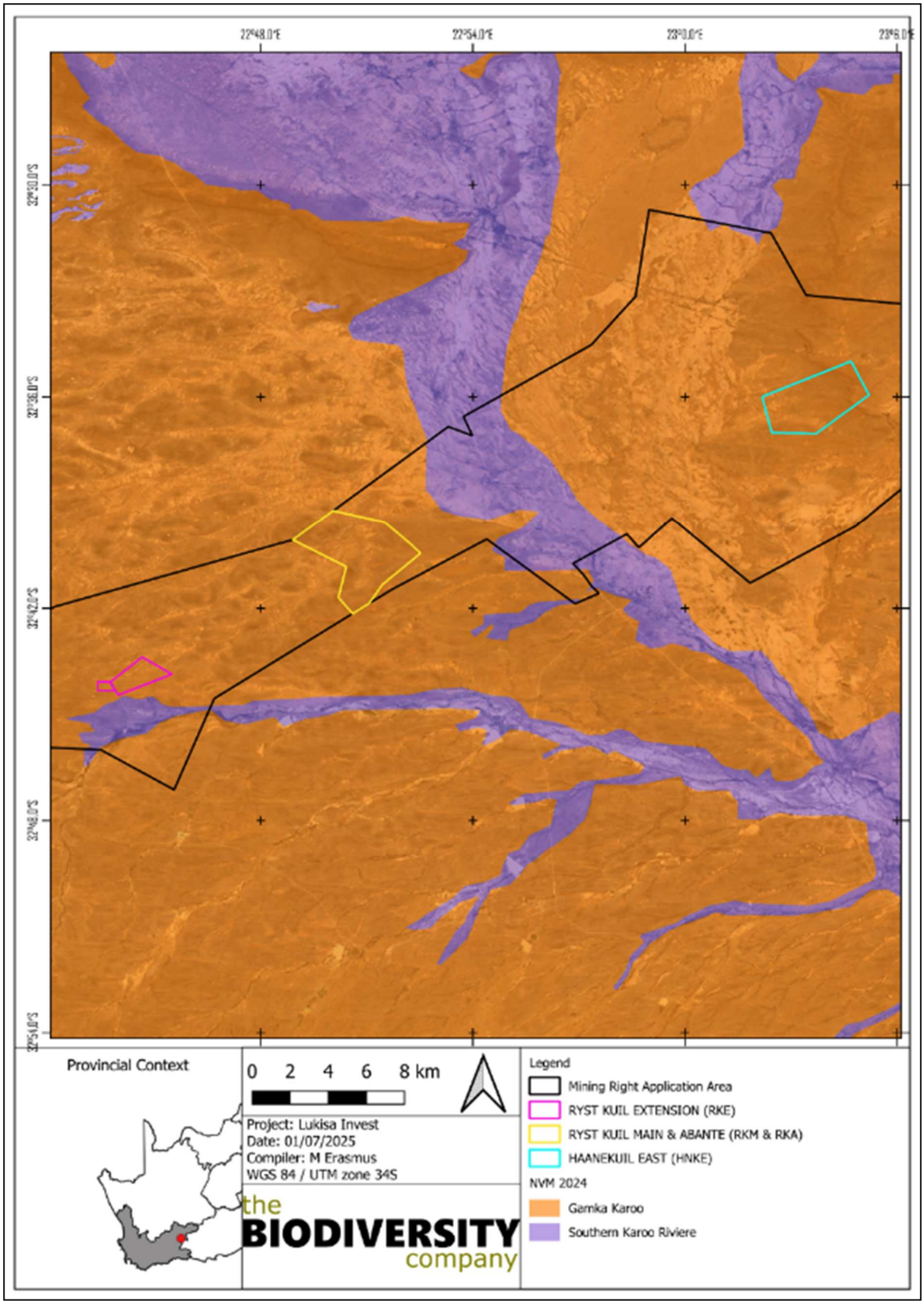


Figure 4-22. Map illustrating the vegetation types associated with the PAOI.

4.1.5.17.2 Gamka Karoo

Western Cape and Eastern Cape Provinces and marginally into the Northern Cape Province: Large basin between the Great Escarpment (Nuweveld Mountains) in the north and northwest and Cape Fold Belt Mountains (mostly Swartberg Mountains) in the south. From approximately the edge of the Gamka basin catchment area (i.e. of the Dwyka River tributary) in the west to about the Kariega River in the east. Altitude varies mostly from 500 to 1,100 m.

Vegetation & Landscape Features

Extremely irregular to slightly undulating plains covered with dwarf spiny shrubland dominated by Karoo dwarf shrubs (e.g., *Chrysocoma ciliata, Eriocephalus ericoides*) with rare low trees (e.g., *Euclea undulata*). Dense stands of drought-resistant grasses (*Stipagrostis, Aristida*) cover broad sandy bottomlands, especially after abundant rains.

Important Plant Taxa in the Gamka Karoo

Tall Shrubs: *Lycium cinereum (d), L. oxycarpum (d), Rhigozum obovatum (d), Vachellia karroo, Cadaba aphylla, Lycium schizocalyx, Searsia burchellii, Sisyndite spartea.*

Low Shrubs: *Chrysocoma ciliata (d), Eriocephalus ericoides subsp. ericoides (d), E. spinescens (d), Felicia muricata (d), Galenia fruticosa (d), Limeum aethiopicum (d), Pentzia incana (d), Pteronia adenocarpa (d), Rosenia humilis (d), Aptosimum indivisum, Asparagus burchellii, Blepharis mitrata, Eriocephalus microphyllus var. pubescens, Felicia filifolia subsp. filifolia, F. muricata subsp. cinerascens, Galenia secunda, Garuleum bipinnatum, G. latifolium, Gomphocarpus filiformis, Helichrysum lucilioides, Hermannia desertorum, H. grandiflora, H. spinosa, Melolobium candicans, Microloma armatum, Monechma spartioides, Pentzia pinnatisecta, Plinthus karooicus, Polygala seminuda, Pteronia glauca, P. sordida, P. viscosa, Selago geniculata, Sericocoma avolans, Zygophyllum microcarpum, Z. microphyllum.*

Succulent Shrubs: *Ruschia intricata (d), Aridaria noctiflora subsp. straminea, Crassula muscosa, Drosanthemum lique, Galenia sarcophylla, Kleinia longiflora, Ruschia spinosa, Salsola tuberculata, Sarcocaulon patersonii, Trichodiadema barbatum, Tripteris sinuata var. linearis.*

Semi parasitic Shrub*: Thesium lineatum*.

Herbs: *Gazania lichtensteinii (d), Chamaesyce inaequilatera, Dicoma capensis, Galenia glandulifera, Lepidium africanum subsp. africanum, L. desertorum, Lessertia pauciflora var. pauciflora, Leysera tenella, Osteospermum microphyllum, Sesamum capense, Tetragonia microptera, Tribulus terrestris, Ursinia nana.*

Geophytic Herbs: *Drimia intricata, Moraea polystachya*.

Graminoids: *Aristida congesta (d), A. diffusa (d), Fingerhuthia africana (d), Stipagrostis ciliata (d), S. obtusa (d), Aristida adscensionis, Cenchrus ciliaris, Digitaria argyrograpta, Enneapogon desvauxii, Enneapogon scaber, Eragrostis homomalla, E. lehmanniana, E. obtusa, Tragus berteronianus, T. koelerioides.*

Biogeographically Important Taxa (Endemic to Great Karoo Basin)

Succulent Shrubs: *Hereroa latipetala* (also found in Prince Albert Succulent Karoo), *H. odorata* (also found in Koedoesberge-Moordenaars Karoo), *Pleiospilos compactus* (southern and western limits of distribution), *Rhinephyllum luteum, Stapelia engleriana*.

Geophytic Herb: *Tritonia tugwelliae*.

Low Shrub: *Felicia lasiocarpa*.

Succulent Herbs*: Piaranthus comptus, Tridentea parvipuncta subsp. parvipuncta*.

Graminoid: *Oropetium capense* (westernmost limit of distribution).

Endemic Taxa

Succulent Shrubs: *Chasmatophyllum stanleyi, Hereroa incurva, Hoodia dregei, Ruschia beaufortensis*.

Low Shrubs: *Jamesbrittenia tenuifolia*.

Herb: *Manulea karrooica.*

Succulent Herb*: Piaranthus comptus*.

Conservation Status

Least threatened. The conservation target is 16%. About 2% statutorily conserved in the Karoo National Park and some in private reserves, such as Steenbokkie Private Nature Reserve (near Beaufort West). Only a small part has undergone transformation. Erosion is moderate (78%), low (11%), and high (11%)

4.1.5.18 Expected Flora Species

The iNaturalist database indicates that 393 species of plants are expected to occur within the PAOI (see Appendix D). Seven (7) species of conservation concern (SCC) were listed by the iNaturalist database. The Screening Tool lists four (4) flora SCC that may occur within the PAOI. These are presented in Table 4-9.

Please note that the Screening Tool report includes lists of bird, mammal, reptile, amphibian, butterfly and plant species of conservation concern known or expected to occur on the proposed development footprint. Some of these SCC are sensitive to illegal harvesting. Such species have had their names obscured and are listed as sensitive plant unique number / sensitive animal unique number. As per the best practise guideline that accompanies the protocol and screening tool, please, remember that the **name of the sensitive species may not appear in the final EIA report nor any of the specialist reports released into the public domain**. It should be referred to as *sensitive plant* or *sensitive animal* and its threat status may be included, e.g. *critically endangered sensitive plant* or *endangered sensitive animal*.

Table 4-9. Flora SCC expected for the PAOI. DDD = Data Deficient, EN = Endangered, NT = Near Threatened, VU = Vulnerable

Family	Scientific name	Screening Tool Designation	SANBI	Habitat	Likelihood of Occurrence
Aizoaceae	*Peersia frithii*	Medium	VU	Koedoesberge-Moordenaars Karoo, Eastern Upper Karoo, Western Upper Karoo, Eastern Lower Karoo, Gamka Karoo, Matjiesfontein Shale Renosterveld, Southern Karoo Riviere - It occurs on slopes or flats of finely weathered Ecca shales.	Moderate
Aizoaceae	*Bijlia dilatata*	-	EN	Prince Albert Succulent Karoo, Swartberg Shale Renosterveld, Southern Karoo Riviere - Flat areas covered by decomposed dolerite and quartzitic pebbles.	Moderate
Aizoaceae	*Rhinephyllum inaequale*	-	EN	Eastern Lower Karoo, Southern Karoo Riviere - It grows in crevices in sandstone outcrops.	Moderate

Family	Scientific name	Screening Tool Designation	SANBI	Habitat	Likelihood of Occurrence
Aizoaceae	*Ruschia beaufortensis*	Medium	VU	It grows in arid Nama Karoo mountains	Low
Aizoaceae	*Pleiospilos nelii*	-	NT	Nama Karoo - Quartz covered flats in sparse karoo vegetation.	Moderate
Apocynaceae	*Hoodia gordonii*	-	DDD	Tanqua Escarpment Shrubland, Hantam Karoo, Bushmanland Inselberg Shrubland, Northern Knersvlakte Vygieveld, Northern Upper Karoo, Upper Karoo Hardeveld, Gamka Karoo, Bushmanland Basin Shrubland, Kalahari Karroid Shrubland, Bushmanland Arid Grassland, Western Gariep Hills Desert, Eastern Gariep Rocky Desert, Tanqua Wash Riviere - Occurs in a wide variety of arid habitats from coastal to mountainous, also on gentle to steep shale ridges, found from dry, rocky places to sandy spots in riverbeds.	Moderate
Apocynaceae	*Hoodia dregei*	-	VU	Gamka Karoo - It occurs on stony slopes of hills or on stony flat areas.	Moderate
Asparagaceae	*Eriospermum capense subsp. stoloniferum*	-	VU	Swartland Shale Renosterveld, Western Ruens Shale Renosterveld, Peninsula Shale Renosterveld, Lourensford Alluvium - Fynbos, Swartland Alluvium Fynbos	Moderate
Iridaceae	*Tritonia florentiae*		Rare	Tanqua Karoo, Prince Albert Succulent Karoo, Gamka Karoo - It occurs in a variety of vegetation types on gravel flats in washes and drainage lines, flowering in winter and responding rapidly to early winter rains that fall erratically.	Moderate
-	*Sensitive species 383*	Medium	VU	-	Moderate
-	*Sensitive species 1212*	Medium	VU	-	Confirmed

4.1.5.19 Fauna Assessment

4.1.5.19.1 Amphibians

Based on the FrogMap database, provided by the Animal Demography Unit (Fitzpatrick Institute of African Ornithology, 2023), five (5) amphibian species are expected for the PAOI (see Appendix D). One (1) amphibian SCC is expected to occur within the PAOI (Table 4-10). No species were listed by the Screening Tool.

Table 4-10. List of amphibian Species of Conservation Concern that may occur in the PAOI. NT = Near Threatened

Scientific Name	Common Name	Screening Tool Designation	Conservation Status		Likelihood of Occurrence
			SANBI	IUCN	
Pyxicephalus adspersus	Giant Bull Frog	-	NT	LC	Medium

4.1.5.19.2 Reptiles

Based on the ReptileMap database, provided by the Animal Demography Unit (Fitzpatrick Institute of African Ornithology, 2023), 23 reptile species are expected for the PAOI (see Appendix D). Four (4) reptile SCC are expected to occur within the PAOI (Table 4-11). One species was listed by the Screening Tool.

Table 4-11. List of reptile Species of Conservation Concern that may occur in the PAOI. LC = Least Concern, NT = Near Threatened, VU = Vulnerable

Scientific Name	Common Name	Screening Tool Designation	Conservation Status		Likelihood of Occurrence
			SANBI	IUCN	
Chersobius boulengeri	Karoo Padloper	Medium	EN	EN	Confirmed
Psammobates tentorius tentorius	Karoo Tent Tortoise	-	NT	NT	Confirmed

4.1.5.19.3 Mammals

The MammalMap database provided by the Animal Demography Unit (Fitzpatrick Institute of African Ornithology, 2023) lists 12 mammal species that could be expected to occur within the PAOI. Large species generally restricted to protected areas such as game reserves were not expected to occur in PAOI and were removed from the list but those identified by the Screening Tool are retained (see Appendix D). Two (2) mammal SCC are expected to occur within the PAOI (Table 4-12). One (1) mammal species was listed by the Screening Tool.

Table 4-12. List of mammal Species of Conservation Concern that may occur in the PAOI. EN = Endangered, LC = Least Concern, NT = Near Threatened, VU = Vulnerable

Scientific Name	Common Name	Screening Tool Designation	Conservation Status		Likelihood of Occurrence
			SANBI	IUCN	
Bunolagus monticularis	Riverine Rabbit	Medium	CR	CR	Low
Parotomys littledalei	Littledale's Whistling Rat	-	NT	LC	Medium

4.1.5.19.4 Avifauna

SABAP2 data indicate that 180 avifauna species are expected for the PAOI and surrounds (see Appendix D for full list). Of these, 18 are considered SCC (Table 4-13). The likelihood of occurrence within the POAI are included here and six SCC was observed/confirmed during the field investigations.

Table 4-13. Threatened avifauna species that are expected to occur within the PAOI. EN = Endangered, LC = Least Concern, NT = Near Threatened and VU = Vulnerable

Common Name	Scientific Name	Regional*	Global+	Likelihood of Occurrence
Southern Black Korhaan	*Afrotis afra**	VU	VU	Confirmed
Red-billed Teal	*Anas erythrorhyncha*	NT	LC	Low
Yellow-billed Duck	*Anas undulata*	NT	LC	Low
Blue Crane	*Anthropoides paradiseus*	VU	VU	Confirmed
Kori Bustard	*Ardeotis kori*	NT	NT	Confirmed
Kittlitz's Plover	*Charadrius pecuarius*	NT	LC	Low
Black Harrier	*Circus maurus*	EN	EN	Moderate
Burchell's Courser	*Cursorius rufus*	VU	LC	Low
Black-winged Kite	*Elanus caeruleus*	NT	LC	Moderate
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC	High
Lanner Falcon	*Falco biarmicus*	NT	LC	Confirmed
Lesser Kestrel	*Falco naumanni*	VU	LC	Moderate
Ludwig's Bustard	*Neotis ludwigii*	EN	EN	Confirmed

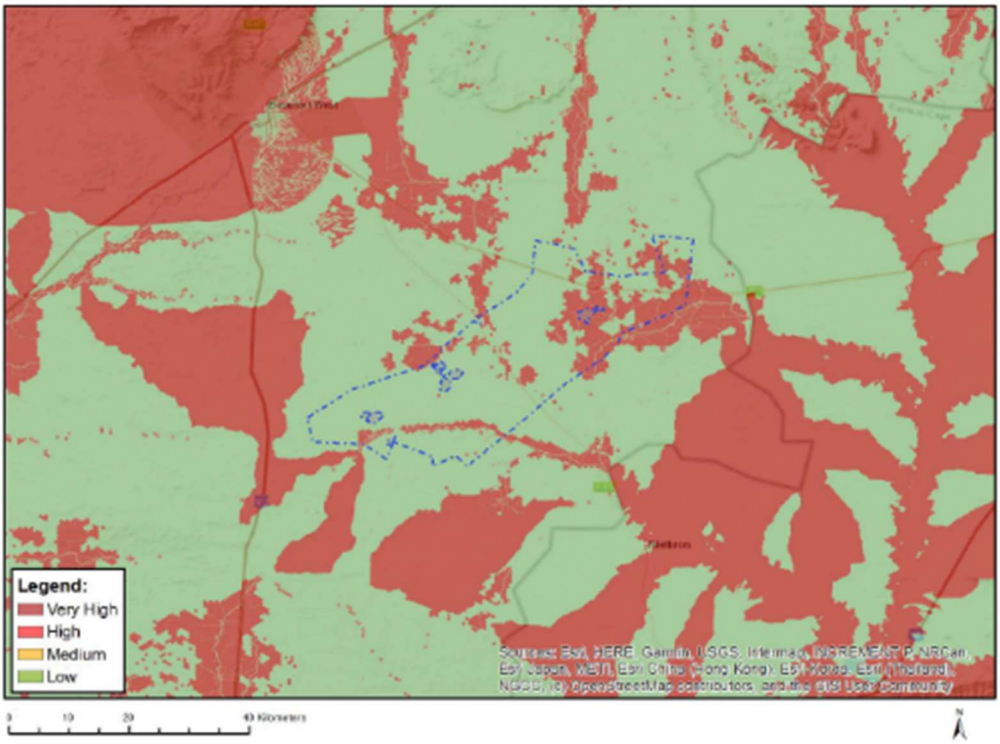
Martial Eagle	*Polemaetus bellicosus*	EN	EN	Confirmed
Secretarybird	*Sagittarius serpentarius*	VU	EN	High
Hamerkop	*Scopus umbretta*	NT	LC	Low
Cape Shoveler	*Spatula smithii*	NT	LC	Low
Sclater's Lark	*Spizocorys sclateri*	NT	NT	Moderate

4.1.5.20 DFFE Screening Tool

According to the Screening Tool Report generated (Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended).

- Terrestrial Biodiversity Theme sensitivity is Very High for the PAOI, with the possibility of a CBA 1, CBA 2, ESA 2 and FEPA Subcatchment being present (Figure 4-23);
- Plant Species Theme sensitivity is Medium for the PAOI, with the possibility of numerous medium and low sensitivity plant species being present (Figure 4-24); and
- Animal Species Theme sensitivity is High for the PAOI, with the possibility of numerous high and medium sensitivity species being present (Figure 4-25).

MAP OF RELATIVE TERRESTRIAL BIODIVERSITY THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

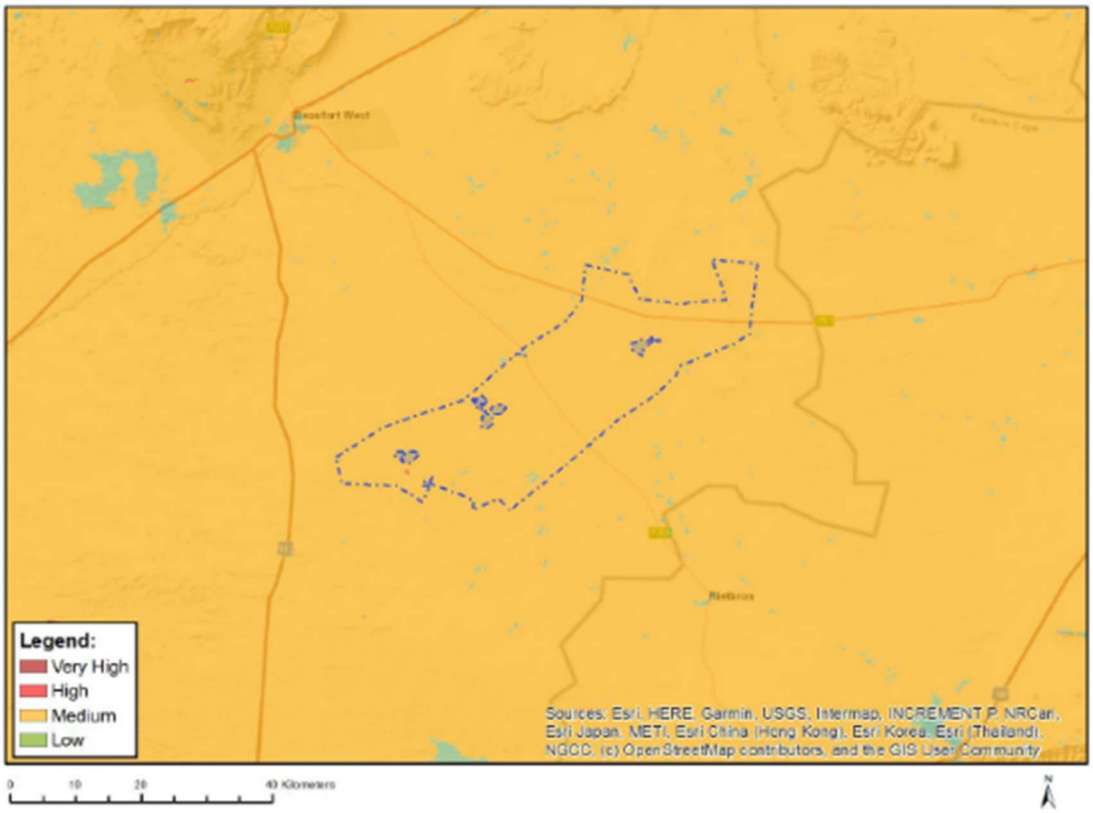
Sensitivity Features:

Sensitivity	Feature(s)
Low	Low Sensitivity
Very High	ESA 2: Restore from other land use
Very High	CBA 2: Terrestrial
Very High	CBA 1: Terrestrial

Figure 4-23. Relative terrestrial biodiversity[1] theme sensitivity for the PAOI.

[1] Note that the screening still uses the previous conservation plan

MAP OF RELATIVE PLANT SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

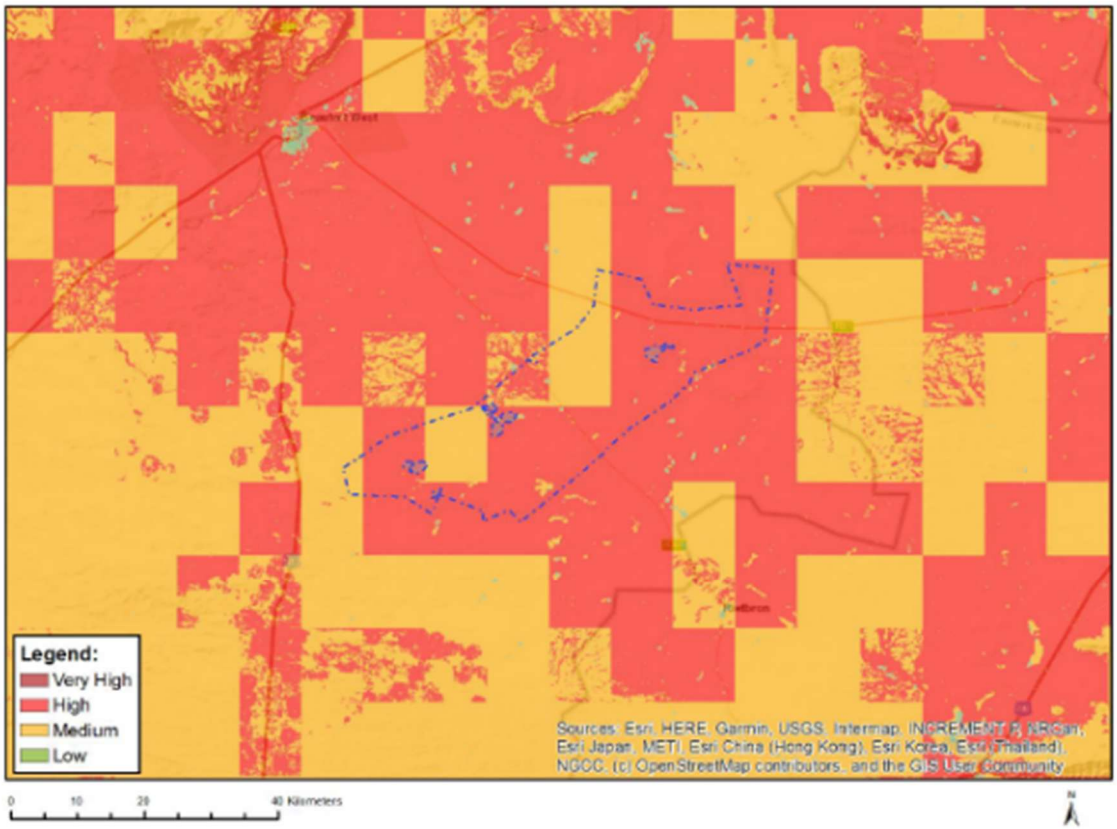
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
		X	

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Ruschia beaufortensis
Medium	Sensitive species 383
Medium	Peersia frithii
Medium	Sensitive species 1212

Figure 4-24. Relative plant species theme sensitivity for the PAOI.

MAP OF RELATIVE ANIMAL SPECIES THEME SENSITIVITY



Where only a sensitive plant unique number or sensitive animal unique number is provided in the screening report and an assessment is required, the environmental assessment practitioner (EAP) or specialist is required to email SANBI at eiadatarequests@sanbi.org.za listing all sensitive species with their unique identifiers for which information is required. The name has been withheld as the species may be prone to illegal harvesting and must be protected. SANBI will release the actual species name after the details of the EAP or specialist have been documented.

Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Aves-Afrotis afra
High	Aves-Neotis ludwigii
High	Reptilia-Chersobius boulengeri
Low	Subject to confirmation
Medium	Aves-Afrotis afra
Medium	Aves-Neotis ludwigii
Medium	Mammalia-Bunolagus monticularis
Medium	Reptilia-Chersobius boulengeri

Figure 4-25. Relative animal species theme sensitivity for the PAOI.

4.1.5.21 Literature Study

4.1.5.21.1 Introduction

An Environmental Impact Assessment (EIA) was carried out by Enviro-Insight (Laurence *et al*., 2017) and submitted in 2017 for the identical project (Figure 4-26). This previous report will be referenced to supplement and compare data, ensuring its relevance to the current assessment. The 2017 assessment is regarded as comprehensive and exemplary, providing ample information for the present evaluation.

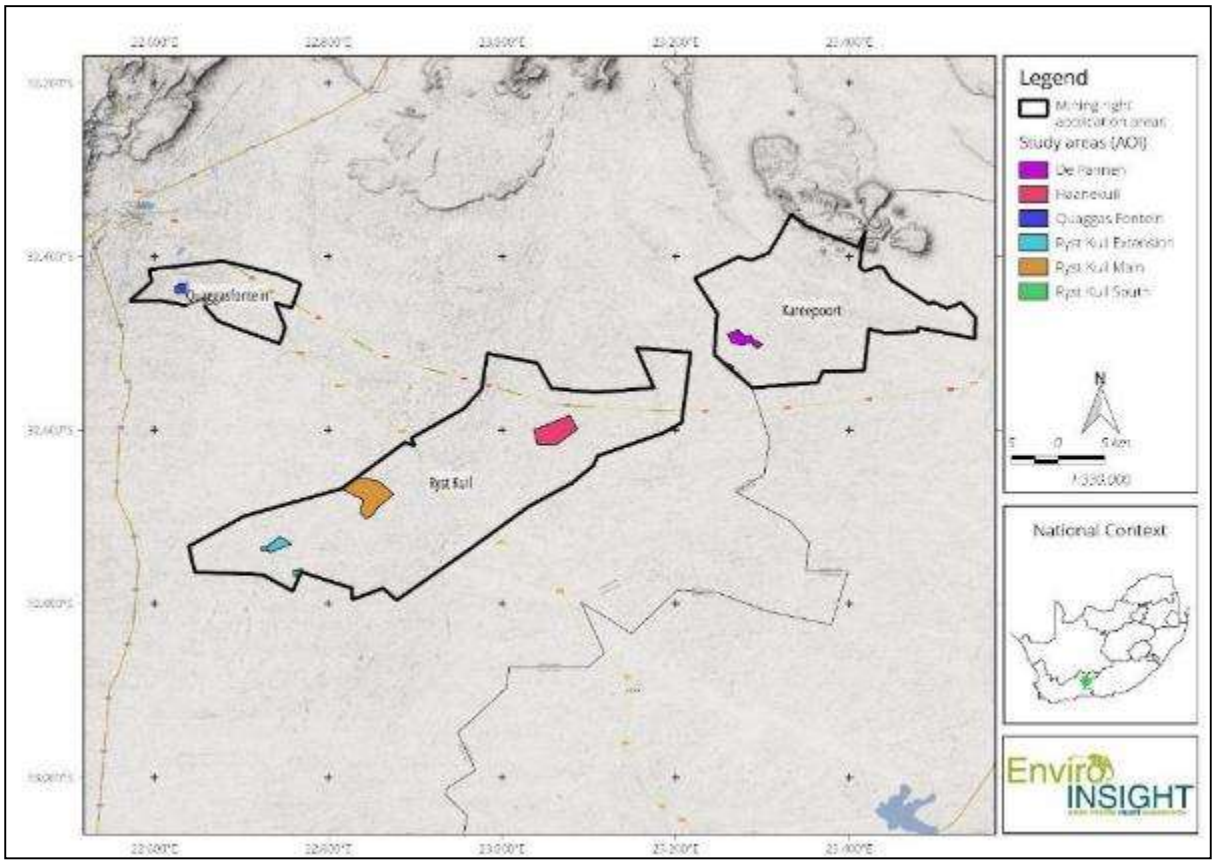


Figure 4-26. Map illustrating the study areas for the pervious project.

4.1.5.22 Flora

The study area, located in the Nama-Karoo Biome, is dominated by the Gamka Karoo vegetation type, which is largely intact and considered "Least Threatened." A total of 157 plant species from 36 families were recorded, with the highest diversity in rocky habitats. Key plant families include Poaceae, Aizoaceae, and Asteraceae. Several species of conservation concern (SCC) were identified, including the Red-Listed *Pleiospilos bolusii* (Vulnerable) and a potentially undescribed Nananthus species. Western Cape protected species such as *Aloe broomii, Crassula pyramidalis*, and *Haworthia viscosa* were also recorded. The presence of these SCCs, especially in rocky and silty habitats, elevates the sensitivity of these areas. The main threats to flora include habitat loss from mining, spread of alien species, and grazing impacts.

4.1.5.23 Fauna

4.1.5.23.1 Herpetofauna

A total of 29 reptiles and three amphibian species were observed, with high densities of tortoises (e.g., Leopard tortoise, Angulate tortoise). Species of conservation concern included the then Data Deficient Not LC Karoo Caco (*Cacosternum karooicum*), Near-Threatened giant bullfrog (*Pyxicephalus adspersus*), and the now Endangered (previously Near-Threatened) Karoo padloper (*Chersobius boulengeri*). Rocky ridges and pans are particularly important for herpetofauna, and these habitats are considered medium-high in sensitivity.

4.1.5.23.2 Mammals

A combined total of 35 mammal species were recorded, including small and large herbivores (e.g., steenbok, kudu, springbok), meso-carnivores (e.g., honey badger, black-backed jackal, caracal), and specialist insectivores (e.g., aardvark, aardwolf). Notable species of conservation concern include the black-footed cat (*Felis nigripes*, Vulnerable) and the honey badger (Mellivora capensis, NEMBA protected). Seasonal drainage lines and artificial water sources are critical for mammal diversity and movement, making these habitats highly sensitive.

4.1.5.23.3 Avifauna

A total of 66 bird species were recorded in the current study, with nine Red-Listed species confirmed, including the Endangered Ludwig's Bustard (*Neotis ludwigii*), Endangered (previously Vulnerable Secretarybird (*Sagittarius serpentarius*), and Near-Threatened Blue Crane (*Anthropoides paradiseus*). Seasonal drainage lines and water sources are vital for avifauna, serving as corridors and breeding/foraging sites. The region is of very high avifaunal importance due to the diversity and density of threatened species

4.1.5.24 Habitats and Sensitivities

Eleven broad habitat units were defined, including rocky ridges, stony slopes, sandy/silty plains, drainage lines, and artificial water points. Sensitivity rankings (1=low, 5=high) were assigned based on criteria such as species diversity, presence of SCCs, and ecological connectivity:

- Rocky ridges and drainage lines: High sensitivity (4–5), due to high species diversity, refugia potential, and presence of SCCs.
- Open water/windmill habitats: High sensitivity for fauna, especially in arid conditions.
- Sandy/silty plains: Medium sensitivity, but critical for certain SCCs like *Nananthus sp*.
- Most other habitats: Medium sensitivity, reflecting intact ecological function but lower uniqueness.

Key threats include habitat loss from mining, spread of alien species, direct mortality from vehicles, and contamination of water sources. Mitigation measures recommended include minimizing development footprints, maintaining habitat connectivity, and implementing strict controls on alien species and pollution.

4.1.5.25 Fieldwork Findings

The following results are a combination of the field survey (19-23 May 2025) conducted by TBC, as well as information as per the EIA by Enviro-Insight in 2017.

4.1.5.26 Flora Assessment

Numerous indigenous flora species were recorded for the PAOI (a list can be provided upon request), characteristic of the vegetation types for the site. Some of these species can be seen presented in Figure 4-27.

Due to the confirmed protected species and SCC, a site walkdown of the approved layout must be conducted prior to construction as the habitats present onsite support several species of flora SCC.

SCC and protected species were recorded in the PAOI and are presented in section 4.1.5.27 below.

Alien invasive plant (AIP) was recorded for the PAOI and is discussed further in section 4.1.5.28 below.

Figure 4-27. Photos illustrating indigenous flora species recorded for the PAOI; A) Aptosimum indivisum B) Stipagrostis ciliata, C) Selago geniculata and D) Carissa bispinosa.

4.1.5.27 SCC and Protected Species

4.1.5.27.1 SCCs

The SCC recorded within the PAOI are still in corroboration with the studies in 2017 ((Laurence *et al*., 2017). The summary of the combined previous studies and 2025 fieldwork can be seen below (Table 4-14, Figure 4-28 shows SCCs observed in 2025.

Table 4-14. Summary of flora SCC recorded within the PAOI of Influence

Species	Habitat	Ryst Kuil Main & Abante		Ryst Kuil Extension		Haanekuil	
		2017	2025	2017	2025	2017	2025

Aloe broomii cf. var tarkaensis *2017-Rare* 2020-LC)		N/A					
Aloe longistyla *2017*-DD 2020-LC		N/A					
Crassula socialis (Rare)	In rock crevices on cliffs, which are usually south or south-east facing.	High	High	Low	High	Low	Low
Hereroa concava *2017-DDD* *2025-(Vulnerable B1ab(iii))*	Plants occur sheltered among shrubs on flats and plateaus with shale outcrops	Confirmed	Confirmed	Not Observed	Confirmed	Not Observed	Confirmed
Hoodia gordonii (DDD)	Wide variety of arid habitats	Medium	Medium	Medium	Medium	Medium	Medium
Hoodia pilifera. subsp pilifera (Near Threatened B1ab(iii,v))	On steep shale slopes or near the foot of sandstone mountains, usually on hotter, northern aspects, occasional it is found on flat areas and cooler, southern slopes.	Confirmed	Confirmed	Confirmed	Confirmed	Medium	Medium
Indigofera hantamensis (Rare)	Scree slopes.	Medium	Medium	Medium	Medium	Medium	Medium
Lotononis azureoides (Rare)	Steep, rocky sandstone slopes at 1600 m.	Low	Low	Low	Low	Low	Low
Nananthus sp.[2]	Specific micro-habitats within silty clayey habitats	Confirmed	High	High	High	High	High
Pelargonium denticulatum (Rare)	Sandy soils near freshwater streams.	Low	Low	Low	Low	Low	Low
Phymaspermum schroeteri *2017-* (Rare) 2025-LC		N/A					
Pleiospilos bolusii (VU)	Quartz flats in karroid shrubland	Confirmed	Confirmed	High	High	High	Confirmed
Pteronia hutchinsoniana *2017-* Rare 2025-LC		N/A					
Tritonia florentiae **(Rare)**	In a variety of vegetation types on dry stony clay flats.	High	High	High	High	High	High

[2] Due to the precautionary principle, the potentially undescribed *Nananthus* sp. is regarded as a potential SCC

Figure 4-28. Photos illustrating indigenous flora species recorded for the PAOI; A) Hoodia pilifera. subsp pilifera B) and C) Pleiospilos bolusii.

4.1.5.27.1.1 Note on the potentially undescribed Nananthus sp.

In July 2016, a potentially new, undescribed *Nananthus* species was found on Kariegesfontein farm, near Aberdeen in the Eastern Cape, South Africa. The discovery was reported to the project team in March 2017 (Enviro-Insight,2017). Nananthus is a genus of succulents with six known species in South Africa, but little is known about this possible new species. To address this, a survey was conducted from 22–25 May 2017, focusing on areas likely to be affected by mining (De Pannen, Ryst Kuil Main, and Quaggasfontein). GIS analysis was also used to identify suitable habitats. The survey found eight sub-populations totaling at least 80 individuals: six on De Pannen (previously proposed mining area) and two at Ryst Kuil Main. A detailed report with a preliminary description of the species was produced.

4.1.5.27.2 Protected Plants

Western Cape protected plant species include all species within the families Asclepiadaceae and Mesembryanthemaceae (Aizoaceae). In addition, species within the *Aloe, Haworthia and Anacampseros* genera, together with certain *Euphorbia* species are also protected. More than ten (10) species of protected plant were recorded for the PAOI (Table 4-15), some of these species are shown in Figure 4-29. These species are not to be disturbed in any way. Should they need to be removed, the appropriate permits must be procured[3] prior to the relocation or removal of these species.

Table 4-15. Provincially protected plants recorded.

Family	*Species*	IUCN
Aizoaceae	*Ruschia intricata*	LC
Amaryllidaceae	*Ammocharis coranica*	LC

[3] Western Cape Department of Environmental Affairs and Development Planning (DEA&DP)

Anacampserotaceae	*Anacampseros albidiflora*	LC
Anacampserotaceae	*Anacampseros filamentosa*	LC
Asphodelaceae	*Aloe broomii*	LC
Asphodelaceae	*Aloe longistyla*	LC
Asphodelaceae	*Aloe claviflora*	LC
Asphodelaceae	*Haworthia viscosa*	LC
Crassulaceae	*Crassula pyramidalis*	LC
Crassulaceae	*Crassula capitella*	LC
Crassulaceae	*Crassula hemisphaerica*	LC
Crassulaceae	*Crassula deltoidea*	LC
Crassulaceae	*Crassula corallina ssp. corallina*	LC
Iridaceae	*Lapeirousia plicata*	LC
Iridaceae	*Moraea polystachya*	LC
Iridaceae	*Tritonia securigera*	LC

Figure 4-29. Photos illustrating some of the protected flora species recorded for the PAOI; A) Colchicum asteroides B) Lapeirousia plicata, C) Aloe claviflora, D) Ruschia intricata and E) Crassula corallina ssp. Corallina.

4.1.5.28 Alien Invasive Plants

Alien Invasive Plants (AIPs) tend to dominate or replace indigenous flora, thereby transforming the structure, composition and functioning of ecosystems. Therefore, it is important that these plants are controlled by means of an eradication and monitoring programme. Some invader plants may also degrade ecosystems through superior competitive capabilities to exclude native plant species.

The National Environmental Management: Biodiversity Act (NEMBA) is the most recent legislation pertaining to alien invasive plant species. In August 2014, the list of Alien Invasive Species was published in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (Government Gazette No 78 of 2014).

The Alien and Invasive Species Regulations were published in the Government Gazette No. 43726, 18 September 2020. The legislation calls for the removal and / or control of alien invasive plant species (Category 1 species). In addition, unless authorised thereto in terms of the National Water Act, 1998 (Act No. 36 of 1998), no land user shall allow Category 2 plants to occur within 30 meters of the 1:50 year flood line of a river, stream, spring, natural channel in which water flows regularly or intermittently, lake, dam or wetland. Category 3 plants are also prohibited from occurring within proximity to a watercourse. Below is a brief explanation of the three categories in terms of the National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA):

- Category 1a: Invasive species requiring compulsory control. Remove and destroy. Any specimens of Category 1a listed species need, by law, to be eradicated from the environment. No permits will be issued.
- Category 1b: Invasive species requiring compulsory control as part of an invasive species control programme. Remove and destroy. These plants are deemed to have such a high invasive potential that infestations can qualify to be placed under a government sponsored invasive species management programme. No permits will be issued.
- Category 2: Invasive species regulated by area. A demarcation permit is required to import, possess, grow, breed, move, sell, buy or accept as a gift any plants listed as Category 2 plants. No permits will be issued for Category 2 plants to exist in riparian zones.
- Category 3: Invasive species regulated by activity. An individual plant permit is required to undertake any of the following restricted activities (import, possess, grow, breed, move, sell, buy or accept as a gift) involving a Category 3 species. No permits will be issued for Category 3 plants to exist in riparian zones.

Note that according to the regulations, a person who has under his or her control a category 1b listed invasive species must immediately:

- Notify the competent authority in writing;
- Take steps to manage the listed invasive species in compliance with:
- Section 75 of the Act;
- The relevant invasive species management programme developed in terms of regulation 4; and
- Any directive issued in terms of section 73(3) of the Act.

Overall, as per the previous assessment, the study areas showed relatively low levels of alien and invasive plant infestation, which was mostly limited to specific, localized spots—often near agricultural operations or homesteads. Species of particular concern included Atriplex spp, Opuntia spp, *Argemone spp*.) or *Eucalyptus spp*. In the Karoo, most invasive plant species are spread by sheep and goats, while crows are known to contribute to the dispersal of *Opuntia ficus-indica* seeds.

4.1.5.29 Fauna Assessment

As stated, the biodiversity impact assessment for the study area (Laurence *et al*., 2017) was consulted extensively (especially the herpetofauna), over multiple years. The status changes between 2017 and 2015 can be seen in the relevant tables.

4.1.5.29.1 Mammals

The mammal assessment for the PAOI combined previous studies and new fieldwork, resulting in a comprehensive inventory. A total of 35 mammal species were recorded, including small and large herbivores,

meso-carnivores, small carnivores, primates, and specialist insectivores. The region supports a medium-rich mammal diversity, which is notable given the arid environment. No additional species were recorded within the PAOI in 2025.

Figure 4-30. Photos illustrating mammal species recorded within the PAOI; A) Otocyon megalotis (Bat-eared fox), B) Proteles cristata (Aardwolf) and C) Raphicerus campestris (Steenbok).

4.1.5.29.2 Species of Conservation Concern (SCCs)

The Riverine Rabbit (*Bunolagus monticularis*, Critically Endangered (Cr)) is unlikely to occur in the PAOI due to lack of suitable habitat. Table 4-17 is a summary of the mammal SCCs identified in the study area, including their most recent conservation status and likelihood of occurrence by site.

Table 4-16. The mammal Species of Conservation Concern (SCCs) identified in the study area

Species (Common Name)	Scientific Name	Status (IUCN/National)		Likelihood of Occurrence (by site)
		2017	2025	
Black--footed cat	*Felis nigripes*	Vulnerable, NEMBA	Vulnerable, NEMBA Protected	Low–High (varies by site, highest at De Pannen)
Cape fox	*Vulpes chama*	NEMBA Protected	NEMBA Protected	High (all sites)
Honey badger	*Mellivora capensis*	NEMBA Protected	NEMBA Protected	Low in all areas

4.1.5.30 Herpetofauna

The previous herpetofauna assessment for the Karoo Uranium Project area was comprehensive, combining literature review, field surveys, and local interviews. The study recorded 29 reptile species and three amphibian species over nine sampling days, representing 64% and 27% of the expected regional diversity, respectively. When combined with previous surveys, a total of 37 reptile and four amphibian species have been observed in and around the study areas, which is a high proportion for the region.

No additional species were recorded within the PAOI in 2025.

4.1.5.30.1 Species of Conservation Concern (SCCs)

Table 4-17 summerises the herpetofauna Species of Conservation Concern (SCCs) identified in the study area, including their most recent conservation status and likelihood of occurrence by site.

Table 4-17. The herpetofauna Species of Conservation Concern (SCCs) identified in the study area

Species (Common Name)	Scientific Name	Status (IUCN/National)		Likelihood of Occurrence (by site)
		2017	2025	
Karoo caco	*Cacosternum karooicum*	Data Deficient	LC	Confirmed (Ryst Kuil Main), Low elsewhere
Giant bullfrog	*Pyxicephalus adspersus*	NT	NT	Confirmed (Ryst Kuil Main, Ryst Kuil Extension), High (Ryst Kuil South), Low elsewhere
Karoo padloper (tortoise)	*Chersobius boulengeri boulengeri*	NT	EN	Confirmed (Ryst Kuil Main), Medium (Ryst Kuil Extension, , Haanekuil),
Karoo tent tortoises	*Psammobates tentorius tentorius*	LC	NT	Confirmed in all areas in 2025 (Figure 4-32)

Figure 4-31. Photos illustrating the 'carcass' of an SCC, Psammobates tentorius tentorius in 2025.

4.1.5.30.1.1 Karoo padloper (*Homopus boulengeri*)

This species inhabits ridges and rocky outcrops within the Karoo and is rarely encountered. Populations are thought to be in decline, primarily due to habitat degradation caused by overgrazing from livestock.

Laurence *et al,*2017 stated that since 2005, only three records of this species have been submitted to the Animal Demography Unit Virtual Museum (http://vmus.adu.org.za), with one of these records originating from the previous field survey conducted by the current author (see Ferguson *et al*. 2008). The extremely low number of observations highlights the species' rarity and underlines its conservation importance. Notably, since the 2017 study, the threat status of the Karoo padloper has increased to Endangered (EN), which is significant.

4.1.5.31 Avifauna

The avifauna assessment for the PAOI combined previous studies and new fieldwork, resulting in a robust species inventory and a clear understanding of habitat use and sensitivities. Since the previous studies, several threat statuses and name changes have occurred (Table 4-17). Eight (8) SCC were recorded during the 2025 surveys.

The region is of very high avifaunal importance due to the diversity and density of threatened and endemic species. Key habitats for birds include seasonal drainage lines, pans, and artificial water sources, which serve as critical corridors, breeding, and foraging sites. Rocky ridges are also important for raptors and other species. The main threats to avifauna are habitat loss and fragmentation, collision with powerlines and fences, road mortality, disturbance from mining activities (noise, dust, lighting), and contamination of water sources.

The study confirmed the presence of several SCCs, including globally and regionally threatened species such as Ludwig's Bustard, Blue Crane, Secretarybird, and Martial Eagle. The presence of breeding pairs and regular sightings of SCCs, especially large terrestrial and raptor species, highlight the area's conservation value (Laurence *et al*., 2017). The known breeding periods are summarised in Table 4-19.

Table 4-18. The Avifauna SCCs identified in the study area

Common Name	Scientific Name	Regional*	Global+	2017	2025
Southern Black Korhaan	*Afrotis afra**	VU	VU	X	X
Red-billed Teal	*Anas erythrorhyncha*	NT	LC	X	
Yellow-billed Duck	*Anas undulata*	NT	LC	X	
Blue Crane	*Anthropoides paradiseus*	VU	VU	X	X
Kori Bustard	*Ardeotis kori*	NT	NT	X	X
Kittlitz's Plover	*Charadrius pecuarius*	NT	LC	X	X
Black Harrier	*Circus maurus*	EN	EN	X	
Burchell's Courser	*Cursorius rufus*	VU	LC	X	
Black-winged Kite	*Elanus caeruleus*	NT	LC	X	
Karoo Korhaan	*Eupodotis vigorsii*	NT	LC	X	X
Lanner Falcon	*Falco biarmicus*	NT	LC	X	X
Lesser Kestrel	*Falco naumanni*	VU	LC	X	
Ludwig's Bustard	*Neotis ludwigii*	EN	EN	X	X
Martial Eagle	*Polemaetus bellicosus*	EN	EN	X	X
Secretarybird	*Sagittarius serpentarius*	VU	EN	X	
Hamerkop	*Scopus umbretta*	NT	LC	X	
Cape Shoveler	*Spatula smithii*	NT	LC	X	

Figure 4-32. Photos illustrating some of the avifauna SCCs observed in 2025: A) Kittlitz's Plover, B) Ludwig's Bustard and C) Karoo Korhaan.

Table 4-19. The Avifauna SCCs identified in the study area and their known breeding periods

Species Name	Karoo Breeding/Nesting Periods[4]
Southern Black Korhaan	August–March
Red-billed Teal	Mainly January–June (after good rains)
Yellow-billed Duck	Mainly July–September, but can be year-round
Blue Crane	October–March
Kori Bustard	September–March
Kittlitz's Plover	August–April (after rain, opportunistic)
Black Harrier	August–November
Burchell's Courser	August–April (after rain, opportunistic)
Black-winged Kite	July–November (can be year-round)
Karoo Korhaan	August–March
Lanner Falcon	July–October
Lesser Kestrel	November–March (summer migrant breeder)
Ludwig's Bustard	August–March
Martial Eagle	April–November
Secretarybird	March–August (can be year-round)
Hamerkop	September–April (after rain, opportunistic)
Cape Shoveler	July–September (can be year-round)

[4] Many Karoo species breed opportunistically after rainfall, so exact timing can vary year to year. "Year-round" means breeding can occur in any month, but peaks are indicated where known. "Opportunistic" means breeding is closely tied to rainfall events, which are unpredictable in the Karoo

4.1.5.32 Site Sensitivity Verification

4.1.5.32.1 Habitat Assessment and Site Ecological Importance

4.1.5.32.1.1 Habitats

The main habitat types identified across the PAOI were initially identified largely based on aerial imagery, but also comparing with the habitats in the previous assessment. These main habitat types were refined based on the field coverage and data collected during the survey; the delineated habitats can be seen in Figure 4-33 to Figure 4-35 . Emphasis was placed on limiting timed meander searches within the natural habitats and therefore habitats with a higher potential of hosting SCC.

Field observations concluded that the eleven (11) broad habitat units that were defined and delineated in 2017, are still accurate and relevant, and thus the delineations were used verbatim, with some changes (such as modified and degraded areas, being included).

As outlined in the report by Laurence *et al.*, 2017; the basic habitat substrate characteristics within the study area can be categorized into three main communities: Rocky Community habitats, Stony Community habitats, and Sedimentary Community habitats. Within each of these broad communities, habitats were further identified and distinguished according to their general location within the local terrain. Areas with local slopes of 5 degrees or greater were classified as "Ridges." Regions with slopes between 2 and 5 degrees were designated as "Slopes," while areas with slopes less than 2 degrees were identified as "Plains." These morphological features particularly slopes and plains are characterized by very subtle variations within the landscape.

A summary of these communities can be seen in Table 4-20 Each of the habitats identified and descriptions of the habitat units can be found in Table 4-25. Not all habitats described appear in each and every PAOI.

Table 4-20. Table providing a summary of the habitat communities of the habitat types delineated for the PAOI.

Community Type	Habitat Subtype	Description & Key Features	Typical Plant Species
Rocky Community	Rocky Ridge	Bedrock/boulders protrude from ground, deep cracks/fissures, steep slopes.	*Hereroa concava (VU), Hoodia pilifera. subsp pilifera (NT), Rhigozum obovatum, Tenaxia dura, Eriocephalus ericoides, Pteronia adenocarpa, Indigofera nigromontana, Euphorbia stellispina, Euphorbia ferox*
	Rocky Slope	Stones/rocks >200mm, interspersed with low bedrock, upper slopes to plains.	*Searsia burchelli, Carissa bispinosa, Gymnosporia polyacantha, Rhigozum obovatum, Tragus koelerioides, Eriocephalus ericoides, Lasiosiphon deserticola, Pteronia glomerata, Ruschia spinosa, Crassula corallina*
	Rocky Plain	Similar to rocky slope, on plains, stones/rocks >200mm.	As above
Stony Community	Stony Ridge	Ridge habitats, stones/rocks 11–200mm, no deep cracks/fissures.	*Hereroa concava (VU) Ruschia spinosa, Pentzia incana, Pteronia glomerata, Hermannia grandiflora, Pleiospilos bolusii (VU), Crassula pyramidalis*
	Stony Slope	Upper slopes to plains, stones/rocks 11–200mm, fringes sandy/silty plains.	*Hereroa concava (VU)Blepharis capensis, Euphorbia ferox, Euphorbia stellispina, Monsonia camdeboense*
	Stony Plain	Plains, stones/rocks 11–200mm, often adjacent to sandy/silty plains.	As above
Sedimentary Community	Sandy/Silty Plain	Flat areas, silty or sandy substrate, little/no rock cover, may have gravel (<10mm). Often associated with dry watercourses, periodic flooding.	*Lycium cinereum, Asparagus recurvispinus, Eragrostis x pseud-obtusa, Rosenia humilis, Kleinia longiflora, Aptosimum spinescens, Salsola tuberculata, Pentzia spp., Nananthus sp*.
	Sandy Ridge	Higher lying, upper extents of ephemeral drainage, lacks silty substrate.	*Kewa salsoloides, Hermannia grandiflora*, similar to stony ridges/slopes
	Sandy Slope	Upper to foot-slopes, sandy deposits trapped in vegetation, embedded in stony communities.	As above
	Drainage	Well-defined ephemeral channels, sandy substrate, banks may be flat or steep.	*Vachellia karoo, Gymnosporia buxifolia, Searsia burchelli, Carissa bispinosa, Lycium oxycarpum, Gymnosporia polyacantha*
	Open Water/Windmill	Artificial or natural water points, may develop wetland attributes.	Wetland-associated species (sedges, reeds), variable

The highest concentration of protected and SCC plants was found within the rocky and stony habitat communities.

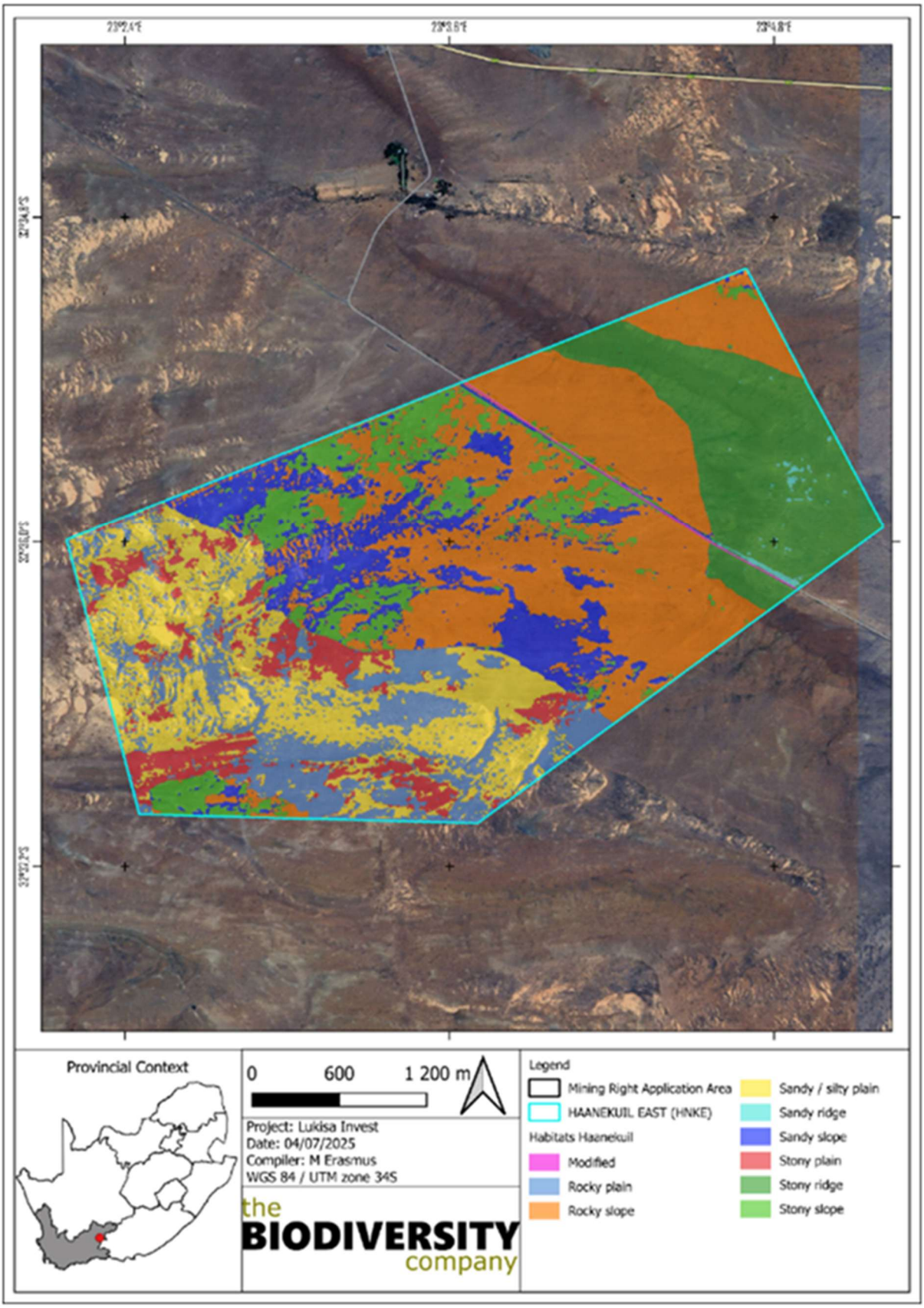


Figure 4-33. Map of the habitats delineated for the Haanekuil PAOI.

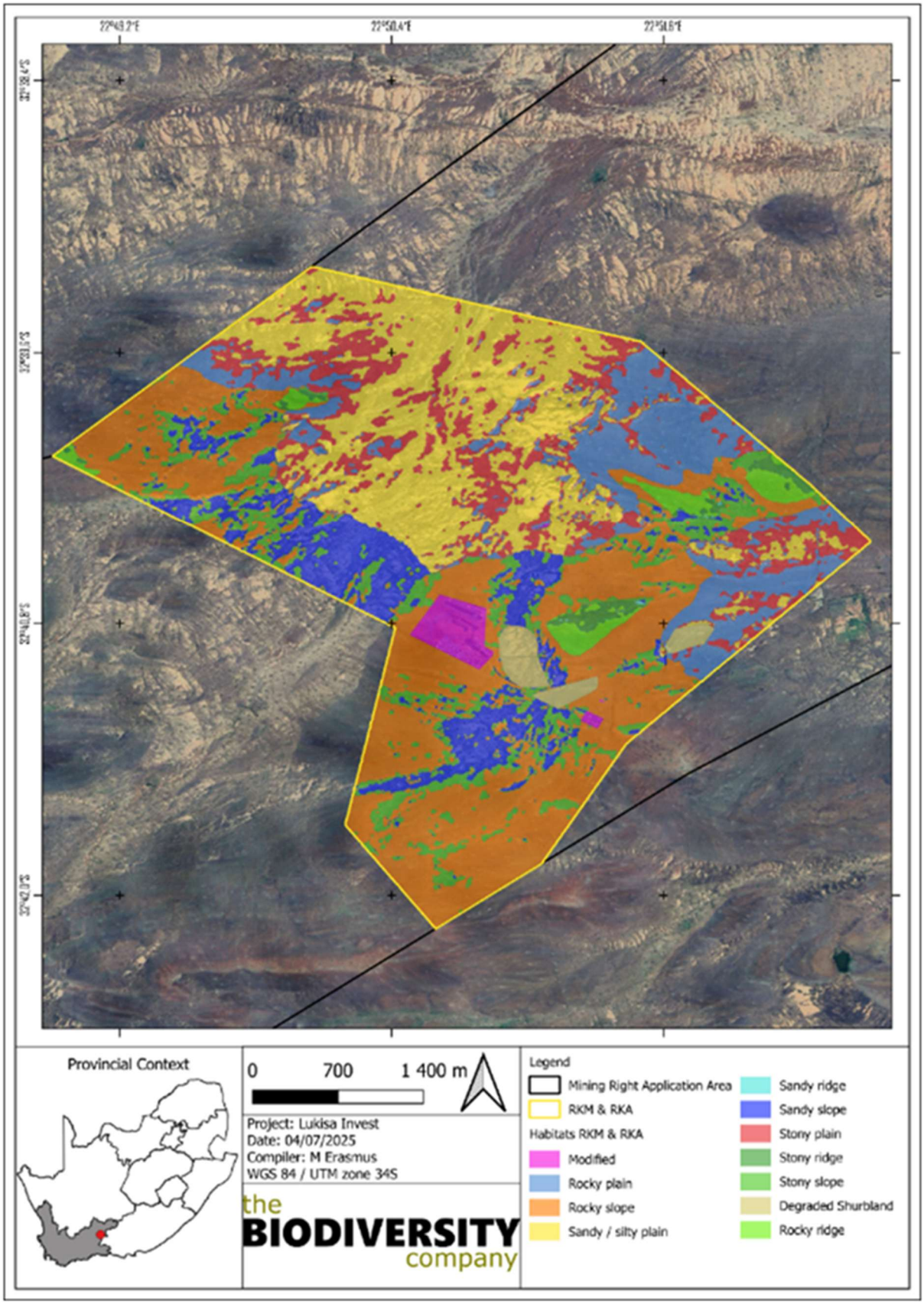


Figure 4-34. Map of the habitats delineated for the Ryst Kuil main and Abante PAOI.

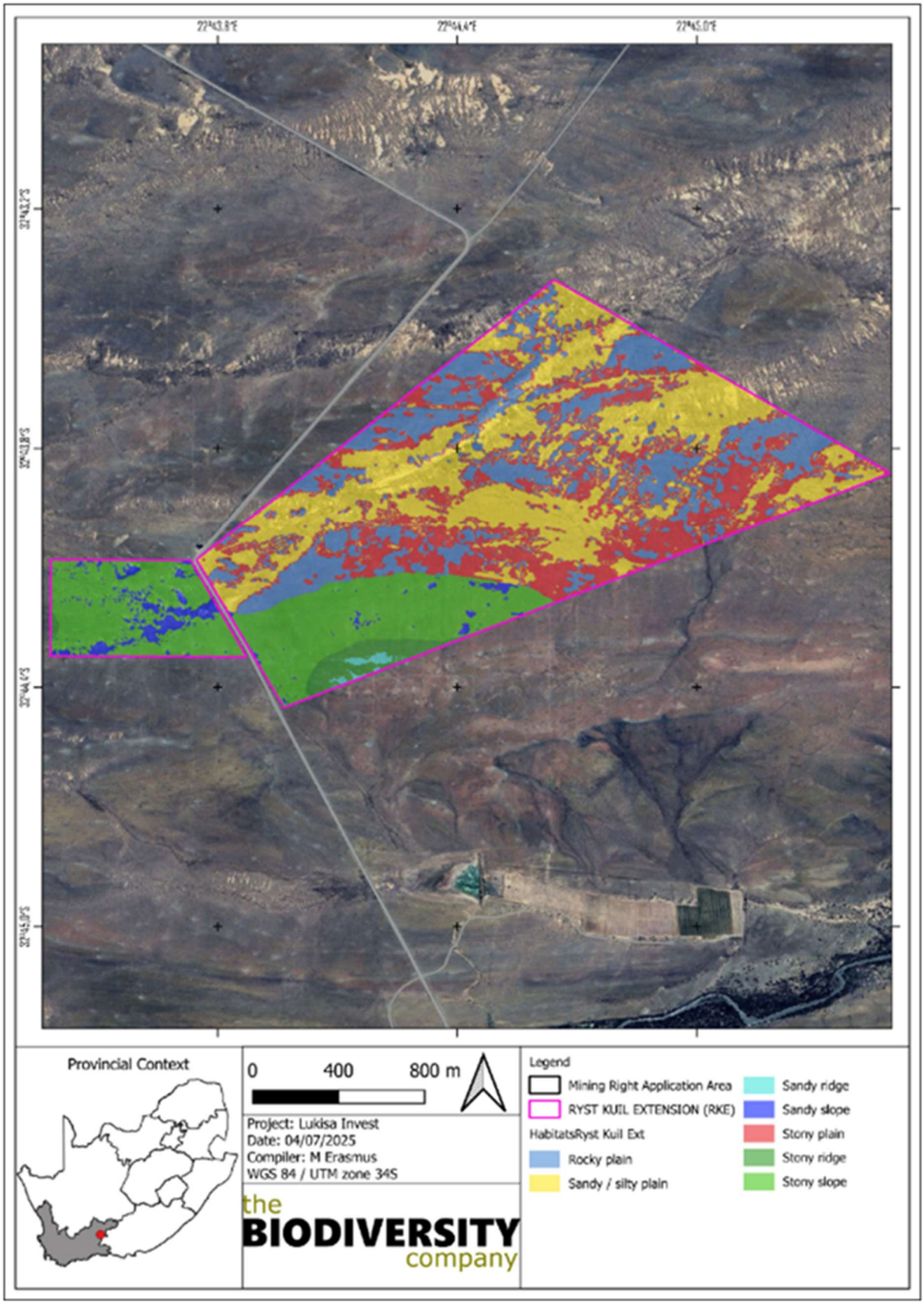
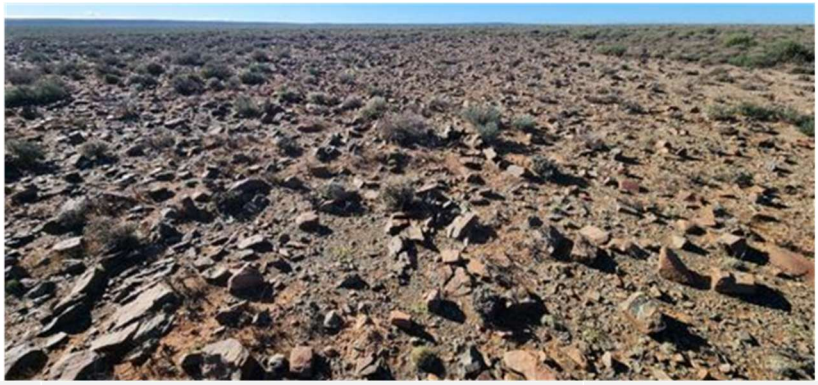


Figure 4-35. Map of the habitats delineated for the Ryst Kuil Extension PAOI.

Table 4-21. Table providing descriptions of the habitat types delineated for the PAOI

Habitat	Description and Condition	Ecosystem Processes and Services
Rocky Plain	Flat terrain with large rocks (>200 mm), low slopes (<2°). Sparse vegetation, mostly karoo shrubs and herbs. Generally intact with limited disturbance. The floral structure consists of a mixture between tall shrubs interspersed with lower-growing karoo bushes and grasses.	Provides microhabitats for reptiles and small mammals. Contributes to soil stability and water retention. Structural heterogeneity supports species diversity.
		
Rocky Ridge	Elevated slopes (>5°), with exposed bedrock and boulders. Supports taller woody shrubs and high vegetation structural diversity. Generally high ecological condition. Plant species typically associated with Rocky Ridges include *Rhigozum obovatum, Eriocephalus ericoides, Pteronia adenocarpa, Indigofera nigromontana, Euphorbia stellispina and Euphorbia ferox.*	Offers high refugia and nesting opportunities for rupicolous (rock-dwelling) species. Stabilises slope erosion. Functions as a biodiversity hotspot within the arid landscape.
Rocky Slope	Intermediate slopes (2–5°) with rocky substrates. Vegetation varies from grasses to dwarf shrubs. Slightly less diverse than ridges but still relatively intact.	Important for shelter, nesting and movement of terrestrial vertebrates. Plays a role in erosion control and nutrient cycling.

Habitat	Description and Condition	Ecosystem Processes and Services
Sandy/Silty Plain	Flat areas with fine sandy or silty soils. Vegetation is sparse and often patchy due to grazing pressure. Condition is fair to moderate; vulnerable to degradation.	Supports burrowing species (e.g., rodents, reptiles), acts as corridors for animal movement. Fertile microsites under vegetation aid in primary productivity and soil formation.
Sandy Ridge	Slightly elevated terrain with sandy substrate. Often supports a mix of shrubs and grasses. Typically shows low levels of human disturbance.	Enhances drainage and infiltration. Offers movement routes and forage for small to medium-sized mammals. Also important for plant colonisation due to improved drainage and exposure.
Sandy Slope	Gentle to moderate incline, sandy composition. Vegetation is more stable than on plains but more vulnerable than ridges. Condition is moderately intact.	Supports faunal movement and foraging. Assists with rainfall infiltration and erosion control. Limited refugia potential but facilitates landscape-level ecological connectivity.

Habitat	Description and Condition	Ecosystem Processes and Services
Stony Plain	Flat terrain covered in smaller stones or gravels. Low slopes. Vegetation consists of hardy shrubs and grasses. Generally intact but moderately impacted by grazing.	Soil stabilisation, supports insect and reptile life. Offers forage for browsers and limited cover for small vertebrates. Helps moderate surface temperature fluctuations.
Stony Ridge	Elevated with high stone density. Vegetation is denser and more structured than stony plains. Often serves as ecological refugia due to inaccessibility and low impact.	High importance for sheltering fauna, erosion mitigation, and biodiversity conservation. May support rare or red-listed species due to lower human disturbance.
Stony Slope	Mid-slope habitat with gravel and stones. Vegetation is moderately diverse. Impacts are moderate.	Important for faunal movement and ecosystem stability. Prevents excessive erosion and provides diverse niches for different animal taxa.

Habitat	Description and Condition	Ecosystem Processes and Services
Open Water/Windmill	Artificial or natural water points associated with windmills or dams. Often with surrounding green flushes. These are rare but vital in the arid region. May be impacted by livestock activity or contamination.	Critical water source in a dry ecosystem; attracts fauna and enhances biodiversity locally. Supports amphibians, tortoises, birds and insects. Acts as stepping stones for movement and survival in the landscape.
Drainage Habitat	Natural or ephemeral streams and surrounding banks, often with enhanced vegetation and rocky features. Somewhat rare and highly sensitive. May be subject to sedimentation and disturbance.	Supports species during droughts, acts as a corridor for movement, and plays a critical role in nutrient transport and vegetation regeneration. High refugia and foraging value. Key in maintaining ecological function across seasons in this arid system.
Modified	This habitat unit includes all areas that maintain little to no native vegetation and/or where anthropogenic activity has substantially modified an area's primary ecological functions and species composition. This habitat unit no longer maintains its functional integrity and does not contribute significantly to	The ecological services provided by this habitat are limited due to the extent of land transformation and the large amount of bare ground.

Habitat	Description and Condition	Ecosystem Processes and Services
	ecosystem services. This habitat unit is predominantly made up of gravel roads, and old mine areas	
Degraded Shrubland	In summary, degraded Karoo shrubland that is recovering from past disturbances is an area where the natural vegetation is slowly returning after being damaged by agriculture or other human impacts. The process is slow but vital for restoring the health and biodiversity of the Karoo landscape.	Ecosystem processes in recovering Karoo shrubland are limited until they gradually return to normal as native vegetation re-establishes, soil health improves, and animal communities return.

4.1.5.33 Site Ecological Importance

The different habitat types within the PAOI were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of SCCs and their ecosystem processes. As per the terms of reference for the project, GIS sensitivity maps are required in order to identify sensitive features in terms of the relevant specialist discipline/s within the PAOI. Based on the criteria provided in Appendix B of this report, all habitats within the PAOI were assigned a sensitivity category, i.e., a SEI category. (Table 4-26), the guidelines for each category can be seen in Table 4-27. The SEI of the PAOI is illustrated in Figure 4-39.

Table 4-22. Summary of habitat types delineated within field assessment area.

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance[5]	Project Component in relation to habitat type	Receptor Resilience	Site Ecological Importance[6]
Rocky and Stony Community Potential *Nananthus sp* habitat	Medium Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (EN, VU) etc. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.	High Large intact area for any conservation status of ecosystem type. Good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts, with no signs of major past disturbance and good rehabilitation potential.	**Medium**	Planned Infrastructure	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring.	**High**
Sedimentary Community	Medium Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.	High As above	**High**	Planned Infrastructure	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor	**Medium**
Degraded Shrubland	Low .< 50% of receptor contains natural habitat with limited potential to support SCC	Low Several minor and major current negative ecological impacts.	**Low**	Planned Infrastructure	Medium As Above	**Low**

[5] Considered as the 'sensitivity'

[6] Considered as the sensitivity in relation to the project component.

Modified	Low < 50% of receptor contains natural habitat with limited potential to support SCC.	Very Low Several major current negative ecological impacts.	**Very Low**	Planned Infrastructure	High Habitat that can recover relatively quickly	**Very Low**

Table 4-23. Guideline for interpreting Site Ecological Importance in the context of proposed project activities.

Site Ecological Importance	Interpretation in relation to proposed development activities
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

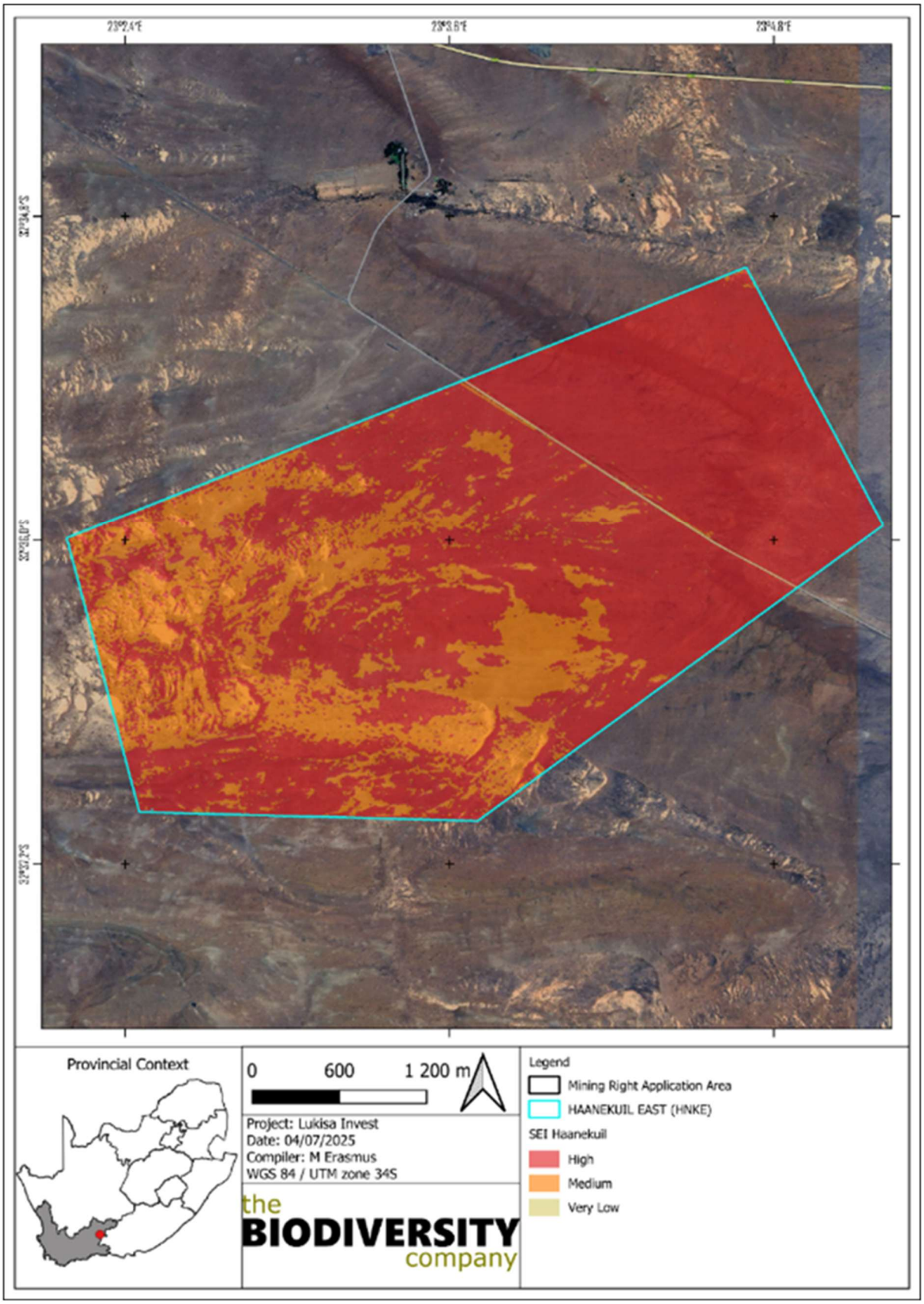


Figure 4-36. Site Ecological Importance of the Haanekuil PAOI

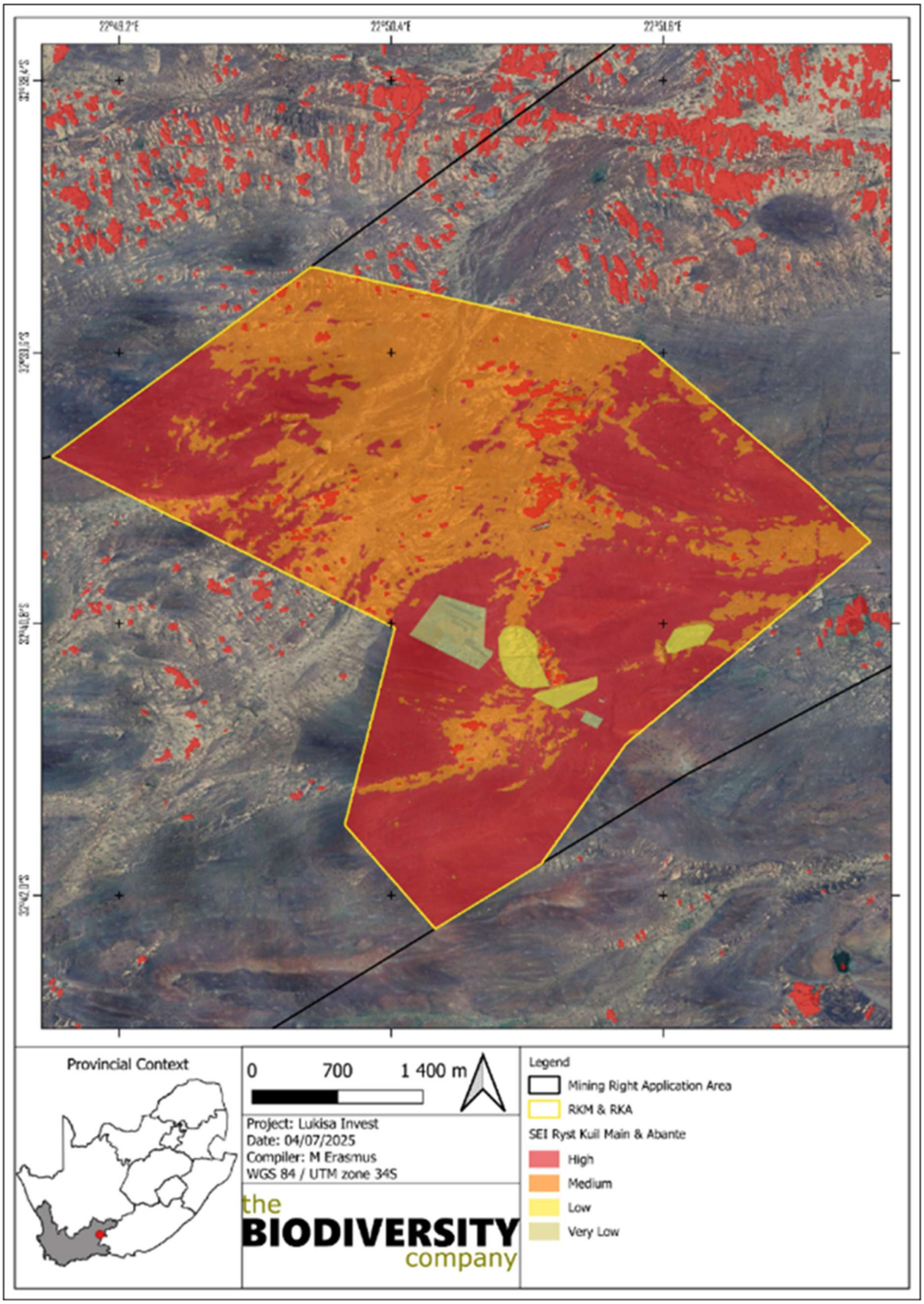


Figure 4-37. Site Ecological Importance of the RKMain & Abante PAOI

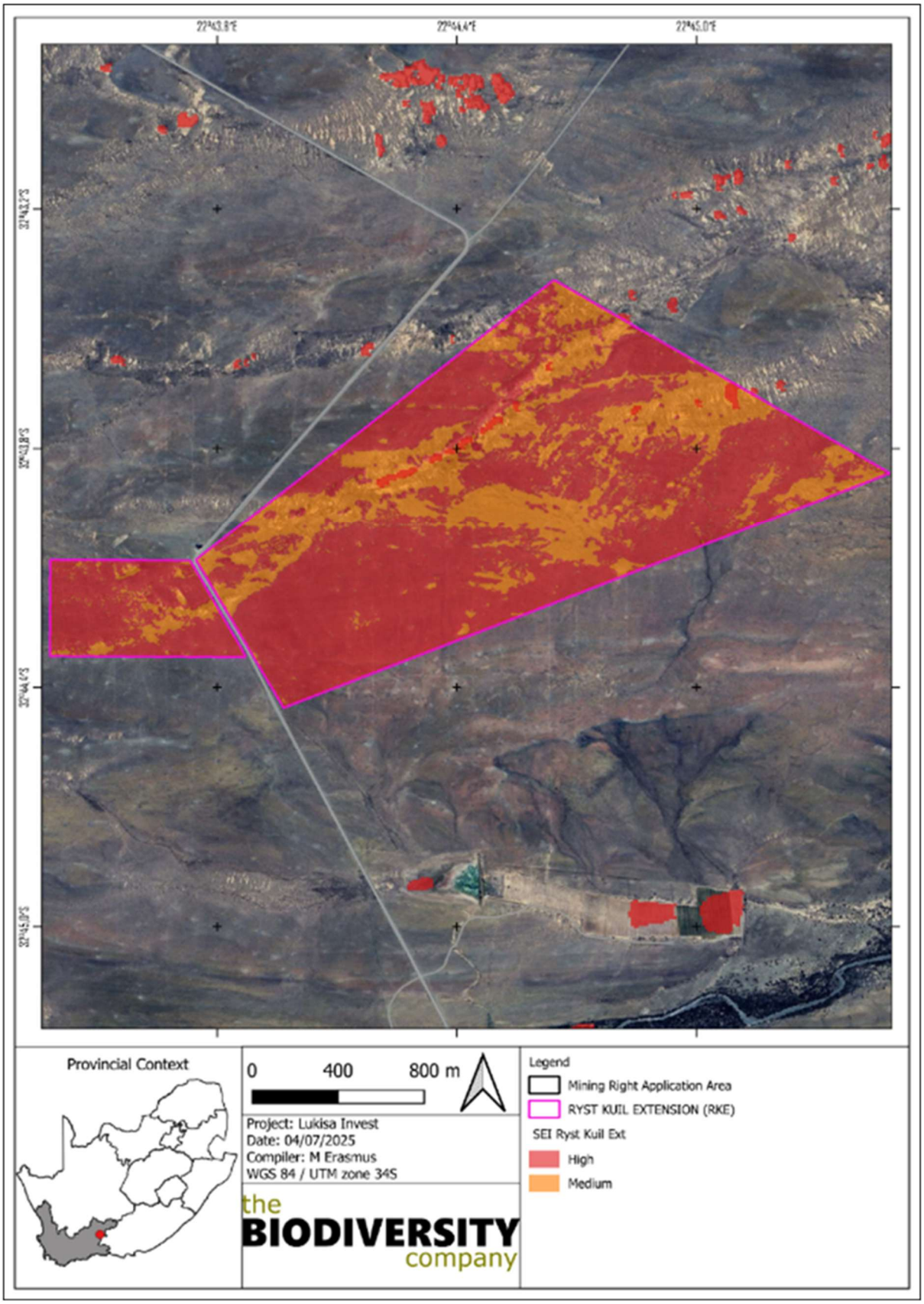


Figure 4-38. Site Ecological Importance of the RKE PAOI

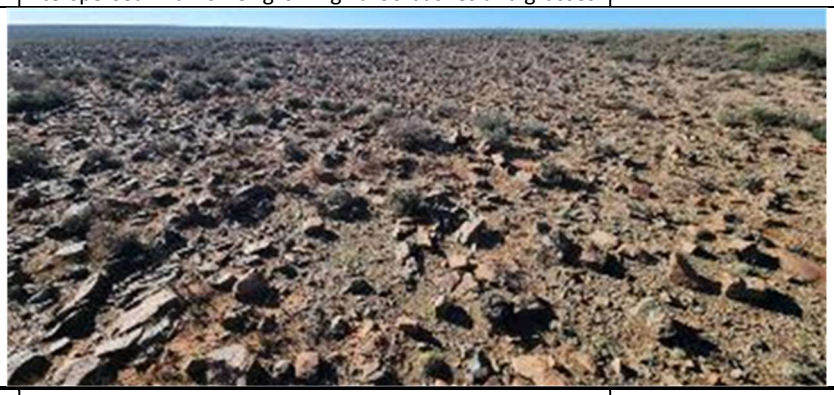
4.1.5.34 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas in Table 4-28 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species.

Table 4-24. Summary of the screening tool vs specialist assigned sensitivities.

Screening Tool Theme	Screening Tool	Habitat	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	**High**	**-**	**High**	Validated – High SEI habitat is intact and capable of supporting recorded and some expected SCCs.
Plant Theme	**Medium**	**-**	**High**	Disputed – High SEI habitat is intact and supports SCC. Sensitive species 1212 confirmed.
Terrestrial Theme Low-Very High		**Rocky and Stoney Community**	**High**	Disputed – Habitat remains in good condition and delivers important ecological functions. Some minor disturbance evident in the form of grazing pressure. Considered as CBA area.
		Sedimentary Community	**Medium**	Disputed – Habitat remains in good condition and delivers important ecological functions. Some minor disturbance evident in the form of grazing pressure. Considered ESA area.
		Degraded Shrubland	**Low**	Disputed – Habitat degraded and in unlikely to recover without human intervention
		Modified	**Very Low**	Disputed – Habitat is entirely modified

Table 4-25. Table providing descriptions of the habitat types delineated for the PAOI.

Habitat	Description and Condition	Ecosystem Processes and Services
Rocky Plain	Flat terrain with large rocks (>200 mm), low slopes (<2°). Sparse vegetation, mostly karoo shrubs and herbs. Generally intact with limited disturbance. The floral structure consists of a mixture between tall shrubs interspersed with lower-growing karoo bushes and grasses.	Provides microhabitats for reptiles and small mammals. Contributes to soil stability and water retention. Structural heterogeneity supports species diversity.
		
Rocky Ridge	Elevated slopes (>5°), with exposed bedrock and boulders. Supports taller woody shrubs and high vegetation structural diversity. Generally high ecological condition. Plant species typically associated with Rocky Ridges include *Rhigozum obovatum, Eriocephalus ericoides, Pteronia adenocarpa, Indigofera nigromontana, Euphorbia stellispina and Euphorbia ferox.*	Offers high refugia and nesting opportunities for rupicolous (rock-dwelling) species. Stabilises slope erosion. Functions as a biodiversity hotspot within the arid landscape.
Rocky Slope	Intermediate slopes (2–5°) with rocky substrates. Vegetation varies from grasses to dwarf shrubs. Slightly less diverse than ridges but still relatively intact.	Important for shelter, nesting and movement of terrestrial vertebrates. Plays a role in erosion control and nutrient cycling.
Sandy/Silty Plain	Flat areas with fine sandy or silty soils. Vegetation is sparse and often patchy due to grazing pressure. Condition is fair to moderate; vulnerable to degradation.	Supports burrowing species (e.g., rodents, reptiles), acts as corridors for animal movement. Fertile microsites under vegetation aid in primary productivity and soil formation.

Habitat	Description and Condition	Ecosystem Processes and Services
Sandy Ridge	Slightly elevated terrain with sandy substrate. Often supports a mix of shrubs and grasses. Typically shows low levels of human disturbance.	Enhances drainage and infiltration. Offers movement routes and forage for small to medium-sized mammals. Also important for plant colonisation due to improved drainage and exposure.
Sandy Slope	Gentle to moderate incline, sandy composition. Vegetation is more stable than on plains but more vulnerable than ridges. Condition is moderately intact.	Supports faunal movement and foraging. Assists with rainfall infiltration and erosion control. Limited refugia potential but facilitates landscape-level ecological connectivity.
Stony Plain	Flat terrain covered in smaller stones or gravels. Low slopes. Vegetation consists of hardy shrubs and grasses. Generally intact but moderately impacted by grazing.	Soil stabilisation, supports insect and reptile life. Offers forage for browsers and limited cover for small vertebrates. Helps moderate surface temperature fluctuations.

Habitat	Description and Condition	Ecosystem Processes and Services
Stony Ridge	Elevated with high stone density. Vegetation is denser and more structured than stony plains. Often serves as ecological refugia due to inaccessibility and low impact.	High importance for sheltering fauna, erosion mitigation, and biodiversity conservation. May support rare or red-listed species due to lower human disturbance.
Stony Slope	Mid-slope habitat with gravel and stones. Vegetation is moderately diverse. Impacts are moderate.	Important for faunal movement and ecosystem stability. Prevents excessive erosion and provides diverse niches for different animal taxa.
Open Water/Windmill	Artificial or natural water points associated with windmills or dams. Often with surrounding green flushes. These are rare but vital in the arid region. May be impacted by livestock activity or contamination.	Critical water source in a dry ecosystem; attracts fauna and enhances biodiversity locally. Supports amphibians, tortoises, birds and insects. Acts as stepping stones for movement and survival in the landscape.

Habitat	Description and Condition	Ecosystem Processes and Services
Drainage Habitat	Natural or ephemeral streams and surrounding banks, often with enhanced vegetation and rocky features. Somewhat rare and highly sensitive. May be subject to sedimentation and disturbance.	Supports species during droughts, acts as a corridor for movement, and plays a critical role in nutrient transport and vegetation regeneration. High refugia and foraging value. Key in maintaining ecological function across seasons in this arid system.
Modified	This habitat unit includes all areas that maintain little to no native vegetation and/or where anthropogenic activity has substantially modified an area's primary ecological functions and species composition. This habitat unit no longer maintains its functional integrity and does not contribute significantly to ecosystem services. This habitat unit is predominantly made up of gravel roads, and old mine areas	The ecological services provided by this habitat are limited due to the extent of land transformation and the large amount of bare ground.
Degraded Shrubland	In summary, degraded Karoo shrubland that is recovering from past disturbances is an area where the natural vegetation is slowly returning after being damaged by agriculture or other human impacts. The process is slow but vital for restoring the health and biodiversity of the Karoo landscape.	Ecosystem processes in recovering Karoo shrubland are limited until they gradually return to normal as native vegetation re-establishes, soil health improves, and animal communities return.

Habitat	Description and Condition	Ecosystem Processes and Services

4.1.5.35 Site Ecological Importance

The different habitat types within the PAOI were assigned Ecological Importance (EI) categories based on their ecological integrity, conservation value, the presence of SCCs and their ecosystem processes. As per the terms of reference for the project, GIS sensitivity maps are required to identify sensitive features in terms of the relevant specialist discipline/s within the PAOI. Based on the criteria provided in the specialist report, all habitats within the PAOI were assigned a sensitivity category, i.e., a SEI category. (Table 4-26), the guidelines for each category can be seen in Table 4-27. The SEI of the PAOI is illustrated in Figure 4-39.

Table 4-26. Summary of habitat types delineated within field assessment area

Habitat	Conservation Importance	Functional Integrity	Biodiversity Importance[7]	Project Component in relation to habitat type	Receptor Resilience	Site Ecological Importance[8]
Rocky and Stony Community Potential *Nananthus sp* habitat	Medium Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (EN, VU) etc. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.	High Large intact area for any conservation status of ecosystem type. Good habitat connectivity, with potentially functional ecological corridors and a regularly used road network between intact habitat patches. Only minor current negative ecological impacts, with no signs of major past disturbance and good rehabilitation potential.	**Medium**	Planned Infrastructure	Low Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~ less than 50% of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of: (i) remaining at a site even when a disturbance or impact is occurring.	**High**
Sedimentary Community	Medium Confirmed or highly likely occurrence of populations of Near Threatened (NT) species, threatened species (EN, VU) listed under Criterion A only and which have more than 10 locations or more than 10 000 mature individuals. Presence of range-restricted species. > 50% of receptor contains natural habitat with potential to support SCC.	High As above	**High**	Planned Infrastructure	Medium Will recover slowly (~ more than 10 years) to restore > 75% of the original species composition and functionality of the receptor	**Medium**
Degraded Shrubland	Low .< 50% of receptor contains natural habitat with limited potential to support SCC	Low Several minor and major current negative ecological impacts.	**Low**	Planned Infrastructure	Medium As Above	**Low**
Modified	Low	Very Low	**Very Low**		High	**Very Low**

[7] Considered as the 'sensitivity'
[8] Considered as the sensitivity in relation to the project component.

	< 50% of receptor contains natural habitat with limited potential to support SCC.	Several major current negative ecological impacts.		Planned Infrastructure	Habitat that can recover relatively quickly	

Table 4-27. Guideline for interpreting Site Ecological Importance in the context of proposed project activities.

Site Ecological Importance	Interpretation in relation to proposed development activities
High	Avoidance mitigation wherever possible. Minimisation mitigation – changes to project infrastructure design to limit the amount of habitat impacted, limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimisation and restoration mitigation – development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimisation and restoration mitigation – development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimisation mitigation – development activities of medium to high impact acceptable and restoration activities may not be required.

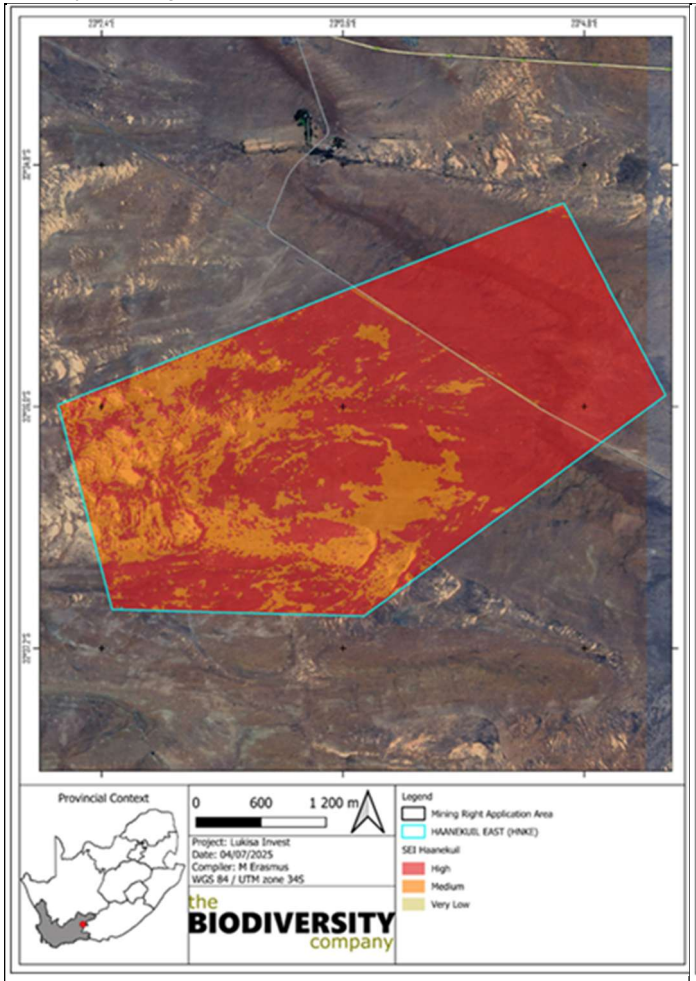


Figure 4-39. Site Ecological Importance of the Haanekuil PAOI.

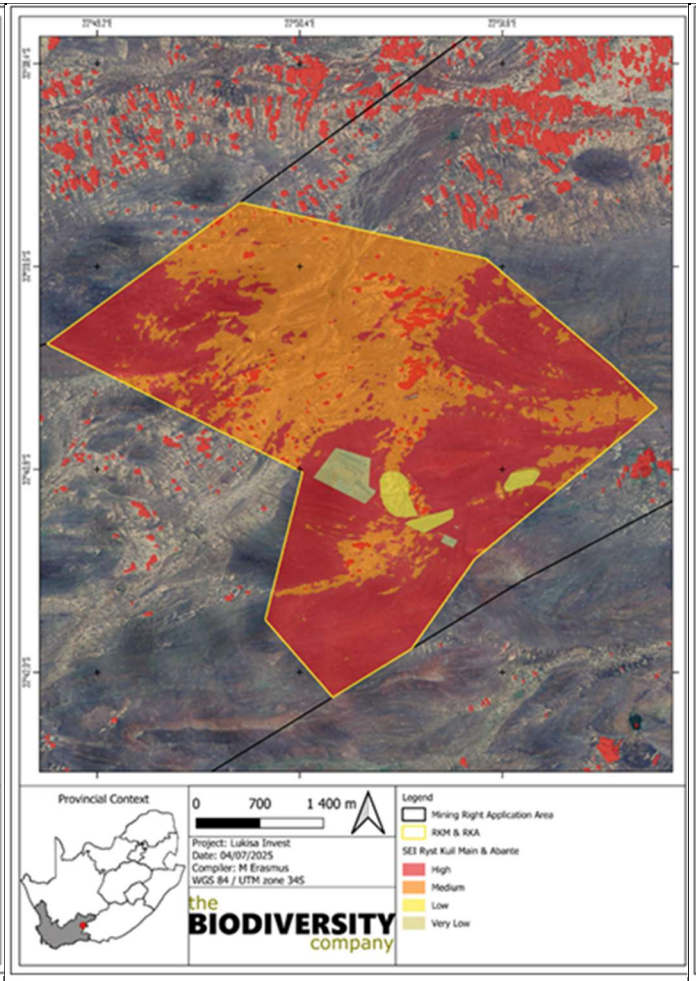


Figure 4-40. SEI of the RKM & RKA PAOI.

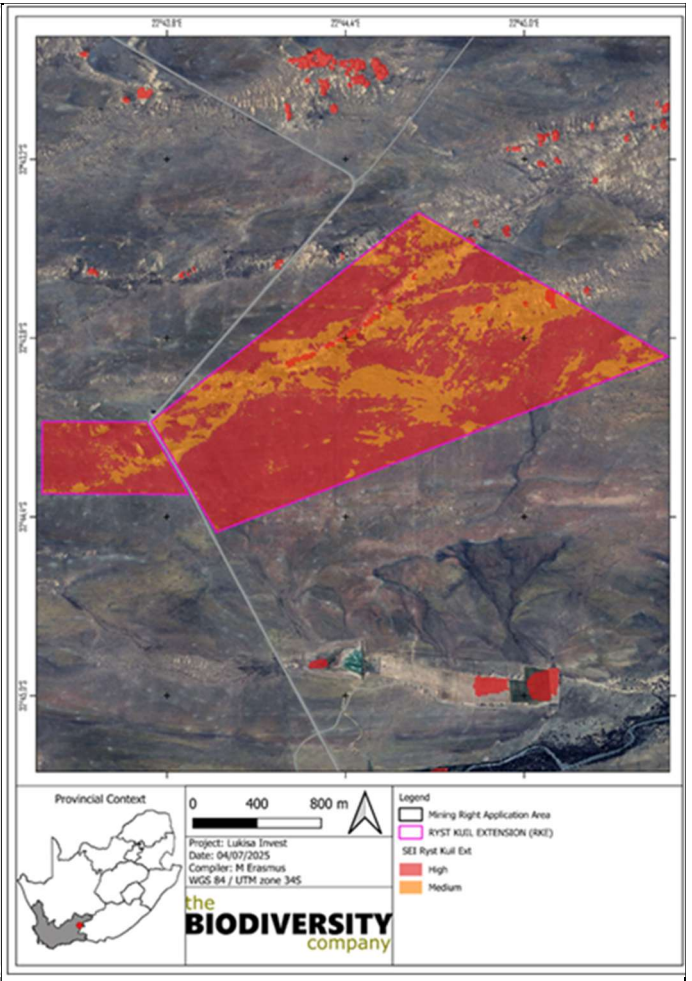


Figure 4-41. Site Ecological Importance of the RKE PAOI

4.1.5.36 Screening Tool Comparison

The allocated sensitivities for each of the relevant themes are either disputed or validated for the assessed areas in Table 4-28 below. A summative explanation for each result is provided as relevant. The specialist-assigned sensitivity ratings are based largely on the SEI process followed in the previous section, and consideration is given to any observed or likely presence of SCC or protected species.

Table 4-28. Summary of the screening tool vs specialist assigned sensitivities.

Screening Tool Theme	Screening Tool	Habitat	Specialist	Tool Validated or Disputed by Specialist - Reasoning
Animal Theme	**High**	**-**	**High**	Validated – High SEI habitat is intact and capable of supporting recorded and some expected SCCs.
Plant Theme	**Medium**	**-**	**High**	Disputed – High SEI habitat is intact and supports SCC. Sensitive species 1212 confirmed.
Terrestrial Theme Low-Very High		**Rocky and Stoney Community**	**High**	Disputed – Habitat remains in good condition and delivers important ecological functions. Some minor disturbance evident in the form of grazing pressure. Considered as CBA area.
		Sedimentary Community	**Medium**	Disputed – Habitat remains in good condition and delivers important ecological functions. Some minor disturbance evident in the form of grazing pressure. Considered ESA area.
		Degraded Shrubland	**Low**	Disputed – Habitat degraded and in unlikely to recover without human intervention
		Modified	**Very Low**	Disputed – Habitat is entirely modified

4.1.6 Soil

The Ryst Kuil application area is subject to very arid climatic conditions and is dominated by very shallow soils with low agricultural potential and is mainly used for sheep farming. The topography is dominated by flat to slight undulating midslopes and footslopes. The soils are dominated by shallow soils of the Mispah, Glenrosa and Coega soil forms. Flat floodplains and riverbeds are dominated by Swartland, Valsrivier and Augrabies soil forms. The soil types are shown in Figure 4-42 which contains an abbreviated soil legend. A detailed soil legend is provided in Table 4-29 which described the soils in terms of the following aspects:

- Dominant and subdominant soil forms and families;
- An average effective depth range;
- The estimated clay content of the A and B soil horizons;
- The texture class range;
- A description of the terrain unit and slope;
- A broad description of the dominant soil form in terms of the effective soil depth, internal drainage, soil colour, soil texture class and terrain unit;
- An agricultural potential rating and the land capability classification; and
- The area and percentage comprised by each soil type.

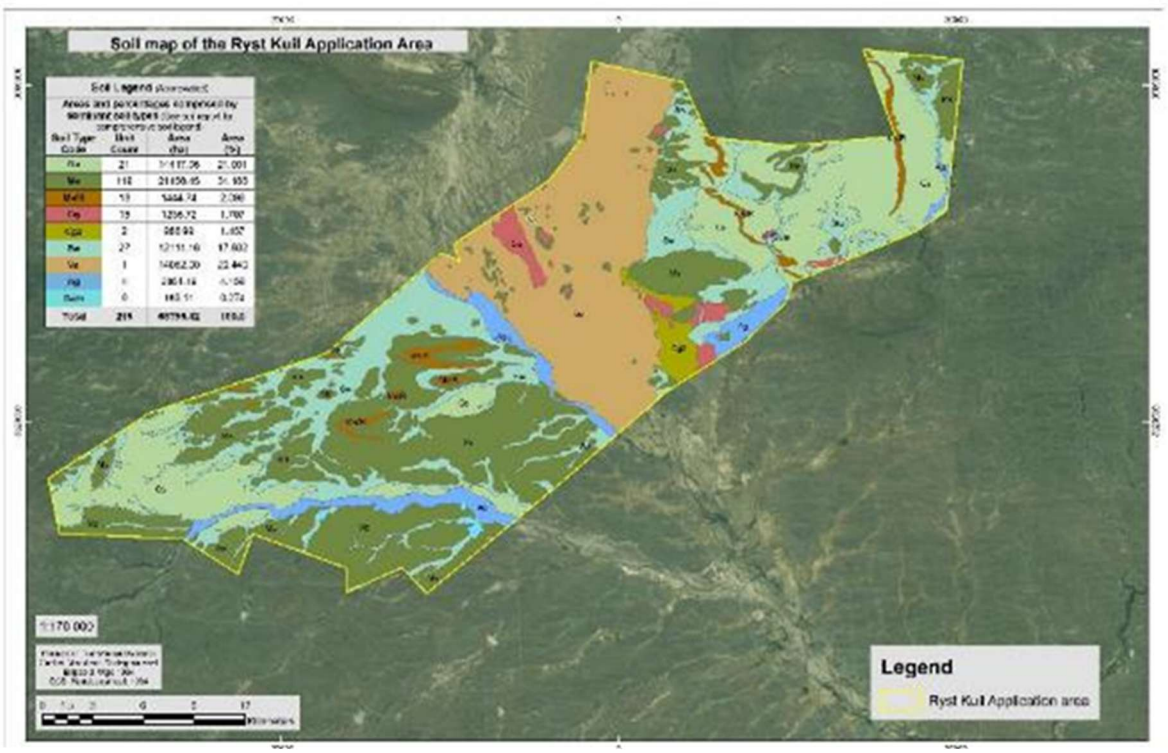


Figure 4-42. Soil distribution in the Ryst Kuil application area.

Table 4-29. Soil legend of the Ryst Kuil application area

SOIL LEGEND									
Soil Type Code	**Dominant Soil Form and Family**	**Effective soil depth (mm)**	**Clay % A-horizon B-horizon**	**Texture Class**	**Summarized Description of Dominant Soil Form in terms of effective soil depth, colour, texture, underlying material, terrain unit and percentage surface stone**	**Agricultural Potential**	**Land Capability**	**Area (ha)**	**Area (%)**
Gs	***Glenrosa 1211;** Mispah 1100, Augrabies 1110, Swartland 1211, Oakleaf 1110	200-300	A: 10-15 -	Loamy sand	Very shallow (200-300 mm), reddish brown, loamy sand soils underlain by weathered or fractured rock, situated mainly on flat to slight undulating footslopes with occasional stony patches covering 1-30% of the surface.	Very low	Grazing	14447.06	21.001
Ms	***Mispah 1100;** Glenrosa 1211, Augrabies 1110, Swartland 1211, Oakleaf 1110	50-250	A: 10-15 -	Loamy sand	Very shallow (50-250 mm), reddish brown, loamy sand soils underlain by hard or fractured rock, situated mainly on wide stretched, flat to slight undulating footslopes with occasional rocky outcrops with 2-15% surface stone.	Very low	Grazing	21456.45	31.188
Ms/R	*Mispah 1100; Glenrosa 1211, Augrabies 1110, Oakleaf 1110	0-100	A: 10-15 -	Loamy sand	Very shallow (50-150 mm) reddish to greyish brown, loamy sand soils underlain by hard rock situated on steep, narrow, linear rocky edges (10-60% surface rock) or frequent undulating, mild to steep crests, midlopes, footslopes and narrow stony drainage lines.	Very low	Grazing	1444.74	2.098
Cg	***Coega 2000;** Glenrosa 1212, Brandvlei 1000, Mispah 1200,	100-300	A: 10-15 -	Loamy sand	Very shallow (100-300 mm), yellowish brown, loamy sand soils underlain by hardpan carbonate, situated on isolated flat footslopes.	Very low	Grazing	1235.72	1.797
Cg2	***Coega 1000;** Glenrosa 1212, Brandvlei 1000, Mispah 1200, Swartland 1211	150-350	A: 10-18 -	Loamy sand to sandy loam	Shallow (150-350 mm), yellowish to reddish brown, loamy sand soils underlain in a complex association by either hardpan carbonate (dominant) and to a lesser extent by hard, weathered or fractured rock, situated on flat footslopes.	Very low	Grazing	988.99	1.437
Sw	***Swartland 1211;** Hutton 3200, Oakleaf 1110, Glenrosa 1211, Augrabies 1120	200-450	A: 20-30 B: 25-35	Sandy clay loam	Shallow (200-450 mm), reddish brown, well-drained, weak to moderately structured, sandy clay loam alluvium soils underlain by fractured rock, situated mainly in narrow dry drainage zones. Weaker structured phases of this soil type occur frequently and qualify as Hutton, Oakleaf and Glenrosa forms.	Low	Riparian	12111.16	17.602
Va	***Valsrivier 1211;** Augrabies 1120, Swartland 1212, Oakleaf 1110, Glenrosa 1212	600-1200	A: 20-30 B: 25-40	Loam-clay loam	Moderately deep to deep (600-1200 mm), well-drained, reddish brown, moderately structured, loam to clay loam alluvial soils, situated on flat, wide stretched floodplains. Weaker structured phases of this soil type occur frequently and qualify as Oakleaf and Augrabies forms.	Moderate-low	Riparian	14062.00	20.440

Ag	***Augrabies 1120;** Valsrivier1212, Oakleaf 1120, Addo 1221, Glenrosa 1212	600-1500	A: 10-20 B: 15-35	Sandy loam-clay loam	Deep (600-1500 mm), well-drained, brown, apedal to weakly structured, sandy loam to clay loam, calcareous alluvial soils, situated in eroded non-perennial riverbeds.	Moderate-low	Riparian	2861.19	4.159
Dam	-	0	-	-	Mainly local farm dams	None	Wilderness	188.11	0.274
*** Dominant soil form and family**							**Total**	**69134**	**100.0**

4.1.6.1 Land Capability

The land capability of the Ryst Kuil application area is summarized in Table 4-30 which shows the soil types grouped into each land capability class, the number of polygons per land capability class and the area and percentage comprised by each land capability class. The general grazing capacity as obtained from various farmers during the time of the assessment is 6-8 ha per small stock unit.

Table 4-30. Land Capability of the Ryst Kuil Application Area

LEGEND: LAND CAPABILITY					
Areas and Percentages Comprised by Land Capability Classes					
Land Capability Code	**Land Capability Class**	***Soil Types**	**Polygon Count**	**Area (ha)**	**Area (%)**
G	**Grazing**	Gs, Ms, Ms/R, Cg, Cg2	128	39573.01	57.52
R	**Riparian**	Sw, Va, Ag	16	29034.38	42.20
W	**Wilderness**	Dam	8	188.10	0.27
A	**Arable**	-	0	0.00	0.00
WL	**Wetland**	-	0	0.00	0.00
*See soil map **Figure 3-1**		**Total**	**152**	**68844**	**100.0**

The location and extent of land capability classes within the Ryst Kuil application area are shown in Figure 4-43. Land Capability map of the Ryst Kuil application area.

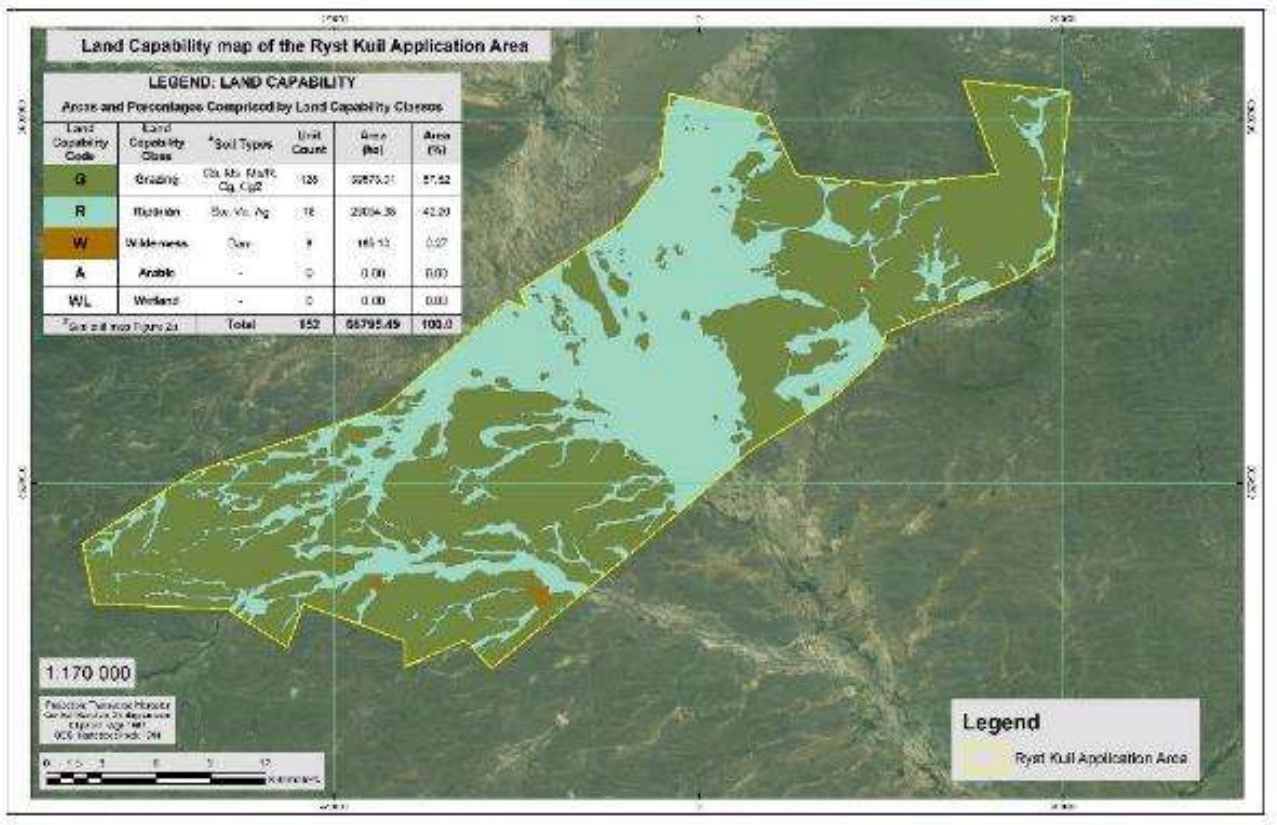


Figure 4-43. Land Capability map of the Ryst Kuil application area.

4.1.6.2 Land Use

The extent of current land uses within the Ryst Kuil application area is summarised in Table 4-31 and shown in Figure 4-44.

Table 4-31. Land Use of the Ryst Kuil application area

LEGEND – CURRENT LAND USE				
Land Use Code	**Land Use**	**Polygon Count**	**Area (ha)**	**Area (%)**
G	Grazing – Natural Karoo bush.	1	68471.76	99.53
C	Cultivation and old fields.	1	14.36	0.02
D	Local farm dams - Includes only the bigger dams as well as Grootpan.	8	188.11	0.27
F	Farmstead – Includes mostly the farmhouse, related farm building and labourer cottages.	15	102.29	0.15
M	Old mining site – Abandoned site consisting of a few structures, discard and waste material.	1	21.68	0.03
	TOTAL	**26**	**69016**	**199.0**

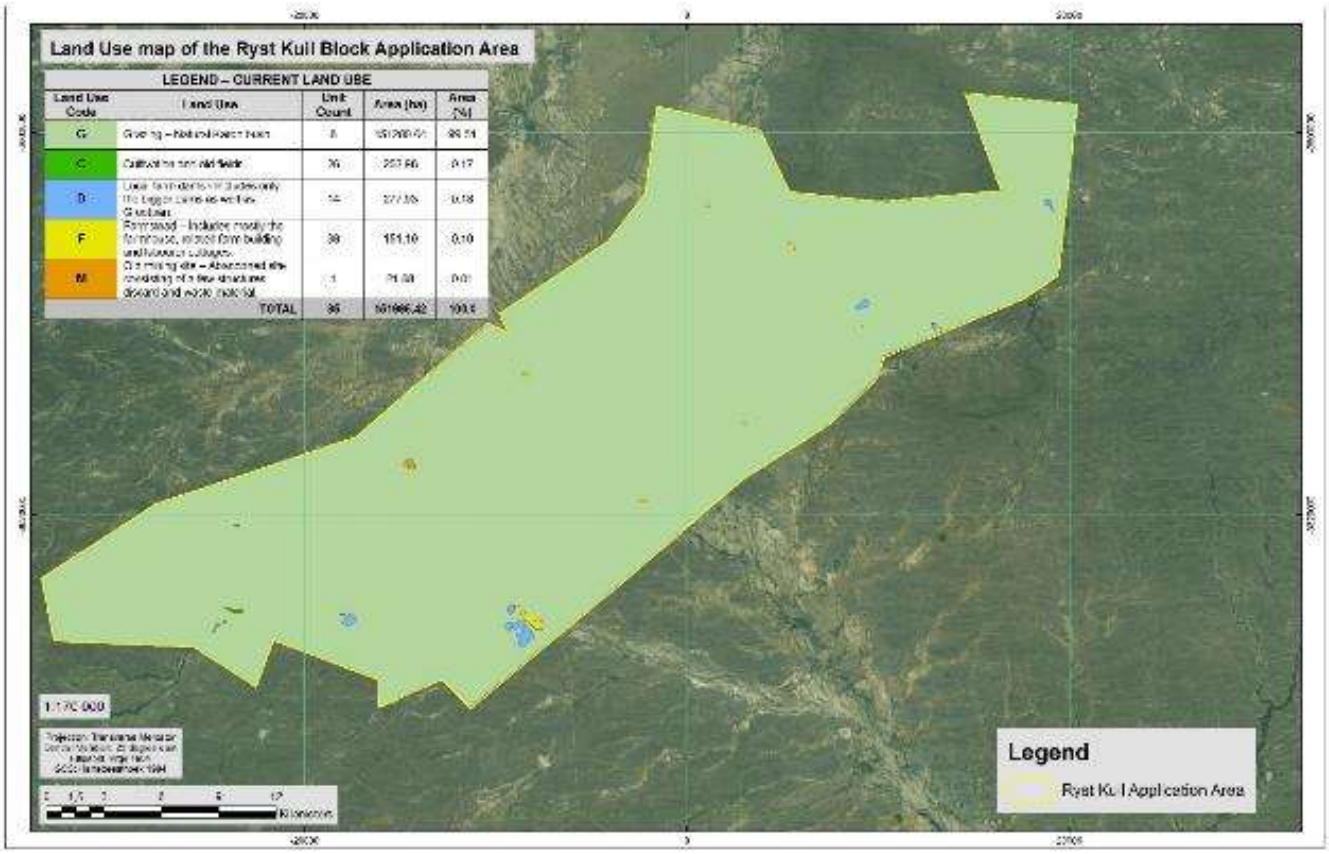


Figure 4-44. Land use map of the Ryst Kuil application area.

4.1.7 Groundwater

Groundwater is a vital resource in this arid region, used extensively for livestock, irrigation, domestic, and municipal needs. The area features a unique landscape, with steep mountains in the north transitioning to flat pedeplains in the south, formed by erosion of the Great Escarpment. These plains have shallow alluvial soils that are prone to flooding and significant water loss through evaporation.

The Ryst Kuil study area contains three types of aquifers: intergranular (primary), fractured, and mixed fractured-intergranular. Primary aquifers occur along river channels and contain sand, silt, gravel, and boulders, with an average thickness of ~10 m. Groundwater levels in these aquifers range from 10–25 m deep, with yields >5 L/s, though water quality is generally poor due to evaporation and salt accumulation.

Fractured aquifers are mainly found in Beaufort Group sandstones, while mixed aquifers are linked to Karoo dolerites. The uranium mineralization is hosted in palaeo-channel sandstones, which also serve as key groundwater zones. Groundwater movement in these formations depends on fractures and bedding planes, as the sandstone has minimal primary porosity. Better quality groundwater is generally found in the fractured aquifers, particularly near the Ryst Kuil and Haanekuil ore bodies.

Table 4-32. Summary of Selected 2008 Exploration Borehole Logs

Borehole No.	Depth (m)	Lithology	Water Strikes (mbgl)
HKLW1	50	Sst*/dolerite	16, 24, 35, **44**
HKLW4	125	Sst	35, 38, 47, 60, **74**
KKDW1	140	Interbedded sst/mst**	48-49, 55, 66, 76-78, **87**, 91, 113, 124, 131, 133
KDKW2	140	Interbedded sst/mst	41, 52, 125, **133**
KDKW4	120	Interbedded sst/mst	28, 43, 54, **75**
KRKW1	120	Interbedded sst/mst	59-60, 64-65, 68, 73, 78, 96, **108**
KRKW2	120	Interbedded sst/mst	12, 35, 41-45, 52-53, 61-62, **66**, 95

*sandstone
**mudstone
#main water strike in bold

The channel sandstone aquifer, which includes interbedded mudstone, shows that 83% of water strikes occur at depths shallower than 100 m—key data used for selecting aquifer parameters in numerical modelling. Groundwater in the fractured aquifer flows primarily along two joint sets-oriented east-west and NNW-SSE, influenced by sandstone thickness and folding due to the nearby Cape Fold Belt. The sandstone aquifer is typically 20–40 m thick and extends to depths of 100–140 m, with widths of ~2.5 km, widening northeast and southwest.

Aquifer transmissivity ranges from ~12 to 380 m²/day and borehole yields from ~5 to 25 L/s, highest in the southwest and declining northeast, due to changes in lithology, structure, and folding. A strong east-west anisotropy in transmissivity is also noted.

Secondary aquifers have relatively deep groundwater levels (15–40 m below ground), with little long-term fluctuation even during droughts. Highly permeable sandstone layers can be fully abstracted without significantly affecting less permeable layers. Rest water levels (RWLs) are consistently >40 m above main water strikes, suggesting stable conditions, even in farmer boreholes lacking detailed data.

Notably, the extent of the aquifer system in Ryst Kuil was only identified through uranium prospecting in 1978/79 and 2007/08. An offer to share this information with Beaufort West Municipality for groundwater development in ~2005 was not taken up.

4.1.7.1 Hydrocensus

Farms in the LRP area were visited in August and September 2016 and details on 248 boreholes e.g. depth, yield and use obtained, where available (see Figure 4-28). However, relatively little information could be obtained from the owners. The groundwater is used for stock watering, irrigation and domestic purposes. Information from the owners on borehole depths and yields was generally very sparse and estimates of abstraction have been made based on i) windpump size and use for stock watering and ii) hectares of irrigated land. Most boreholes are equipped with windpumps and are estimated to yield relatively small volumes in the range 600 - 800 m^3/a. Some are equipped with submersible or turbine pumps and the groundwater is used mainly for irrigation purposes, mostly during the period September to April.

Table 4-33. Comparison of Groundwater Levels, 2007 and 2016

Borehole Number	2007 Water Level (mbgl)	2016 Water Level (mbgl)
VPS17	20.59	21.71
KKRW1	34.73	37.15
KKRW2	26.25	31.44
KKL011	41.14	41.35
KKR333	40.98	33.21
ERW5	9.22	9.88
ERW9	25.86	23.64
ERW10	3.04	7.18

Water levels range from 'near-surface' (<10mbgl) to 'shallow' (<30mbgl) to 'deep' (>30mbgl), with the two shallowest water levels showing the largest fluctuation (drop), as might be expected. From the somewhat sparse record above it would appear that groundwater levels have mostly not declined significantly over the past nine years, which is corroborated by the water levels recorded in the monitoring network.

Claims have been made by locals of interference by mine exploration boreholes on privately-owned boreholes, with one of the latter apparently running dry allegedly due to exploration drilling c.9km away. This claim was posed to a number of experienced Karoo ground water speacialists with and the consistent response from each was that such interference (from drilling/pumping of single boreholes) is considered to be highly unlikely in an essentially unconfined aquifer system.

A hydrocensus was carried out in late April 2025 to update the 2016 information, during which 46 boreholes were checked. Results are shown in Table 4-34 and borehole positions are shown on Figure 8.

Table 4-34. April 2025 Hydrocensus data

Bh No	Equipment	Use	RWL (mbgl)	EC* (mS/m)	2016 EC (mS/m)	pH	2016 RWL (mbgl)	RWL Change (m)	Comments
BDK1	WP	Stock	5.68				7.86	2.18	
BDK14	WP	Stock	3.65				5.72	2.07	

BDK2	Submersible	Domestic	5.09	147	188	7.59	7.28	2.19	
BDK22	WP	Stock	4.86				7.29	2.43	
BDK4	WP	Stock	4.54				6.83	2.29	
BDK5	WP	Stock	4.76				7.1	2.34	
BDK6	Submersible	Irrigation	4.22				6.56	2.34	
HK48	None	None	46.11				48.51	2.4	
HKL13	Submersible	Domestic	4.47	105	112	7.54	8.28	3.81	
HKL8	WP	Stock	21.59	170	209	7.48	7.98	-13.61	2025 pumping water level
HKLW1	None	None	3.62				6.51	2.89	
HKLW2	Solar pump	Stock	25.5	126	175	7.53	19.56	-5.94	2025 pumping water level
HKLW3	None	None	20.61				19.95	-0.66	2007 water level
HKLW4	Solar pump	Stock	25.29	136	160	7.5	24.5	-0.79	2025 pumping water level
HNKW26	None	None					7.56		Not visited, too wet
KDK0002	WP	None	7.54						WP out of order, no 2016 WL, roots in bh
KDK1931	None	None	36.09						No previous water level
KDK820H	None	None	25.89				29.22	3.33	
KDKW1	None	None	32.64				34.25	1.61	
KDKW2	None	None	28.13				30.2	2.07	2007 water level
KDKW4	None	None	25.07				26.98	1.91	2007 water level
KGT18	Submersible	Domestic	9.4	190		7.6			New bh
KGT3			14.94	91		7.65	21.56	6.62	
KGT9	WP	Stock	10.29	197	298	7.5	23.37	13.08	
KKL001	Submersible	None	7.08				37.25	30.17	Standby, pumps dry after 10 minutes
KKL002	None	None	4.74				6.23	1.49	
KKR333	None	None						0	Demolished
KKR333A	None	None	14.39				36.74	22.35	2016 WL measured in demolished bh KKR333 150m south
KKR333B	None	None	12.9						
KKRW1	None	None	29.53				34.73	5.2	2007 water level
KKRW2	Submersible	Domestic	25.21	158	160	7.6	31	5.79	
KPS10	Submersible	Irrigation	14.89				27	12.11	
KPS9	WP	Domestic	9.36	160	173	7.6	11.05	1.69	
LTS10	None	None	10.84				12.56	1.72	Ran "dry", no longer in use
LTS11	Submersible	Domestic	25.47	129	119	7.45	23.05	-2.42	2025 pumping water level
LTS12	Submersible	None	15.1				22.12	7.02	Not in use
LTS3	Submersible	Irrigation	3.1				5.89	2.79	
RKMA064U	None	None	24.45						No previous water level
RSK13	WP	Stock	6.13	226	284	7.6	8.53	2.4	
RSK14	WP	Domestic	5.95	248	200	7.65			No previous water level
RSK5	WP	Stock	5.12				7.25	2.13	
RSK7	WP	Stock	5.92	575		7.7	12.52	6.6	
VKL1	Submersible	Domestic	16.26	66	88	7.7			2025 pumping water level
VKLM1	None	None	6.57				13.24	6.67	
VPS17	WP	Stock	20.98	104	113	7.4	20.59	-0.39	
VPS2	Submersible	Stock	14.98	135	165	7.5	13.43	-1.55	2007 WL
VPS8								0	Not visited - too wet

*blue indicates a decrease in EC, red, an increase

4.1.7.2 Borehole Siting, Drilling and Testing

During the 2007/08 investigation, 17 groundwater exploration boreholes were drilled in the LRP, to depths of between 50 and 143 m. Extensive yield testing was carried out with pumping rates ranging from 3 - 26 L/s and T and S values obtained. Packer testing was also carried out on three boreholes to determine zone-specific K values. It was therefore considered that sufficient data were available for this area and further drilling and testing was not carried out in the LRP in 2016 or 2025. Selected details of these boreholes are given in Table 4-35 and locations are shown on Figure 4-45. Test pumping information is used to assist with the numerical model calibration in the following section below.

Table 4-35. Results of Groundwater Exploration Drilling in the RK Area 2008

BH No.	Depth (m)	Tested Yield (L/s)	Long-term Sustainable Yield (L/s)	EC (mS/m)	Water Level (mbgl)	T (m^2/day)
KDKW1	120	26.74	24.0*	176	34.25	265-380
KDKW2	140	8.64	8.7	150	30.20	27-112
KDKW4	120	10.27	5.8	165	26.98	12-22
KKRW1	120	15.14	16.0	165	34.73	90-110
KKRW2	120	10.04	5.1	160	26.25	14-33
HKLW1	49	3.55	4.5	138	5.87	42-70
HKLW4	125	7.12	8.3	165	24.50	37-70

*probably optimistic and 50% of this would be a more realistic starting yield.

The results obtained from the nine yield tested boreholes, as well as three previously tested boreholes (BH758, BH725 and 636), were analysed by using the FC-Flow Characteristic method and some using the Cooper–Jacob method (SRK, 2008). The FC-method was specifically developed for determining sustainable yields of boreholes penetrating fractured-rock aquifers. In the calculations, the following allowances were made:

1. Abstraction from all other known production boreholes in the area;
2. Effective recharge of 5 mm/annum (3.9 mm in calibrated model);
3. Data extrapolated for a nominal 5 years; and
4. Dewatering of a nominal 30 – 40 m (available drawdown) over this period.

The long-term sustainable yields listed in the above table appear to be on the high side (see also comment on effective recharge), although undoubtedly attainable in the short-term (weeks). The pumping of 16L/s over a period of one year from the trial mine (SRK, 2007), despite grouting of some major water-bearing fractures, supports this. However, for inclusion in numerical modelling scenarios of pumping of groundwater for supply to the CPP, much reduced yields have been assumed. The discussion on yield and T and S values is continued in the sections below.

Table 4-36 shows a comparison of groundwater RWLs measured in the May 2007 hydrocensus with those measured in August/September 2016 (RKH sub-areas only) and April 2025. According to SRK, 2007, the main rainfall in the area occurs from January to March. The 2007 hydrocensus was carried out in May, i.e. soon after the main rains should have fallen. Although the 2016 hydrocensus was apparently carried out prior to the main rains, there had been extensive rainfall in the area prior to the survey, making some gravel roads temporarily

impassable. This was also the case in 2025. Those water levels showing a >10% change are indicated in red (drop) and blue (rise) whilst those in black show minimal change.

Table 4-36. Comparison of Groundwater Levels, 2007, 2016 and 2025

Borehole Number	2007 RWL (mbgl)	2016 RWL (mbgl)	2025 RWL (mbgl)
VPS17	20.59	21.71	20.08
KKRW1	34.73	37.15	29.33
KKRW2	26.25	31.44	25.21
KKL011	41.14	41.35	-
KKR333	40.98	33.21	14.30*
ERW5	9.22	9.88	-
ERW9	25.86	23.64	-
ERW10	3.04	7.18	-

*KKR333 demolished; water level measured in borehole 150m away

Water levels range from 'near-surface' (<10 mbgl) to 'shallow' (<30 mbgl) to 'deep' (>30 mbgl), with the two shallowest water levels showing the largest fluctuation (drop), as might be expected. From the somewhat sparse record above it would appear that groundwater levels have mostly stayed at similar levels or risen in the past 18 years.

Groundwater levels obtained from the NGA database were used to compile an illustrative groundwater elevation contour map, as shown in Figure 4-50. This map shows groundwater flows from the west, north and east, centred on the Sout River drainage. Wider spacing of the contour lines in the central area indicates either a thickening of the aquifer or an increase in K/T in this area.

Some comparisons of ECs with 2007, 2016 and 2025 measurements are available and are listed in Table 4-37. Noteworthy changes are indicated in blue (>20% decrease), although this is a small sample population.

Table 4-37. Comparison of 2007, 2016 and 2025 EC Readings

Borehole No.	2007 EC (mS/m)	2016 EC (mS/m)	2025 EC (mS/m)
HKL13	118	112	105
VKL01	134	88.3	66
KDK0002	162	99.5	-
KKL001	192	121	-

Most readings show a decrease in 2016 compared to 2007 but this could be influenced by most of the duplicate ECs being on the low side for the area. However, the 2025 EC readings almost all show a decrease over 2016, as indicated. Groundwater quality as EC from the 2025 hydrocensus is shown on Figure 4-51.

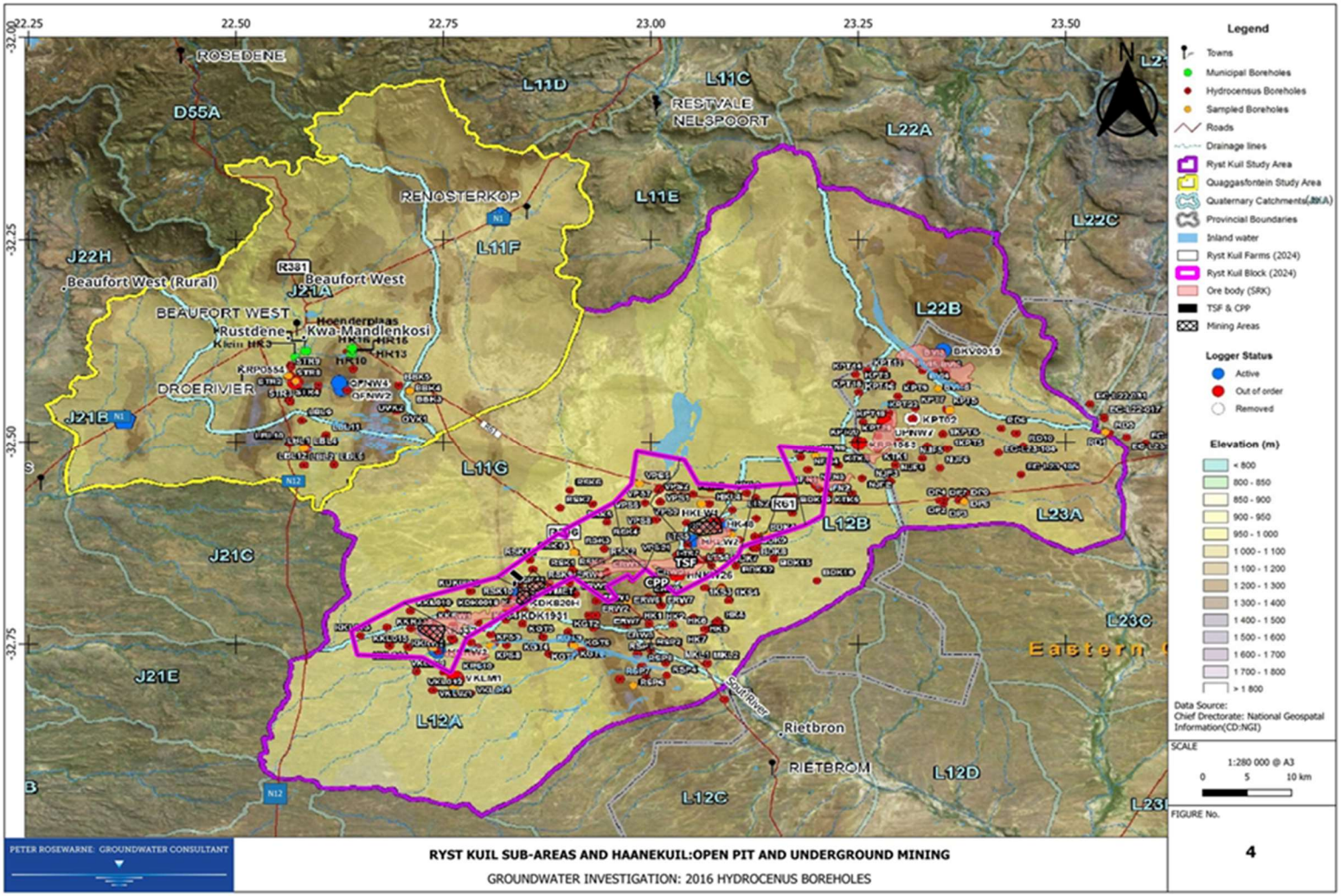


Figure 4-45. 2016 Hydrocensus.

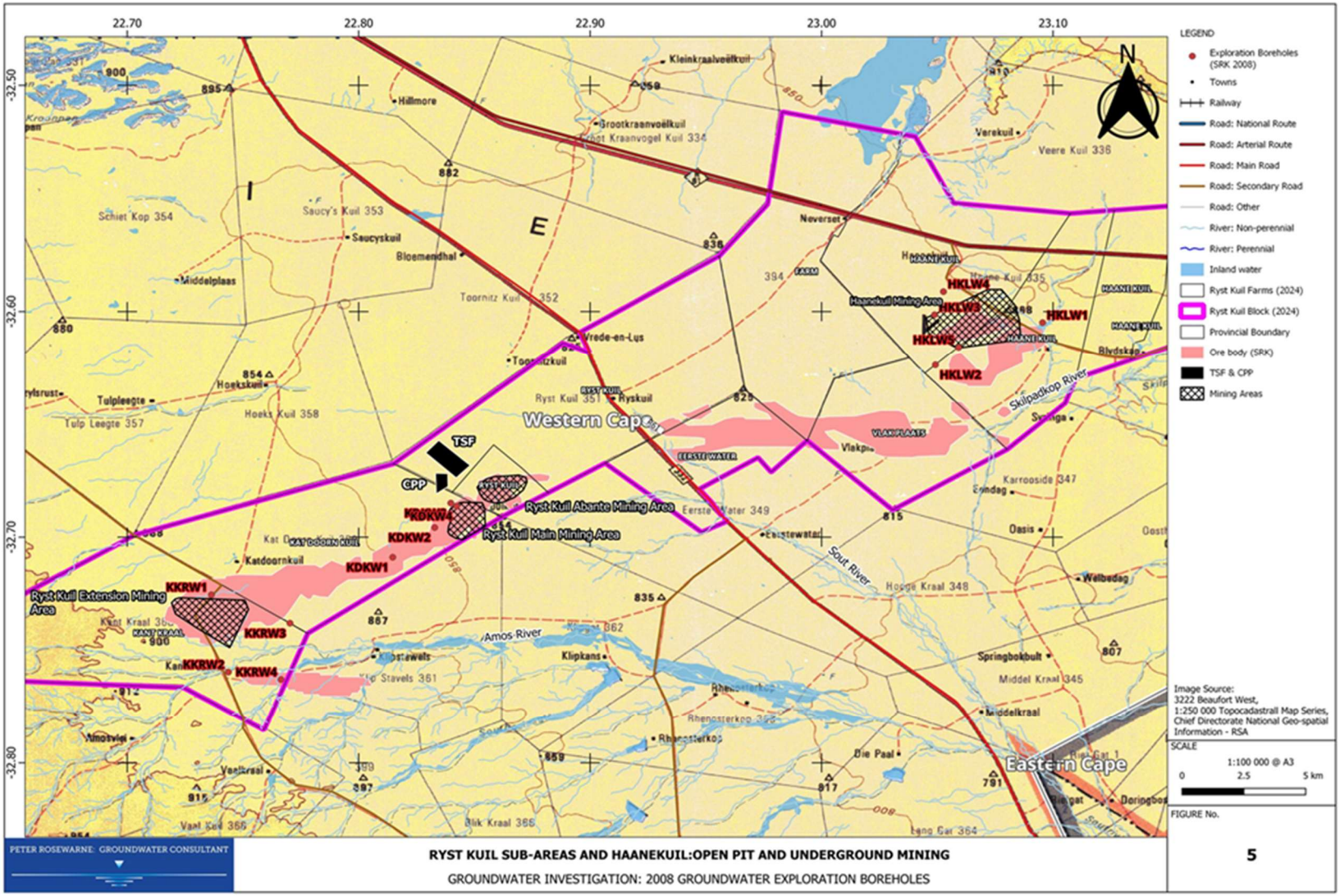


Figure 4-46. 2008 Groundwater Exploration Boreholes.

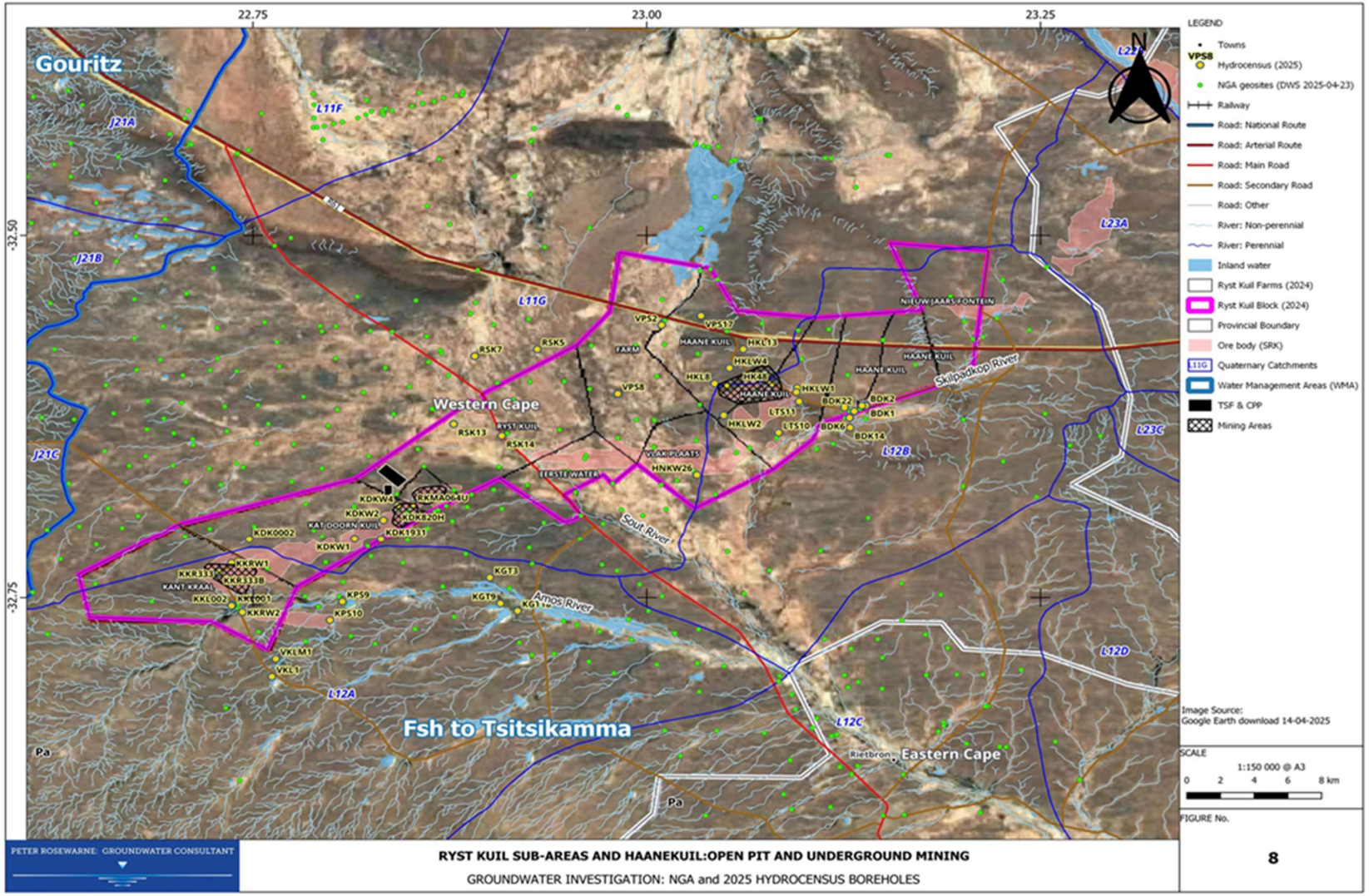


Figure 4-47. NGA and Hydrocensus boreholes 2025.

4.1.7.3 Water Quality Analyses

4.1.7.3.1 Macro-Chemistry

Water samples collected during the hydrocensus were submitted to UIS Laboratories in Centurion for metals scans and macro-chemical analyses.

The groundwater is alkaline and most ECs are within the range c.90 – c.300mS/m. The higher ECs may be associated with boreholes along river courses and in pediment areas, probably due to evaporative effects on shallow groundwater and incorporation of evaporite salts into local, direct recharge. EC is a measure of the ability of water to conduct an electrical current. This ability is a result of the presence of ions in the water, mainly bicarbonate ($HCO_3)_2$, chloride (Cl), sulphate (SO_4), nitrate, sodium (Na), potassium, calcium (Ca) and magnesium (Mg), all of which carry an electrical charge (positive or negative).

The groundwater is hard to very hard and is mostly a mixed NaCl/Ca-$MgSO_4$, $Na_2Ca(HCO_3)_2$ type. Fluoride (F) is generally elevated compared to drinking water standards (<1.5 mg/L recommended by SANS 241), commonly 1 - 2 mg/L and up to 2.67 mg/L (KGT3). Elevated F is a common feature of Karoo groundwater and is usually attributed to dissolution of detrital apatite (a calcium phosphate mineral containing F) grains in sandstones. Nitrate levels (<11mg/L as nitrogen - N - recommended by SANS 241) are also generally elevated-to-highly elevated, c.6 - 22mg/L as N, e.g. in KGT3 and KGT9, probably as a result of agricultural activities, e.g. application of fertilizers and wastes from stock pens.

4.1.7.3.2 Radiological Analyses

Selected (mainly those used for domestic supply) water samples from the 2016 hydrocensus were submitted to the NECSA laboratory in Pretoria for gross α and β activity analyses. A summary of gross α and β activities is given in Table 4-38.

Table 4-38. Summary of Gross Alpha & Beta Activity and Uranium Concentration 2016

Borehole No.	Alpha Activity (Bq/L)	Beta Activity (Bq/L)	U (metals scan, mg/L)
SANS target limit	**-**	**-**	**0.03**
DWS ideal target	**0.5**	**1.28**	**<0.07**
DWS upper limit	**-**	**-**	**0.284**
LKL1	1.25	0.44	0.066
RSK13	1.06	0.27	0.018
KPS9	0.397	0.0071	<0.01
RSP6	2.46	0.35	0.032
HKL13	0.778	0.402	0.014
LTS11	0.695	-0.0037	0.015
KGT9	1.42	0.24	0.025
KGT3	1.02	0.21	0.022
BDK1	0.997	0.16	0.017
1KS2	0.963	0.25	0.02
VV1	0.387	0.194	NA
GP1	0.244	0.12	NA

The metals scans show U generally <0.03mg/L (SANS 241-1:2015 target limit 0.03 mg/L), DWS domestic water "Ideal" target limit is <0.07 mg/L and "Upper" limit is 0.284 mg/L), apart from LKL1.

4.1.7.3.2.1 Groundwater Levels

4.1.7.3.2.1.1 Haanekuil Sub-Area

The groundwater level behaviour of boreholes in this sub-area is illustrated inFigure 4-48. The logger installed in borehole HNKW26 malfunctioned less than three years after it was installed. During this period, the groundwater level fluctuations in this borehole mimicked those of borehole HKLW1. Both boreholes have shallow groundwater levels of <10mbgl. Prominent spikes in the groundwater level recorded in borehole HKLW1 are caused by recharge from the adjacent earth dam when it fills after intense thunderstorms.

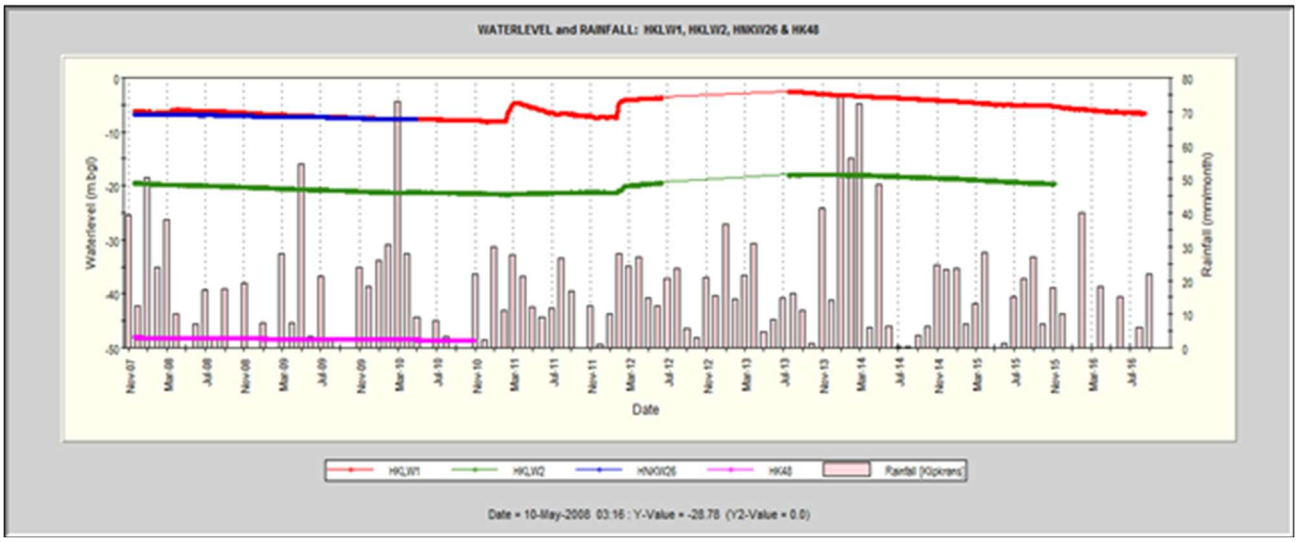


Figure 4-48. Groundwater Level Behaviour of Boreholes in the Haanekuil Sub-Area.

Borehole HKLW2 has much less pronounced groundwater level fluctuations, and the water level remains fairly constant. Again, the water level in this borehole is relatively deep compared to that of boreholes HKLW1 and HNKW26. The groundwater level behaviour recorded in borehole HK48 is also very stable with a continuous gradual decline during the period November 2007 to November 2010. This decline correlates well with the declines recorded in the other three boreholes during this time. The logger malfunctioned after November 2010, and no more water levels were recorded.

4.1.7.3.2.1.2 Ryst Kuil Sub-Area

The groundwater level behaviour of boreholes in this sub-area is illustrated in Figure 4-49. The logger installed in borehole VKLM1 malfunctioned after the download of 2013, and therefore no recent groundwater records are available. The loggers installed in boreholes KDK820 and KKR333 have also malfunctioned since the last download in October 2015. However, with the data available, it is clear that borehole VKLM1 has a different groundwater level behaviour compared to boreholes KDK820H, KKRW2 and KKR333. This is due to the combined effect of recharge from a nearby earth dam when filled after thunderstorms and abstraction from irrigation boreholes in the area. Also, the groundwater level in borehole VKLM1 is much shallower than the levels in the other boreholes in the area.

Groundwater levels in boreholes KKRW2 and KDK820H show a very similar long-term trend. Several spikes, which are associated with local good rainfall events (which do not necessarily reflect in the rainfall recorded at Klipkrans rainfall station 10 km south-west and Beaufort West 45 km north), are visible in the groundwater level

recorded in borehole KDK820H. This phenomenon is likely to be caused by direct recharge from the old mine decline in the vicinity of this borehole. During intense thunderstorms surface runoff enters the decline causing a substantial rise in the water level. Apparently, borehole KDK820H is linked to the shaft by fractures and/or joints which cause a similar rise in the groundwater level of this borehole. It is also clear that there is a time lag of about three years between good rainfall events and the peak of a gradual rise of the groundwater level in these boreholes. Therefore, the recharge caused by the good rains received during the 2013/2014 summer may only cause a rise of the groundwater levels in these boreholes by the end of 2016/early 2017.

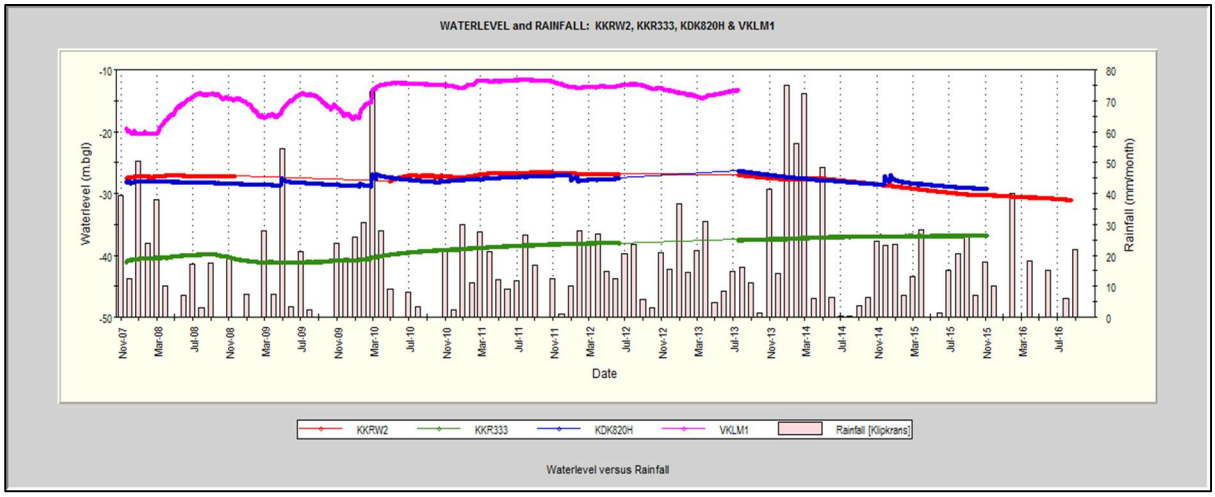


Figure 4-49. Groundwater Level Behaviour of Boreholes in the Ryst Kuil Sub-Area

Borehole KKR333 has a different long-term groundwater level behaviour to boreholes KDK820H and KKRW2. This borehole also has the deepest groundwater level. The reason for the decline evident during the period September 2008 to March 2009 and subsequent gradual rise of the groundwater level in this borehole is still uncertain. However, it is assumed to be linked to a deeper circulating groundwater system with longer time lapses between rainfall events (possibly regional rather than local) and rising water levels in the borehole. The gradual variations of groundwater level over extended periods of time are further supported by this theory. A further mechanism that could be in operation here is the slow drainage of groundwater from matrix mudstones into fractures in the sandstone and the masking of depletion of groundwater in the latter by piezometric pressures in the former.

4.1.7.3.2.2 Groundwater Supply

It was estimated (DWAF 2005) that recharge for the LRP is c.64 Mm^3/a (2.4% of Mean Annual Precipitation, MAP). However, the volume of groundwater that may be practically/sustainably abstracted from the aquifers in the study area is limited by, inter alia, transmissivity and connectivity over the respective sub-catchments. Based on this consideration, the Utilisable Groundwater Resource Potential (UGRP) was determined (DWAF, 2005). When considering the sub-catchments containing the mine application areas, i.e. L11G, L11A and L11B, the UGRP under 'dry' conditions is c.7 Mm^3/a or c.220L/s.

Water feed and storage requirements listed herein were verified by DRA (pers. comm. D. Dalrymple, May 2017). The CPP requires c.43L/s at full operating capacity, with the groundwater quality indicated above meeting requirements for this purpose. The CPP will have three water storage dams, two of 2 000 m^3 capacity and one of 1 900 m^3 (this excludes provision for storm water control). These need to be full six months prior to full plant

commissioning to enable water and leak testing to be carried out. It is proposed to meet this requirement by pumping from the trial mine (dewatering) at 17L/s for c.100 days. The balance of 26L/s will be met from production boreholes, either those drilled in 2007/2008 or, if these are found to be unusable for any reason, then nearby replacement boreholes. These may have to be deepened as mining progresses and may also act as mine dewatering boreholes.

A combination of 40% recycling of TSF water, dewatering/supply boreholes and pit inflows will sustain the CPP water requirements thereafter. Pumping rates will be reduced by at least 50% compared to the long-term rates indicated in Table 4-20. This supply is sustainable based on historical pumping of the trial mine, test pumping of purpose-drilled groundwater exploration boreholes and numerical modelling.

Claims were made by farmers in 2016 of interference by mine exploration boreholes on privately-owned boreholes, with one of the latter apparently running dry allegedly due to exploration drilling c.9 km away. Such interference (from drilling/pumping of single boreholes) is highly unlikely in an essentially unconfined aquifer system. To illustrate this, a simple consideration of Darcy's Law (Q=KiA), where:

Q = flow (m^3/day);

K = hydraulic conductivity (m/day);

i = hydraulic gradient; and

A = area (m^2).

indicates that matrix flow into a fracture along a 9 km length would compensate for any likely impact of an additional borehole, viz:

0.1 (lowest K for mudstone) x 0.5 (50 m drawdown extending 100 m laterally from fracture) x 9 000 (1 m effective fracture width) x 2 (flow from both sides of the fracture)

= c.900 m^3/day or 37.5 m^3/hour (10.4 L/s).

Some prominent hydrogeologists with many decades of Karoo groundwater experience were canvassed for their opinions on the likelihood of such interference and they were unanimous in rating it as highly unlikely (pers. comms. March 2017, Dr K Pietersen, A Woodford, D Visser and P Hobbs). It is considered most likely that the borehole was simply over-pumped and, with either no water level measurements to provide warning or fracture storage depletion being masked by piezometric pressures in less permeable layers, the borehole suddenly failed. Detailed site investigations would be required to shed further light on this matter.

4.1.7.4 Trial Mining Area

An exploration programme was initiated on the farm Ryst Kuil by ESSO during 1974. Following identification of outcropping mineralization and an exploration drilling programme on Ryst Kuil, the extent of an c.70 km strike-length subsurface fluvial sandstone palaeochannel and several large discontinuous U-Mo deposits were defined (SRK, 2007).

A decline and trial mine were established by ESSO in the Ryst Kuil ore body, in the current proposed Ryst Kuil Main mine area, whereby they constructed a sample preparation plant extracting about 4 500 t of ore between August 1978 and September 1979. Access to the ore body was via an approximately 500 m long, 6° tracked decline (SRK, 2007). Dewatering of the decline/trial mining area, which was c.50 m below ground surface, was by means of boreholes and a sump. Drawdown of up to 1 m was propagated for c.1.5 km in an east-west direction and c.<1 km in a north-south direction. This indicates anisotropy in terms of fracture/aquifer hydraulic conductivity (K) and T, paralleling the main fold trends in the area. This has been considered in the numerical

modelling. SRK (1979c) reported that certain areas of the trial mine were subjected to moderate to high groundwater inflows from fractures, which were subsequently grouted to reduce the long-term dewatering requirements. As a result of the grouting, steady inflow into the workings was approximately c.16 L/s. It was estimated that without the grouting, inflow may have amounted to between c.35 and c.52 L/s, with some areas in the decline containing large fractures yielding c.75 L/s. This grouting appears to have only had a local effect on groundwater flow, with high yielding boreholes being developed in the area in 2008 (SRK, 2008). Pumping at 16 L/s for one year resulted in the removal of c.505 000 m3 from storage, which gives some idea of the amount of groundwater contained in the regional channel sandstone aquifer. This water was discharged to a settling area to the north and subsequent investigation of soil radioactivity in c.2008 revealed no measurable residual impact (pers. comm. J. Slabbert, 2017).

Chemical analyses of water samples obtained from one exploration borehole penetrating the flooded area, TM15, and two nearby shows that the macro-chemistry is similar to that in surrounding farmer's boreholes. A summary of the chemical analyses is given in Table 4-39. Samples were also sent to the Necsa laboratory in Pretoria for radioactivity analysis. Uranium, thorium and gross α and ß activity were analysed for and results are shown in Table 4-40.

Table 4-39. Summary of Chemical Analyses from Trial Mining Area Boreholes (2007)

Determinand*	Results		
	TM05	TM15	TM21
pH at 25 °C	7.6	7.5	7.6
Electrical conductivity (mS/m, 25 °C)	78.5	49.5	91.9
Calcium	39.8	48.6	55.3
Magnesium	10.3	7.1	12.3
Sodium	112	64	126
Potassium	6.4	7.6	4.6
Free and saline ammonia as N	< 0.3	< 0.3	< 0.3
Chloride	75	23	96
Sulfate	52	35	95
Total alkalinity as $CaCO_3$	217	172	210

*all determinands in milligrams per litre unless otherwise stated

The macro-chemical results indicate that the fluoride content in groundwater from the trial mine area is relatively high and only borehole KDKW6 continuously yields groundwater suitable for prolonged human consumption. This borehole is drilled into the trial mine/decline from the 1978/1979 work by ESSO (SRK, 2007) and the EC values indicate that there is very good recharge from local rain events. The decline entrance was formerly open to surface water runoff (sealed in c.2008, although run-off could still enter) and there is evidence that rainwater drained down the decline. The nitrate values of groundwater samples taken from boreholes KDKW1, KDKW4 and KDK0017 vary considerably over time. The high nitrate concentrations are likely linked to pollution from surface sources, e.g. livestock wastes, via active recharge.

Table 4-40. Radioactivity Analysis Results from Trial Mining Area Boreholes (2007)

Radionuclide (mBq/L)*	Sample ID		
	TM05	TM15	TM21
U-238	178	38.6	105
U-234	664	85.2	379
Th-230	1.29	NA	NA
U-235	7.52	1.78	4.84

Th-227	0.57	0.724	3.12
Th-232	0.427	0.0766	1.92
Th-228	0.926	0.604	1.67
Gross α activity (Bq/L)**	0.657	0.178	0.571
Gross ß activity (Bq/L)	0.388	0.226	0.241

NA – Not analysed *milli-Bequerels per litre **Bequerels per litre

4.1.7.4.1 Groundwater Quality

The results of chemical analyses on water samples taken during the 2025 hydrocensus are shown in Table 4-41, with DWAF (1996) Target Limits for domestic water use indicated.

Table 4-41. Summary of Macro-Chemistry for 2025 Sampled Boreholes*

BH No.	pH 6-9#	EC (mS/m) 70	Total Alkalinity (as $CaCO_3$)	Na <100	K <50	Ca <32	Mg <30	Cl <100	SO_4 <200	NO_3 (as N) <6.0	F <1.0	As <0.1	Mo	U
Haanekuil														
VPS2	7.10	139	440	158	6.72	60.35	35.36	148	108	2.69	1.69	0.002	0.019	0.062
BDK2	7.21	169	337	171	7.31	59.22	37.40	215	183	10.2	1.71	0.002	0.019	0.053
HKL13	7.59	108	326	92.11	7.09	36.59	24.88	108	68.79	10.68	1.42	0.004	0.014	0.04
Ryst Kuil														
KDKW1	7.01	54.36	175	57.72	3.51	25.88	4.70	31.91	37.06	5.45	1.30	0.003	0.013	0.008
RKM064U	7.14	102	277	90.11	3.65	58.61	12.70	123	77.01	1.59	1.11	0.093	0.534	0.082
KKRW2	7.4	183	265	173	4.27	91.09	24.87	276	226	2.93	0.923	0.006	0.019	0.045
KGT9	7.41	265	356	335	16.71	97.92	55.36	398	379	13.86	1.61	0.005	0.024	0.060
VKL1	7.36	67.75	208	59.13	2.97	47.39	12.25	34.44	92.77	4.77	1.44	0.009	0.029	0.013

**values are reproduced from the original laboratory certificate of analysis, all in mg/L unless otherwise stated. #DWAF Target limits for domestic water use.*

Although most constituents exceed the DWS Target values, apart from in KDKW1 and VKL1, all others with the exception of KGT9, are of potable standard, especially for residents used to this quality of water. The waters are hard to very hard. Borehole KGT9 is of poor quality with very high sodium, chloride, sulphate and nitrate. It is located close to the Amos River and is thus probably subject to influence from evaporated salts. The generally high nitrate values are attributed to animal wastes. Uranium levels are low.

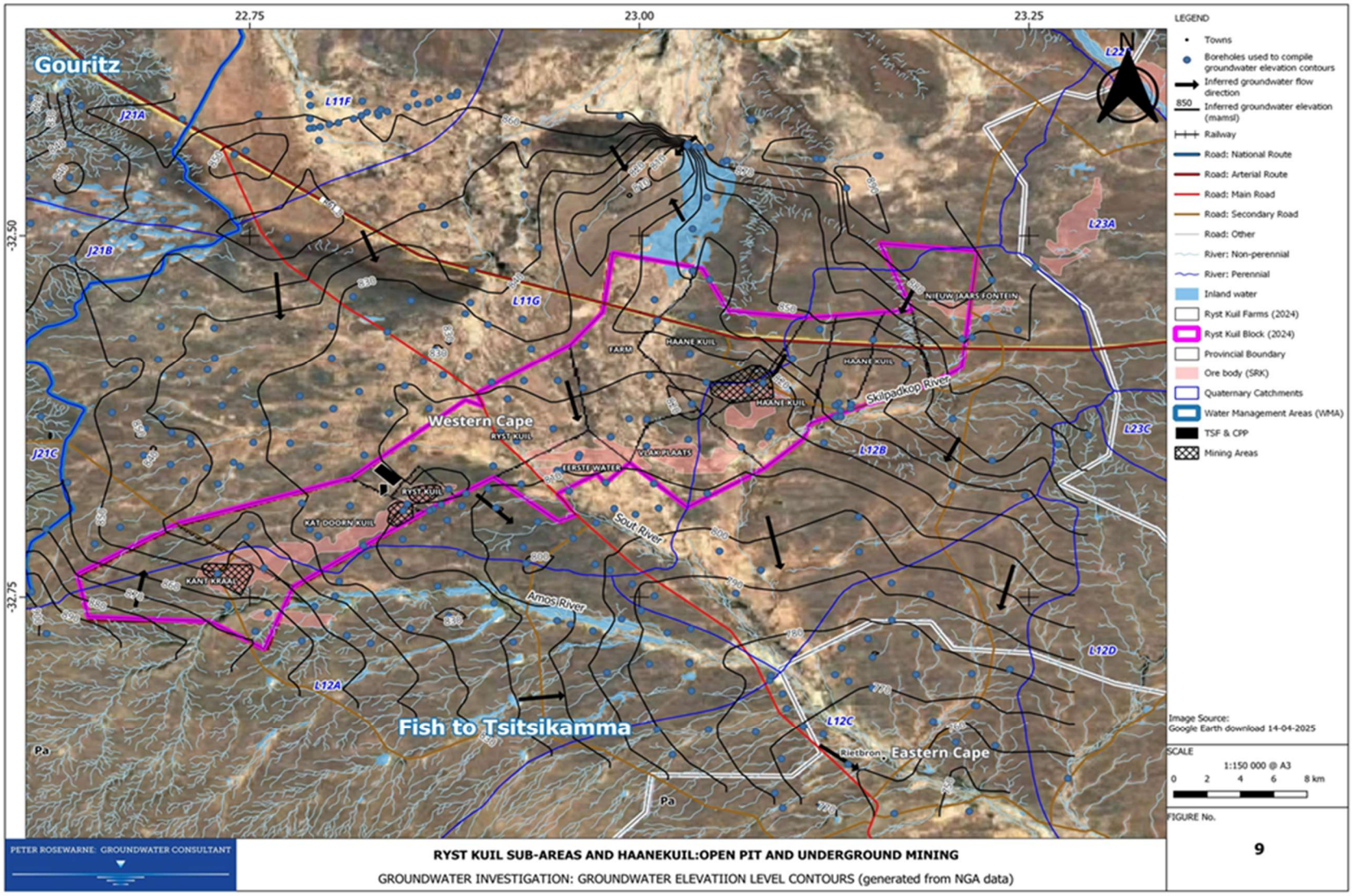


Figure 4-50. Groundwater Elevation Contours (mamsl) [generated from NGA borehole data]

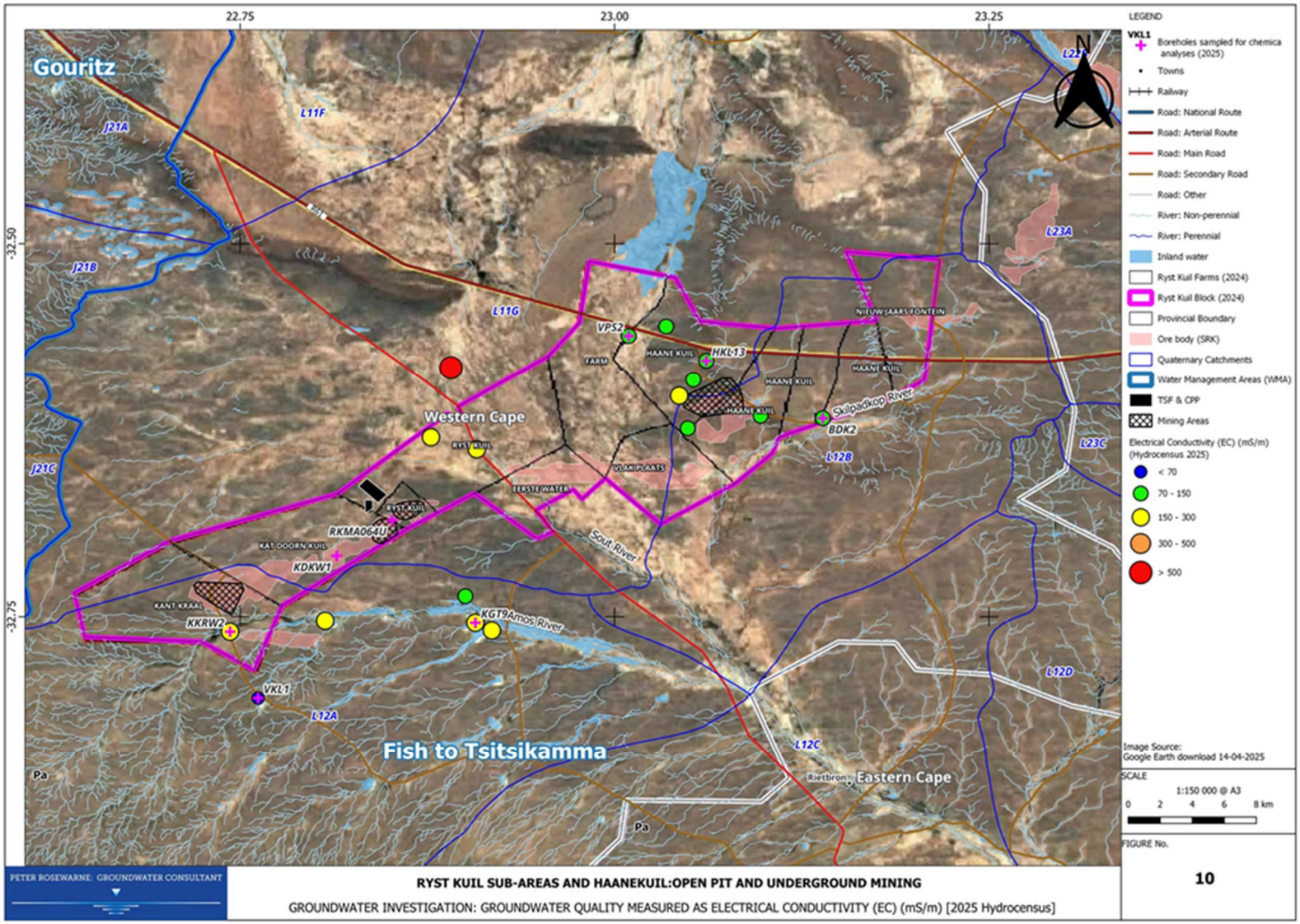


Figure 4-51. Groundwater Quality Measured as Electrical Conductivity (EC) (mS/m) [Hydrocensus 2025].

4.1.7.5 Groundwater Monitoring 2018 - 2025

In December 2022, the trial mine adit was sealed with concrete, the radioactive material left on site from the trial mining was placed at the bottom of the access road/decline and covered with material stockpiled on site (see Figure 4-52). This was all approved by the National Nuclear Regulator.

Figure 4-52. Rehabilitated Decline Area.

Table 4-42. Monthly Rainfall at Beaufort West 2019 – 2025 (mm)

Month	2019	2020	2021	2022	2023	2024	2025
January	0	50	35	28	26	7	15
February	17	46	9	59	16.5	4	14.5
March	16	61	21	42	78.5	15	72
April	19	12	5	17	1	51	32.5
May	21	0	6	52	50	0	
June	0	0	0	32	36	32	
July	4	3	8	8	6	15	
August	0	17	18	2	4	0	
September	11	7	0	18	32	4	
October	0	45	23	3	38	20	
November	0	11	32	37	0	5	
December	2	9	100	121	33	0	
TOTAL	90	261	257	419	321	153	134

The table shows how erratic rainfall is in the Karoo, with 2019 being a very dry year while 2022 and 2023 could be described as “wet” years. There was high rainfall in March 2025 which could account for the generally raised RWLs measured during the late April hydrocensus. Overall, it can be summarised that groundwater RWLs and quality have been maintained or enhanced despite the periodic droughts that afflict the area and that the channel sandstone aquifer is resilient to stress.

4.1.8 Geochemistry

4.1.8.1 Metal Enrichment versus Average Crustal Abundance

The Geochemical Abundance Index (GAI) is a semi-quantitative tool used to assess the degree of elemental enrichment or depletion in geological samples relative to a reference median abundance, typically crustal values or those specific to a lithological context. The GAI provides a standardized method to identify potentially

anomalous concentrations of elements, which may have implications for environmental management and mineral resource evaluation.

The GAI was used to evaluate potential elemental enrichment in samples from four areas, i.e. Haanekuil, Ryst Kuil Abante, Ryst Kuil Extension, and Ryst Kuil Main.

The GAI is calculated by comparing the measured concentration of an element in a sample to its background or median abundance in a relevant reference medium. The resulting value is expressed on a logarithmic scale and truncated to an integer between 0 and 6.

A GAI value of 3 or higher is generally considered to indicate significant enrichment, potentially warranting further geochemical or environmental investigation.

Analytical data from SRK (2017) indicate that several elements display GAI values ≥3 across the Ryst Kuil project area. These results are summarized in the Table below.

Table 4-43. Elements with GAI ≥3 at Ryst Kuil

Element	GAI Value	Number of Samples	Observations
Silver (Ag)	3	5	Notable silver enrichment across multiple samples
Arsenic (As)	3	1	Isolated arsenic anomaly
Boron (B)	3	1	Localised enrichment
Selenium (Se)	≥3	All waste lithologies	Enrichment may be overstated due to high detection limits
Uranium (U)	≥3	All sampled lithologies	Consistent and widespread enrichment observed

Of particular significance is the widespread enrichment of uranium (U) and selenium (Se) across all waste rock lithologies. These elements may pose environmental risks due to their potential mobility and toxicity, especially in oxidizing conditions.

However, the apparent selenium enrichment must be interpreted with caution. The reported method detection limit for Se was approximately six times higher than the average crustal abundance. Consequently, the calculated GAI values for Se may reflect analytical limitations rather than actual geochemical anomalies.

The presence of GAI ≥3 values for silver, arsenic, selenium, and uranium suggests that the Ryst Kuil project area exhibits zones of significant geochemical enrichment. These findings have several implications:

- Environmental Risk: Enriched elements such as As, Se, and U are known for their toxicological profiles and may require monitoring and mitigation during mining or waste rock disposal.
- Resource Potential: The silver and uranium enrichment may also indicate mineralisation zones of potential economic interest.
- Analytical Considerations: The influence of detection limits on GAI calculations, particularly for selenium, highlights the need for method validation and supplementary analyses to ensure robust interpretations.

The application of the Geochemical Abundance Index at Ryst Kuil provides a valuable framework for identifying geochemically enriched elements in the Karoo Basin lithologies. The observed enrichment of silver, arsenic, selenium, and uranium, particularly where GAI ≥3, is of environmental and geological significance.

4.1.8.2 Criteria for Assessing Acid Potential

The screening criteria set by Prediction Manual for Drainage Chemistry from Sulfidic Geological Materials (MEND Report 1.20.1, 2009) were used on the Acid Base Accounting (ABA) data (presented in SRK, 2017) to assess the potential for Acid Mine Drainage (AMD) generation.

These classifications are based on the Modified Sobek ABA method. The Modified SOBEK ABA method is a geochemical tool used to assess whether mine waste materials, such as waste rock or tailings, have the potential to generate AMD. It evaluates the balance between:

- Acid Potential (AP) – from sulphur (typically sulphide) content.
- Neutralization Potential (NP) – from carbonate or other alkaline minerals.

Key Calculations:

- AP = % Sulphur × 31.25 (kg $CaCO_3$ equivalent/tonne).
- NNP = NP – AP (Net Neutralization Potential).
- NPR = NP / AP (Neutralization Potential Ratio).

Table 4-44. Classification criteria for accessing acid potential.

Classification	NNP (kg $CaCO_3$/t)	NPR (NP/AP)	Interpretation
Potentially Acid Forming (PAF)	< 0	< 1	Likely to generate acid
Uncertain / Borderline	0 to +20	1 to 2	May generate acid
Non-Acid Forming (NAF)	> +20	> 2	Unlikely to generate acid

4.1.8.3 Criteria for assessing Net Acid Generation (NAG) results

The NAG test is used to assess whether a sample is capable of neutralizing the potential acidity. A strong oxidising agent, hydrogen peroxide (H_2O_2), is used to rapidly oxidise sulphide minerals in the sample. Single addition NAG test involves the addition of 250 ml of 15% H_2O_2 to a 2.5 g of pulverised sample. The NAG screening criteria to assess the capacity of a sample to neutralise acidity generated during the test procedure, is set by MEND (2009), and is presented Table 4-45.

Table 4-45. NAG Test Assessment Criteria

Acid Generating Potential	Final NAG pH
Potential acid generating	NAG pH < 4.5
Uncertain	NAG H < 4.5
Uncertain	NAG pH ≥4.5
Non-Acid Forming	NAG pH ≥4.5

NAG testing alone is insufficient to determine a sample's acid-generating potential. When combined with mineralogical analyses and ABA tests, it offers a more complete assessment of acid mine drainage (AMD) risk. However, both NAG and ABA tests involve crushing samples, which increases reactive surface area and may not accurately reflect natural conditions. Therefore, interpreting these results alongside quantitative mineralogical data provides a more reliable understanding of AMD potential.

4.1.8.4 Whole Rock Geochemistry

Elemental composition was carried out to identify the metals and metalloids in the composite waste rock samples (SRK, 2017). The purpose of these analyses is to quantify the total metal content of the material. The presence of a potential element of concern does not necessarily indicate a potential impact on the receiving environment; however, it does indicate where to focus needs when assessing the potential for metal mobility.

The elemental composition and corresponding GAI values compared to average crustal abundance of waste rock lithologies is given in Table 4-46.

Table 4-46. Elemental Concentrations and GAI of the Various Waste Rock Types (from SRK, 2017)

Sample ID	SRK8616		SRK8618		SRK8617		SRK8606		SRK8605	
Deposit	Haanekuil						Abante			
Lithology	MDST	GAI	SDST	GAI	SLST	GAI	SDST	GAI	SLST	GAI
Silver	0.55	2	<0.4	1	<0.4	1	1.2	3	1.3	3
Arsenic	3	0	15.7	2	4	0	13.7	2	8.2	1
Boron	93	2	57	1	86	2	58	1	100	2
Barium	411	0	392	0	372	0	327	0	443	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	<0.1	0	<0.1	0	<0.1	0	0.24	0	0.63	1
Cobalt	15.7	0	13.5	0	17.8	0	12.6	0	18.2	0
Chromium	54	0	46	0	55	0	45	0	54	0
Copper	26	0	16.7	0	27	0	47	0	63	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	290	0	247	0	326	0	602	0	388	0
Molybdenum	<0.1	0	13.2	2	<0.1	0	2.8	0	<0.1	0
Nickel	23	0	17.9	0	22	0	17.5	0	23	0
Phosphorus	508	0	427	0	467	0	370	0	774	0
Lead	13.4	0	13.5	0	24	0	9.6	0	22	0
Antimony	<1	1	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5	<3	5
Tin	5.4	0	4.1	0	6.3	1	6	0	5.7	0
Strontium	76	0	169	0	137	0	150	0	111	0
Thorium	28	1	29	1	29	1	13.3	0	16.1	0
Titanium	3272	0	2168	0	3191	0	1952	0	3363	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	90	0	57	0	83	0	53	0	85	0
Zinc	83	0	51	0	82	0	55	0	92	0
Zirconium	89	0	47	0	74	0	44	0	85	0

Sample ID	SRK8608		SRK8620		SRK8607		SRK8609	
Deposit	Ryst Kuil Extension							
Lithology	MDST	GAI	MDST	GAI	SDST	GAI	SLST	GAI
Silver	<0.4	1	<0.4	1	0.9	2	<0.4	1
Arsenic	5.1	0	<1	0	19	2	8.8	1
Boron	93	2	95	2	66	2	82	2
Barium	600	0	516	0	490	0	562	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	<0.1	0	<0.1	0	0.17	0	0.56	1
Cobalt	16.8	0	17.8	0	13.4	0	15.8	0
Chromium	53	0	56	0	49	0	47	0
Copper	59	0	23	0	40	0	21	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	281	0	337	0	378	0	433	0
Molybdenum	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Nickel	23	0	23	0	16.3	0	20	0
Phosphorus	371	0	537	0	455	0	513	0
Lead	17.4	0	21	0	11.5	0	27	0
Antimony	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5
Tin	6.8	1	7	0	6.1	0	6.5	1
Strontium	139	0	215	0	229	0	173	0
Thorium	15.8	0	30	1	17.8	0	21	0
Titanium	3105	0	3166	0	2466	0	2980	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	86	0	87	0	67	0	76	0
Zinc	135	0	84	0	57	0	82	0
Zirconium	79	0	77	0	70	0	89	0

Sample ID	SRK8624		SRK8625		SRK8627		SRK8603		SRK8604		SRK8630		SRK8623		SRK8626		SRK8628	
Deposit	Ryst Kuil Main																	
Lithology	MDST	GAI	MDST	GAI	MDST	GAI	SDST	GAI	SDST	GAI	SDST	GAI	SLST	GAI	SLST	GAI	SLST	GAI
Silver	<0.4	1	<0.4	1	0.66	2	1.1	3	<0.4	1	0.42	1	<0.4	1	1.8	3	0.63	2
Arsenic	3.3	0	4.8	0	2.6	0	37	3	18.3	2	16.3	2	<1	0	5.1	0	6	1
Boron	104	2	101	2	129	3	51	1	57	1	60	2	98	2	63	2	80	2
Barium	516	0	449	0	399	0	513	0	538	0	502	0	363	0	333	0	440	0
Berylium	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0	<0.2	0
Bismuth	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2	<0.5	2
Cadmium	0.1	0	0.13	0	0.19	0	0.19	0	0.13	0	0.18	0	0.13	0	0.48	1	0.1	0
Cobalt	17.3	0	17.2	0	18.8	0	15.1	0	11.4	0	14.5	0	14.7	0	12.6	0	14.3	0
Chromium	51	0	60	0	57	0	45	0	39	0	43	0	46	0	46	0	45	0
Copper	26	0	19	0	53	0	60	0	16.8	0	11	0	22	0	31	0	24	0
Mercury	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0	<0.1	0
Manganese	392	0	362	0	442	0	392	0	409	0	355	0	463	0	327	0	258	0
Molybdenum	<0.1	0	<0.1	0	<0.1	0	2.5	0	0.72	0	0.46	0	<0.1	0	<0.1	0	<0.1	0
Nickel	21	0	24	0	27	0	15.8	0	14.9	0	19.3	0	18.4	0	16	0	18.4	0
Phosphorus	580	0	502	0	484	0	353	0	348	0	337	0	469	0	527	0	476	0
Lead	23	0	14.3	0	58	1	12.4	0	9.5	0	12.6	0	21	0	20	0	17.6	0
Antimony	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1	<1	1
Selenium	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5	<3	5
Tin	8.2	1	6.4	1	8	1	5.7	0	5.2	0	5.3	0	6.7	1	2.4	0	4.1	0
Strontium	118	0	89	0	99	0	149	0	190	0	138	0	90	0	336	0	119	0
Thorium	30	1	33	1	38	1	6.1	0	6.1	0	38	1	29	1	40	1	38	1
Titanium	3109	0	3276	0	3210	0	2189	0	2032	0	1944	0	2803	0	2478	0	2983	0
Thallium	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0	<0.9	0
Uranium	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0	<0.4	0
Vanadium	82	0	95	0	97	0	59	0	49	0	55	0	73	0	57	0	66	0
Zinc	79	0	93	0	106	0	44	0	48	0	60	0	69	0	58	0	62	0
Zirconium	76	0	75	0	85	0	52	0	53	0	43	0	80	0	54	0	77	0

Sample ID	SRK8609	
Deposit	Tailings	
Lithology	Tailings	GAI
Silver		
Arsenic	492	6
Boron	62.5	2
Barium	601	0
Berylium		
Bismuth		
Cadmium	4.9	4
Cobalt	<500	3
Chromium	<500	1
Copper	46.5	0
Mercury	0.7	1
Manganese	871	0
Molybdenum	317	6
Nickel	25.1	0
Phosphorus		
Lead	60.6	1
Antimony	4.4	2
Selenium	4	5
Tin	0	1
Strontium		
Thorium		
Titanium		
Thallium		
Uranium	203	5
Vanadium	64	1
Zinc		
Zirconium		

A sample of the tailings material was prepared by MINTEK as part of the metallurgical test work (SRK, 2017).

4.1.8.5 Mineralogy

The results of the X-Ray Diffraction (XRD) analyses show that the waste rocks are primarily composed of feldspar and mica group mineral (alumina-silicate minerals) and quartz (Table 4-47). Although calcite vein infilling was observed in the core and very minor disseminated sulphide. The concentrations of these phases in the rock appears, on average, to be below the detection limit.

Calcite was the only carbonate phase detected, which was reported in all samples from the Ryst Kuil South orebody, and in a single sample from the Ryst Kuil Main siltstone sample. No sulphide minerals were detected in any of the samples analysed. Other minor mineral phases reported are hematite in a single sample from the Depanne orebody (SRK, 2017). Samples from other potential mining areas that are located adjacent to the areas of interest for the current project, where included for the sake of completeness.

Table 4-47. Mineralogy of composite samples from the various mining areas (SRK, 2017).

	Mineral	Calcite	Chlorite	Muscovite	Biotite	Microcline	Plagioclase	Quartz	Enstatite	Hematite	Gypsum
Sample no	**Deposit**										
SRK8610	RKE		6.5	8.8		5.4	49.5	29.8			
SRK8625-1	RKM		14.3	21.7		4.7	16.7	42.5			
SRK86034	RKM		4.7	9.6		3	51	31.8			
SRK8626-1	RKM	6.4	8	15.7		3.4	28.1	38.5			
SRK8616-2	HNK		13.1	18		5.6	19.4	44			
SRK8618-2	HNK		9.6	10.8		2.8	38.6	38.2			
SRK8617-2	HNK		12.6	20.6		3.7	18.9	44.2			
Tailings			3.6		7.4	5.2	27.2	46.1	1.4		9

4.1.8.6 Leachate Quality

To assess the leachability of the major and trace elements, the waste rock samples were subjected to short-term leach tests. The results were used as a qualitative screening tool to identify parameters of potential environmental concern (SRK, 2017).

Contact leach testing involved the leaching of waste rock samples using deionised water at a solid to liquid ratio of 1:1, have shown that the potentially leachable concentrations of the trace elements are generally low, and below their respective drinking water guideline values. The concentrations of F, Mo, Al and Se all exceed their respective drinking water guideline values in at least one sample (SANS 241-1: 2015 – Edition 2: Drinking water standards, DWS).

The quality of the actual leachate which is likely to be generated by the waste rock dumps must be determined through appropriate scaling up, mass balance calculations based on the relative proportions of the various waste rock lithologies.

4.1.8.7 Acid Base Accounting

Acid Base Accounting (ABA) assesses the balance between a rock's acid-generating and neutralizing potential to predict the risk of acidic drainage, which can release harmful metals like uranium. In the waste rock samples, sulphide-sulphur—a key acid source—was below detection limits, but conservatively assumed at that limit for calculations. ABA results showed the waste rock has a high paste pH (7.7 to 9.2), indicating net alkalinity and no active acid generation, likely due to calcite neutralization. Except for one sandstone sample, all waste rock samples were classified as non-acid generating, suggesting low acid rock drainage (ARD) risk.

Table 4-48. ABA Results for the Waste Rock Samples (SRK, 2017)

Sample No.	Mine area	Rock type	Paste pH	Total S	TAP	NP	NNP	TNPR
				%	(CaCO3) kg/t			
SRK8606	Ryst Kuil Abante	Sst	8.8	<0.01	<0.31	11.9	11.6	38.39
SRK8606		Sst	8.5	<0.01	<0.31	21.4	21.1	69.03
SRK8605		Slst	8.8	<0.01	<0.31	6.88	6.6	22.19
SRK8605		Slst	8.2	<0.01	<0.31	22.4	22.1	72.26
SRK8615		Sst	8.1	<0.01	<0.31	9.43	9.1	30.42
SRK8614		Slst	8.3	<0.01	<0.31	7.13	6.8	23
SRK8616	Haanekuil	Mst	7.7	<0.01	<0.31	12	11.7	38.71
SRK8618		Sst	8.7	<0.01	<0.31	13.2	12.9	42.58
SRK8617		Slst	8.4	<0.01	<0.31	23.9	23.6	77.1
SRK8620	Ryst Kuil Ext.	Mst	8.1	<0.01	<0.31	15	14.7	48.39
SRK8607		Sst	8.7	<0.01	<0.31	0.26	-0.1	0.84
SRK8609		Slst	8.4	<0.01	<0.31	15.8	15.5	50.97
SRK8625	Ryst Kuil Main	Mst	8.6	<0.01	<0.31	13.8	13.5	44.52
SRK8627		Mst	8.5	<0.01	<0.31	16.8	16.5	54.19
SRK8603		Sst	9	<0.01	<0.31	3.82	3.5	12.32
SRK8604		Sst	9.2	<0.01	<0.31	6.36	6.1	20.52
SRK8630		Sst	8.7	<0.01	<0.31	11.7	11.4	37.74
SRK8603		Sst	8.6	<0.01	<0.31	4.08	3.8	13.16
SRK8604		Sst	8.2	<0.01	<0.31	13	12.7	41.94
SRK8626		Slst	8.9	<0.01	<0.31	33.1	32.8	106.77
SRK8628		Slst	8.4	<0.01	<0.31	13.8	13.5	44.52

4.1.8.8 Net Acid Generation

The waste rock samples all produced a final NAG solution with a pH greater than the 4.5 pH units set by the MEND (2009) criteria, and thus indicates that the waste rock samples are non-acid forming (NAF). It also confirms the short-term net alkalinity indicated by the paste pH.

The NAG findings were compared to the ABA assessment and mineralogy of the waste rock samples. This combination was adopted to identify trends in the findings of the different analytical methods used to assess the acid generating potential of the tailings. The results of this comparison, indicate that the static prediction methods are in good agreement with each other.

4.1.8.9 Water Quality Analyses

Water samples collected during the hydrocensus were submitted to UIS Laboratories in Centurion for metals scans and macro-chemical analyses. A summary of the main indicators and ions (in mg/L) is given in Table 4-49.

Table 4-49. Summary of Macro-Chemistry for 2016 Sampled Boreholes from the Ryst Kuil area (SRK, 2017)

Borehole No.	pH	EC mS/m	Total Hardness (as CaCO3)	Na	K	Ca	Mg	Cl	SO4	NO3 as N	F	As
LKL1	7.8	416	1360	264	14.7	389	95.2	637	508	0.167	1.85	0.011
RSK13	8	284	630	287	9.47	171	49.5	402	394	0.236	1.49	<0.01
KPS9	7.8	173	403	174	4.76	113	29.2	195	237	0.636	0.983	<0.01
RSP6	7.6	327	785	306	9.47	226	53.5	552	351	0.19	1.32	0.01
HKL13	7.7	112	357	112	7.72	92.7	30.6	125	70.4	10.8	1.69	<0.01
LTS11	7.7	119	344	136	5.73	85.5	31.8	136	80.9	9.18	1.92	<0.01
KGT9	8.1	298	570	339	10.7	133	57.6	444	358	21.7	1.99	<0.01
KGT3	8	207	433	242	13.9	116	34.7	242	243	19.6	2.67	<0.01
BDK1	8	188	449	171	6.91	110	42.5	228	163	0.614	2.02	<0.01
1KS2	7.6	306	683	295	8.98	172	61.3	509	347	0.201	1.68	0.011
VPS5	7.9	420	328	745	10.2	132	113	941	634	<0.13	2.09	<0.01
VKL01	7.9	88.3	191	116	3.31	76.7	21.1	88.8	123	4.55	1.41	<0.01
KD0002	8	99.5	240	115	6.67	96.1	26.8	134	119	4.03	0.962	<0.01
RSK14	8	200	298	301	9.74	119	53.8	374	305	0.634	1.79	0.021

The groundwater is alkaline and most ECs are within the range c.90 – c.400mS/m. The higher ECs may be associated with boreholes along river courses and in pediment areas, probably due to evaporative effects on shallow groundwater and incorporation of evaporite salts into local, direct recharge. EC is a measure of the ability of water to conduct an electrical current.

The groundwater is hard to very hard and is mostly a mixed NaCl/Ca-$MgSO_4$, $Na_2Ca(HCO_3)_2$ type. Fluoride (F) is generally elevated compared to drinking water standards (<1.5 mg/L recommended by SANS 241), commonly 1 - 2 mg/L and up to 2.67 mg/L (KGT3). Elevated F is a common feature of Karoo groundwater and is usually attributed to dissolution of detrital apatite (a calcium phosphate mineral containing F) grains in sandstones. Nitrate levels (<11mg/L as nitrogen - N – recommended by SANS 241) are also generally elevated-to-highly elevated, up to 22mg/L as N, e.g. in KGT3 and KGT9.

Monitoring in the area since 2007 has shown generally good quality groundwater. This provides backing for the predicted relatively small plume development reported in SRK (2017).

The 2016 acid-base accounting results (see

Table 4-48) show that the waste rock is classified as non-acid generating and this is supported by the monitoring data collected over recent years, i.e. acid rock drainage is unlikely to occur. Leach testing of waste rock also shows no mobilisation of U, (results below laboratory detection limit) (SRK, 2017).

4.1.8.10 Water Quality Monitoring Data

The groundwater quality in the Ryst Kuil area has been assessed through multiple monitoring efforts spanning from 2013 to 2025. The groundwater is generally alkaline, with electrical conductivity (EC) values mostly ranging between 10 and 250 mS/m. These values indicate fresh to slightly saline conditions, although elevated ECs are observed in boreholes situated along river courses and in pediment areas. These higher values are likely due to evaporative concentration of salts in shallow groundwater and incorporation of evaporite minerals during local recharge. EC levels reflect the presence of dissolved ions such as bicarbonate, chloride, sulphate, nitrate, sodium, potassium, calcium, and magnesium.

Chemically, the groundwater is characterized as hard to very hard and falls predominantly within a mixed NaCl/Ca-$MgSO_4$, $Na_2Ca(HCO_3)_2$ water type, as illustrated in the Piper diagram (Figure 4-53). Fluoride concentrations are typically elevated compared to the SANS 241 drinking water standard of 1.5 mg/L, with values commonly ranging from 1 to 2 mg/L and peaking at 3.14 mg/L. This is a well-documented feature of Karoo aquifers and is attributed to the dissolution of detrital apatite grains in the sandstone formations. Nitrate levels are also generally elevated, with concentrations ranging from 0 to 59 mg/L as nitrogen, exceeding the recommended SANS 241 limit of 11 mg/L in some locations, such as borehole RKMA0254. These elevated nitrate values are most likely linked to agricultural activities in the area.

A comparison of chemical data from 2013, 2022, and 2023, as presented in Table 4-50, indicates no significant temporal changes (i.e., no variations exceeding 20%), although the sample size remains small. The monitoring data suggest that the placement of backfill material has not caused any measurable impact on groundwater quality. Additionally, acid-base accounting performed in 2016 classified the waste rock as non-acid generating, a finding supported by the current groundwater chemistry, which shows no signs of acid rock drainage. Leach testing of waste rock also revealed no mobilization of uranium, with concentrations below laboratory detection limits. Overall, the data indicate that the groundwater system remains chemically stable, with localized quality concerns linked to natural geochemical processes and land use rather than mining or waste disposal activities

Table 4-50. Comparison of 2013, 2022 and 2023 chemical parameters for Ryst Kuil

Sample No.	pH	EC	TDS	Alkalinity	Ca	Fe	K	Mg	Na	F	Cl	NO3 as N	SO4
		(mS/m)	(mg/l)	(mg/l CaCO3)	(mg/l)								
RKM A0254/17/10/2023	7.56	187	1352	104	145	<0.05	20.2	37.54	197.88	3.44	186.12	59.2	429.1
RKM A025U/21/04/2022	7.17	213	1270	189	188	<0.05	6.77	18.5	213	1.76	218	19.8	346.8
RKN2242H/17/10/2023	7.33	81.9	498	281	36.2	<0.05	12.1	10.09	127.22	2.45	77.9	0.3	46.48
RKN2242H/21/04/2022	7.22	123	644	441	55.2	<0.05	17.1	14.5	158	3.14	98	<0.1	37.95
RKM A0644/17/10/2023	7.34	68.9	446	267	49.2	<0.05	3.8	7.79	96.19	0.98	46.64	<0.1	45.24
RKMA064U/21/04/2022	7.16	73.4	414	263	51.8	<0.05	3.54	7.3	94.4	1.44	35.1	<0.1	34.87
RKMA064U/19/07/2013	7.9	20.3	168	81	12.8	0.1	2.3	2.4	23	1	2.9	<0.1	2.9
KDKW6/17/10/2023	7.44	12.4	63.8	57.7	11.4	<0.05	2.69	1.67	7.55	0.132	5.67	<0.1	<1
KDKW6/21/04/2022	7.03	13.1	66	54.3	12.7	<0.05	3.45	1.6	7.33	0.12	5.26	<0.1	<1
KDKW6/19/07/2013	7.6	36	58	41	10.1	0.02	2.7	1.5	7	0.1	4.5	<0.1	0.2

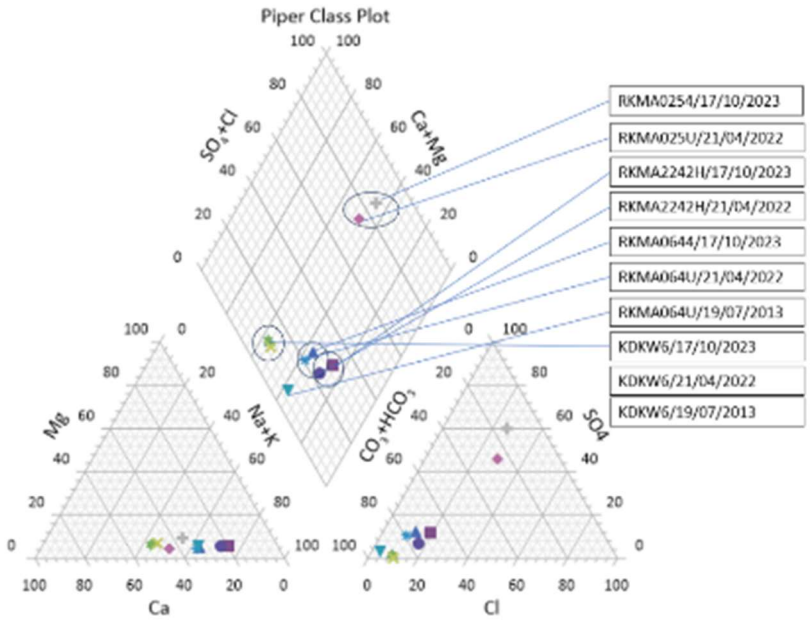


Figure 4-53. Comparison of 2013, 2022 and 2023 chemical parameters for Ryst Kuil.

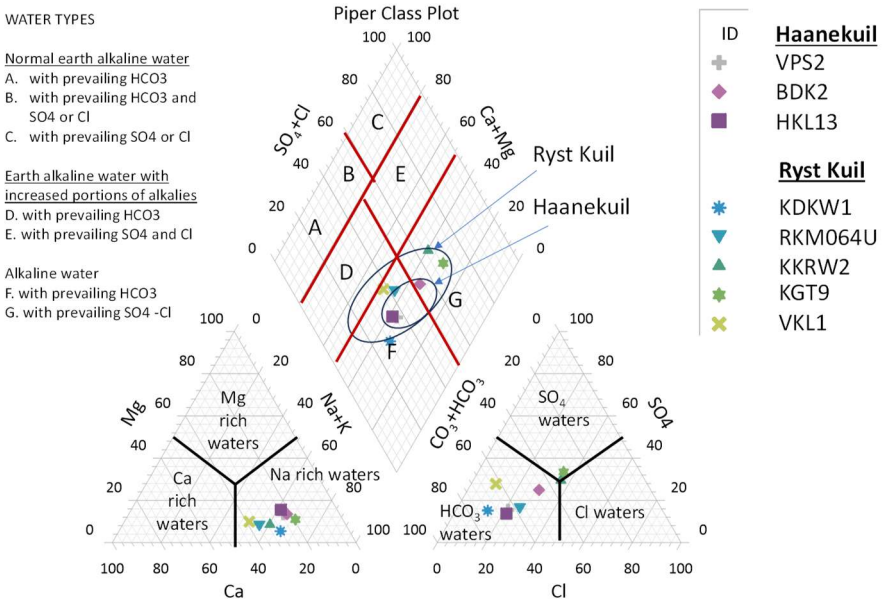


Figure 4-54. Characteristics of macro-chemistry for groundwater sampled from boreholes on Ryst Kuil and Haanekuil, as indicated, during 2025 (from Rosewarne, 2025), plotted on a Piper diagram.

4.1.8.11 Mineralogical status

The important conclusions include:

- From a geochemical perspective the various static tests indicates that the waste rock samples are non-acid forming (NAF). The NAG findings were compared to the ABA assessment and mineralogy of the

waste rock samples. This combination was adopted to identify trends in the findings of the different analytical methods used to assess the acid generating potential of the waste rock. These results all were in good agreement with each other.

- The waste rock has been characterized and classified as Type 3;
- Type 3 waste requires, per legislation, a Class C liner to manage and prevent any drainage or seepage that may occur.

The data used in this study are still regarded as preliminary in terms of geochemical characterisation. It is recommended that additional data should still be added for this project to proceed. A continued monitoring program which oversee variations and trends in water quality is essential.

4.1.9 Heritage and Cultural Aspects

The baseline palaeontological report was prepared by Professor Bruce Rubidge of the Bernard Price Institute at the University of the Witwatersrand in 2008. Rubidge notes that study area falls within the Karoo Supergroup, famous for its palaeontological wealth covering the period of almost 100 million years ago, from the Middle Permian to the Early Jurassic. This rock succession has yielded a rich fossil flora and tetrapod fauna and is internationally known for providing a window on the life of the vertebrate groups. The latter study was complimented by an investigation by Dr JE Almond during May 2025.

The Lusika Mine project area is underlain by continental sediments of the Abrahamskraal and Teekloof Formations (Lower Beaufort Group, Karoo Supergroup) of Late Middle Permian to (possibly) earliest Permian age. These bedrocks contain sparse but important fossil remains of a range of terrestrial and aquatic vertebrates (mainly therapsids), trace fossils and occasional fragmentary plant material which are of considerable research and conservation value, confirming the occurrence of Tapinocephalus Assemblage Zone bedrocks within the project area. Bedrock exposure levels here are generally very poor indeed. The Teekloof Formation, which is represented by three lithostratigraphic members: the Poortjie, Hoedemaker and Oukloof. Fossils from adjoining farms are housed in collections at the Bernard Price Institute and comprise mainly dicynodonts.

The area that will be mined in the southern Karoo is of palaeontological interest for several reasons.

- The rocks of the southern Beaufort Group host the oldest record of living fossil tetrapods in the southern hemisphere and provide one of very few records of Middle Permian continental biodiversity but have received very little research attention;
- Since the Karoo Supergroup records two of the “Big Five” mass extinction events since the Cambrian explosion of live 540 million years ago, it is an excellent place to study biological diversity patterns through time and specifically to periods prior to a mass extinction event and the recovery after it.

The immediate environs of the proposed mining areas are further illustrated in the Baseline Visual Assessment by Steven Stead.

The landscape southeast of Beaufort West is comprised of horizontally bedded, fossiliferous shales and mudstones of the Beaufort Group in the Karoo Supergroup. They are intersected at numerous locations by dolerite dykes which have the effect of damming up small streams resulting in small springs which often generate pans of seasonal water – another feature of the landscape. There are also small, seasonal river beds which are lined with acacia trees. However, in general the landscape to the south of the R61 is remarkably flat,

with little change in elevation though occasional ridges are noted. The natural vegetation is predominantly knee-high with stands of acacia along river beds or at stockposts, and visibility is excellent.

Although technically all the land is characterised as agricultural, in real terms it has the appearance of a wilderness. Occasional stock posts, wire fences, wind pumps, concrete reservoirs and tracks are the only apparent elements of human modification on the landscape apart from the farmhouses. The study area is thinly inhabited and remote. Farmhouses are often located in a clump of exotic trees and are visible from a considerable distance. The evidence for past uranium mining activities in the 1970s has been cleared and the trial mining adit has been closed with concrete.

4.1.10 Visual Assessment

4.1.10.1 Scenic Quality Assessment

The scenic quality is determined making use of the VRM Scenic Quality Checklist that identifies seven scenic quality criteria which are rated with 1 (low) to 5 (high) scale. Making use of the VRM Matrix classification of Scenic Quality for the different physiographic units, the following table depicts a summary of the combined areas to define a broad-brush appraisal of the property scenic quality.

Table 4-51. Scenic Quality Rating table

Landscapes	Rating	Motivation
Landform *Topography becomes more of a factor as it becomes steeper, or more severely sculptured.*	Low	Apart from a few medium to small-sized ridgelines, the area is predominantly characterized by gentle undulations and lacks any prominent landforms that would constitute significant topographic features in the landscape.
Vegetation Primary consideration given to the variety of patterns, forms, and textures created by plant life.	Medium	At a broad scale, the vegetation across the landscape appears relatively uniform, consisting primarily of Gamka Karoo and Southern Karoo Riviere vegetation types of the Nama-Karoo biome. These vegetation types offer limited variation in pattern, form, and texture at a broad level.
Water *That ingredient which adds movement or serenity to a scene. The degree to which water dominates the scene is the primary consideration.*	Low	Although there are low-lying areas that may become wet during rainy periods, the landscape lacks any substantial water features that serve as dominant scenic focal points.
Colour *The overall colour(s) of the basic components of the landscape (e.g., soil, rock, vegetation, etc.) are considered as they appear during seasons or periods of high use.*	Medium	The dominant colours in the landscape are primarily associated with the vegetation types typical of the broader Nama-Karoo region. Although seasonal variation occurs, the colour palette—mostly comprising muted grey-browns—does not present as a dominant visual element in the landscape.
Scarcity *This factor provides an opportunity to give added importance to one, or all, of the scenic features that appear to be relatively*	Medium	No protected or significant landscapes associated with eco-tourism were identified within the project's zone of visual influence. The deep, rural karoo does have value as a landscape resource.

unique or rare within one physiographic region.		
Adjacent Landscapes *Degree to which scenery and distance enhance, or starts to influence, the overall impression of the scenery within the rating unit.*	High	At a regional level, the large expanse of the Nama-karoo, that have very limited man-made modification with isolated karoo farmsteads adding value as a cultural landscape, this is value from the broader landscape.
Cultural Modifications *Cultural modifications should be considered and may detract from the scenery or complement or improve the scenic quality of an area.*	High	
Scenic Quality	**Medium**	
The project's visual impact zone features a gently undulating landscape with limited visual variety. Vegetation is uniform, and there are few water features or prominent landforms. The muted grey-brown colors contribute to the low visual prominence. While no protected or eco-tourism areas are present locally, the broader Nama-Karoo region is culturally and scenically valued for its largely untouched character and dispersed farmsteads.		

4.1.10.2 Receptor Sensitivity Assessment

Different types of receptors are likely to have different responses to the landscape change changes. The following table identified the different criteria used to evaluate a broad understanding of receptor sensitivity to landscape change.

Table 4-52. Receptor Sensitivity Rating table.

Landscapes	Rating	Motivation
Type of Users *Visual sensitivity will vary with the type of users, e.g., recreational sightseers may be highly sensitive to any changes in visual quality, whereas workers who pass through the area on a regular basis may not be as sensitive to change*.	Medium to High	The primary landscape users are remote farming communities; however, tourist receptors travelling along the main roads to the north and south of the proposed mining site are likely to exhibit higher sensitivity to landscape degradation associated with mining activities.
Amount of use *Areas seen or used by large numbers of people are potentially more sensitive.*	Medium to Low	While the northern portion of the mine has high visual exposure, most of the mining landscape change areas are spaced and well set back from key receptors, with some sections falling within 'Seldom Seen' landscape zones where the only the very large mining landforms would be visible.
Public interest *The visual quality of an area may be of concern to local, or regional, groups. Indicators of this concern are usually expressed via public controversy created in response to proposed activities.*	Medium	While there are landscapes that have value as an iconic karoo cultural landscape, there are likely to be a range of perceptions to the mine, with those seeking employment opportunities viewing the mine landscape change in a positive light.
Adjacent land Users *The interrelationship with land uses in adjacent lands. For example, an area within the viewshed of a residential area may be very sensitive, whereas an area surrounded by commercially developed lands may not be as visually sensitive.*	High	Several deep, rural farming communities are located around the proposed mine site, where the landscape change is likely to be negatively perceived due to the significant alteration of the existing Karoo sense of place.
Special Areas *Management objectives for special areas such as Natural Areas, Wilderness Areas or Wilderness Study Areas, Wild and Scenic Rivers, Scenic Areas, Scenic Roads or Trails, and Critical*	Low	No protected areas or landscapes of recognized significance, classified as Special Areas, were identified within the site.

Landscapes	Rating	Motivation
Biodiversity Areas frequently require special consideration for the protection of their visual values.		
Receptor Sensitivity	**Medium to High**	
The landscape around the proposed mine is primarily used by remote farming communities, with tourists traveling nearby routes likely to be more sensitive to visual impacts. While parts of the mine are highly visible, much of the planned development is set back from key viewpoints, with some areas in low-visibility zones. Although the site lacks formal protections, the broader Karoo landscape holds cultural significance. Perceptions of the mine will vary—some may welcome the economic opportunity, while others may see it as a threat to the region's character. Overall, the area is rated as having medium to high sensitivity to landscape change.		

4.1.10.3 Visual Resource Management (VRM) Classes

The Bureau of Land Management (United States) has defined four Classes that represent the relative value of the visual resources of an area and are defined in terms of the VRM Matrix as follows:

i. **Classes I and II** are the most valued.
ii. **Class III** represent a moderate value.
iii. **Class IV** is of least value.

VRM Class I

Class I is assigned when legislation restricts development in certain areas, or when very high visual intrusion or loss of significant landscape resources is likely to take place. The level of change to the characteristic landscape should be very low and must not attract attention. A Class I visual objective was assigned to the following features within the proposed development area due to their protected status within the South African legislation:

- Generic Landscape Issues
    - Rivers / streams, wetlands and associated flood lines buffers identified as found significant by the Aquatic Biodiversity Specialist.
    - Vegetation areas (or plant species) identified as having a high significance by the Botanical Specialists.
    - Heritage area identified as having a high significance as defined by the Heritage Specialist.
- **Landscape Specific Issues**
    - Not applicable.

No significant landscapes that are being used as visual resources were identified in the project zone of visual influence.

VRM Class II

The Class II objective is to retain the existing character of the landscape and the level of change to the characteristic landscape should be low. The proposed development may be seen but should not attract the attention of the casual observer, and should repeat the basic elements of form, line, colour and texture found in the predominant natural features of the characteristic landscape.

- Southern Karoo Riviere.
- R61 View corridor 2km Buffer.
- Ridgeline Buffer 100m.

Although individual landscape features are not highly significant, they collectively enhance the scenic value important for eco-tourism as recognized in local and regional planning. As this is the region's first mining development, the design should aim to minimize visible landscape degradation, especially from scenic routes and isolated Karoo farmsteads. Key recommendations include maintaining a 2 km no-development buffer along the R61 and using the northern ridgeline as a natural visual screen. Most mining activities are already planned south of this ridge, helping preserve the sense of place for key visual receptors. Relocating the Waste Rock Dump (WRD) south of the ridgeline is advised to further reduce its visual impact.

VRM Class III

Class III visual objectives aim to moderately retain the existing landscape character, allowing changes that are noticeable but not visually dominant. Developments should reflect the natural landscape's basic elements. The Gamka Karoo area has been identified as suitable for such development due to its moderate scenic value and lower sensitivity, being remote and rarely seen. However, mitigation measures are essential, including removing all mining structures after closure, shaping the Waste Rock Dump (WRD), controlling dust from vehicles, and minimizing night-time light pollution.

VRM Class IV

Class IV visual objectives allow for major landscape changes where development may dominate the view without significantly harming the overall character. However, no areas within the project's visual zone were found to be sufficiently degraded or industrial to warrant a Class IV rating. Aside from a partially rehabilitated section of the old Rystkuil Uranium Mine, the landscape remains largely intact. Therefore, no areas have been designated as suitable for unmitigated development during either the operational or post-mining phases.

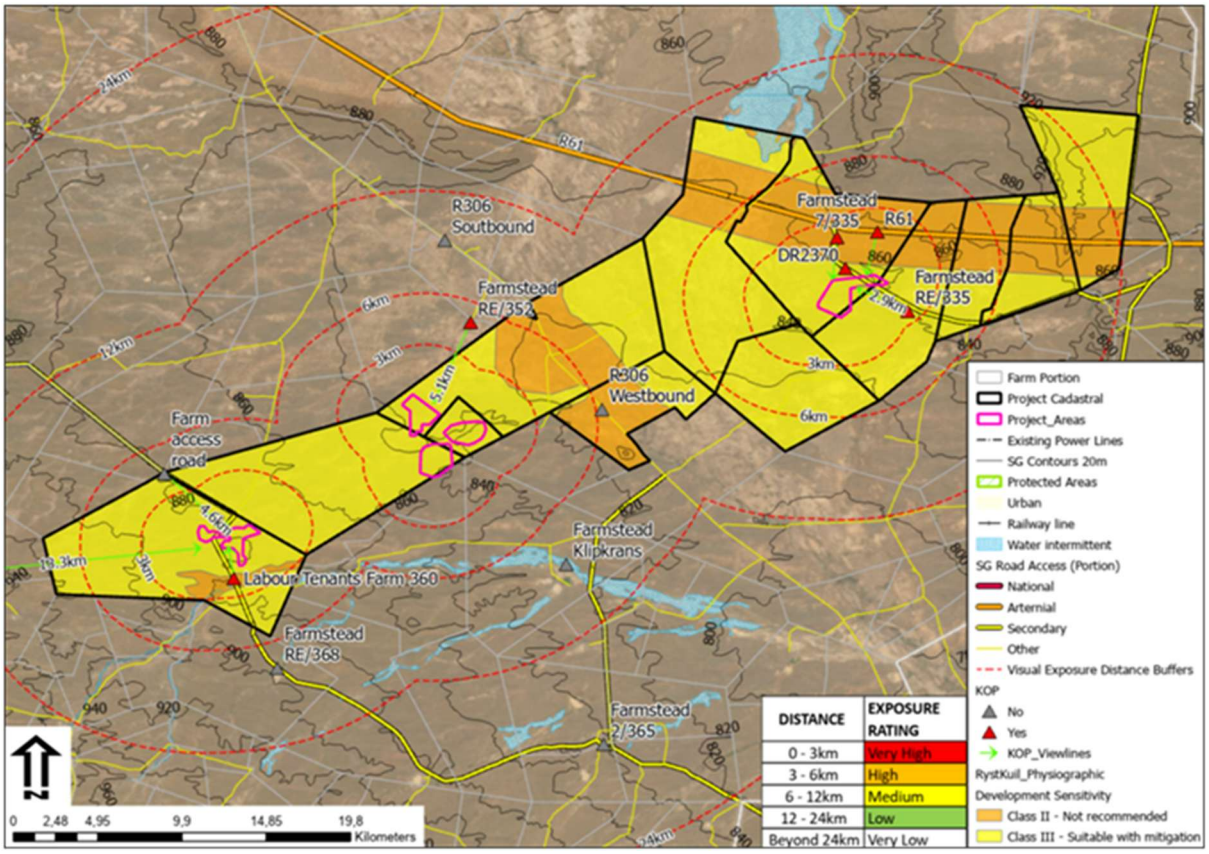


Figure 4-55. Visual Resource Management Classes Map.

4.1.11 Palaeontology

South Africa's fossil record, especially from the Karoo Supergroup, has significantly advanced global understanding of the evolution of life, particularly tetrapods, including mammals and dinosaurs, and Gondwanan plant life. The Karoo basin, covering about 60% of South Africa, provides the most complete continental fossil record from the Middle Permian to Early Jurassic and is globally recognized for its contributions to vertebrate palaeontology.

The Beaufort Group within the Karoo holds exceptionally rich fossil deposits, leading to the development of an 8-fold biostratigraphic scheme, which is the most effective method for long-range correlation in the absence of marker beds. These fossils are also critical for global stratigraphic correlations and basin evolution studies.

The Karoo fossil record includes a wide range of vertebrates such as fish, amphibians, reptiles, therapsids, dinosaurs, and early mammals, many of which are key to understanding the origins and evolutionary transitions of major vertebrate groups. The Tapinocephalus Assemblage Zone offers the only known continental record of the Middle-Late Permian transition, crucial for studying biodiversity changes associated with major extinction events, including the end-Permian and end-Triassic extinctions.

While much of the current mining project area is covered by alluvium and is of low palaeosensitivity, some small, unpredictable high-sensitivity zones do occur, especially in Permian bedrocks. No fossils were found during site inspections, and Late Caenozoic sediments are also considered generally low in sensitivity, though they could occasionally contain Pleistocene remains.

Impacts on palaeontological resources from mining are assessed as moderate (negative) before mitigation, reducing to low (negative) after mitigation. Decommissioning impacts are minimal, and cumulative impacts in the Aberdeen Vlaktes subregion are considered low to very low (negative). The No-Go alternative would have a neutral impact.

4.1.12 Archaeology

Because of the scarcity of caves and shelters in the Karoo, more than 90% of archaeological sites are open sites. They are, as Orton et al. (2016) point out, generally concentrated near permanent sources of water. The artefacts are generally not in primary location and organic remains are rarely preserved. This limits their information value and therefore their significance.

Early and Middle Stone Age

Isolated Early Stone Age artefacts, including occasional handaxes have been reported from the Beaufort West area but are generally quite ephemeral. Kinahan (2008) noted with respect the archaeology of Ryst Kuil, a total of only seven (7) ESA sites, with isolated finds of quartzite artefacts and he commented "none of the ESA material was considered to be in primary context and therefore of little research value". The earlier Pleistocene assemblages are primarily made on coarse-grained quartzites.

Middle Stone Age artefacts are widespread, occurring in isolated as well as relatively dense concentrations over large areas. They do not occur with any associated organic remains. They have been reported by the Kinahan (Turgis Baseline Report 2008) who noted that 126 or 50% of the total sites he recorded were Middle Stone Age

but that they “probably formed part of a continuous surface scatter almost without focal points”. He noted that the MSA artefacts were dominated by quartzite and hornfels. He also notes, interestingly: “There was some evidence of Levallois core production and examples of Howieson’s poort segments and allied forms were found at a number of sites” (Turgis Baseline Report 2008: 225).

This reference to the Howieson’s Poort in this context, is highly significant. The Howieson’s Poort is a name given to a particular expression (or subdivision) of the Middle Stone Age dating to between 80 000 and 60 000 years ago and characterised by backed tools including segments often on fine-grained raw material. Recognized mainly from cave sites along the coastal margins of South Africa, it has not been recorded from open sites in the interior of South Africa. However, despite an intensive field assessment of the area, we did not recognize any Howieson’s Poort material during our survey.

Halkett (2009) and Webley & Hart (2010) support Kinahan's observations on the widespread distribution of MSA material in the Ryst Kuil block.

Late Stone Age

While ESA and MSA stone artefacts are ubiquitous, LSA artefacts are scarcer. They tend to be manufactured on hornfels, but of interest is a patchy occurrence of a chert horizon that forms a capping on some low hills. Halkett (2009) noted that LSA material was located close to dry river courses, typically marked by dense acacia growth. The pre-colonial inhabitants were probably restrained by the need for water and shelter, of which the latter is almost completely absent and acacia stands are the only possibility of respite from wind and sun.

Kinahan (2008) reported on a more focused distribution of LSA sites (97 sites) across the entire Ryst Kuil property. This is supported by Halkett (2009) who found LSA sites along dry river beds. The LSA included a number of suspected hut circles and short lengths of stone walling as well as possible burial cairns. The hut circles/stone kraals have been interpreted to represent pre-colonial pastoralist groups. Kinahan also observed that the occurrence of a minor chert horizon on the Ryst Kuil property provided a raw material of high quality for stone artefact manufacture.

Rock engravings, on dolerite boulders, may occur throughout the mining area although none were recorded by Kinahan (2008) or Halkett (2009).

4.1.13 Socio-Economic Environment

The purpose of this section is to provide a comprehensive socio-economic profile of the BWLM to understand the existing weaknesses and opportunities in terms of the future development of the mining project.

4.1.13.1 Socio-economic Data Sources

The 2022 Census is South Africa’s most recent official socio-economic dataset, but as of June 2025, only data up to local municipality (LM) level has been released, despite promises for sub-place level data by February 2024. The released data shows unexpectedly high growth rates that contradict historical demographic trends, raising concerns among researchers and demographers.

A technical review by the Centre for Actuarial Research (CARe), prepared for the South African Medical Research Council in June 2024, highlighted serious issues:

- The total population figure may be overstated by around 1 million.
- Migration data shows implausible patterns.
- Results are incoherent at sub-national levels, worsening at finer spatial scales.
- Concerns exist over adjustments made for a 31% undercount.

Key conclusions from the CARe report:

- Essential data (fertility, mortality, detailed migration) remains unreleased and should be published urgently.
- Uncritical use of the 2022 Census for planning is inadvisable.
- Population projections should not rely solely on the 2022 Census without addressing inconsistencies.
- CARe is developing alternative population estimates.

Stats SA responded, rejecting the criticisms, affirming the accuracy of the census results, and noting that the data underwent internal and expert review. However, Stats SA later confirmed that due to quality concerns, data on income, labour, mortality, and fertility would not be published—information which CARe had specifically identified as crucial.

Given the uncertainties surrounding Census 2022, especially at the local level, it was decided to complement the census data with other sources for better accuracy:

- 2011 Census – detailed small-area data.
- Community Survey 2016 – local municipal-level data between censuses.
- Local Municipality Projections (2002–2031) – official projections excluding 2022 Census input.
- Mid-Year Population Estimates (MYPE) – used cautiously due to lack of 2022 Census integration.
- CSIR Green Book Projections (to 2030/2050) – long-term local projections tied to development and climate scenarios.
- Western Cape's MERO and SEP reports – additional analytical resources based on existing datasets.

Due to questionable reliability of the 2022 Census at local levels, multiple data sources were used to build a more robust and nuanced socio-economic analysis.

4.1.13.2 Population and Households

The CKD makes up 1.0 per cent of the total Western Cape population, the least populous District in the province. In the CKD, Beaufort West has the largest population share at nearly 70%. The population of BWM is provided in Figure 4-57 for all the sources identified above.

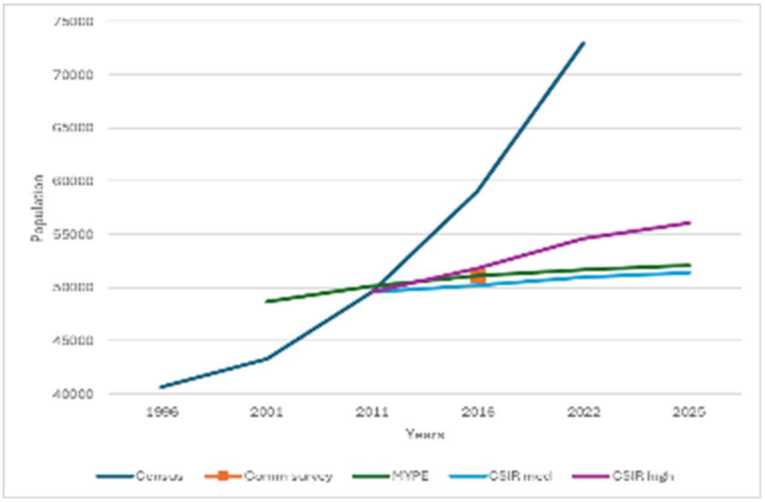


Figure 4-56. Beaufort West LM Population.

As can be seen the majority of the sources show a population of between 51 000 and 55 000 for 2022, except for the 2022 Census which shows a population of 73 792. The Western Cape Government which produces the Municipal Economic Review and Outlook (MERO) and the annual Socio-economic Profile (SEP) for all the districts and municipalities in the province also have an issue to decide which set of figures need to be utilised.

The annual population growth rates for all the sources are provided in Figure 4-57.

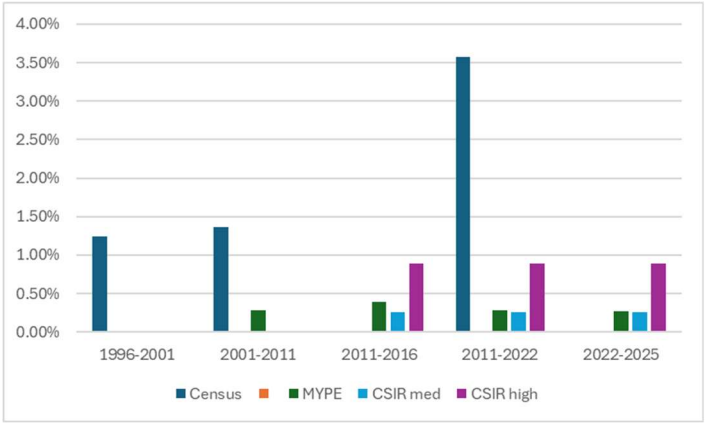


Figure 4-57. Beaufort West LM Annual population growth per period

The Census growth between 2011 and 2022 is 3.6% which is far higher than the other sources of between 0.3% and 0.9% for the same period. In order to understand the growth rate more fully the annual growth rate for BWM is compared to other areas using the Census as well as the MYPE datasets which are both sets of official data from Stats SA, as shown in Figure 4-58.

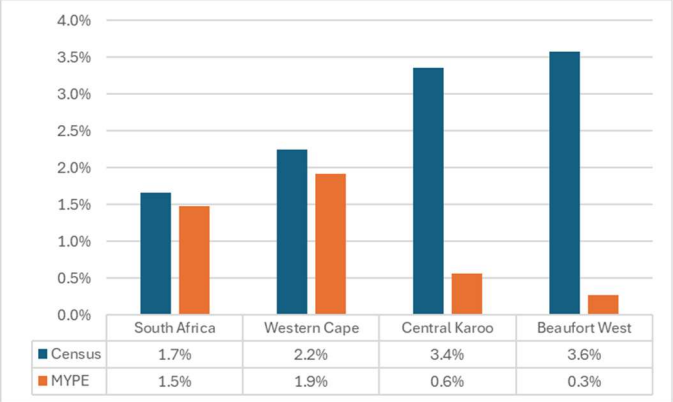


Figure 4-58. Annual Population Growth Rate Comparisons

The 2022 Census growth rates exceed those of the Mid-Year Population Estimates (MYPE) across all geographic levels, with the discrepancy increasing at more localized levels, raising concerns about data reliability. Discussions with Beaufort West Municipality (BWM) and Central Karoo District Municipality (CKDM) suggest that the reported 3.6% growth over 11 years for Beaufort West is highly unlikely.

For planning purposes, the most realistic 2025 population estimate for Beaufort West is approximately 54,000, with a possible range of 52,000 to 56,000. The Socio-Economic Profile (SEP) recorded a 2024 population of 52,667, and future annual growth is projected at 0.3% to 1.0%, reflecting limited economic development, infrastructure challenges, and harsh environmental conditions in this rural, semi-desert region.

By 2030, the population is expected to be between 55,500 and 57,000. Despite growth, household size has remained stable at 3.8 persons from 2011 to 2022, indicating that growth is driven by an increase in households rather than larger households. In 2025, Beaufort West is estimated to have 14,200 households (range: 13,500–15,000), increasing to 14,500–15,000 by 2030.

Beaufort West is the most urbanised municipality in CKDM with 89.7% urbanisation, followed by Prince Albert and Laingsburg. The district is 86.9% urban overall, a stable trend due to long-term rural-urban migration. The largest urban centres are Beaufort West (38%) and Rustdene (16%), with Rooivlakte and Beaufort West seeing the greatest population growth.

Though urbanisation is growing, the BWM area remains sparsely populated, with a density of 2.4 persons/km² across 21,916 km². Rooivlakte, Rustdene, and Kwa-Mandlenkosi have experienced the most notable increases in population density, emphasizing the importance of spatial and infrastructure planning in these areas.

- **Beaufort West** **2.4 people/km²**
- Laingsburg 1.1 people/km²
- Prince Albert 1.9 people/km²
- Central Karoo District 2.0 people/km²

4.1.13.3 Demographic Profile

Figure 4-59 provides an overview of the municipal area's population distribution across different age groups, presented as a dependency ratio, indicating the workforce (ages 15 - 64) versus dependents (children and seniors). Demographic insights are vital for economic planning, highlighting potential challenges in resource allocation and social welfare programs.

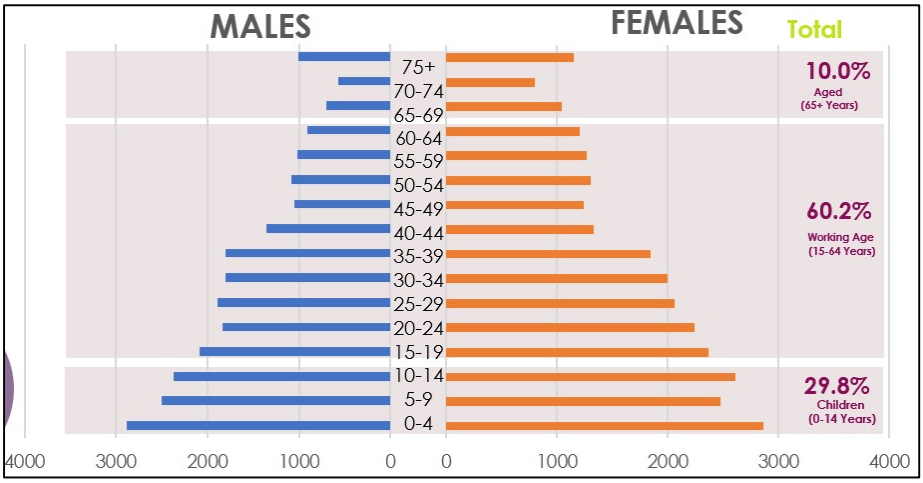


Figure 4-59. BWM Age and Sex Profile, 2024 (SEP).

According to the 2024 Socio-Economic Profile (SEP) for Beaufort West Municipality (BWM):

- 60.2% of the population is in the economically active age group (15–64 years), while children (0–14 years) make up 29.8%, and the elderly (65+) account for 10%.
- The dependency ratio is 66.2%, which is considered high. However, a shift in the age structure—due to growth in the working-age group—suggests a positive trend for future economic productivity.

Racial demographics show the population is predominantly:

- Coloured – 71.5%
- Black African – 20.4%
- White – 7.6%
- Indian/Asian – 0.5%

The sex ratio is 91.4 males per 100 females, with males making up 47.2% and females 52.8% of the population. This gender imbalance may result from migration, socioeconomic factors, or demographic trends and is important to consider in policy and planning.

4.1.13.4 Spatial & built environment/ housing

There are four settlements in Beaufort West Municipality:

- Beaufort West Town
- Nelspoort
- Murraysburg
- Merweville

According to the CSIR, a settlement is a distinct human community requiring engineering and social services, and settlements are organized into a hierarchy based on size and function. Population plays a key role in determining this hierarchy and guiding the distribution of basic services.

In Beaufort West Municipality, which is predominantly rural, the town of Beaufort West serves as the regional service centre for both the local and district municipalities. It hosts most of the region's medical, educational, commercial, and administrative functions. The National Spatial Development Framework (NSDF) classifies Beaufort West as a Regional Development Anchor, although its declining economic potential could alter its status.

Other settlements include:

- Murraysburg – a major rural settlement providing some services to nearby farming communities.
- Merweville and Nelspoort – minor rural settlements offering limited services related mainly to farming and transport activities.

The settlement hierarchy reflects varying service capacities across these communities (Figure 4-60).

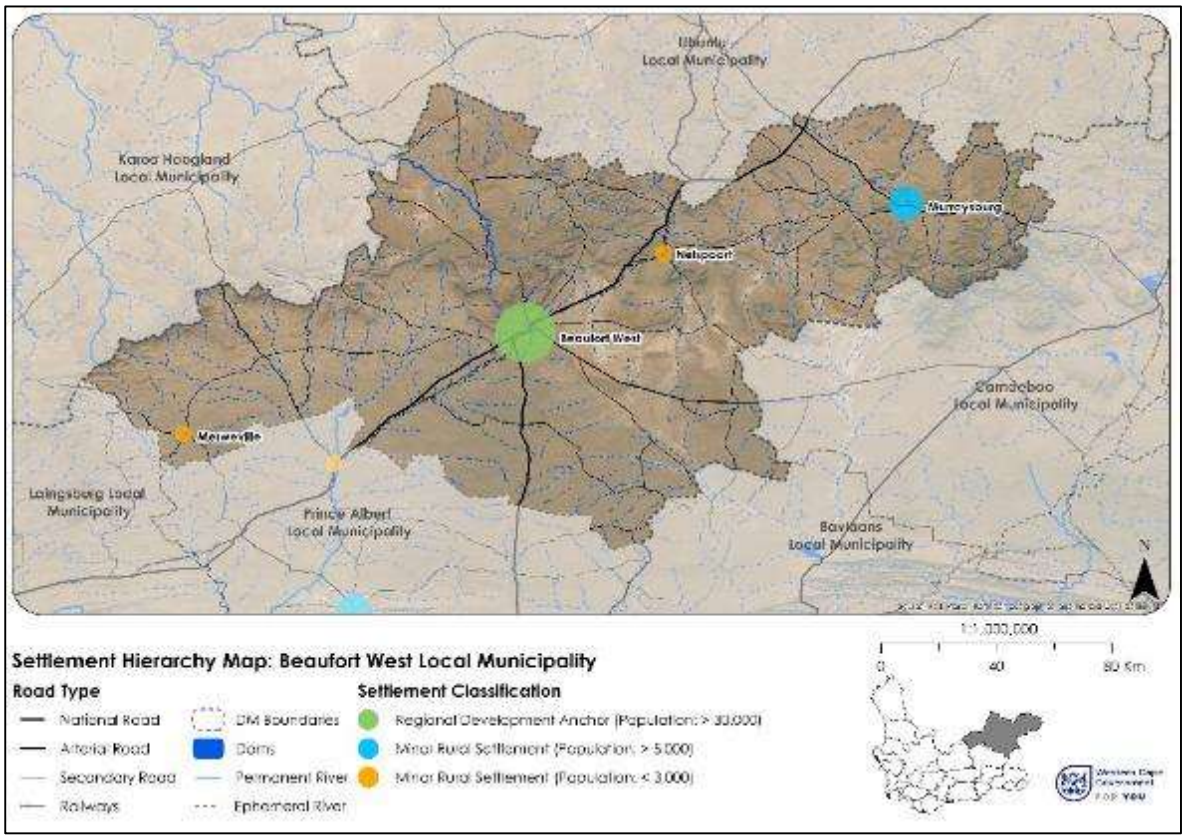


Figure 4-60. Settlement Hierarchy for Beaufort West Municipality (BWM SDF).

4.1.13.5 Education

According to the Socio-Economic Profile (SEP), education is a key driver of change, equipping people with the knowledge and skills needed for employment. Key education indicators include enrolment, school facilities, learner retention, teacher ratios, and matric pass rates—all critical for policy development and public funding allocation.

In 2023, the Beaufort West Municipality (BWM) had 11,239 learners enrolled across 18 public schools, a slight decline from 11,502 learners in 2022. Despite this, there was a 0.3% enrolment increase between 2021 and 2022. Most public schools (77.8%) are classified as no-fee schools, meaning they do not charge school fees. 14 schools have library facilities, supporting learning beyond textbooks.

The learner-teacher ratio, a measure of classroom capacity and interaction quality, improved from 32.4 in 2022 to 31.4 in 2023. However, ratios remain high for teachers paid solely by government, indicating they manage larger classes. The Department of Education recommends maximum ratios of 40:1 for primary schools and 35:1 for high schools. Lower ratios are linked to better education outcomes through more individualised teacher-learner engagement.

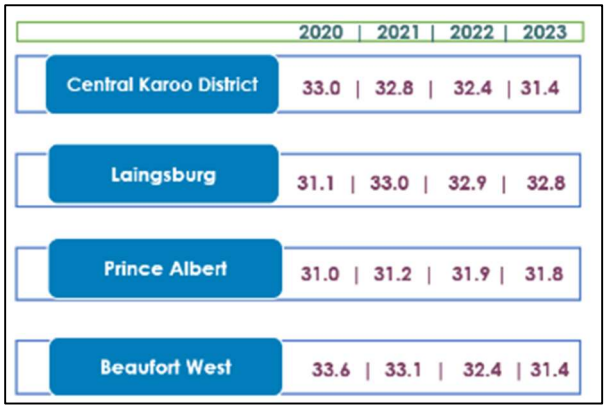


Figure 4-61. Learner Teacher Ratio, 2020-2023 (SEP).

According to the Socio-Economic Profile (SEP), the learner retention rate in Beaufort West Municipality (BWM) improved from 60% in 2022 to 66.3% in 2023, largely due to learners returning after COVID-19 disruptions. However, this remains below the 79.5% retention seen in 2020, indicating that 34% of learners still drop out before completing Grade 12.

High dropout rates negatively affect the economy, as learners leave school without the skills needed for employment, and are linked to social issues like teen pregnancy and drug use. Strategies to reduce dropout include expanding technical and vocational education, providing early intervention, offering psychological support, and targeting at-risk learners.

Educational performance in BWM has fluctuated, with matric pass rates declining from 79.0% in 2022 to 74.0% in 2023. This decline, coupled with high dropout rates, is expected to worsen youth unemployment and reduce future job prospects.

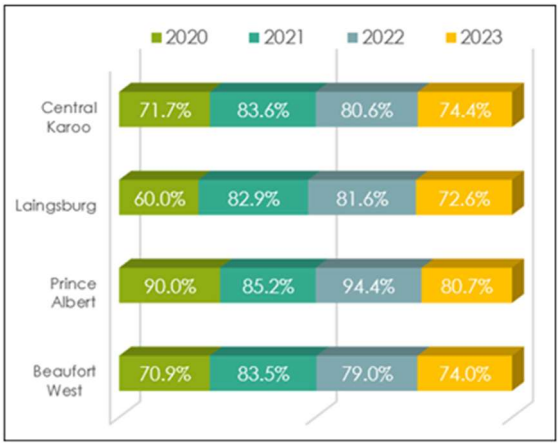


Figure 4-62. Matric Outcomes, 2020-2023 (SEP).

Unfavourable outcomes have been recorded for Mathematics, Physical Science and English in 2023. On the other hand, Mathematical literacy and Afrikaans home language shows better pass rates.

4.1.13.6 Health

Health indicators in Beaufort West Municipality (BWM) offer important insights into community wellbeing, especially regarding maternal and child health, emergency services, and access to treatment.

Healthcare Infrastructure (2023):

- primary healthcare facilities
- district hospitals
- mobile/satellite clinics
- ART (Antiretroviral Therapy) sites
- TB clinics
- provincial ambulances (0.6 per 10,000 people) — not including private services

Key Health Indicators:

- Maternal mortality rate: 0.0 per 100,000 population, aligned with the district average
- Teenage pregnancies: Increased to 18.9% (from 17.4%), slightly higher than the district average (18.3%), contributing to school dropout rates
- Pregnancy terminations: 0.3%, similar to the district rate (0.2%)
- Immunisation coverage for children under one year dropped to 56.4% in 2023/24 from 76.2% in 2022/23, remaining below the district average
- Severe malnutrition in under-fives increased from 1.3 to 3.0 per 100,000
- Neonatal mortality improved to 14.7 per 1,000 live births from 19.6, indicating better care around birth
- Low birth weight (<2.5kg) babies decreased to 20.8% from 22.1%

Treatment Trends:

- ART patients increased by 25%, from 1,572 to 1,958
- TB treatment patients rose from 465 to 504, reflecting improved detection and care

BWM has a relatively comprehensive healthcare infrastructure, but challenges remain, particularly in immunisation coverage, teenage pregnancies, and child malnutrition. Improvements in neonatal outcomes and treatment enrolments for HIV and TB are promising, though further targeted interventions are needed to address service gaps and sustain progress.

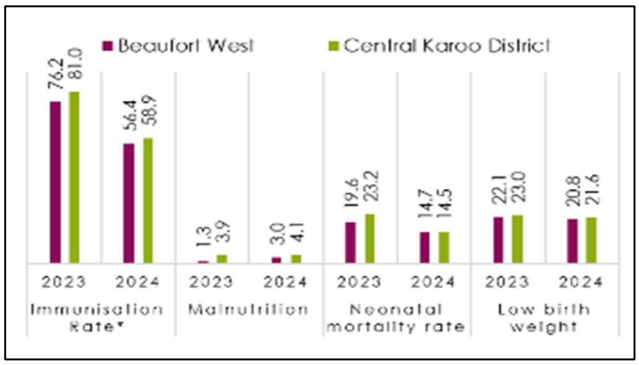


Figure 4-63. Child Health Indicators, 2023-2024 (SEP).

4.1.13.7 Income and Poverty

Gross Domestic Product by Region (GDPR) per capita measures the average economic output per person and is an important indicator of economic development. Growth in GDPR per capita occurs only when economic growth outpaces population growth.

In 2023, Beaufort West Municipality (BWM), although the largest economy in the Central Karoo District (CKD), recorded a GDPR per capita of R28,069, below the district and provincial averages, indicating lower income levels. GDPR per capita in the municipality has also fluctuated over the past three years.

Unlike GDPR per capita, median income better reflects typical income levels. While GDPR per capita declined, median incomes remained relatively stable across CKD municipalities:

- Beaufort West: R9,447 – the highest, due to its diverse economy and transport-linked location
- Prince Albert: R4,664 – modestly higher, supported by agriculture and tourism
- Laingsburg: R4,587 – the lowest, reflecting small-scale agriculture and low diversification

The CKD average median income is R6,730, balancing Beaufort West's stronger economy against the weaker economic profiles of Laingsburg and Prince Albert.

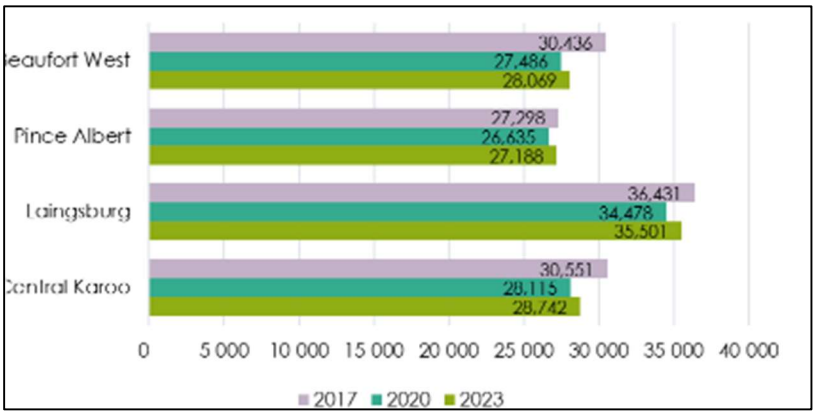


Figure 4-64. GDPR per Capita, 2024 (SEP).

Income inequality measures how unevenly income is distributed within a population, with the Gini Index (0 = perfect equality, 1 = perfect inequality) being a common metric. South Africa has one of the world's highest income inequalities.

From 2020 to 2023, the Central Karoo District (CKD) saw a reduction in income inequality, with its Gini coefficient dropping from 0.601 to 0.575, due to improved education, skills development, workforce participation, and better employment, especially for historically disadvantaged groups.

The National Development Plan (NDP) aims by 2030 to eliminate households earning less than R419 per person monthly and reduce the national Gini coefficient from 0.690 to 0.600 through evidence-based policies that tackle poverty and inequality.

In Beaufort West Municipality (BWM), income inequality slightly improved from 0.59 to 0.58 in 2023 but remains the highest among the three CKD municipalities. Lack of economic diversification limits high-paying jobs, especially in towns like Leeu-Gamka and Klaarstroom, which have the lowest median incomes and significant inequality, with many earning well below the median, causing disparities in living standards.

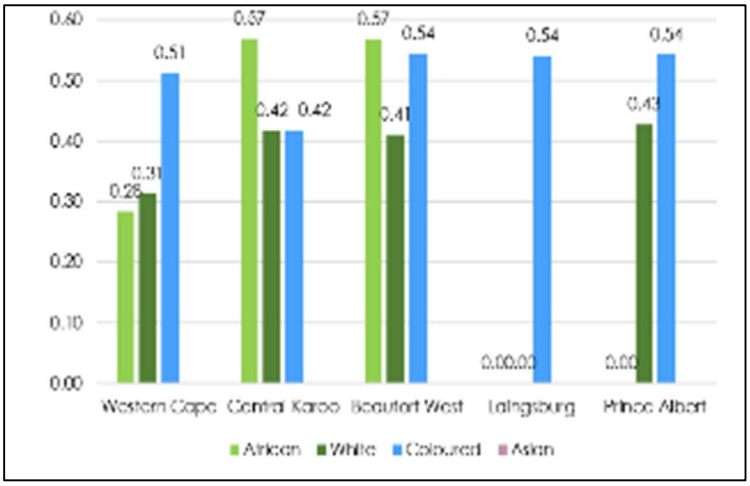


Figure 4-65. Income Inequality, 2024 (SEP).

According to the Socio-Economic Profile (SEP), income inequality varies by racial group in 2023, with the African group having the highest Gini coefficient at 0.57, followed by the Coloured group at 0.54, while the White group shows a more equal income distribution with a Gini of 0.41.

The Upper Bound Poverty Line (UBPL), set at R1,417 per person per month (April 2022 prices), defines the poverty threshold for adequate food and non-food items. In 2023, 83.7% of the population lived below this line, indicating widespread poverty linked to lower life expectancy, malnutrition, crime, poor education, and living conditions.

To combat poverty, initiatives like public works, skills development, small business support, and investment in infrastructure (roads, schools, healthcare) are critical.

Indigent household income thresholds vary by municipality, reflecting local socio-economic conditions:

- Laingsburg: lowest threshold, indicating widespread low income
- Prince Albert: R4,000 threshold
- Beaufort West: R4,900 threshold (twice the Old Age Pension amount)

The number of indigent households in the CKD fell by 10.2% from 8,426 in 2022 to 7,570 in 2023 (37.5% of total households), largely due to reduced unemployment. In Beaufort West, indigent households declined by 10.3% to 5,985 (44.1% of total), influenced by urban-rural economic disparities where urban residents have better income and opportunities.

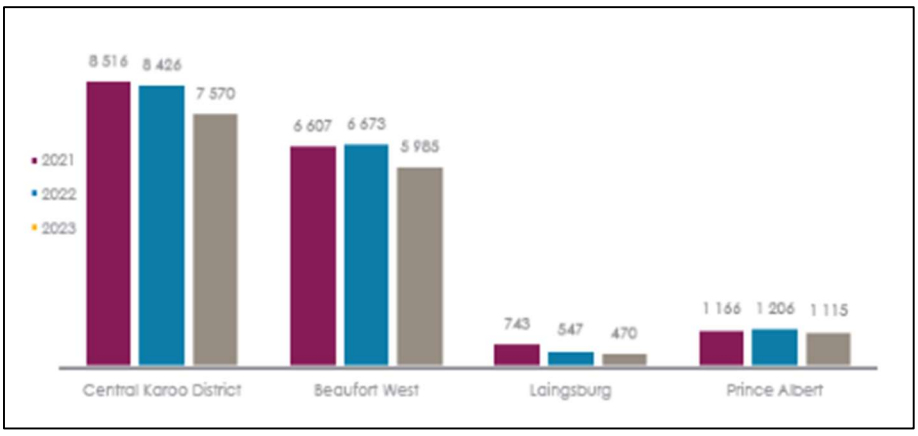


Figure 4-66. Number of Indigent Households, 2021-2023 (MERO).

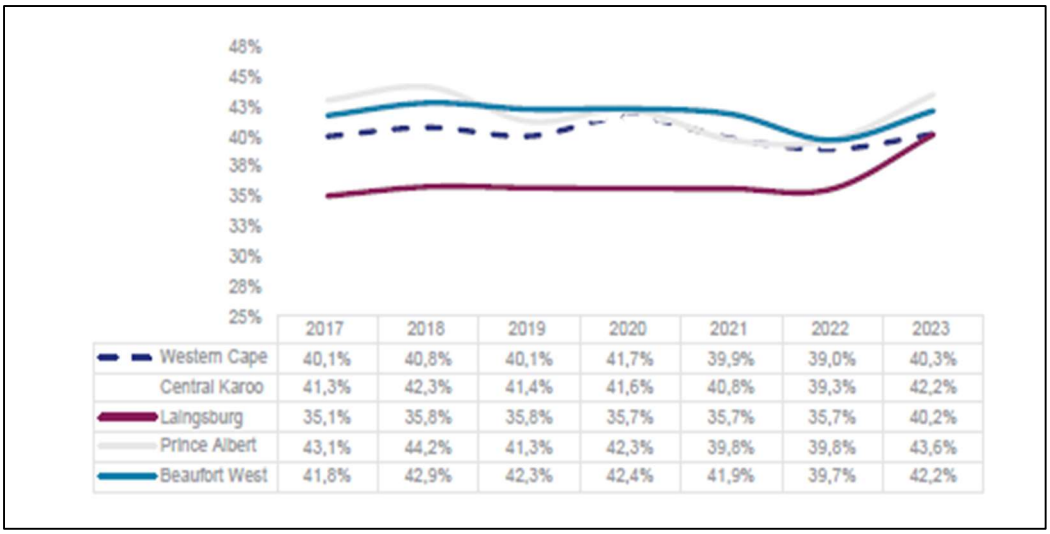
Source: Quantec, 2024

Food security involves consistent access to safe, nutritious food and depends on four pillars: availability, access, utilisation, and stability (BFAP). In contrast, food insecurity reflects limitations in these areas.

In 2023, 42.2% of the Central Karoo District (CKD) population lived below the food poverty line, indicating a rising challenge in ensuring food security.

- Laingsburg: food insecurity rose from 35.7% (2022) to 40.2% (2023)
- Prince Albert: increased from 39.8% to 43.6%
- Beaufort West: rose from 39.7% to 42.2%, largely due to economic instability and high unemployment

The worsening trend across all municipalities highlights the need for targeted, root-cause-focused interventions to improve food security.



	2017	2018	2019	2020	2021	2022	2023
Western Cape	40,1%	40,8%	40,1%	41,7%	39,9%	39,0%	40,3%
Central Karoo	41,3%	42,3%	41,4%	41,6%	40,8%	39,3%	42,2%
Laingsburg	35,1%	35,8%	35,8%	35,7%	35,7%	35,7%	40,2%
Prince Albert	43,1%	44,2%	41,3%	42,3%	39,8%	39,8%	43,6%
Beaufort West	41,8%	42,9%	42,3%	42,4%	41,9%	39,7%	42,2%

Figure 4-67. Proportion of Population below the Food Poverty Line, 2017-2023 (MERO).

Source: Quantec, 2024

4.1.13.8 Human Development Index (HDI)

The Human Development Index (HDI), developed by the UNDP, measures progress in life expectancy, education, and standard of living. It reflects the average achievement in these key areas of human development.

In the Central Karoo District (CKD), the COVID-19 pandemic negatively impacted life expectancy, education, and employment, lowering income levels. However, by 2023, the HDI showed signs of recovery, improving from 0.686 in 2022 to 0.694, due to gains in income, education, and health.

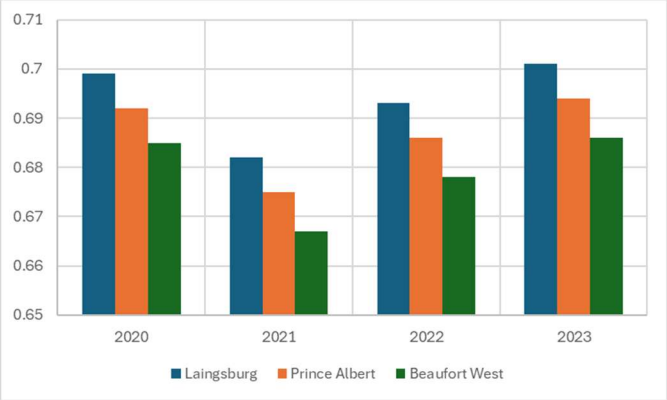


Figure 4-68. HDI per Municipa Area, 2020-2023 (MERO).

Source: Quantec, 2024

The HDI levels vary significantly within the district. However, the HDI levels are quite differentiated with the district. The Laingsburg municipal area recorded the highest HDI in 2023, at 0.701, despite high levels of unemployment and inequality. It was closely followed by the Prince Albert municipal area at 0.694, largely influenced by disproportionately low incomes associated with work in the informal agricultural sector. Lastly, the Beaufort West municipal area reported a relatively lower HDI of 0.686, reflecting slightly higher incomes and improved access to education and healthcare. These disparities underscore the urgent need to address socio-economic inequalities, expand educational opportunities, and raise income levels to uplift communities and create a more equitable and prosperous region.

The HDI provides a multidimensional view of a region's socio-economic development. A region's economic performance holds immense significance in determining the quality of life of its residents. As economies thrive, human development tends to improve, translating into better quality of life for individuals. The prosperity and growth of an economy can foster advancements in education, healthcare and access to resources, which in turn contribute to the overall wellbeing of the population.

4.1.13.9 Housing and Services

The Constitution guarantees the right to adequate housing, including essential services like water, sanitation, electricity, and waste removal. In 2024, 99.6% of households in Beaufort West Municipality (BWM) had access to formal housing—slightly above the CKD average of 99.0%—and had the lowest proportion of informal dwellings in the district (0.4%).

Despite this, BWM has the highest housing demand in the CKD, with 75% of households registered on the Western Cape Housing Demand Database. The bulk of this demand (89.5%) comes from Beaufort West Town, followed by Murraysburg (13.6%). Informal settlements remain small but present, with about 46 households spread across Beaufort West, Merweville, and Murraysburg.

Challenges include:

- Poorly located housing sites on the settlement periphery.
- Inadequate integration of housing with public space and economic opportunities.
- Lack of diverse housing types and quality public spaces.

Access to basic services in BWM is strong, with:

- 99.8% of households having piped water access.
- 97.2% with electricity for lighting.
- 98.0% with access to flush or chemical toilets.
- However, refuse removal services lag slightly at 79.5%, below the district average of 81.4%.

Indigent households, receiving free basic services, decreased from 6 673 in 2022 to 5 985 in 2023, reflecting slight economic improvement. Ensuring well-located, service-integrated housing remains crucial for uplifting communities and supporting economic development.

4.1.13.10 Risk and Vulnerability Factors

According to the CSIR Green Book, Beaufort West is increasingly vulnerable to drought due to climate change, with annual rainfall expected to decline—particularly in spring and autumn—and drought years projected to double from 2 to 4 per decade by 2050. Combined with higher evaporation rates, this raises the risk of water shortages, threatening agriculture, processing industries, and urban settlements.

Degradation of water catchment systems (due to land-use changes, alien plant infestations, and wetland modifications) will further reduce water input and retention, compromising water security, especially given the region's heavy reliance on groundwater, which remains poorly understood.

By 2050, temperatures in Beaufort West are expected to rise, with up to 24 more hot days per year, and 2–5 fewer frost days, increasing the risk of wildfires and reducing human and animal productivity.

The KRSDF (2020) highlights that:

- The area may be South Africa's most groundwater-dependent.
- Infrastructure should focus on capturing floodwaters to support groundwater recharge.
- Heatwaves and temperature extremes will strain both human and livestock resilience.
- Dry sanitation systems may become necessary.
- Extensive livestock and game farming face uncertain futures due to climate constraints and rising costs.

These climate risks must be factored into economic planning and project development to ensure resilience and sustainability.

4.1.13.11 Economic Performance

In 2023, Beaufort West Municipality (BWM) had the largest economy in the Central Karoo District (CKD), contributing nearly 70% (R2.089 billion) of the district's GDP. The tertiary sector dominated the local economy, making up 65.9% of GDP, driven by community and social services (19%), finance and business services (18%), and transport and communication (16%). This highlights the central role of both government and private services in the local economy.

The primary sector, mainly agriculture, contributed 14%, with livestock, game farming, and crop production playing vital roles in both the economy and employment. Mining and quarrying contributed only 0.04%.

The secondary sector (9.2%) included manufacturing (2.9%), construction (2.5%), and utilities (3.8%), supporting infrastructure and urban development.

Employment patterns mirror these sectoral contributions: services employ both skilled and semi-skilled workers, while agriculture remains dependent on low-skilled labour. Efforts are underway to diversify job opportunities and support infrastructure and service-sector growth.

Despite its leading role, economic growth in BWM is projected to remain modest, with forecasts of 0.5% in 2024, and 0.7% in 2025 and 2026, below the district average.

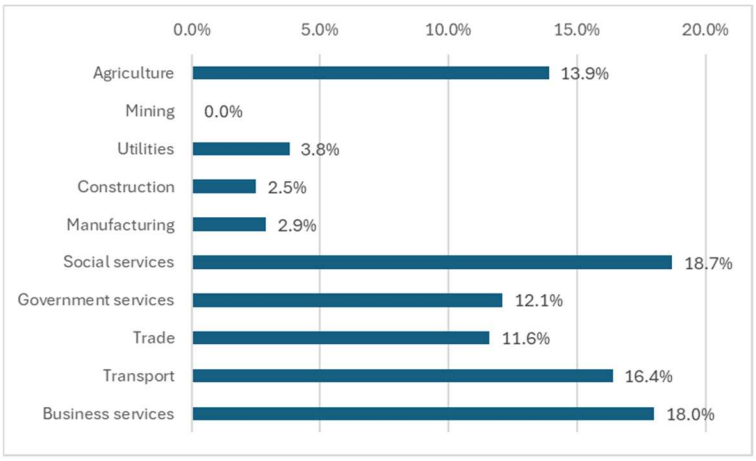


Figure 4-69. Sectoral Contributions to GDPR, 2023 (SEP).

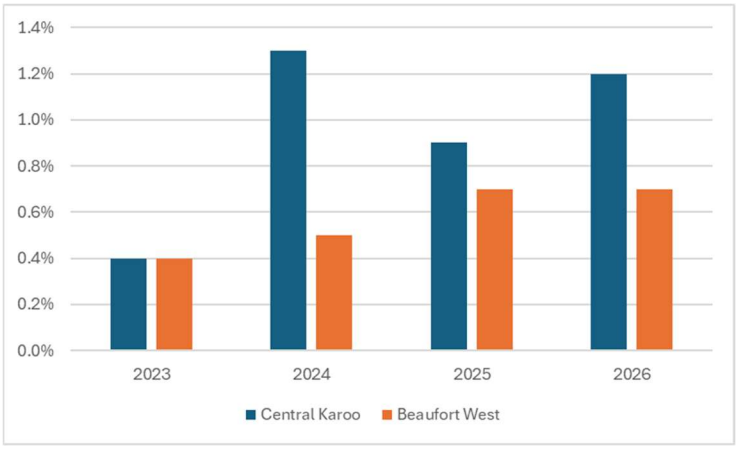


Figure 4-70. GDPR Growth Forecast, 2023-2026 (SEP).

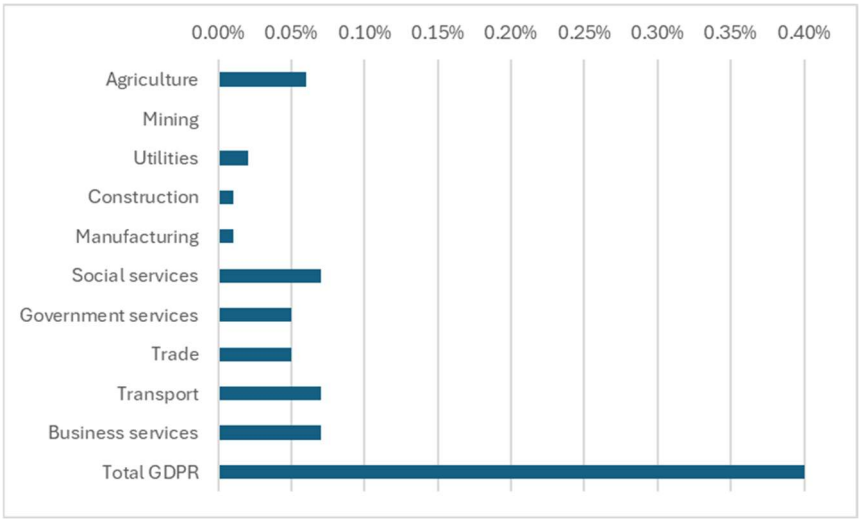


Figure 4-71. BWM Sectoral Contributions to GDPR Growth, 2022 – 2023, (MERO).

In 2023, Beaufort West's economy grew by 0.4%, driven primarily by diverse service-based sectors, according to MERO. Key contributors to this growth included:

- Wholesale & retail trade, catering & accommodation (0.05 percentage points),
- Transport, storage & communication (0.05),
- Finance, insurance, real estate & business services (0.07),
- General government (0.07), and
- Community, social & personal services (0.07).

Other sectors such as manufacturing, construction, and utilities had smaller impacts, each contributing between 0.01 and 0.02 percentage points. The agriculture, forestry, and fishing sector contributed 0.06 points, but faces challenges related to climate resilience that could affect future growth.

Trade data from SEP shows Beaufort West recorded a trade deficit of R20.5 million in 2023, with imports of R22.9 million and exports of R2.4 million. While exports rose 83.8%, imports also increased 66.4%, worsening the trade balance. Trade is dominated by the manufacturing and agriculture sectors, with top imports including harvesting machinery and other agricultural equipment, and top exports being tractors, wine, and vegetables.

The tourism sector contributed 9.3% to GDP in 2023 (down slightly from 9.6% in 2022). Sustained tourism development will require strategies to attract off-peak visitors and ensure long-term industry viability.

4.1.13.12 Employment

According to MERO, employment trends in Beaufort West show mixed signals. In 2023, the region saw a modest recovery with an increase of 11 full-time equivalent (FTE) jobs, bringing the total to 4,043 jobs, reaching pre-pandemic levels. However, formal employment stagnated, and the informal sector has grown in importance, contributing 17.8% of total employment in 2021, particularly in trade.

Over the past decade, skilled workers have consistently fared better in the formal sector compared to semi- and low-skilled workers. The tertiary sector dominates employment, led by public administration (887 local and 512 provincial FTEs), followed by retail (272 FTEs) and hospitality (160 FTEs), indicating the strong role of government and services in job creation.

The secondary sector, though smaller, provides key semi- and skilled jobs in livestock processing (112 FTEs) and plumbing and HVAC services (103 FTEs), contributing to local industrial activity.

A mismatch exists between sectors that contribute most to GDP (e.g., finance and business services) and those that create the most jobs (e.g., public services and retail). This highlights the need for strategic skills development to align the workforce with high-value sectors and ensure sustainable, inclusive job growth.

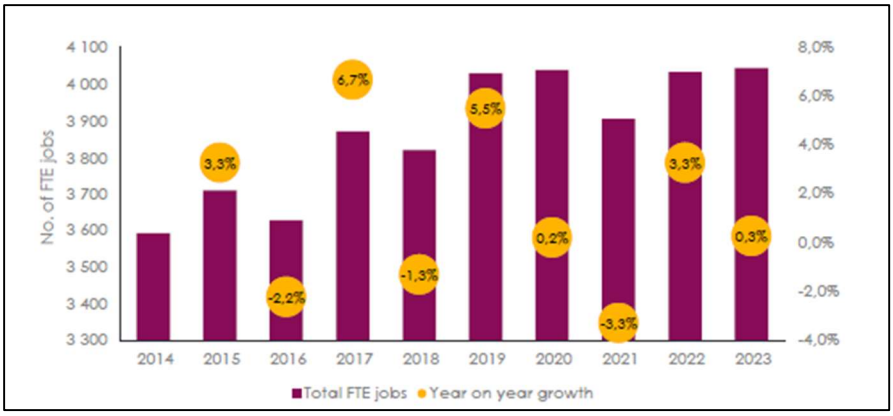


Figure 4-72. Full-Time Equivalent Jobs Growth, 2014 – 2023, (MERO).

Source: Nell, A & Visagie, J. Spatial Tax Panel 2014 – 2023 (dataset). Version 3. National Treasury Cities Support Programme and Human Sciences Research Council (producer and distributor), 2024

Table 4-53. Top 10 Sectors by Number of FTE Jobs, Beaufort West, 2023 (MERO)

Main Sector	Occupation	No. of FTE jobs
Tertiary	General public administration at Local Government level	887
Tertiary	General public administration at Provincial Government level	512
Tertiary	Public order and safety activities at National Government level	329
Tertiary	Retail of automotive fuel in specialised stores	272
Tertiary	Short term accommodation activities of guesthouses, bed and breakfast	160
Tertiary	Food service activities of take away counters	125
Tertiary	Residential care activities for the elderly and disabled	117
Secondary	Slaughtering, dressing and packing of livestock, including poultry and small game for meat	112
Secondary	Plumbing, heat and air-conditioning installation	103
Tertiary	General public administration at National Government level	102

Source: Nell, A & Visagie, J. Spatial Tax Panel 2014 – 2023 (dataset). Version 3. National Treasury Cities Support Programme and Human Sciences Research Council (producer and distributor), 2024

Beaufort West's local economy showed mixed employment results, with a net loss of 41 jobs in 2023. While 170 jobs were created, particularly in the tertiary sector (e.g., automotive fuel retailing, health services, and security systems) and the primary sector (sheep/goat farming and livestock slaughtering), there were 211 job losses in other areas.

Significant job losses occurred in mixed farming (-70), petroleum support activities (-42), local government administration (-52), short-term accommodation (-22), and religious organisations (-24). These losses point to challenges such as economic pressures, infrastructure limitations, and skills gaps.

To reverse this trend, targeted investment in skills development and business support is needed to stabilise employment and promote sustainable economic growth.

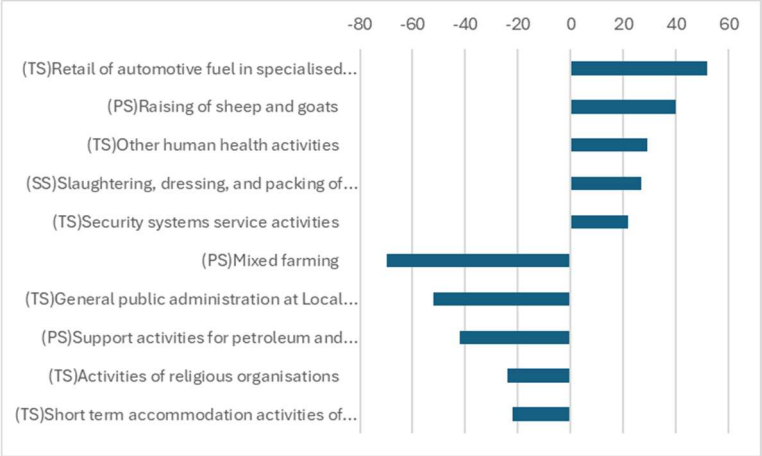


Figure 4-73. Top Five Sectors for Job Creation and Job Losses, 2022 – 2023, (MERO).
Source: Nell, A & Visagie, J. Spatial Tax Panel 2014 – 2023 (dataset). Version 3. National Treasury Cities Support Programme and Human Sciences Research Council (producer and distributor), 2024

In 2023, Beaufort West's economy showed strong GDP contributions from high-value sectors like finance and business services (18% of GDP), but these sectors generated few jobs. Employment remained concentrated in the agriculture (13.9% of GDP) and public administration sectors, which offer essential and stable jobs despite challenges.

While the tertiary sector saw job growth in retail, health services, and local government, there were notable job losses in agriculture (especially mixed farming), accommodation, religious organisations, and petroleum support activities. These shifts highlight the vulnerability of labour-intensive sectors.

To ensure balanced and sustainable growth, targeted investment in infrastructure, skills development, and economic diversification is needed. This will help align employment with both high-value and labour-intensive sectors, fostering resilience and broader job opportunities in the region.

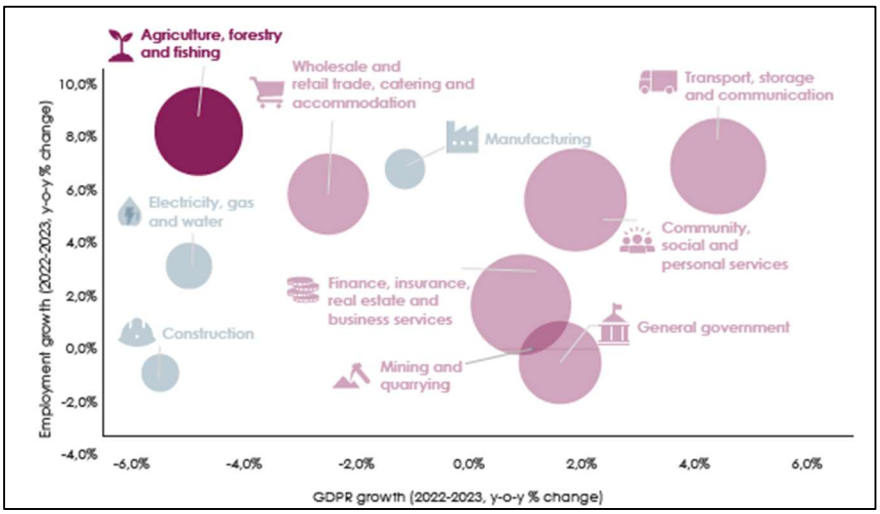


Figure 4-74. Employment & GDPR Performance by Sector, 2022 – 2023, (MERO).
Source: Quantec, 2024

4.1.13.13 Labour Skills and Salaries

Skills facilitation is crucial for improving employment opportunities in Beaufort West Municipality (BWM). In 2023, BWM employed approximately 12,316 workers, with 79.4% in the formal sector—mostly semi-skilled (40.7%) and low-skilled (34.6%)—and 24.7% skilled workers. Wages in BWM are higher compared to surrounding areas due to its diversified economy and role as a public services hub. The median income was the highest in the Central Karoo District (CKD) at R9,447.

Wage disparities persist, with over half the population earning above the minimum wage (~R3,200), but only 13.9% earning between R25,600 and R51,200, reflecting income inequality. The accommodation and food service sector, tied to tourism, mostly offers low-wage, lower-skilled jobs.

Taxpayer numbers in the CKD grew by 3.4% from 2021 to 2022, led by Beaufort West, with average taxable incomes rising modestly but still below the provincial average. Laingsburg showed the highest income growth, followed by Beaufort West and Prince Albert.

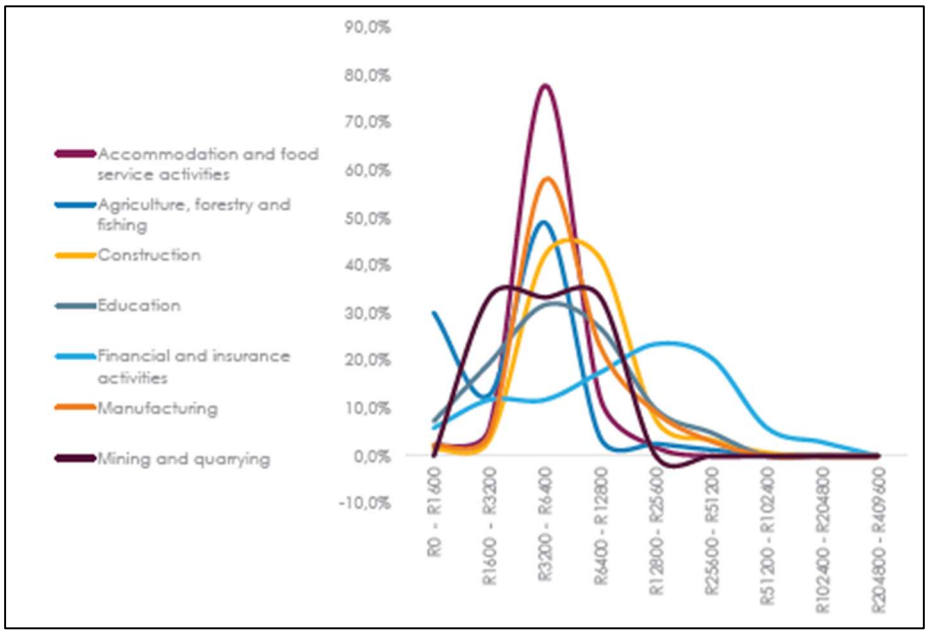


Figure 4-75. Wage Distribution per Industry in CKD, 2023 (MERO).
Source: Nell, A & Visagie, J. Spatial Tax Panel 2014 – 2023 (dataset). Version 3. National Treasury Cities Support Programme and Human Sciences Research Council (producer and distributor), 2024

4.1.13.14 Economic Sector Analysis

This section will analyse the most important public sectors in the local economy.

4.1.13.15 Tourism

The Karoo Regional Spatial Development Framework places a significant focus on tourism within the Karoo region, arguing for the development of a single Karoo brand to market the region to visitors. While it is important to develop tourism at the regional scale, the unique assets of individual places and streetscapes within towns are key to doing this. Tourist attractions in Beaufort West include the Karoo National Park and the Chris Barnard Museum, along with attractions like Karoo architecture, charm, cuisine, and culture.

Most tourists visiting the Central Karoo District (92.5%) are domestic tourists. The Western Cape accounts for the highest share of visitors to the district (with 41% of visitors originating in the province), followed by Gauteng with 23%. The majority (77%) of visitors coming to the district do so for the purposes of leisure, followed by business (12%) and visiting family and friends as shown in Figure 4-76. Culture and heritage are the dominant (68%) activity undertaken followed by crafts/food markets (22%) and Karoo lam (20%) as shown in Figure 4-77.

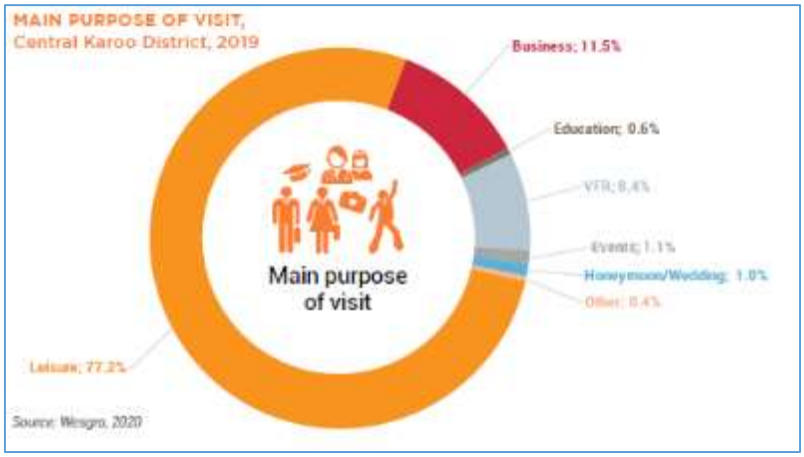


Figure 4-76. Main purpose of visit to the CKDM, 2019 (Western Cape Government, 2020).

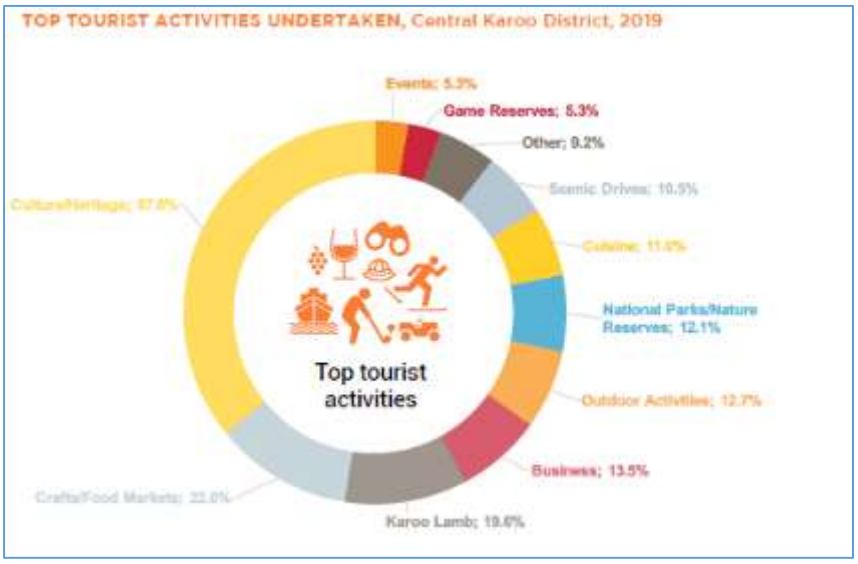


Figure 4-77. Top Tourist Activities Undertaken in the CKDM, 2019 (Western Cape Government, 2020).

Preserving and enhancing Beaufort West's heritage, streetscapes, Karoo charm, architecture, and natural resources is vital for economic growth and job creation. Key areas like Donkin Street, Merweville, Nelspoort, and Murraysburg can benefit from municipal investment and attract private sector involvement and tourism. Additionally, protecting the Karoo National Park and its buffer zones from harmful development is crucial to maintaining its ecological and tourism value, with the municipality encouraged to allocate funds for conservation efforts.

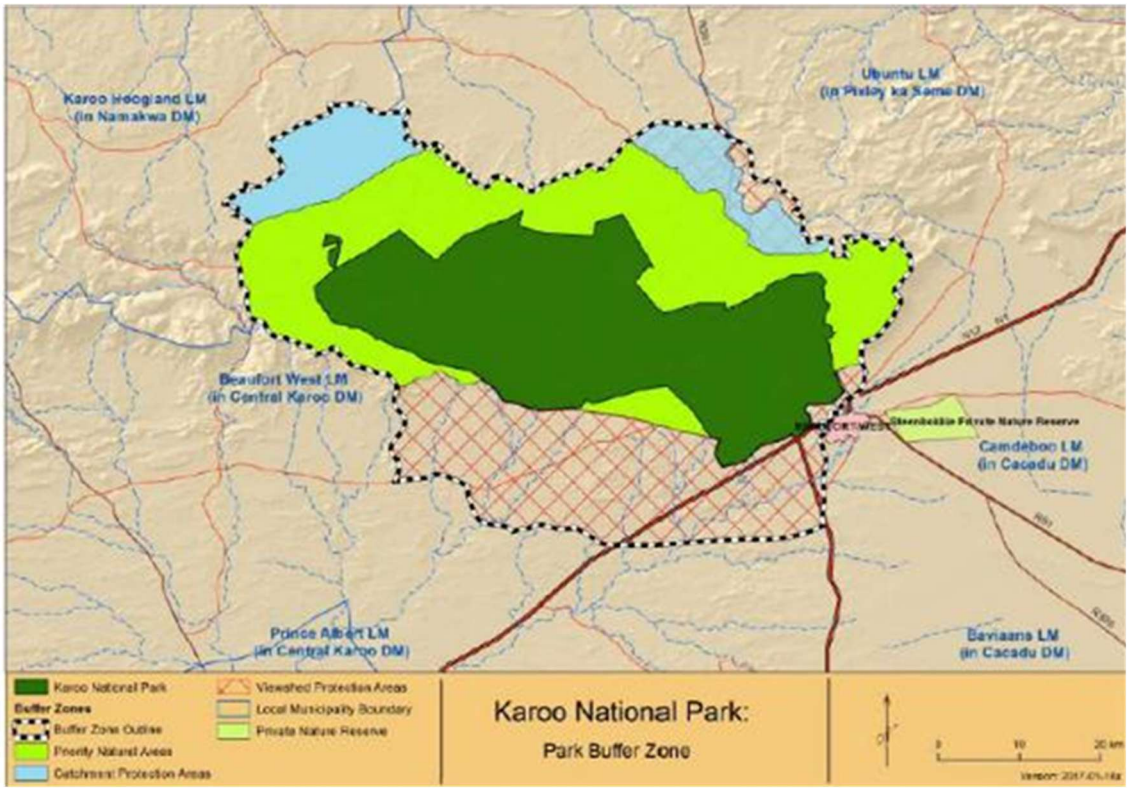


Figure 4-78. The Karoo National Park and Buffer Zones (SANParks, 2021).

Critical Biodiversity Areas and Ecological Support Areas identified in the Western Cape Biodiversity Spatial Plan (WCBSP) must be carefully managed and protected from inappropriate development. The WCBSP will guide the Spatial Planning Categories in the MSDF, especially for rural land use outside urban edges. Priority should be given to ecological infrastructure such as mountain catchments, rivers, wetlands, and rangelands. The Karoo National Park and its buffer zones must be protected by preventing or mitigating development-related disturbances.

4.1.13.16 Trade

While the Central Karoo District has a positive trade balance, Beaufort West Municipality (BWM) contributes very little despite having the largest local economy. The district's trade is mainly driven by Prince Albert's dairy and wine exports and a manufacturing sector linked to agriculture. BWM's declining agricultural activity and worsening droughts explain its minimal trade contribution. Future trade growth in BWM is expected mainly from mining and quarrying, particularly shale gas and uranium. There may be untapped manufacturing potential due to BWM's strategic location, but attracting private investment requires improved municipal governance, infrastructure, and urban management.

4.1.13.17 Agriculture

Beaufort West Municipality has limited agricultural resources due to water scarcity, worsened by a prolonged drought, making agriculture a minor part of the regional economy (11.7% of GDPR in 2018) and contracting by 8.7% in 2019. Agricultural activities mainly include livestock farming (mostly sheep) and some lucerne and feed-grain production, with cultivated land concentrated near Murraysburg. Despite low production, Beaufort West

is identified as an Agri Hub due to its strategic transport links, playing a key regional role beyond local production. Agricultural decline is also driven by land being repurposed for projects like the Square Kilometre Array and national parks. Key challenges include water scarcity, climate change, and rangeland degradation, while opportunities lie in agri-tourism, green energy investment, adoption of 4IR technologies (e.g., drones), and ecological infrastructure for resilience and job creation.

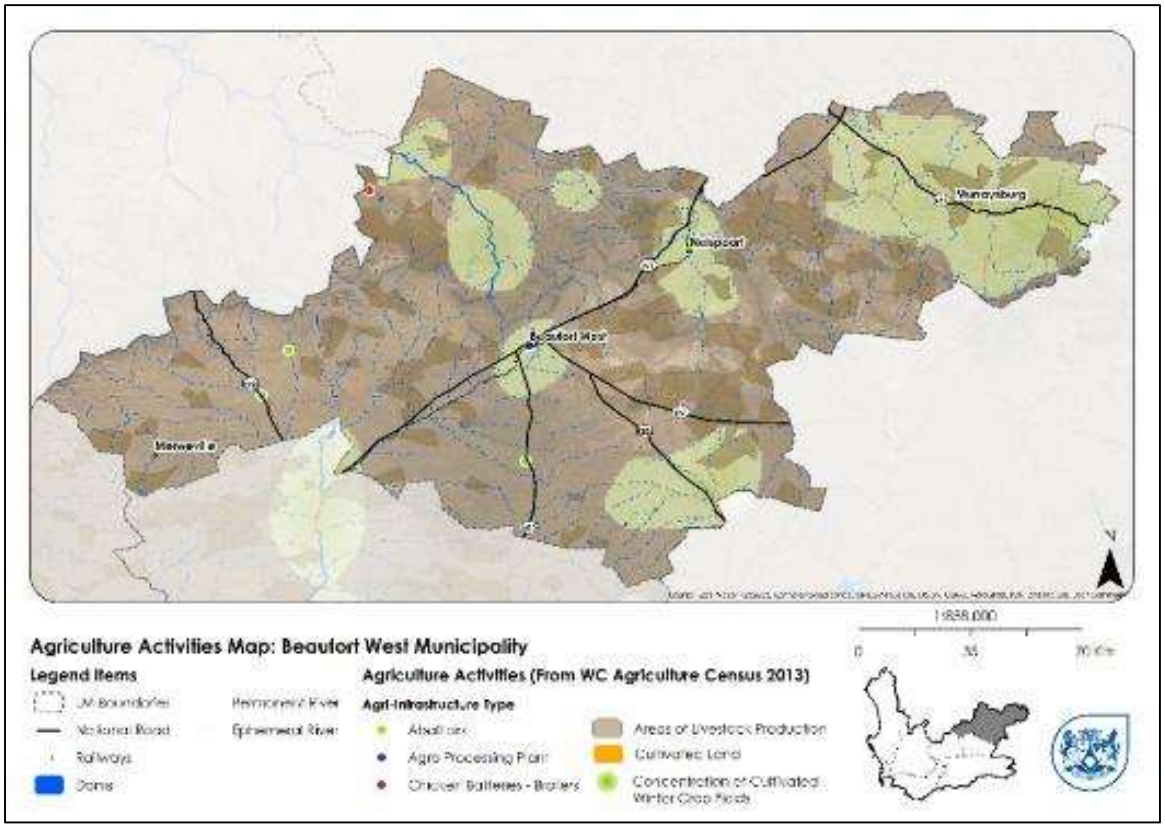


Figure 4-79. Agricultural Activities Map for BWM (KRSDF, 2020).

4.1.13.18 Minerals and mining

Beaufort West Municipality is on the cusp of significant change in its mineral resources sector due to extensive uranium deposits and potential shale gas exploration across the area. While shale gas development could boost South Africa's energy resilience and support the transition to renewables, it raises environmental concerns, particularly for groundwater and biodiversity. The Strategic Environmental Assessment outlines three development scenarios (Small, Medium, Big Gas), with production lasting 10–30 years and substantial spatial impacts, including increased demand for housing, infrastructure, and services. Managing these impacts will require strong planning and resource capacity. Development must protect critical biodiversity areas per the Western Cape Biodiversity Spatial Plan and ensure groundwater protection. Any new residential or commercial growth linked to shale gas must occur within existing towns and comply with municipal development guidelines.

4.1.14 Traffic and Transportation

The existing roadway characteristics of the major roads in the study are summarised in Table 4-54.

Table 4-54. Existing Roadway Facilities

Roadway	Classification	Posted Speed (km/h)	Road Surface
N1	National Road	120	Tar
N12	National Road	120	Tar
R61(TR35/1)	Provincial Trunk Road	120	Tar
R306 (MR411)	Provincial Main Road	80	Gravel
DR2302	Provincial Divisional Road	80	Gravel
DR2304	Provincial Divisional Road	80	Gravel
DR2358	Provincial Divisional Road	80	Gravel
DR2370	Provincial Divisional Road	80	Gravel

All the existing intersections are stop controlled intersections with stop-control on the minor roads. All the paved roads in the site vicinity are two lane roads one lane per direction.

4.1.14.1 Existing Cross Sections and Surface Conditions

The N1 has 3.7m lanes with 2m paved shoulders and the N12 has 3.3m lanes with 2m gravel shoulders. All Provincial trunk roads and main roads also has 3.3m lanes with gravel shoulders. The gravel roads are typically 8m wide with narrower sections in some areas. Refer the photos below for the typical cross-section of the major roads in the site vicinity.

Figure 4-80. Eastbound view along the R61 (TR35/1) towards the R306.

Figure 4-81. Northbound view along R306 (MR411) towards Beaufort West.

4.1.14.2 Existing Traffic Volumes

The Annual Average Daily Traffic (AADT) and peak hour traffic volumes along the major roads in the area are summarised in Table 4-55 below.

Table 4-55. Traffic Volumes

Road	AADT	Peak Hour Volume	% Heavy Vehicles
N1	4 200	260	60%
N12	800	60	28%
R61(TR35/1)	550	40	15%
R306 (MR411)	50	10	8%
DR2302	16	6	13%
DR2304	22	5	27%
DR2358	21	5	1%
DR2370	15	2	1%

Based on historical traffic count information along the roads in the site vicinity, the traffic volumes along the roads in the site vicinity have not changed much over the past 10 years. See the Graphs in Traffic and Transportation report for illustrations of the daily variation in traffic flow along some of the major roads.

4.1.14.3 Transport Routes and Site Access

4.1.14.4 Regional Transport Routes

Regional transport routes for transporting the large equipment to the site is possible via the N1 and the Provincial Road Network around Beaufort West. The railway can also be used for regional/long distance transport of equipment and the end product. The final routes will have to be checked for compliance during the final design stages of the project. Permits will need to be obtained from the relevant road authorities for all abnormal loads and the specific route will be specified based on the characteristics of each load type.

4.1.14.5 Local Access Roads

Access is proposed mostly via existing farm access roads. Access positions along Provincial roads are identified with a kilometre marks, where kilometre marks are not available the access position is identified with Google Earth coordinates.

- Ryst Kuil: Access is proposed via existing farm accesses off DR2358 (KM42.18), DR2370 (KM4.85 & KM6.7/OP8842), R306 (KM81.69/OP8833 & KM79) & DR2304 (KM59.77/OP8837). Figure 4-80 and Figure 4-81 shows the available shoulder sight distances along the R61 and the R306 from the OP8835 intersections. The haul route is proposed via OP8835 and then along a private access road up to the processing plant.

The required Shoulder Sight Distance (SSD) for articulated heavy vehicles along roads with a posted speed limit of 80km/h is 300 metres based on the Department of Transport's geometric design guidelines. The available SSD at all the accesses is sufficient.

4.1.14.6 Traffic Impact Analysis

The expected effects of traffic that would be generated by the proposed development during peak hours were analysed as follows:

- The background traffic volumes were determined for the study network in the vicinity of the site. These are the traffic volumes that would be on the road network in the absence of the proposed development (No-go Alternative);
- A growth factor was applied to account for regional growth
- Construction Phase Traffic
- Site-generated trips were estimated for the proposed development;
- The construction-phase traffic and the assigned site-generated traffic from the proposed development were added to the background traffic volumes to determine the total traffic conditions with the development completed.

4.1.14.7 Year 2030 Background Traffic Conditions (No-go alternative)

For the purposes of this study, year 2030 background traffic volumes were developed by applying a 3.0 percent annual traffic growth rate to the existing traffic volumes on the major links. This estimated growth rate was assumed to allow for the additional traffic volumes that will be generated by other in-process and future developments in the area.

Due to the low traffic volumes the current road network will continue to operate at acceptable levels-of-service during the background conditions. The surface conditions of some of the gravel roads in the site vicinity will continue to deteriorate without proper maintenance. The gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition and these roads can accommodate the expected growth in traffic volumes in the year 2030 Background conditions.

4.1.15 Noise

The project area falls within the Nama-Karoo Biome and is characterised by the Gamka Karoo regional vegetation type. The predominant land use type for this region is sheep and goat farming with large areas also dedicated specifically to game farming. The main reason for this is that the annual rainfall and soil conditions are not suitable for intensive agriculture. Although not without their ecological impacts, livestock and game farming in general does not cause severe transformation to the landscape in comparison to intensive agricultural practices.

The study area has a low population density with many historical homesteads no longer occupied and some falling into ruin. The topography is in many parts of the study area flat, punctuated by low ridges and small koppies. In the northern and north-western parts of the study area the topography changes with the plateau as the altitude increases.

4.1.15.1 District Acoustic Character

The noise character of the rural Karoo has been assessed and documented by various studies. Under South African standards, various types of districts are classified according to their acoustic character. This acoustic character is provided in SANS 10103:2008 as provided in Table 4-56 below. The SANS 10103:2008 document also provides the anticipated Categories of Community Group Responses when noise levels increase within such an environment. The rural nature of the proposed mining sites and central processing plant has a well understood and documented acoustic character.

Table 4-56. District Noise Rating levels

Type of monitoring	What	Frequency	Resp. Person	Results/comments
Environmental noise	Drilling	See note above	EM	No noise assessment has been conducted on the drilling rigs.

Type of District	Equivalent Continuous Rating Level for Noise ($L_{Req,T}$) dBA					
	Outdoors			Indoors with Windows open		
	Day-night	Daytime	Night-time	Day-night	Daytime	Night-time
Residential						
a) Rural district	45	45	35	35	35	25
b) Suburban district	50	50	40	40	40	30
c) Urban district	55	55	45	45	45	35
Non Residential Districts						
d) Urban districts (some workshops, business premises and main roads)	60	60	50	50	50	40
e) Central business districts	65	65	55	55	55	45
f) Industrial districts	70	70	60	60	60	50

4.1.15.2 Desktop Assessment

The baseline noise assessment by JH Consulting (2011) in the area between Middelburg, Cradock and Queenstown, revealed field test results congruent with those described by SANS 10103:2008. Baseline test results for this study for LAeq ranged from 34.6 – 47.6dBA where no traffic was present. The lowest Lmin during these assessments was 17.3dBA. These results are typical of a remote rural setting with acoustic character influenced mostly by wind, rustling of vegetation and bird song. The same study revealed the impact of traffic where the LAmin results ranged from 17.5 – 35.2 dBA and the LAeq ranged from 55.8 – 69.2dBA. These influences were characteristic of a tarred/paved rural main road with cars and light and heavy delivery vehicles travelling upwards of 80km/h. A M2 Environmental Connections Report (2012) for the Der Brochen Platinum Mine demonstrated similar sound pressure levels typical of a remote rural setting with LAeq from 317 – 59.9dBA.

4.1.15.3 Field Assessment

A Sensitive Receptors list has been completed and compiled as indicated in Figure 4-82 below. Eleven monitoring positions were selected based on the planned project infrastructure and mining layout as well as the existing Sensitive Receptors in the area. The applicable nomenclature provided in this plan has been utilised to identify the positions where each noise measurement was captured.

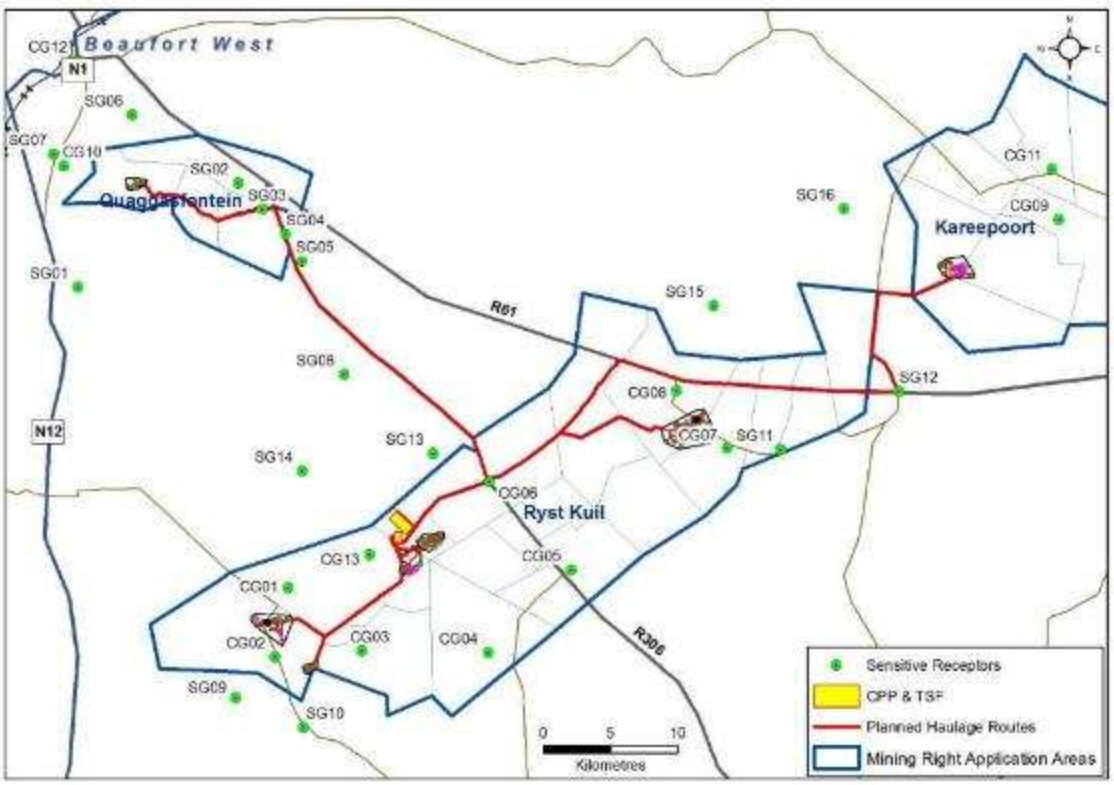


Figure 4-82. Map indicating the project area and identified potential sensitive noise receptors.

The following results table is provided based on the field assessment.

Table 4-57. Noise, field assessment results

Monitoring Site	Site Description	Date/ Time	Location Coordinates	Comments	LAeq (dBA)
SG12	Located on Nelspoort dirt road at intersection with R61 adjacent to Rooidam farmstall	11/01/2017 10:20	S 32˚34'39.8" E 23˚14'00.7"	Strong gusting wind. Numerous cars passing on tarred R61 road. One LDV approached on Nelspoort road and turned off at the farm stall before passing the monitoring position	64.8
SG16	Located on eastern verge of Nelspoort dirt road between future De Pannen operations and SG16	11/01/2017 10:40	S 32˚29'12.8" E 23˚13'10.1"	Strong gusting wind. Some bird song. No vehicles passed during monitoring period.	63.2
Night Fall	Located on dirt road proximal to Ryst Kuil south western side. Nocturnal measurement	10/01/2017 10:40	Not representative of CG or SG therefore no position recorded	Strong gusting wind with some sparse rainfall. No vehicles passed during monitoring.	54.8

These field monitoring results confirm the rural nature and noise character of the project area.

4.1.16 Radiological Baseline Assessment

NORM reaches humans through exposure pathways at various concentrations and these concentrations depend on the particular environmental setting. The important exposure pathways for establishing a radiological baseline are:

- external radiation from terrestrial sources (land surface areas);
- inhalation of radon (Rn-222) and its short half-life decay products;
- ingestion of drinking water;
- ingestion of foodstuffs which constitute a large part of the diet and for which bioaccumulation of nuclides occur; and
- inhalation of airborne dust that contain NORM radionuclides (LL-alpha radioactivity).

The baseline study consists of two phases. Phase 1 has been completed and included exploratory environmental monitoring, limited biological sampling and a general radiological description of the proposed mine areas. Phase 2 consists of detailed radiation surveys of the future mine footprints and the adjacent off-site environment. The information will serve as reference for rehabilitation and closure criteria. Phase 2 monitoring will also continue further afield, e.g. airborne dust, biological samples, e.g. farm produce to be collected at farmsteads nearest to the mining activities and monitoring of the radiological quality of groundwater and surface water.

Two types of areas are discussed in the sections that follow:

- the natural background radiation of areas not affected by historical uranium prospecting and trial mining in the period 1970/1980's, and
- areas impacted during historical uranium prospecting and trial mining.

4.1.16.1 Natural External Background Radiation in the Karoo

Variations in external radiation across environmental regions are due to differing concentrations of gamma-emitting radionuclides in the topsoil, with radiation mainly coming from the upper meter of soil. The global average annual external radiation dose is about 0.48 mSv, typically ranging from 0.3 to 0.6 mSv. A survey in areas unaffected by historic mining found generally low gamma radiation, except at uranium-rich surface outcrops where radiation levels can be extremely high—up to 750 times above background levels. These natural radiation anomalies are common in various locations across the Karoo.

Figure 4-83. Natural uranium-rich outcrops with relatively high radiation levels.

The regulatory dose limit for members of the public that applies to uranium mining is 1 mSv/yr and defines the maximum additional annual dose above the natural background dose resulting from human activities. The global average dose rates from natural sources are listed in Table 4-45.

Table 4-58. Dose to humans from natural sources

Source		Global average effective dose (µSv/yr)	Typical range (µSv/yr)
External exposure:	Cosmic rays	0.4	0.3 to 1[a]
	Terrestrial rays (mainly gamma radiation)	0.5	0.3 to 0.6[b]
Internal exposure:	Inhalation (mainly radon and its decay products)	1.2	0.2 to 10[c]
	Ingestion	0.3	0.2 to 0.8[d]
Total		2.4	Typically ranges from 1 to 10 mSv, depending on circumstances at particular locations, with sizeable populations also receiving 10 to 20 mSv

([a]) Range from sea level to high ground elevation;
([b]) Depending on radionuclide composition of soil and building materials;
([c]) Depending on radionuclide composition of soils;
([d]) Depending on radionuclide composition of foods and drinking water.

The radiation results of surveys carried out over a wide region. The initial surveys were done with two types of portable monitoring equipment, namely, an Electra GM Plus 1A surface contamination monitor, and a Canberra Inspector 1000 digital handheld multichannel analyser equipped with a sensitive 3-inch gamma probe. At each measurement location, the general area was first screened to confirm the absence of large variations in radiation fields. Gamma dose rate measurements on contact with the soil and at 1-metre height were then performed and recorded.

A further survey of external radiation was also done using thermoluminescent dosimeter (TLD) monitors at fixed locations. The locations represent the future LRP mining areas and nearby farmsteads. The TLDs for environmental monitoring were supplied and analysed by the SABS. The range of dose rates for the 28 locations in the different areas (excluding historical trial mining areas) are summarised in Table 4-59. TLD external dose rates.

Table 4-59. TLD external dose rates

Range	Value
Average	1.50 mSv/yr
Minimum	1.10 mSv/yr
Maximum	2.03 mSv/yr

4.1.16.1.1 RADON CONCENTRATIONS

4.1.16.1.1.1 Radon Background Information

Radon (specifically Rn-222) is a naturally occurring radioactive gas produced by uranium and thorium decay in soil and rocks. It can migrate into the atmosphere, with outdoor concentrations influenced by geology, uranium content, and weather conditions. Radon levels vary daily and seasonally, averaging around 10 Bq/m³ globally but ranging widely from 1 to over 100 Bq/m³ depending on location. Most people's annual radon exposure falls between 1 and 3 mSv, though some experience much higher or lower doses. The main health risk comes from inhaling radon's short-lived decay products, which can deposit in lung tissue and increase lung cancer risk. Recent International Commission on Radiological Protection (ICRP) findings suggest lung cancer risk estimates from radon exposure may double, but current safety standards and dose conversion factors remain in use until updated.

4.1.16.1.1.2 Radon concentrations in the mining right application areas

Radon concentrations were measured using passive polycarbonate track-etch devices supplied by PARC RGM (Radon Gas Monitoring) (Pty) Ltd. Two surveys were done and during each survey the monitors were deployed for approximately 3 months at outdoor locations in the region. The first survey involved monitoring locations representative of the larger region, including Beaufort West. The second survey involved monitoring locations at the proposed future mine areas where ore stockpiles and processing plants will be located.

The two sets of results are included in Appendix 2 of the Radiation impact assessment report and indicate very low environmental radon concentrations. A summary of the results is provided Table 4-60.

Table 4-60. Ambient radon concentration in the LRP region

Rn-222 monitoring at fixed locations to obtain a 3-months integrated concentration		Rn-222 Bq/m³	Derived dose, mSv/yr
Survey 1 2009	Minimum	2.1	0.066
	Maximum	38.5	1.233
	Average	9.4	0.301
Survey 2 2015	Minimum	8.6	0.275
	Maximum	14.9	0.477
	Average	11.1	0.353

Outdoor radon concentrations are generally low, but indoor levels can be much higher due to limited ventilation and radon emanating from building materials and underlying soils. Additional radon monitoring is planned for key buildings. At the sealed Cameron decline underground mine, radon levels were significantly elevated (134 Bq/m³) compared to surface levels (~10 Bq/m³), reflecting poor ventilation underground. Surface radon concentrations at the site and nearby areas were below the regional average, highlighting how local atmospheric conditions and material types affect radon levels. The low background radon data from proposed mining areas will help detect future radon emissions from mining activities more sensitively.

4.1.16.1.2 DUST

Baseline monitoring of airborne dust will be introduced as part of Phase 2 of the on-going baseline monitoring. The dispersion patterns (isopleths) of airborne dust calculated for the purposes of this radiological assessment report will guide the identification of sensitive areas where dust monitoring units will be installed. The dust collected by the monitoring units will be analysed for their radioactive LL-alpha content. Assessment of dust concentrations and fallout dust against environmental non-radioactive criteria will also be carried on the samples collected at these monitoring locations.

4.1.16.1.3 WATER RADIOACTIVITY

Natural water sources can contain Naturally Occurring Radioactive Materials (NORM), with some areas, like those over granite formations in South Africa's Namakwa Land, showing elevated Ra-226 levels. Water samples from boreholes near the proposed LRP mining area reveal elevated uranium (U-238, U-234) and thorium (Th-230) levels, reflecting common uranium mineralization in the Great Karoo, primarily in shallow channel sandstones. Local farms rely on groundwater and surface water for livestock, irrigation, and domestic use. The report builds on earlier comprehensive groundwater studies, including one by SRK Consulting (2007/2008), which involved extensive hydrological and geophysical assessments and modeling. Water radiological quality is classified based on potential radiation doses from drinking the water, assuming it as the sole water source. The dose calculation is as follows:

Dose (mSv/yr) = Radioactivity in water (Bq/L) × Annual Consumption of water (L)
× Radioactivity Dose Conversion Factor (mSv/Bq)

Table 4-61. A classification scheme for the radiological quality of water

Class/ Colour	Dose range; mSv/yr	Health Effects and Typical Exposure Scenarios	Comments and Intervention Decisions
Class 0 (Blue – Ideal water quality)	≤ 0.10	There are no observable health effects. This is the range of exposure from ideal quality water sources. Most treated water falls in this water quality range. Additional doses that result from human activities that fall within this range are difficult or impossible to determine and/or to distinguish from variations in background doses with sufficient confidence.	Drinking water supplied by municipal water treatment plants at tap should be in this category.
Class 1 (Green – Acceptable water quality)	> 0.10 to 1	This is the exposure range from some natural and untreated water sources (e.g. groundwater/ wells). A dose between 0.2 and 0.8mSv/yr is the typical world-wide range of ingestion radiation dose resulting from water as well as food. A dose equal to 1mSv/yr additional to background corresponds to the regulatory public dose limit for human activities involving radioactive material.	ALARA and intervention considerations apply if mining practices contributes to public dose via water exposure and the regulatory dose constraint is exceed.
Class 2 (Yellow – Marginal water quality)	> 1 to 10	A small increase in fatal cancer risk is associated with this dose range. Only a small number of natural water sources of this quality exist, usually resulting from exceptional geological conditions. Abnormal/accident conditions at regulated nuclear and radiation facilities may result in a dose in this range when a person drinks untreated water. Intervention will most likely be required to improve the quality of water that is released into the public domain.	Regulatory intervention and mine mitigation is required if mining is the cause of this water class.

Class 3 (Red – Poor water quality)	> 10 to 100	Health effects are statistically detectable in very large population groups. This range represents excessive exposure. It is highly unlikely to find water of this poor quality in the natural environment.	Intervention is required and the time scales to be decided by the regulatory authorities on a case-by-case basis.
Class 4 (Purple – Unacceptable water quality)	> 100	Health effects may be clinically detectable and the dose represents a significant increase in the fatal cancer risk. A dose greater than 100mSv can only occur during a major accident at a nuclear facility. These facilities have to demonstrate that such an accident has an extremely small likelihood.	Immediate intervention is required

A graded radioanalysis approach to characterising the radiological quality water of from natural sources such as farm boreholes and dams is used to establish baseline conditions prior to mining activities:

- A Basic Screening method (BS) is used for an initial radiological classification of water and to identify sources which could result in elevated doses and require further radioanalysis.
- An Advanced Screening method (AS) provides adequate information to radiologically classify the water quality.
- A Detailed Radioanalysis (DRA), measuring most of the individual radionuclides in the U-238 and Th-232 decay chains, allows a detailed dose assessment to be performed.

Table 4-62 describes the three methods. For routine monitoring purposes, one commences with the BS method and depending on the results as described in the column "Decision Guide, one would progress to more detailed analysis methods, i.e. AS and DRA methods.

Table 4-62. A graded approach to determining the radioactivity in water

Analysis Method	Description	Decision guide
Basic Screening Method (BS)	Gross alpha and gross beta radioactivity concentration are measured. The chemical concentration of U (uranium) and K (potassium) are also determined. This criterion is based on the fact that when one considers the dose conversion factors of all the relevant radionuclides and calculates the committed effective doses for the intake for these alpha and beta emitters (≤ 1Bq/L and ≤ 10Bq/L) an annual dose less than 1mSv is obtained.	1. If Gross Alpha radioactivity concentration ≤ 0.1Bq/L and Gross Beta radioactivity concentration ≤ 1Bq/L then Water Classification is **Blue** (annual dose ≤ 0.1mSv/yr) 2. If Gross Alpha radioactivity concentration ≤ 1Bq/L Gross Beta radioactivity concentration ≤ 10Bq/L then Water Classification is **Green** (annual dose ≤ 1mSv/yr) 3. If Gross Alpha radioactivity concentration > 1Bq/L Gross Beta radioactivity concentration > 10Bq/L then Water Classification is potentially **Yellow** and further nuclide specific radioanalysis is necessary.
Advanced Screening Method (AS)	This involves radionuclide activity measurement of two specific radionuclides, i.e. U-238 and Ra-226. Gross alpha activity and uranium chemical concentration are also measured and are used to check the validity of conclusions made based only on U-238 and Ra-226.	Assume U-234 in equilibrium with U-238 and Pb-210 and Po-210 in equilibrium with Ra-226 Calculate U-235 = U238 ÷ 21.7

Analysis Method	Description	Decision guide
	Low-probability radionuclide behaviour, for example a high relative abundance of thorium radioisotopes, should be indicated by a low uranium chemical concentration (µg/L) and a high gross alpha-activity concentration. This would then indicate a requirement to analyse for more radionuclides in the U-235, U-238 and Th-232 decay series. This screening method is conservative at very low radioactivity concentrations (dose in the range 0.01mSv/yr to 0.10mSv/yr) when compared to a calculation using more or all measurable nuclides in the U-238, U-235 and Th-232 decay series. The assumption in the screening method of Pb-210 and Po-210 being in equilibrium with Ra-226 is used purely to introduce conservatism in the calculation and to flag a situation when the radioactivity concentration in the water may be high.	Note: U-235 is included since it has a constant natural abundance in relation to U-238. Result of dose calculation determines the water classification according to colour scheme.
Detailed Radioanalysis (DRA)	A wide spectrum radionuclide radioanalysis of the U-238 and Th-232 decay chains is performed, together with the chemical concentrations of U and K	Resultant dose calculation determines the water classification with a high degree of confidence

The World Health Organization's guideline for drinking water radioactivity corresponds to a "Blue" classification, which natural borehole water often cannot meet without treatment. This level is typically achievable in towns and cities supplied by water treatment plants that reduce NORM. In a 2016 hydrocensus survey, seventeen water samples from Kareepoort and Ryst Kuil were tested for alpha and beta radioactivity. Initial results suggest six samples may fall into a "Yellow" classification, indicating the need for further analysis to accurately assess their radiological quality.

Table 4-63. Summary of the radioactivity results of water sampled in the application areas

#	Borehole identification	Alpha activity (Bq/L)	Beta activity (Bq/L)
1	DP6	2.36	0.96
2	LKL1	1.25	0.44
3	ERW5	1.59	0.47
4	RSK13	1.06	0.27
5	KPS9	0.397	0.0071
6	RSP6	2.46	0.35
7	KPT16	0.628	0.29
8	HKL13	0.778	0.402
9	LTS11	0.695	-0.0037
10	KGT9	1.42	0.24
11	KGT3	1.02	0.21
12	BDK1	0.997	0.16
13	1KS2	0.963	0.25
14	NFN3	0.11	-0.054
15	RD10	0.431	0.18
16	VV1	0.387	0.194
17	GP1	0.244	0.12

Water classification using the WaterRad software accounts for radiation dose differences across age groups by calculating an age-weighted dose, reflecting varying sensitivity to radioactivity and water intake throughout life. A notable feature of groundwater is the uranium isotope ratio (U-234:U-238), which typically exceeds 1 due to recoil damage during radioactive decay, making U-234 more easily leached from rocks than U-238. Radiological quality assessments of two groundwater samples—one from the Ryst Kuil historical trial mine aquifer and another from a domestic borehole unaffected by mining—illustrate differences between water impacted by mining and natural baseline conditions. The results for the two water samples are as follows:

WaterRad results for RKNA 64 groundwater sample	
Test Number:	RKNA64
Sample Date:	May 2008
User Name:	J Slabbert
Source:	Ryst Kuil Ore Body
Source Category:	B
Reasons for choosing category B:	Water sample from groundwater in contact with the Cameron Shaft ore body
Dose for different age groups:	
Dose for 0 - 1 years:	0.941 339 1 mSv/yr
Dose for 1 - 2 years:	0.208 301 5 mSv/yr
Dose for 2 - 7 years:	0.159 628 3 mSv/yr
Dose for 7 - 12 years:	0.146 701 0 mSv/yr
Dose for 12 - 17 years:	0.238 215 0 mSv/yr
Dose for 17 - 70 years:	0.201 175 4 mSv/yr
Lifetime Average Annual Dose:	0.207 638 0 mSv/yr
Water Class:	1 (**Green** – Acceptable radiological water quality when considering the lifetime average dose)

WaterRad results for JOS 5 groundwater sample	
Test Number:	JOS5 (Necsa Job Reference RA-09172)
Sample Date:	October 2008
User Name:	J Slabbert
Source:	Ryst Kuil Environment Baseline
Source Category:	A (natural groundwater unaffected by human actions)
Reasons for choosing category A:	Groundwater samples representative of water used for domestic purposes in the farming communities in the Ryst Kuil area (boreholes not in immediate proximity of ore body)
Dose for different age groups:	
Dose for 0 - 1 years:	0.562 mSv/yr
Dose for 1 - 2 years:	0.099 mSv/yr
Dose for 2 - 7 years:	0.081 mSv/yr
Dose for 7 - 12 years:	0.075 mSv/yr
Dose for 12 - 17 years:	0.123 mSv/yr
Dose for 17 - 70 years:	0.116 mSv/yr
Lifetime Average Annual Dose:	0.117 mSv/yr
Dose range (mSv/yr):	0.10 to 1
Water Class:	1 (**Green** – Acceptable radiological water quality) based on dose for most sensitive age group, 0 to 1 year

The radiological quality of the two groundwater samples are of similar radiological quality.

The radioanalyses of another borehole gave significantly higher results when compared to all the other borehole water results. The water sample taken from borehole KDK017 in the Ryst Kuil area during November 2009 showed an unexplained spike in respect of U-238 and U-234 and remained high for at least 4 years, although gradually decreasing in uranium concentrations. The concentrations were still high compared to the sample results prior to November 2009. Water from this borehole will require treatment should it be used for human consumption. The results of the radiological quality assessment with WaterRad for KDK 017 are as follows:

WaterRad results for KDK017 groundwater sample	
Test Number:	KDK017 (Necsa Job Reference RA-14671-01
Sample Date:	December 2013
User Name:	J Slabbert
Source:	Ryst Kuil Environment Baseline
Source Category:	A (natural groundwater unaffected by human activity)
Reasons for choosing category A:	Groundwater samples representative of water that could be used for domestic purposes if the high concentrations are not known
Dose for different age groups:	
Dose for 0 - 1 years:	1.901 mSv/yr
Dose for 1 - 2 years:	0.458 mSv/yr
Dose for 2 - 7 years:	0.353 mSv/yr
Dose for 7 - 12 years:	0.328 mSv/yr
Dose for 12 - 17 years:	0.537 mSv/yr
Dose for 17 - 70 years:	0.433 mSv/yr
Lifetime Average Annual Dose:	0.448 mSv/yr
Dose range (mSv/yr):	1.0 to 10
Water Class:	1 (**Yellow** – Marginal water quality and some measure of intervention is required) based on dose for the most sensitive age group, 0 to 1 year

In addition to its radiological risks, uranium poses chemical toxicity hazards, with kidney inflammation being the primary concern from short-term exposure. The WHO guideline for uranium in drinking water is 30 µg/L to prevent sub-clinical kidney effects. Borehole KDK017 has a uranium concentration close to 100 µg/L—well above this limit—though it is unlikely to be impacted by historical mining due to its distance from the trial site. The borehole, currently not used for human or agricultural purposes, will be further investigated as part of ongoing monitoring.

4.1.16.1.4 SHEEP FARMING PRODUCE

Sheep farming, including meat and wool production, is a key agricultural activity in the region, along with game farming and mohair production. As part of baseline environmental studies before potential mining, samples of mutton, sheep liver, wool, and one springbok sample were collected and analysed for naturally occurring radioactive material (NORM). The measured radioactivity reflects the natural presence of NORM in the environment. The study aimed to estimate human radiation dose from ingesting local sheep products, assess the relative levels of different radionuclides in various biological samples (including wool and mohair), and compare findings with similar studies in the literature.

Samples were collected from the locations listed in Table 4-64.

Table 4-64. Biological samples collected for radioanalysis

Biological sample type	No. of samples	Farming area
Mutton	6	2 x Quaggasfontein 1 x Haanekuil 2 x De Pannen 1 x A butchery in Beaufort West (1)
Sheep liver	3	2 x Quaggasfontein 1 x Haanekuil
Wool	3	1 x Haanekuil 1 x Kat Doorn Kuil 1 x De Pannen
Mohair	1	1 x Quaggasfontein
Springbok venison	1	1 x De Pannen

(1) The sample collected from a local butcher represents a random sample from the general region being sold to the public.

4.1.16.1.4.1 Radioactivity concentrations

The radioactivity concentrations measured in the biological samples are listed above, while the radionuclide concentrations relative to one another are illustrated in Table 4-65.

Table 4-65. Radioactivity concentration is samples (Bq/kg - fresh weight)

Nuclide	Mutton (Bq/kg)			Liver (Bq/kg)			Wool (Bq/kg)			Springbok venison (Bq/kg)
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	
U-238	2.15E-02	7.30E-03	4.66E-02	8.16E-02	2.65E-02	1.90E-01	3.82E+00	2.00E+00	5.30E+00	1.20E-02
U-234	2.17E-02	7.40E-03	4.70E-02	8.25E-02	2.67E-02	1.92E-01	3.85E+00	2.02E+00	5.35E+00	1.20E-02
Ra-226	5.35E-01	1.28E-01	1.61E+00	5.13E-01	9.53E-02	9.95E-01	3.11E+00	1.81E+00	3.73E+00	2.09E-01
Pb-210	9.60E-01	9.60E-01	2.60E+00	5.10E-01	5.10E-01	5.10E-01	2.72E+01	1.47E+01	3.97E+01	< MDA
Po-210	1.25E+00	4.00E-01	1.98E+00	1.46E+00	7.27E-01	1.84E+00	2.72E+01	1.47E+01	3.97E+01	2.10E+00
U-235	9.93E-04	3.40E-04	2.14E-03	3.76E-03	1.22E-03	8.76E-03	1.76E-01	9.20E-02	2.44E-01	5.40E-04
Th-232	-	-	2.00E-01	-	-	7.80E-02	3.65E+00	1.99E+00	5.16E+00	< MDA
Ra-228	1.31E+00	1.31E+00	1.31E+00	-	-	1.30E+00	4.28E+00	2.32E+00	5.17E+00	2.20E-01
Th-228	2.38E-01	6.00E-02	4.16E-01	5.76E-02	5.76E-02	5.76E-02	4.02E+00	2.19E+00	4.91E+00	< MDA
K-40	7.02E+01	5.54E+01	8.79E+01	6.60E+01	5.39E+01	8.70E+01	7.11E+02	3.39E+02	1.42E+03	9.35E+01

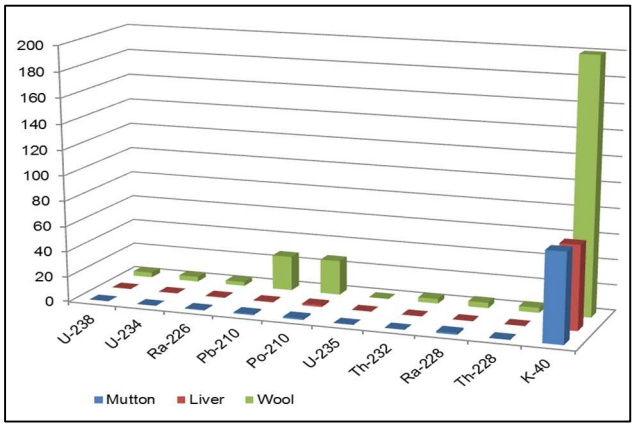


Figure 4-84. Radionuclide specific activities in sheep samples (average values on a linear scale).

Radioactive potassium (K-40) levels in Karoo sheep are consistent with literature and typically higher than other radionuclides. Po-210 was not analyzed in wool and mohair since they are not ingested; its levels are assumed to match Pb-210. Karoo sheep radioactivity levels, including U-238, Ra-226, and K-40, are comparable to those found in European studies of uncontaminated areas. In contrast, sheep from the Boco mining area in Portugal—an unrehabilitated, historically mined site—showed much higher Ra-226 levels, particularly in internal organs. These findings highlight the importance of rehabilitating mine sites to baseline environmental conditions or enforcing land-use restrictions after closure to protect human and environmental health.

4.1.16.1.5 Human dose from eating sheep mutton and liver containing radioactivity concentrations representative of baseline conditions in the region

Human dose estimates for the consumption of mutton and sheep liver listed in Table 4-53 are based on ICRP publication 72 dose coefficients and the National Nuclear Regulator guideline values.

Table 4-66. Estimated age specific human consumption rates

Category	Kg per year fresh weight		
	Infant	Child	Adults
% of Adult	40	60	100
Mutton (kg/a)	10	15	25
Sheep liver	4	6	10

Table 4-67 lists radionuclide specific ingestion dose and total ingestion dose based on the average concentrations calculated for all sheep samples.

Dose calculations included only radioactivity concentrations above the minimum detectable activity (MDA), which represents the threshold at which radioactivity can be confidently distinguished from background levels (typically at 95% confidence). The calculated radiation dose from ingestion falls within the global natural background range (0.2–0.8 mSv/year), though the dose to infants—the most sensitive group—is slightly above the global average of 0.3 mSv/year. Po-210, a highly radiotoxic alpha emitter and decay product of radon, contributes the most to human dose. Although K-40 appears in the highest concentrations, it is far less radiotoxic. K-40 is naturally occurring, and its levels are highest in wool compared to muscle or liver tissue.

Table 4-67. Radionuclide specific and total annual effective dose per (mSv/y)

Nuclide	Infant		Child		Adult	
	Dose (max radioactivity concentration)	Dose (average radioactivity concentration)	Dose (max radioactivity concentration)	Dose (average radioactivity concentration)	Dose (max radioactivity concentration)	Dose (average radioactivity concentration)
K-40	5.15E-02	4.05E-02	2.39E-02	1.88E-02	1.90E-02	1.50E-02
U-238	1.47E-04	6.50E-05	1.25E-04	5.53E-05	1.38E-04	6.09E-05
U-234	1.59E-04	7.04E-05	1.36E-04	6.01E-05	1.50E-04	6.64E-05
Th-230	5.03E-04	0.00E+00	4.41E-04	0.00E+00	6.44E-04	0.00E+00
Ra-226	1.93E-02	7.11E-03	2.02E-02	8.88E-03	1.18E-02	5.18E-03
Pb-210	4.19E-02	4.19E-02	2.95E-02	3.32E-02	1.79E-02	2.01E-02
Po-210	2.39E-01	1.61E-01	6.58E-02	7.15E-02	5.06E-02	5.50E-02
U-235	7.34E-06	3.25E-06	6.01E-06	2.66E-06	6.63E-06	2.94E-06
Pa-231	7.34E-05	0.00E+00	7.79E-05	0.00E+00	1.00E-04	0.00E+00
Ac-227	1.75E-04	0.00E+00	1.27E-04	0.00E+00	1.55E-04	0.00E+00
Th-227	3.95E-06	0.00E+00	1.95E-06	0.00E+00	1.24E-06	0.00E+00
Ra-223	6.21E-05	0.00E+00	3.81E-05	0.00E+00	1.41E-05	0.00E+00
Th-232	1.04E-03	0.00E+00	1.01E-03	0.00E+00	1.33E-03	0.00E+00
Ra-228	1.04E-01	7.47E-02	1.07E-01	7.66E-02	3.16E-01	2.26E-01
Th-228	1.62E-03	9.66E-04	9.88E-04	5.87E-04	7.90E-04	4.70E-04
Ra-224	2.90E-03	0.00E+00	1.71E-03	0.00E+00	7.13E-04	0.00E+00
Total dose (mSv/y)	***0.463***	***0.327***	***0.251***	***0.210***	***0.419***	***0.322***

4.1.16.2 NATURAL EXISTING RADIATION LEVELS

Baseline monitoring indicates that natural background radiation in the region is generally low, with higher external radiation only near surface uranium outcrops. Radon concentrations are low, and any future increases from mining should be detectable early. Groundwater radioactivity is primarily from U-238, U-234, and occasionally Th-230, with most samples showing acceptable quality except for borehole KDK017. Airborne dust levels, particularly fine particles (<10 µm), are assumed to be very low due to the Karoo's vegetation and rocky terrain, resulting in negligible background inhalation dose. Dust monitoring will continue in Phase 2.

4.1.16.3 RADIOACTIVELY CONTAMINATED AREAS THAT RESULTED FROM HISTORICAL URANIUM PROSPECTING AND TRIAL MINING

Uranium exploration in the Karoo peaked in 1978 with ESSO Minerals' trial mining at the Ryst Kuil ore body near Beaufort West. About 4,500 tonnes of ore were extracted, but no on-site processing occurred. The site was later abandoned without proper remediation or secure storage of uranium stockpiles, some of which were used as gravel on farm roads. These radioactive materials have since been removed and stored safely. Current regulations by the National Nuclear Regulator (NNR) now require Certificates of Registration (COR) for exploration and mining involving elevated NORM levels, ensuring proper site management. Under these CORs, Tasman and other rights holders are actively rehabilitating historic radioactive sites and improving safety at locations like Ryst Kuil.

4.1.17 *Description of the current land uses and environmental features*.

The current land use Figure 4-23 and Table 4-11 in the application area is in its entirety agricultural. The farm land is used for small livestock farming which includes sheep and goats. In addition to these stock animals, free roaming springbuck and other game also frequent the application area. Soils are subject very shallow effective depth within semi-arid climatic conditions and are therefore mainly utilized for sheep farming.

4.1.17.1 Description of specific environmental features and infrastructure on the site.

Infrastructure

Infrastructure with the application area is limited to agricultural activities with the exeption of historical trail mining infrastructure at the farm Ryst Kuil.

Agricultural Activities

- Fence lines
- Access roads
- Stock watering points and windmills (cribs and dams)
- Kraals

Historic trial mining infrastructure:

- Decline adit (Cameron shaft) - backfilled
- Crusher
- Stockpiles
- Waste rock
- Ventilation shaft
- Fence line.

5 Impacts and risks identified including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts can be reversed

5.1 Impact on Geochemistry

The more important impact from a geochemical perspective include:

- The various static chemical tests indicates that the waste rock samples are non-acid forming (NAF). The NAF findings were compared to the ABA assessment and mineralogy of the waste rock samples. This combination was adopted to identify trends in the findings of the different analytical methods used to assess the acid generating potential of the waste rock. These results all were in good agreement with each other, namely that the rock is unlikely to form an acid leachate. The lack of AMD formation is confirmed with the monitoring results of both surface and groundwater.
- The waste rock has been characterized and classified as Type 3;
- Type 3 waste requires, per legislation, a Class C liner to manage and prevent any drainage or seepage that may occur.
- Effectively monitoring quantity and quality of groundwater is essential when assessing aquifer vulnerability, degradation tendency and identifying groundwater protection zones. Groundwater contamination and the identification of vulnerable points/areas and the mapping thereof has played a key role in preserving aquifers as it identifies and distinguishes the role of natural aquifer properties and anthropogenic activities on groundwater quality. The fundamental approach towards groundwater protection is to keep it safe from contamination.

5.2 Impact on Geology

Impact: Potential subsidence of the hanging wall (roof) of underground mining operations. Geotechnical studies were conducted which included rock mass rating parameters and laboratory strength test. The results were used by rock engineers to derive the input parameters for the mine design. This is evidenced by the underground trial mine which has not collapsed over a 40-year period at a depth of ~50m.

5.3 Impact on Air quality

5.3.1 Emissions

The primary source of emissions from the mining activity will be particulates. The CPP may also emit sulphur trioxide from the acid leeching process.

Auxiliary equipment, such as boilers, may also cause emissions of particulate matter, oxides of nitrogen and/or sulphur dioxide. This was however not quantified due to insufficient information.
Throughout this section, reference is made to the following documents:

- Australia' *National Pollutant Inventory Emission Estimation Technique Manuel for Mining, Version 3.1,* hereafter referred to as *NPI mining EET manual.*
- *United States Environmental Protection Agency Compilation of Pollutant Emissions Factors from Stationary Sources (AP-42)*, hereafter referred to as *USPEA AP-42.*

5.3.1.1 Summary of emissions

A summary of the particulate emissions, as modelled, are shown in Table 5-1 below. The location of the sources, as modelled, are shown in the Figure 5-1 below.

Table 5-1. Summary of particulate emissions

Source Description	Type	Emissions (tonne per annum)		
		TPM	PM_{10}	$PM_{2.5}$
Underground mining vent 1	Point source	26.0	26.0	13.0
Underground mining vent 2	Point source	26.0	26.0	13.0
CPP crushing and pulverising	Point source	18.5	6.8	6.8
Drying and packaging	Point source	5.9	5.9	5.9
Pit - Extension	Area source	26.7	15.1	1.7
Pit – Main & Abante	Area source	69.6	39.4	4.5
Pit – Haanekuil	Area source	24.0	13.6	1.3
Waste stockpile – Extension	Area source	97.2	48.4	22.8
Waste stockpile – Main and Abante	Area source	253	125.9	59.2
Waste stockpile – Haanekuil	Area source	87.1	43.3	20.4
Ore stockpile – CPP	Area source	15.9	7.8	2.8
Tailings	Area source	93.1	46.5	23.3
Haul roads – ore stockpiles to CPP	Line source	13 108	2 786	407
Haul roads - pits to waste stockpiles	Line source	1 790	381	55.6

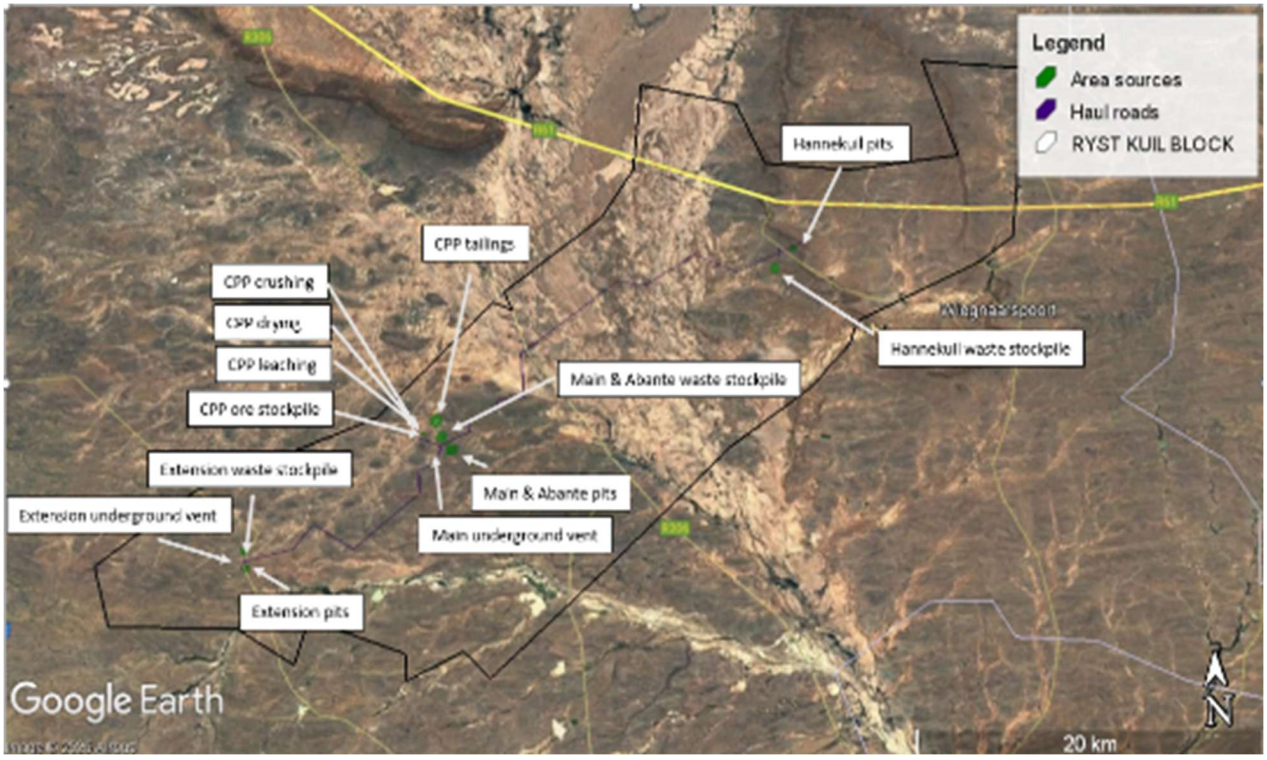


Figure 5-1. Layout of emission sources as modelled.

5.3.1.2 Point sources

5.3.1.2.1 Underground mining vents

Two vents will be used to provide circulation for underground mining. The 2017 Screening Report states that each vent will displace 82.5 m^3/s of air. The information provided assumed an exit velocity of 11.7 m/s and a stack height of 1.5 m.

Based on this information, the mass emissions were determined as follows:

- The conservative approach was taken, assuming that all PM are smaller or equal to PM_{10} in size.
- The assumption was made that the PM concentration is equal to the OHSA limit for total inhalable dust of 10 mg/m^3.
- $PM_{2.5}$ was assumed equal to the OHSA respirable dust limit of 5 mg/m^3.
- It was assumed that the vents are operational 24 hours per day, all days of the year.

5.3.1.2.2 CPP crushing and screening

The crushing and screening operation consists of 2 stages:

- Primary crushing.
- Screening.

Between these stages, the ore is transported by conveyor systems and pass through transfer points along the way. Emissions were calculated based on a throughput of 1.2 million tonnes per annum. It was assumed that there are 4 transfer points for this operation.

As no stack details were provided, the following was assumed at each transfer point:

- Emissions are emitted through a single stack
- Stack height is 20 m.
- Exit velocity is 10 m/s
- The total particulates concentration in the stack is 50 mg/m^3.
- The stack is at ambient temperature.

Additional assumption made:

- For transfer points only PM_{10} emission factors are available. Therefore, it was assumed that the emission of TPM and $PM_{2.5}$ are equal to the emission of PM_{10}.
- For crushing and screening no $PM_{2.5}$ data is available. Therefore, it was assumed that the concentration of $PM_{2.5}$ is equal to that of PM_{10}.

5.3.1.2.3 Drying and packaging

The emissions reported for packaging are negligible and not included in the study. The emissions for drying were used as provided in the *2017* uMoya-Nilu due to lack of further details.

The following stack details are assumed:

- Stack height is 10 m.
- Exit velocity is 10 m/s.
- The total particulates concentration in the stack is 50 mg/m^3.

Additional assumption made:

- For drying, only PM_{10} emission factors are available. Therefore, it was assumed that the emission of TPM and $PM_{2.5}$ are equal to the emission of PM_{10}.

5.3.1.3 Area sources

The mining pits and stockpiles were modelled as area sources.

5.3.1.3.1 Open cast mining pits

A summary of the emissions from the open cast mining pits are shown in Table 5-2.

Table 5-2. PM emissions from open pits

Area source	Activity	Annual emissions (tpa)		
		TPM	PM_{10}	$PM_{2.5}$
Extension	Topsoil removal	7.10	5.33	0.75
	Mining (overburden + ore) - Drilling	9.31	4.89	0.28
	Mining (overburden + ore) - Blasting	0.90	0.47	0.03
	Mining (overburden + ore) - Loading	9.42	4.45	0.67
	Combined	***26.73***	***15.14***	***1.73***
Main and Abante	Topsoil removal	18.48	13.86	1.94
	Mining (overburden + ore) - Drilling	24.23	12.73	0.73
	Mining (overburden + ore) - Blasting	2.34	1.22	0.07
	Mining (overburden + ore) - Loading	24.50	11.59	1.75
	Combined	***69.56***	***39.40***	***4.50***
Haanekuil	Topsoil removal	6.36	4.77	0.67
	Mining (overburden + ore) - Drilling	8.34	4.38	
	Mining (overburden + ore) - Blasting	0.81	0.42	0.02
	Mining (overburden + ore) - Loading	8.44	3.99	0.60
	Combined	**23.95**	**13.57**	**1.30**

The pits were modelled as described in below.

Table 5-3. Open-pits modelled source details.

Source	Release height (m)[a]	Area (ha/a)
Open-cast pits – Extension	0	10.3
Open-cast pits – Main and Abante	0	27.0
Open-cast pits – Haanekuil	0	9.2

The emissions were quantified based on the details described below. For the pits, wind erosion was not considered. The combined area of the mining operation was taken as equal to the area of blasting each year. The ratio of mining that occurs at each site was determined relative to the total volume of the pits planned at each site.

Topsoil removal:

Topsoil removal by grader (30 centimetres). Emission factor is for total particulates.

PM_{10} and $PM_{2.5}$ fractions were determined based on the ratio of PM_{10} and $PM_{2.5}$ emissions generated by bulldozing overburden with a silt content of 6.9% and a moisture content of 7.9%.

Drilling

Drilling emissions were calculated based on an area blasted per year of 466 643 m^2 through 300 blasts with a total of 71002 holes drilled per year. Emissions factors from the NPI mining EET manual were used to estimate these emissions.

Blasting

Blasting emissions were calculated as per NPI mining EET Manual. The area per blast was calculated to be 1555 m^2.

Loading

Loading emissions were calculated using the emission factors provided in USEPA AP-42 ore mining. The default exposed ground moisture content of 3.4% was used for all material as the region is dry and a mean wind speed of 7 m/s were used.

For modelling purposes, the pits were modelled as single area sources located in each region. It was assumed that, due to the scale of the project, the individual locations of the pits will have negligible impact on the overall impact of the operations on the ground level concentration of particulates.

5.3.1.3.2 Stockpiles

The stockpiles consist of waste material stockpile, were unusable material (overburden) that result from blasting are stored and an ore stockpile located at the CPP. The area of each stockpile was calculated based on the total area of the waste stockpiles of 113 ha determined from the information provided in the *2017*, and divided per site based on the relative mining areas of the sites detailed in Table 5-4.

For modelling purposes, the stockpiles were assumed round with a height of 20 m. The ore stockpile size was calculated based on a volume of 540 000 m^3.

Table 5-4. Stockpile emissions.

Area source	Activity	Emission (tpa)		
		TPM	PM_{10}	$PM_{2.5}$
Extension	Loading to stockpile	8.70	4.11	0.62
	Wind erosion	88.51	44.25	22.13
	Combined	**97.20**	**48.37**	**22.75**
Main and Abante	Loading to stockpile	22.63	10.70	1.62
	Wind erosion	230.33	115.16	57.58
	Combined	**252.96**	**125.87**	**59.20**
Haanekuil	Loading to stockpile	7.79	3.69	0.56
	Wind erosion	79.31	39.65	19.83
	Combined	**87.10**	**43.34**	**20.38**
CPP ore stockpile	Loading to stockpile	3.24	1.53	0.23
	Loading from stockpile	3.24	1.53	0.23
	Wind erosion	9.46	4.73	2.37
	Combined	**15.94**	**7.80**	**2.83**

The stockpiles were modelled using the descriptions provided in Table 5-5.

Table 5-5. Stockpiles modelled source details

Source	Release height (m)[a]	Area (ha)
Waste stockpile – Extension	20	25.3
Waste stockpile – Main and Abante	20	65.7
Waste stockpile – Haanekuil	20	22.6
Ore stockpile – CPP	20	2.7

a: above the surface, not mean sea level.

The emissions were quantified based on the details described below.

Loading

Loading emissions were calculated as for the pits.

Wind erosion

Particulate emissions from wind erosion were calculated as per NPI mining EET manual using the default values. The emissions of $PM_{2.5}$ is not explicitly stated in the NPI mining EET manual and was thus determined from the ratio of PM_{10} and $PM_{2.5}$ emissions from wind erosion as provided *in USEPA AP-42* Chapter 13.2.

5.3.1.3.3 Tailings

Wind entrainment of particulates from tailings storage facilities is influenced by the physical size of the impoundment and the nature of the exposed surface, i.e. the moisture content, degree of vegetation cover, size of particles on the surfaces, and wind speed. As wet slurry is deposited on the tailings facility, moisture content is high. For this study, the percentage of dry beach area is assumed to be 80% on the upper surface as the slurry dries out. No vegetation cover is assumed due to the arid nature of the project site. The final tailings facility is designed to have a volume of approximately 8 300 000 m^3. A height of 20 metres is assumed giving an area of 2.7 ha. The area was modelled as a square area source. Loading emissions were considered negligible as the tailings are wet when loaded.

Emissions caused by wind erosion was determined as for stockpiles. This is conservative and an overestimate given that the tailings will be covered in time.
Emissions are estimated as follows:

TPM emissions: 93.07 tpa.
PM_{10} emissions: 46.53 tpa.
$PM_{2.5}$ emissions: 23.27 tpa.

The source was modelled with the following details:

Release height: 20 m above the surface.
Area: 2.7 ha.

5.3.1.4 Line sources

Ore will be hauled from the pits to the CPP. Overburden from the mining operation will also be hauled to the waste stockpiles. Particulate emissions from unpaved roads were determined based on the following equation as per USEPA AP-42 section 13.2.2 as

$$E = k \left(\frac{s}{12}\right)^a (\frac{W}{3})^b$$

where s is taken at a default 8.4%. W is the mean vehicle mass, taken as 22.5 tonne, determined based on a full mass of 35 tonne per dump truck and an empty mass 10 tonnes. The values a, b and c are empirical constants, and k is a size factor.

Vehicle exhaust emissions were not quantified as they are considered negligible in comparison to the unpaved road emissions with respect to particulates.

5.3.1.4.1 Haul roads from pits to CPP

The information provided states that there are 14 haul trucks completing 10 trips per day each. As this is an AQA, a conservative approach was taken. Emissions are calculated based on 10 trips per truck, on the longer hauls (from Haanekuil and Ryst Kuil Extension, to the CPP). An equal split was made between the 14 trucks for the two distant sites.

Resulting emissions are as follows:

TPM emissions: 13 108 tpa.

PM_{10} emissions: 2 786 tpa.

$PM_{2.5}$ emissions: 407 tpa.

The sources were modelled with the following details:

Road width: 10 m.

Distance per trip (one way): 27.7 km and 16.5 km.

5.3.1.4.2 Haul roads from pits to waste stockpiles

Additional haulage is required to move the overburden/waste rock from the mines to the waste stockpiles. It was assumed that at each site, the distance travelled will be 500 metres. Most of the material will be moved in this manner.

Based a total tonnage of material handled a year of 16.7 million tonnes per year, removing the haulage to the CPP by the 140 trips per day as discussed above, this leaves a balance of 42 000 tonnes of material that needs to be moved per day via short hauls to the stockpiles.

The emissions are as follows:

Line source	**Activity**	**Emission (tpa)**		
		TPM	**PM_{10}**	**$PM_{2.5}$**
Extension to waste stockpile	Haul roads	398	84.6	12.4
Main and Abante to waste stockpile	Haul roads	1 036	220	32.2
Hanekuil pit to waste stockpile	Haul roads	356	75.8	11.1
Combined	***Haul roads***	***1 790***	***381***	***55.6***

The roads were modelled with the following details:

Road width: 10 m.

Distance per trip (one way): 500 m per area, for each of the open-cast mining areas.

5.3.2 Impact on overall Air Quality

Ambient AQ standards for some criteria pollutants were published by the Department of Environmental Affairs (DEA) in Government Notice No. 1210 on 24 March 2009 (GN1210). This included particulates in the form of PM_{10}. In 2012, $PM_{2.5}$ was added to the list of ambient air quality standards through the publication of GN486. These limits applicable to the Ryst Kuil project are shown in Table 5-6.

Table 5-6. Ambient air quality standards

Pollutant	**Averaging period**	**Ambient air quality standard (µg/m³)**	**Exceedances allowed**
PM_{10}	Annual	40	0
PM_{10}	Daily	75	4 per annum
$PM_{2.5}$	Annual	20 (15 from 2030)	0
$PM_{2.5}$	Daily	40 (25 from 2030)	4 per annum

There are currently no ambient air quality standards for sulphuric acid and thus its dispersion was not modelled.

5.3.2.1 PM_{10} emissions

The highest annual average concentration is estimated to be 113 µg/m^3. This result falls on the Ryst Kuil project area, near the CPP and the Main mining area. This exceeds the ambient air quality standard of 40 µg/m^3. The highest 4-time daily concentration was shown to be 533 µg/m^3 for the same area. This exceeds the maximum daily standard of 75 µg/m^3.

However, no exceedance of either standard is expected outside the project area as can be seen from Figure 5-2 and Figure 5-3. The main public road passing through the area, the R61, is not significantly affected by the operation.

The primary contributor to these emissions is the haul roads. To show the significance of the source, the impacts of only the haul roads are shown in Figure 5-4 and Figure 5-5.

5.3.2.2 $PM_{2.5}$ emissions

The highest annual average concentration of $PM_{2.5}$ is estimated to be 16.4 µg/m^3 and is located on the Ryst Kuil project area, near the CPP and the Main mining area. This is below the current ambient air quality standard of 20 µg/m^3, but marginally exceeds the air quality standard for $PM_{2.5}$ that will come into effect in 2030. The highest 4-time daily concentration was shown to be 64.5 µg/m^3 for the same area. This exceeds the maximum daily standard of 40 µg/m^3 and the new standard of 25 µg/m^3 that will come into effect in 2030.

None of the ambient air quality standards are expected to be exceeded off site due to the Ryst Kuil project operations only.

$PM_{2.5}$ are a subset of particulate matter that refers to ultra-fine particulates. These particles are small enough to pass through the lungs and be absorbed into the bloodstream. In comparison to PM_{10}, the $PM_{2.5}$ emissions are generally lower relative to the ambient air quality standards for this operation. This is primarily due to the nature of the most significant emission source, i.e. the emissions from unpaved roads. The size distribution of particulates emitted from unpaved roads show that the majority of particles are relatively large. The fraction of PM_{30} emitted is about 4 times as much as the fraction of PM_{10} emitted, and the fraction of $PM_{2.5}$ is less than a fifth of the PM_{10} emitted.

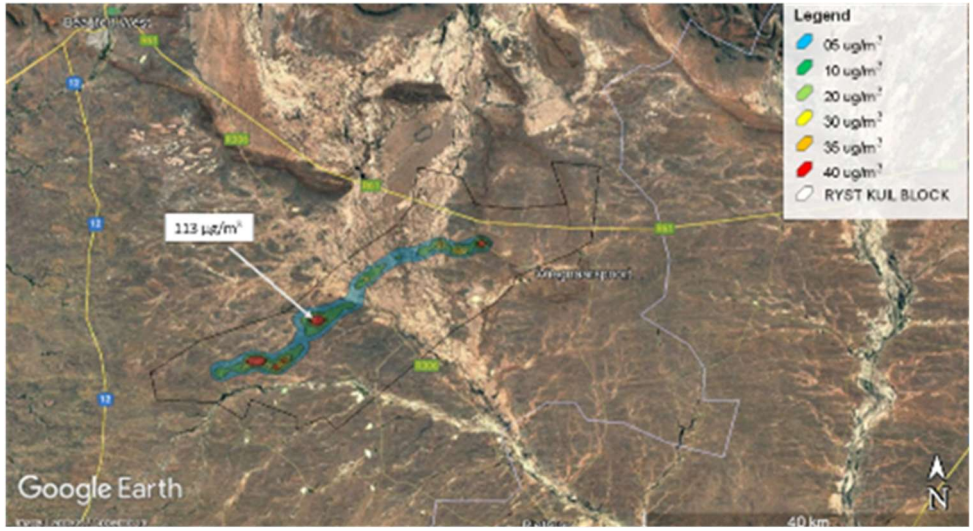


Figure 5-2. Annual average PM10 concentrations.

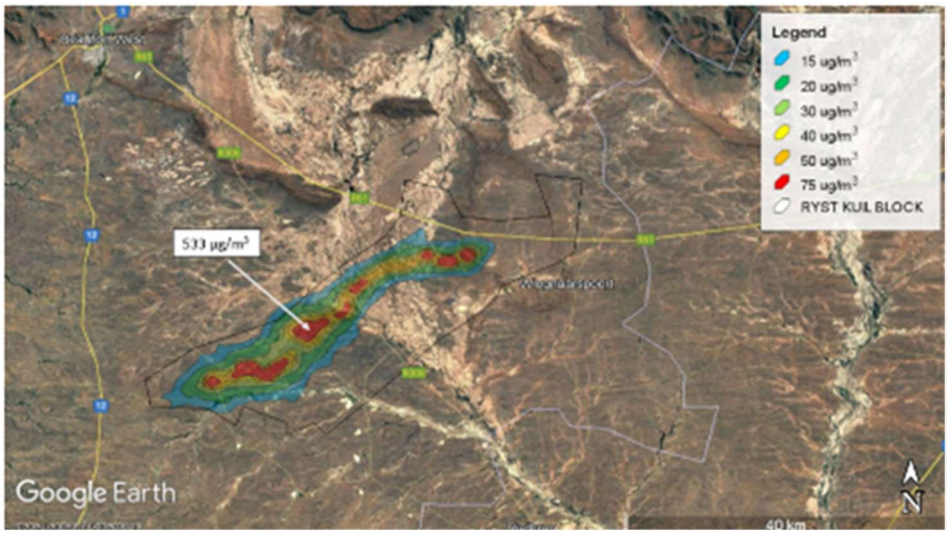


Figure 5-3. 4-time high daily average PM10 concentrations.

Figure 5-4. Annual average PM10 concentrations – haul roads.

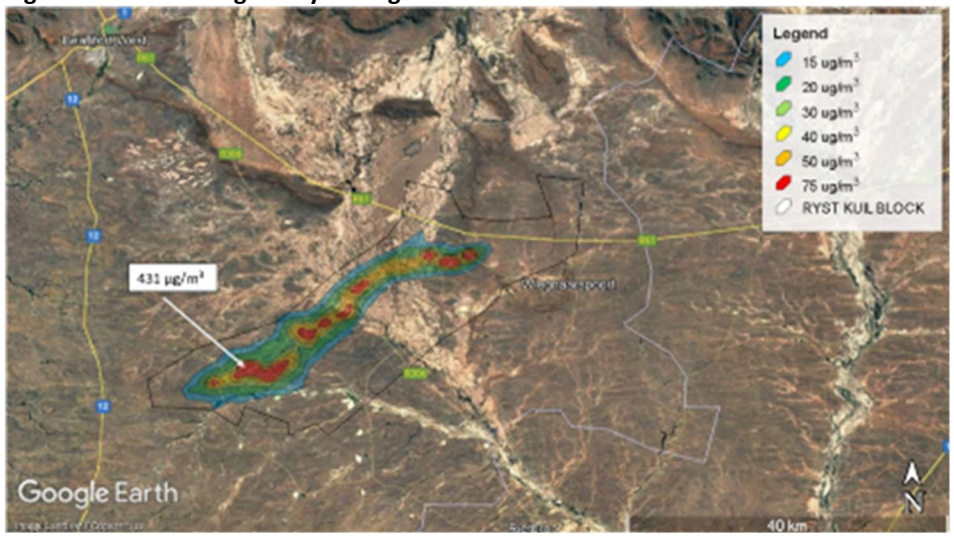


Figure 5-5. 4-time high daily average PM10 concentrations – haul roads

Figure 5-6. Annual average PM2.5 concentrations.

Figure 5-7. 4-time high daily average PM2.5 concentration (99-percentile).

5.3.2.3 Uncertainty of emissions

The annual mass of emissions of PM_{10} particulates from the various mining operations must be interpreted with care. Emissions were estimated using mining capacities provided in the 2017 Screening Report, and a combination of emission factors contained in the NPI mining emissions estimation technique manual as well as the USEPA's AP-42.

As the mine is still in the planning stage, capacities provided must be considered as design data which may differ substantially from capacities reached during full operation. LAQS was provided with limited data for the mining operation and based the emissions of the 2017 screening report.

Furthermore, emission factors all have reliability ratings, ranging from "A" to "U" with the following descriptions:

A - Excellent
B - Above average
C - Average
D - Below average
E - Poor
U - Unrated

The reliability of emission factors for the activities listed are:

Excavators / Shovels / Front-end loaders, on overburden	U
Drilling	C
Blasting	C
Wheel generated dust from unpaved roads	B
Scrapers, removing topsoil	E
Loading stockpiles	U
Loading from stockpiles	U
Miscellaneous transfer points, including conveying	U
Wind erosion	U

The reliability of some of the emission factors used have not yet been rated, while some others vary between "excellent" and "poor". It is likely, therefore, that much uncertainty can be attached to the emission on which this assessment is based, but more reliable information is extremely scarce.

5.4 Biodiversity related impacts

5.4.1.1 Biodiversity Risk Assessment

5.4.1.1.1 Impact Assessment Considerations and Procedure

Anthropogenic activities cause habitat destruction, leading to the displacement or death of flora and fauna, loss of breeding and nesting sites, and disruption of wildlife corridors. The removal of natural vegetation reduces available habitat, affecting species populations and diversity. Potential environmental impacts from the proposed development were assessed using data from desktop and field studies, focusing on the construction and operational phases (excluding closure due to the project's long-term nature). Only impacts deemed relevant through this analysis were considered for mitigation, and further impacts may be identified in the future.

Impacts were assessed for the following activities:

- Construction Phase
- Operational Phase; and
- Decommissioning and Rehabilitation.

5.4.1.2 Present Impacts

Considering the anthropogenic activities and influences within the landscape, several negative impacts to biodiversity were observed within the PAOI (Table 5-7).

Table 5-7. Summary of the screening tool vs specialist assigned sensitivities

Impact	Description
Livestock grazing	Primary land use; grazing by sheep and goats leads to selective vegetation loss, displacement of native species, erosion, and spread of invasive species. This has widespread, ongoing, and cumulative effects on ecosystem health.
Fencing inhibiting free movement of fauna	Extensive fencing fragments habitats, preventing free movement and migration of fauna, leading to isolated populations and increased risk of local extinctions.
Wildlife-vehicle collisions (WVCs)	Increased road traffic causes direct mortality of fauna (tortoises, lizards, snakes, ungulates, birds) through collisions, especially where fencing funnels animals onto roads.
Fences causing direct faunal mortalities	Fencing (including "jackal proof" fences) causes direct deaths of fauna (e.g., birds, small ungulates, tortoises) through collision or entanglement.
Powerline infrastructure causing avifaunal mortality	Existing powerlines cause deaths of large birds (e.g., bustards, cranes, korhaans) due to collisions, contributing to population declines.
Presence of alien/invasive species	Localized infestations of alien/invasive plants, often near agricultural activities or homesteads. Spread mainly by livestock and sometimes by birds.
Hunting (legal and illegal)	Predator eradication campaigns and hunting (both legal and illegal) target predators and sometimes tortoises, impacting local populations.
Previous mining for uranium and associated infrastructure	Past uranium exploration and mining activities have resulted in habitat destruction, pollution, and the presence of contaminated or disturbed sites. These areas may have altered soil and water quality, persistent radioactive residues, and legacy infrastructure that does not continue to impact local biodiversity and ecosystem function.
Pollution and littering	Unregulated dumping of refuse and building rubble, leading to windblown litter (e.g., plastic bags) that can harm fauna through ingestion or entanglement. Feral animals are attracted to these sites.
Residential presence of feral predators	Feral cats and dogs from settlements prey on native fauna and spread diseases; cats can hybridize with African wild cats, affecting gene pools.
Dust effects and wetland contamination	Dust from roads and erosion contaminates wetlands and pans, affecting water quality and vegetation. Radioactive dust is a potential future risk.
Exploration drilling impacts	Past drilling activities have caused habitat destruction, pollution, and left unplugged drill holes that can trap and kill fauna.
Rock collection for fencing	Rocks are removed from natural areas to secure fences, causing habitat loss and direct faunal mortality, but may create artificial refugia along fences.
Previous agricultural attempts	Some areas were previously ploughed for agriculture, leading to altered vegetation and increased susceptibility to invasive species.

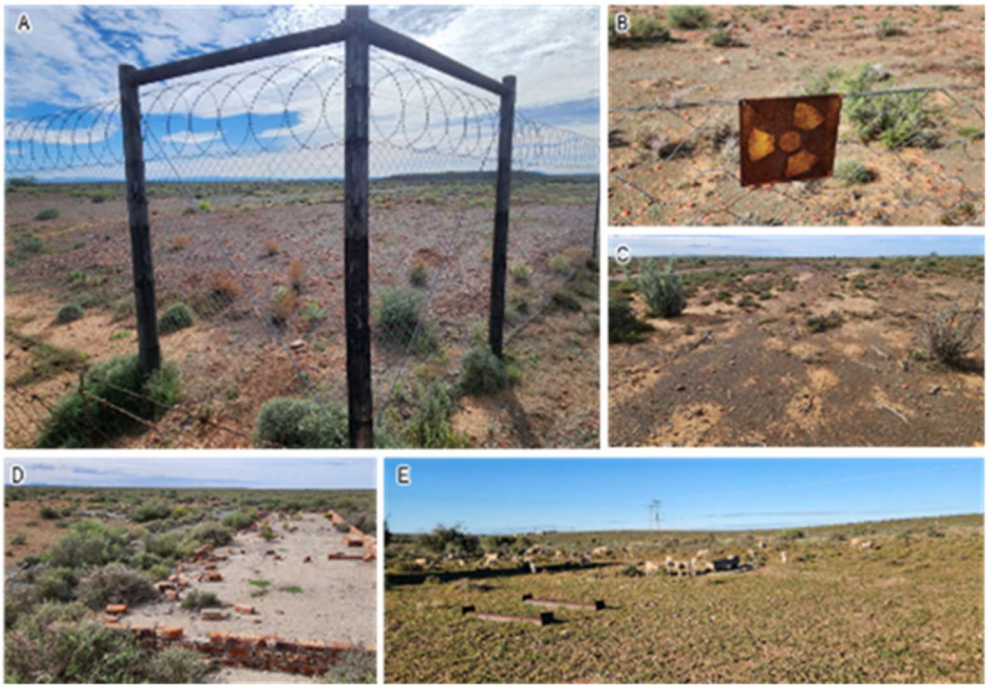


Figure 5-8. Photos illustrating some of the existing impacts observed; A) Fencing, B &C) Previous uranium mining area and infrastructure, C) Previous agriculture, D) Livestock.

5.4.1.3 Irreplaceable Loss

Any development of the PAOI will result in the irreplaceable loss of:

- CBA 1, ESA 1, ESA 2 areas;
- Drainage lines/Water resources;
- SCC as well as Protected species; and
- Indigenous vegetation.

5.4.2 Identification of Additional Potential Impacts

The following potential activities and potential impacts are expected. A summary of the potential impacts during the construction and operational phases of the proposed activity are presented in Table 5-8.

Table 5-8. Summary of potential impacts to biodiversity associated with the proposed activity

Main Impact	Project Activities	Secondary Impacts Anticipated
Loss of indigenous habitat	• Direct loss because of construction and operation of the proposed development. • Secondary impacts associated with noise, dust and influx of AIPs into these areas. • Access roads and servitudes. • Prevention of fires or incorrect fire regimes. • Improper solid waste disposal. • Dust precipitation.	• Habitat fragmentation. • Loss of ecosystem services. • Emigration of fauna species, potentially including SCC. • Increased potential for soil erosion. • Habitat fragmentation. • Increased potential for establishment of alien invasive vegetation.
Encroachment of AIP species in disturbed areas.	• Vegetation removal. • Soil disturbance.	• Habitat loss for native flora & fauna (including potential SCC).

Main Impact	Project Activities	Secondary Impacts Anticipated
	• Vehicles potentially spreading seed. • Unsanitary conditions surrounding infrastructure promoting the establishment of alien and/or invasive rodents. • Creation of infrastructure suitable for breeding activities of alien and/or invasive birds.	• Alteration of fauna assemblages due to habitat modification. • Reduced forage quality of grazing habitat. • Spreading of potentially dangerous diseases.
Direct mortality of fauna species.	• Clearing of vegetation. • Roadkill due to vehicle collision. • Preparation of soil with heavy machinery • Soil excavations and soil transportation. • Intentional killing of fauna for food (hunting) or persecution (especially regarding herpetofauna). • Pollution of water resources due to spilling of hazardous chemicals from heavy machinery during construction.	• Loss of habitat. • Loss of ecosystem services. • Explosion of rodent populations and associated disease risk.
Emigration of fauna	• Disturbance from construction activities. • Loss of habitat and degradation of surrounding habitats.	• Reduced population of protected species, and potentially SCC • Loss of ecosystem services.
Reduced dispersal/migration of fauna	• Removal of vegetation • Loss of landscape used as corridor. • Compacted roads.	• Loss of ecosystem services • Reduced plant seed dispersal.
Disruption/alteration of ecological life cycles (breeding, migration, feeding) due to noise, light and dust	• Operation of machinery (generators, crushers, vehicles). • Vehicles operating at night. • Large, intense fluorescent and mercury vapor lighting.	• Loss of ecosystem services.
Loss of SCCs and/or protected species	• All unregulated/unsupervised activities outdoors. • Poaching and trapping • Staff and others interacting directly with fauna (potentially dangerous), or flora.	• Loss of SCC. • Harm to people (dangerous fauna).
Environmental pollution due to water/ mine drainage runoff	• Project activities that can cause pollution in watercourses and the surrounding environment • Chemical (organic/inorganic) spills • Erosion • Potential release of radioactive material	• Secondary impacts associated with disruption/alteration of ecological life cycles due to noise • Loss of ecosystem services • Secondary impacts associated with disruption/alteration of ecological life cycles due to dust • Loss of ecosystem services

5.4.2.1 Project Surface Infrastructure

The development of surface infrastructure for the mining complex—including facilities such as offices, workshops, stockpiles, and Pollution Control Dams—will require significant vegetation clearance and land

leveling. This will result in the loss and fragmentation of plant communities, habitat degradation, and increased vulnerability to erosion and alien invasive species. Fauna, including IUCN-listed species, may be displaced, face habitat loss, disruption of movement and breeding, and risk mortality from equipment and increased traffic. Human activity could further heighten risks of poaching, disease spread, and the introduction of feral animals.

During operations, habitat degradation will intensify due to dust, edge effects, and continued spread of invasive species. Adjacent areas may also be degraded through increased accessibility, livestock intrusion, and unregulated human movement. Sensory disturbances from noise, light, and vibrations will further displace wildlife and disrupt ecological processes.

In the decommissioning phase, impacts will persist until effective rehabilitation begins. If infrastructure is not removed and rehabilitation is not undertaken, the site may become a long-term ecological dead zone. However, with proper rehabilitation—removing artificial structures and restoring natural conditions—vegetation and fauna may re-establish, improving ecological recovery and land capability.

5.4.2.2 Linear Infrastructure

The development of linear infrastructure—such as access roads, haul roads, powerlines, and service corridors—within the mining area will require vegetation clearance and land grading. This will directly remove and fragment plant communities, reducing habitat connectivity and increasing vulnerability to invasive species. Soil disturbance, human activity, and altered ecological dynamics further facilitate the spread of alien plants.

Although powerline structures occupy small physical footprints, the broader ecological impact stems from road construction and maintenance, particularly given the lack of finalized layouts. Sensitive ecosystems within proposed corridors are at risk of habitat loss and fragmentation.

Faunal impacts include habitat loss, displacement (including IUCN-listed species), and increased mortality from vehicle collisions and poaching. Construction and operational phases will intensify disturbances through traffic, noise, dust, and pollution, degrading habitats along infrastructure edges and enabling further vegetation loss, informal land use, and introduction of feral species and diseases.

During decommissioning, the potential for ecological recovery depends on the removal of infrastructure and active rehabilitation. Without intervention, degraded areas may become long-term ecological dead zones. Effective rehabilitation can restore native vegetation, support faunal return, and reinstate ecological function.

5.4.3 Quantitative Impact Assessment

The identified impacts for the different phases of the development are assessed below. These assessments consider the loss of the area in relation to the proposed infrastructure.
The purpose of the impact assessment is to:

- Assess impacts of proposed activities on biodiversity of the proposed development area;
- Assess whether proposed activities are likely to have significant impacts on biodiversity and specifically species of conservation concern; and
- Identify practical, implementable mitigation measures to reduce the significance of proposed activities on biodiversity.

It is important to note that the ratings applied within the risk assessment model, considered impacts to open space or natural habitats within the development area and not for areas already transformed.

5.4.4 Project Infrastructure layout

The project SEI in relation to the proposed infrastructure layout can be seen in Figure 4-39, Figure 4-40 and Figure 4-41. The Impact significance assessment that follows below pertains to the SEI in the figures and the expected impact to these areas.

The layout in general overlaps High SEI areas, which is expected to have a high unmitigated impact.

5.4.5 Overview: Assessment of Impact Significance

The assessment of impact significance considers both pre-mitigation as well as post-mitigation scenarios as relevant to each potential impact. Construction phase, operational phase, and cumulative impacts are discussed and assessed below.

5.4.5.1 Construction Phase

The following potential main impacts on the biodiversity (based on the framework above) were considered for the construction phase of the proposed development. This phase refers to the period during construction when the proposed features are constructed; and is considered to have the largest direct impact on biodiversity. The following potential impacts to terrestrial biodiversity were considered:

- Destruction, loss and fragmentation of the of habitats, ecosystems and vegetation community;
- Introduction of alien and invasive species, especially plants; and
- Displacement of faunal community due to habitat loss, direct mortalities and disturbance (road collisions, noise, dust, vibration and poaching).

5.4.5.2 Operational Phase

It is anticipated that daily activities associated with the operation phase will lead to further spread the AIP, as well as the deterioration of the habitats due to the increase of traffic, dust and edge effect impacts. Dust reduces the ability of plants to photosynthesise and thus leads to degradation/retrogression of the veld. Moving maintenance vehicles do not only cause sensory disturbances to fauna, affecting their life cycles and movement, but will lead to direct mortalities due to collisions, the roads and fences lead to the barrier effect reducing movement and dispersal. Operation will continue to have an effect on erosion of the site with continued disturbance of natural water flow regimes, resulting in a further loss of habitats.

The following potential impacts were considered:

- Continued encroachment and displacement of the natural vegetation community due to alien invasive plant species, dust, erosion and edge effects;
- Continued displacement and direct mortalities of faunal community (including SCC) due to disturbance (road collisions, noise, light, dust, vibration and blasting, including the disruption/alteration of ecological life cycles; and
- Environmental pollution due to water/ mine drainage runoff

5.4.5.3 Decommissioning Phase

The impact of this phase is similar to the operational phase until all mining activities has ended and the anthropogenic activity is concluded.

- Decommissioning activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions and persecution. Destruction of vegetation, encroachment and displacement of the natural vegetation community due to alien invasive plant species, erosion and edge effects;
- Disturbance created during decommissioning will leave the development area vulnerable to erosion and alien plant invasion for several years.

5.5 Current Impacts on Freshwater Biodiversity

The assessed watercourse exhibits impacts on both the catchment and local scale. These impacts result from present and historical land use relating to transport infrastructure development and agricultural practices in proximity to water resources which have transformed their habitats and altered their natural hydrological regime as well as species composition. The list below refers to the present-day local impacts associated with the assessed freshwater areas:

- Wildlife, livestock, grazing, trampling;
- Agricultural Activities;
- Previous Uranium Mining activities;
- Soil Erosion;
- Fences and existing roads and crossings;
- Modified Areas; and
- Edge Effects.

5.5.1 Alternatives Considered

Alternatives were not presented at the time of report compilation. As a result, any mitigation or management efforts were focused on the current proposed project within the proposed setup/footprint.

5.5.2 Loss of Irreplaceable Resources

The freshwater ecology of the project area is considered highly sensitive to disturbance from a hydrological, biological and conservational perspective. This includes the wetland pans and drainage areas. Construction phase and operational phase activities must take cognisance of this and avoid any unnecessary disturbance of these areas. Activities within these sensitive areas will lead to modifications to the present ecological state and therefore ecosystem degradation.

5.5.3 Quantitative Risk and Impact Assessment

The Risk/Impact Assessment considered the direct and indirect impacts of the activity(ies) on the freshwater systems associated with the project area. The mitigation hierarchy as discussed by the Department of Environmental Affairs (2013) will be considered for this component of the assessment (Figure 5-9). In accordance with the mitigation hierarchy, the preferred mitigatory measure is to avoid impacts by considering options in the project location, setting, scale, layout, technology, and phasing to avoid impacts. For this assessment, the specialist was provided with the project footprint and the study focussed on the watercourses within and close to the project area. Mitigation measures should be implemented to negate potential impacts on the watercourses associated with the project area.

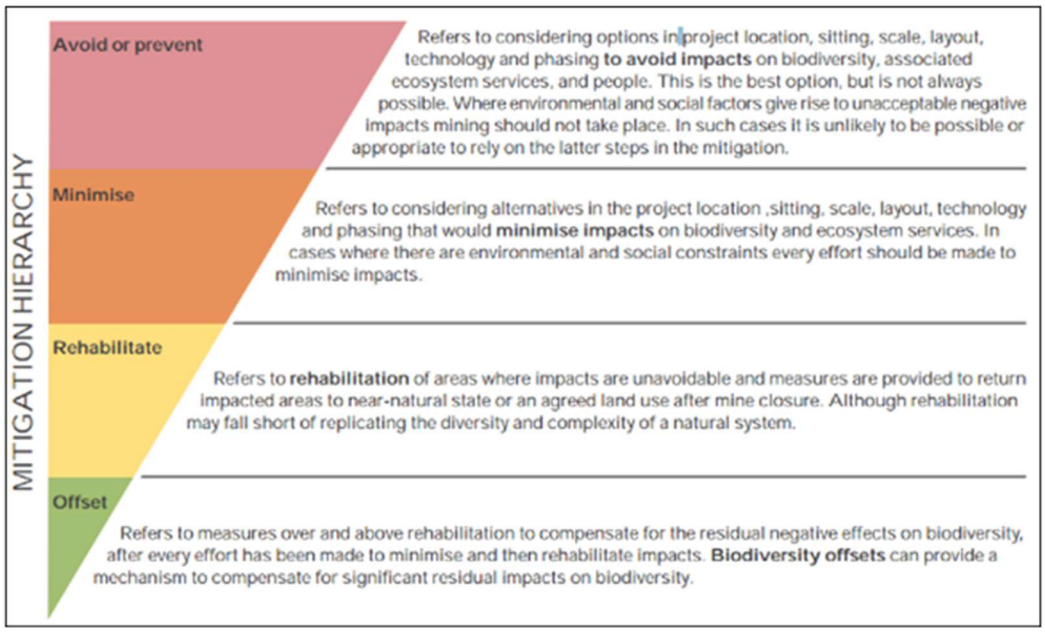


Figure 5-9. The mitigation hierarchy as described by the DEA (2013).

5.5.4 Assessment of Impact Significance (DWS and NEMA)

A single risk assessment was compiled for the project, which relates to open-pit and underground Uranium and Molybdenum mining and associated activities post-mitigation. The DWS Risk Assessment Matrix (GN 4167) was used to assess both risks and impacts anticipated from the proposed activities for WUL and EA as it is in the specialist's opinion that the risk matrix is suitable and sufficient to assess risks to associated water resources and can be used to apply for the full EIA. Table 5-9 illustrates the DWS risk ratings associated with the project. The potential direct and indirect impacts are expected to threaten the integrity of sensitive receptors during the project activities if unmitigated. The post-mitigation significance ratings have been calculated considering various parameters, these results are presented in the subsequent tables.

Table 5-9. Summative results of the DWS Risk Assessment Matrix compiled by Prasheen Singh (Pr. Sci. Nat. 116822)

Phase	Activity	Impact	Potentially affected watercourses	Significance (max = 100)	Risk Rating
CONSTRUCTION	1. Earthworks, clearing of terrestrial and freshwater areas. Construction of mining laydown yards, stockpiling and stormwater management systems. Construction of basic infrastructure	1a. Increase in sediment inputs & turbidity and associated smothering and loss of instream habitat.	Pan 1, Pan 2 and Pan 3	**26.4**	**L**
			Drainage Areas 1 - 9	**44**	**M**
			Drainage Areas 10 - 12	**26.4**	**L**
		1b. Inputs of toxic organic contaminants.	Pan 1, Pan 2 and Pan 3	**11.2**	**L**
			Drainage Areas 1 - 9	**11.2**	**L**
			Drainage Areas 10 - 12	**11.2**	**L**
		1c. Loss of aquatic biota and habitat	Pan 1, Pan 2 and Pan 3	**48**	**M**
			Drainage Areas 1 - 9	**56**	**M**
			Drainage Areas 10 - 12	**16**	**L**
		1d. Excess rubble and construction material in watercourse areas.	Pan 1, Pan 2 and Pan 3	**7.2**	**L**
			Drainage Areas 1 - 9	**7.2**	**L**
			Drainage Areas 10 - 12	**7.2**	**L**
	2. Excavating and levelling of existing roads to surveyed levels. New access roads and associated laydown yards.	2a. Increased sedimentation	Pan 1, Pan 2 and Pan 3	**21.6**	**L**
			Drainage Areas 1 - 9	**21.6**	**L**
			Drainage Areas 10 - 12	**21.6**	**L**
		2b. Increased erosion from exposed surfaces	Pan 1, Pan 2 and Pan 3	**16**	**L**
			Drainage Areas 1 - 9	**16**	**L**
			Drainage Areas 10 - 12	**16**	**L**
		2c. Erosion in key areas (steep and/or exposed areas)	Pan 1, Pan 2 and Pan 3	**21.6**	**L**
			Drainage Areas 1 - 9	**21.6**	**L**
			Drainage Areas 10 - 12	**14.4**	**L**
		2d. Alteration of hydro-dynamics and reduced dispersal/ migration of fauna	Pan 1, Pan 2 and Pan 3	**14.4**	**L**
			Drainage Areas 1 - 9	**21.6**	**L**
			Drainage Areas 10 - 12	**14.4**	**L**
OPERATIONAL	1. Open-pit Mining (Excavations, drilling, crushing and stockpiling). Operation and	1a. Increased erosion from exposed surfaces and sedimentation. Alteration of hydro-dynamics and reduced dispersal/ migration of fauna.	Pan 1, Pan 2 and Pan 3	**38.4**	**M**
			Drainage Areas 1 - 9	**64**	**H**
			Drainage Areas 10 - 12	**38.4**	**M**

	maintenance of roads. Waste Rock Dumps. PCDs. Underground mining.	1b. Habitat destruction and fragmentation. Loss of watercourse habitat (irreplaceable resources)	Pan 1, Pan 2 and Pan 3	**38.4**	**M**
			Drainage Areas 1 - 9	**72**	**H**
			Drainage Areas 10 - 12	**38.4**	**M**
		1c. Contamination associated with vehicles and heavy machinery (hydrocarbons)	Pan 1, Pan 2 and Pan 3	**38.4**	**M**
			Drainage Areas 1 - 9	**51.2**	**M**
			Drainage Areas 10 - 12	**38.4**	**M**
		1d. Contamination associated with acidic mine water, tailings waste, and introduction and spread of radioactive materials.	Pan 1, Pan 2 and Pan 3	**76**	**H**
			Drainage Areas 1 - 9	**76**	**H**
			Drainage Areas 10 - 12	**76**	**H**
	2. Concurrent rehabilitation. Re-shaping, revegetation and contouring.	2a. Increased erosion from exposed surfaces, erosion and alteration of flow patterns. Alien vegetation encroachment.	Pan 1, Pan 2 and Pan 3	**26.4**	**L**
			Drainage Areas 1 - 9	**26.4**	**L**
			Drainage Areas 10 - 12	**26.4**	**L**
		2b. Re-shaping of landscape. Re-vegetation of terrestrial and watercourse habitat.	Pan 1, Pan 2 and Pan 3	**-48**	**+**
			Drainage Areas 1 - 9	**-48**	**+**
			Drainage Areas 10 - 12	**-48**	**+**
DECOMMISSIONING	1. Backfilling of the excavations.	1a. Increased erosion from exposed surfaces.	Pan 1, Pan 2 and Pan 3	**35.2**	**M**
			Drainage Areas 1 - 9	**35.2**	**M**
			Drainage Areas 10 - 12	**35.2**	**M**
		1b. Increased sedimentation. Alteration of patterns of flows (increased flood peaks).	Pan 1, Pan 2 and Pan 3	**26.4**	**L**
			Drainage Areas 1 - 9	**35.2**	**M**
			Drainage Areas 10 - 12	**35.2**	**M**
	2. Final rehabilitation. Re-shaping, revegetation and contouring.	2a. Increased erosion from exposed surfaces, erosion and alteration of flow patterns. Alien vegetation encroachment.	Pan 1, Pan 2 and Pan 3	**26.4**	**L**
			Drainage Areas 1 - 9	**26.4**	**L**
			Drainage Areas 10 - 12	**26.4**	**L**
		2b. Re-shaping of landscape. Re-vegetation of terrestrial and watercourse habitat.	Pan 1, Pan 2 and Pan 3	**-48**	**+**
			Drainage Areas 1 - 9	**-48**	**+**
			Drainage Areas 10 - 12	**-48**	**+**

(L) Low Risk (+) Positive (+ +) Highly positive
(M) Moderate Risk
(H) High Risk

Uranium mining in semi-arid environments presents significant risks to ephemeral water resources, which, although temporary, provide important ecological habitat and support aquatic biodiversity during periods of flow or pooling. Mining and processing activities may mobilize radioactive elements and heavy metals,

contaminating surface water and shallow groundwater through runoff, leaching, and accidental spills. Because water availability is limited in semi-arid areas, contaminants can become highly concentrated, increasing toxicity risks to aquatic organisms and disrupting ecosystem functioning. Radioactive substances may also bioaccumulate through aquatic food chains, creating exposure risks for wildlife and humans.

Across construction, operation, and decommissioning phases, proposed mining activities present risks ranging from low to high before and after mitigation. The highest risks are associated with direct mining within watercourse areas, including drainage lines and valley floor wetlands, as well as contamination of watercourses with radioactive materials. Moderate risks arise from nearby activities such as altered drainage patterns, vegetation clearing, excavation, heavy machinery operation, erosion, sedimentation, hydrocarbon contamination, and alien invasive plant spread. Direct impacts on wetlands and riparian habitats from mining pits, waste rock dumps, and associated infrastructure are considered difficult to mitigate effectively.

While mitigation measures and avoidance of watercourse areas can reduce some impacts, certain activities—including excavation, road crossings, drilling, crushing, backfilling, contouring, and stormwater management—will still result in direct habitat loss, channel modification, and changes to wetland and riparian systems if not carefully controlled. Residual risks remain particularly related to radiological contamination and acid leachate, requiring detailed water and waste management measures such as lined storage facilities, pollution control dams, controlled discharge systems, and monitoring of uranium and radionuclides in surface and groundwater.

Land disturbance also increases the risk of alien invasive plant proliferation and altered runoff, which may lead to erosion, sedimentation, and water quality deterioration. A site management plan, including alien invasive plant control and stormwater management, is therefore required, with sensitive areas clearly demarcated and protected. Concurrent and final rehabilitation of disturbed wetland and riparian areas is recommended to improve ecological integrity and minimize long-term contamination, erosion, and sedimentation impacts.

5.5.5 Unplanned Events

The planned activities will have anticipated impacts as discussed; however, unplanned events may occur on any project and may have potential impacts which will need management.

Table 5-10 is a summary of the findings of an unplanned event assessment from a terrestrial ecology perspective. Note, not all potential unplanned events may be captured herein, and this must therefore be managed throughout all phases according to recorded events.

Table 5-10. Summary of unplanned events for terrestrial biodiversity

Unplanned Event	Potential Impact	Mitigation
Hydrocarbon and tailings spills into the surrounding environment	Contamination of habitat and water resources associated with a spillage.	A spill response kit must always be available. The incident must be reported on and if necessary, a biodiversity specialist must investigate the extent of the impact and provide rehabilitation recommendations.
Fire	Uncontrolled/unmanaged fire that spreads to the surrounding natural areas	Appropriate/Adequate fire management plan need to be implemented.
Erosion caused by water runoff from the surface	Erosion on the side of the road	Stormwater management plan must be compiled and implemented.

Unplanned Event	Potential Impact	Mitigation
Acid Mine Drainage	Severe water quality and in turn habitat degradation	Water treatment, post closure water monitoring and water level management.

The planned activities will have known impacts as discussed above; however, unplanned events may occur on any project and may have potential impacts which will need mitigation and management. Table 5-11 is a summary of the findings from a watercourse ecology perspective. Please note not all potential unplanned events may be captured herein and this must therefore be managed throughout all phases of the project.

Table 5-11. Unplanned Events, Risks and their Management Measures

Unplanned Event	Potential Impact	Mitigation
Leaks and spills of contaminants into watercourse	Contamination of sediments and water resources associated with the spillage, with associated negative biological effects (reduction in ecological integrity).	A spill response kit and protocol must be available at all times. The incident must be reported on and if necessary, an aquatic specialist must investigate the extent of the impact and provide rehabilitation recommendations. Berms must be created between the facility and the watercourse to limit/ contain the spill from entering the watercourse.
Uncontrolled erosion	Sedimentation of downstream watercourse.	Erosion control measures must be put in place. These should be adaptive to on-site conditions.
Introduction of radioactive materials into the environment.	Contamination of sediments and water resources associated with the introduction of radioactive isotopes, with associated negative biological effects (reduction in ecological integrity).	All mining activities should be placed outside of the watercourse and buffer areas. There should be no interaction between mined products, decant and mining materials with watercourses. Strict controls should be in place that prevent the introduction of radioactive materials into the environment, and should introduction occur then there should be effective mitigation to prevent and reduce the impacts.

5.5.6 Cumulative Impact

The impacts of projects are often assessed by comparing the post-project situation to a pre-existing baseline. Where projects can be considered in isolation this provides a good method of assessing a project's impact. However, in areas where baselines have already been affected, or where future development will continue to add to the impacts in an area or region, it is appropriate to consider the cumulative effects of development. This is similar to the concept of shifting baselines, which describes how the environmental baseline at a point in time may represent a significant change from the original state of the system. This section describes the potential impacts of the project that are cumulative for terrestrial fauna and flora.

Localised cumulative impacts include the cumulative effects from operations that are close enough to potentially cause additive effects on the environment or sensitive receivers. These include dust deposition, noise and vibration, disruption of wildlife corridors or habitat, groundwater drawdown, groundwater and surface water quality, and transport. The overall cumulative impact is expected to be High (Table 5-12).

Table 5-12. Cumulative impact assessment for the development

Impact Nature: Loss / Degradation to Local Ecology		
	Overall impact of the proposed development considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Low (2)	High (4)
Duration	Long term (4)	Long term (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Highly probable (4)
Significance	**High**	**High**
Status (positive or negative)	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

5.6 Identified Heritage related impacts

The following heritage related impacts have been identified in terms of the palaeontology, archaeology, built environment and visual impacts. The assessment of heritage impacts in South Africa does not conform to the standard impact assessment methodology, but is described.

5.6.1 Palaeontology

Due to the flat topography and the fact that the rocks of the Karoo Supergroup are covered in alluvium, very little opportunity exists for palaeontologists to examine the fossil potential of the area. Indeed, Rubidge (2008) stresses “because of the total lack of outcrops in the study area, these are not outcrops which would normally have been prospected for fossils by palaeontologists”. Because of poor outcrops, both palaeontological and lithological data is poorly known and any additional information is of importance. While mining activities will be intrusive from an environmental perspective, excavations will enhance possibilities for finding new fossil evidence in this poorly-known part of the Karoo Basin. Mining is therefore considered to have a generally beneficial impact from the palaeontological perspective.

5.6.1.1 Archaeology

The archaeological survey, and earlier surveys, confirm that archaeological material is present in the form of isolated flakes and cores and there are very few obvious archaeological “sites”. It is anticipated that the impact of the proposed mining development on archaeological material will be very low.

5.6.1.2 Built Environment

There are no listed conservation-worthy buildings or places of celebrated heritage significance in the area. No demolition of farm buildings is proposed. While some of the existing farm houses contain 19th century fabric, very few have anything more than low heritage significance. The proposed mining operations will not be visible from the N1 highway. Limited impacts will be experienced from the R61 (Figure 4-62) and R306 which are not considered scenic routes. Due to the lack of screening in the context of wide open vistas, there is a potential for

visual impact in the flat, arid Karoo landscape but farmsteads are sparse. Impacts to the Cultural Landscape are very limited.

5.6.1.3 Visual

Visual impacts occur when developments exceed the visual capacity of the landscape to absorb the change and results in a radical change to the sense of place of the area or region. As a result of the flat horizontal landscape character visibility is high and the viewshed extends over a large area (Figure 5-10). The analysis was conducted using the highest point within the operational area, which will be the waste rock stockpiles. These stockpiles will not exceed a height of 20m. Due to the inherent lack of available screening in the context with the flatter, wide open vistas, there is a high potential for visual impact in the flat arid Karoo landscapes. It is important that development is managed in such a way that does not detract from the elements which define significant landscape character, specifically relating to the tourism industry.

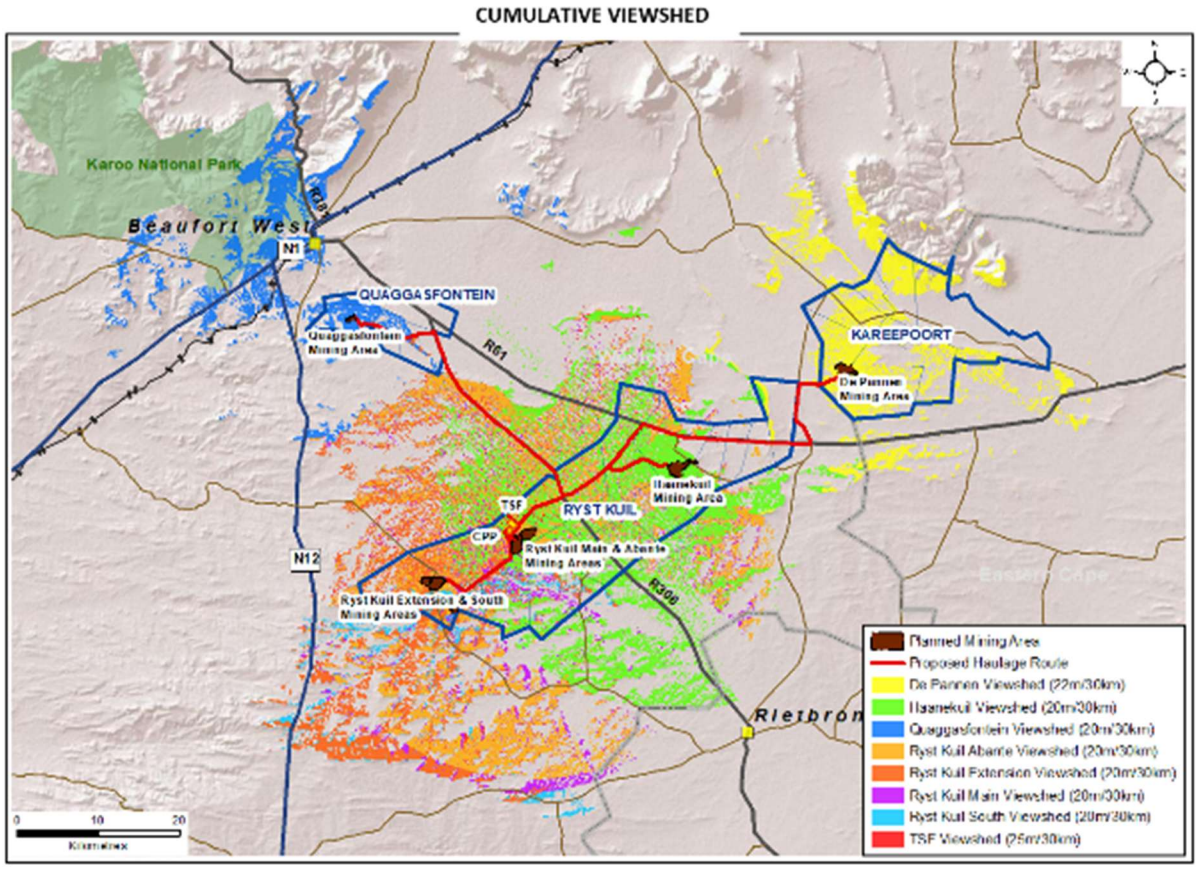


Figure 5-10. Cumulative viewshed-analysis of all proposed mining areas.

5.7 Identified Noise related impacts

Within a mining site, increased noise levels are directly linked with the various activities associated with the construction of the mining area and related infrastructure, and the operational as well as closure phases of the activity.

Construction Phase

The proposed Construction Phase activities are anticipated to include the following:

- Establishing of office complex infrastructure,
- Access road widening,
- Top soil stripping,
- Waste and ROM stockpile footprint civils,
- Soft overburden and hard material (drill and blast to remove very hard material) during the development of the pit box-cuts, etc.

General Civil Works

The activity of clearing vegetation, widening access roads and preparing footprints and foundations for the office complex, waste rock stockpile and related infrastructure will impact on the acoustic character of the area.

Blasting

Hard rock blasting will be required as part of the civil works to prepare the footprint and foundations, as well as during the development of the pit box cuts.

Traffic

During the construction phase a significant increase in traffic to and from the site is anticipated. Internal traffic within the site boundaries will also be elevated. The movement of large numbers of employees and contract workers during construction will increase noise levels. In addition, the delivery of materials and infrastructure on large trucks will commence during the construction phase.

Operational Phase

Mining

The following noise related activities are anticipated during the operational phase of mining:

- Topsoil stripping and loading;
- Soft overburden load and haul;
- Drill and blast operations;
- Infill and exploration drilling;
- Crushing;
- In Pit Loading;
- Material Hauling;
- Waste rock disposal;
- Equipment and vehicle maintenance;
- General vehicle movement.

Mining operations are planned to take place over 2 shifts for a 7-day week. A day shift will start at 06h30 and a night shift that will start at 17h00.

Closure/Decommissioning Phase

The decommissioning phase activities are by their very nature less intrusive from a noise perspective than those produced during operational phase activities. Verification of anticipated operational phase noise impacts will take place over the Life of Mine and will inform the Closure Phase impact assessment and mitigation measures. It is however unlikely that any additional/new mitigation measures will be required during the closure phase.

5.8 Identified Radiation related impacts

The doses that are reported are for end of mine life conditions when the sources terms are assumed to be at maximum values and deposition of radioactive dust has accumulated in the environment over the total period of mine operations.

Table 5-13. Annual production rates of different material at Ryst Kuil

Mine Area	U ore production rate (t/yr)	Radionuclide	Ore U-238 and Th-232 specific radioactivity (Bq/g)
Haanekuil	4.07E+05	U-238	15.1
	4.07E+05	Th-232	0.1
Ryst Kuil Main	6.05E+05	U-238	13.4
	6.05E+05	Th-232	0.1
Ryst Kuil Abante	2.79E+05	U-238	12.0
	2.79E+05	Th-232	0.1
Ryst Kuil Extension	5.14E+05	U-238	11.4
	5.14E+05	Th-232	0.1
Central Processing Plant	1.21E+06	U-238	12.8
	1.21E+06	Th-232	0.1

The source terms that have been developed for LRP are listed in Table 5-14. The natural occurrence of Th-232 and its principal decay products have been included in the source terms (approximately 3 Bq/g).

5.8.1 Radiation dose from atmospheric exposure pathways

The Ryst Kuil group consists of Ryst Kuil Main, Ryst Kuil Extension, Ryst Kuil Abante, the CPP and the TSF.

Table 5-14. Annual discharges from identified sources to the atmosphere used in the safety assessment, Bq/yr

Mine Area	Source	Rn-222	U-238	Th-230	Ra-226	Pb-210	Th-232
Ryst Kuil Group: Main, Extension, Abante	RK Main Pit 01	5.44E+12	1.08E+08	1.08E+08	1.08E+08	1.08E+08	8.98E+05
	RK Main Waste Rock	1.87E+13	2.45E+07	2.45E+07	2.45E+07	2.45E+07	1.32E+06
	RK Abante Waste Rock01	1.03E+13	1.34E+07	1.34E+07	1.34E+07	1.34E+07	7.17E+05
	RK Abante Waste Rock02	3.08E+12	4.05E+06	4.05E+06	4.05E+06	4.05E+06	2.16E+05
	RK Abante Waste Rock03	1.69E+12	2.21E+06	2.21E+06	2.21E+06	2.21E+06	1.18E+05
	RK Extension Waste Rock01	2.26E+12	2.96E+06	2.96E+06	2.96E+06	2.96E+06	1.58E+05

	RK Extension Waste Rock02	1.93E+12	2.54E+06	2.54E+06	2.54E+06	2.54E+06	1.36E+05
	RK Abante Pit03	7.24E+12	1.45E+08	1.45E+08	1.45E+08	1.45E+08	1.48E+06
	RK Extension Waste Rock03	4.90E+12	6.39E+06	6.39E+06	6.39E+06	6.39E+06	3.43E+05
	RK Extension Waste Rock04	5.00E+12	6.53E+06	6.53E+06	6.53E+06	6.53E+06	3.50E+05
	RK Extension Waste Rock05	3.43E+12	4.52E+06	4.52E+06	4.52E+06	4.52E+06	2.41E+05
	RK Extension Pit01	3.57E+12	7.14E+07	7.14E+07	7.14E+07	7.14E+07	7.51E+05
	RK Extension Pit04	1.51E+12	3.01E+07	3.01E+07	3.01E+07	3.01E+07	3.17E+05
	RK TSF	3.04E+14	3.98E+07	3.98E+08	3.98E+08	3.98E+08	3.43E+06
	CPP U Plant Drying Packing	0.00E+00	1.01E+10	5.07E+07	1.01E+07	1.01E+07	0.00E+00
	CPP Ore Pad	2.04E+13	2.67E+07	2.67E+07	2.67E+07	2.67E+07	2.11E+05
	CPP Crusher	5.71E+07	5.71E+08	5.71E+08	5.71E+08	5.71E+08	4.45E+06
	CPP Truck Unloading	0.00E+00	4.76E+08	4.76E+08	4.76E+08	4.76E+08	3.74E+06
Haanekuil	HK Truck Loading (in pits)	0.00E+00	1.87E+08	1.87E+08	1.87E+08	1.87E+08	1.25E+06
	HK Pit 05	2.25E+13	4.22E+07	4.22E+07	4.22E+07	4.22E+07	4.39E+05
	HK Pit 04	3.47E+13	6.46E+07	6.46E+07	6.46E+07	6.46E+07	6.70E+05
	HK Waste Rock	1.64E+13	2.15E+07	2.15E+07	2.15E+07	2.15E+07	1.15E+06

Drying and packing uranium: U3O8 Production rate; (t/yr)	**U-238 (Bq/yr)**	**≤ 0.1% Drying and packing plant stack release (Bq/yr)**			
		U-238	**Th-230**	**Ra-226**	**Pb-210**
1066	1.11E+13	1.11E+10	5.57E+07	1.11E+07	1.11E+07

The development of these source terms included the following information:

- elevation of discharges;
- area and location of discharges;
- discharge rates;
- radon and dust particle containing LL-alpha radioactivity size distribution; and
- meteorology and climatology (e.g. wind speeds, atmospheric stability and rainfall).

Towards the end of a mine's life, the Tailings Storage Facility (TSF) becomes the main source of low-level alpha (LL-α) radioactive dust and radon emissions. The TSF contains radionuclides such as Th-230, Ra-226, Pb-210, and residual U-238/234. Its dry beach and sidewall areas are the primary contributors to airborne radioactivity. Although dose models assume the entire TSF surface emits dust and radon, studies show that only about 30% of the dry exposed surface typically acts as a significant source due to factors like wind fetch and particle dynamics.

The TSF is also a key source of atmospheric radon (Rn-222), especially from drier, more porous beach areas. Radon primarily emanates from the top 500 mm of material, with emissions influenced by TSF properties and weather conditions. A conservative emission rate of 12.8 Bq/m²/s is assumed for an 80-hectare TSF.

Additionally, the Central Processing Plant (CPP)—particularly its yellowcake drying and packing facility—is a major potential airborne radioactivity source. While sealed and operated under negative pressure with dust filters, up to 0.1% of product loss is conservatively assumed in dose assessments. In reality, modern systems

(e.g., rotary vacuum dryers) typically release less, around 0.05%. At short distances, the CPP is the dominant dose contributor, while radon from the TSF becomes more significant at longer ranges.

5.8.2 Radon discharge from underground ventilation shafts

The dose models created for the Karoo Uranium Project do not include radon discharges from the underground mine ventilation shafts. Preliminary design information of ventilation rates was used to derive source terms for ventilation shafts that will be active during mining. Only two ventilation shafts will be actively discharging radon at any stage of mining. It was assumed that the radon concentrations in the underground worker areas are at levels that approach the dose limit for workers (i.e. 50 mSv in a single year). The source terms are listed in Table 5-15.

Table 5-15. Underground mine radon release to environment

Mine area	Bq.m-3 per 50 mSv	Upcast ventilation speed; m3/s	Bq/s
RK Extension	8.03E+03	255.75	2.05E+06
RK Main	8.03E+03	168.75	1.35E+06

The CALPUFF atmospheric dispersion software was used to calculate the annual radon concentrations in the region. The results are illustrated in Figure 3 4. It shows that the radon is dispersed to very low concentrations within a short distance from the shafts. It can be concluded that the radon released from underground mining operations makes a negligible contribution to public dose.

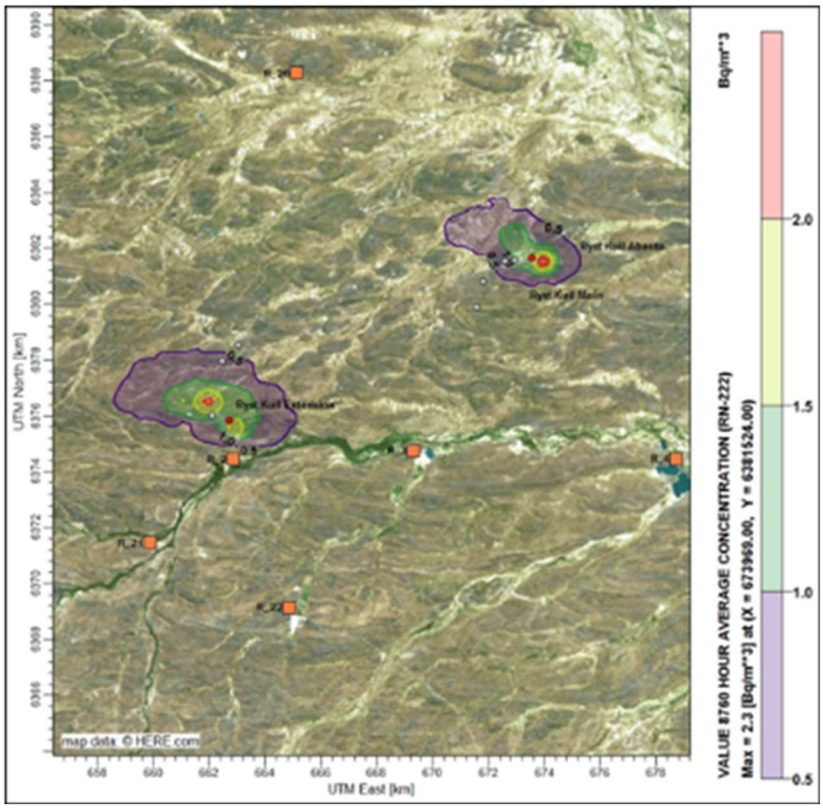


Figure 5-11. Environmental radon concentrations from upcast ventilations shafts servicing underground mining areas.

5.8.3 Radiation dose from atmospheric exposure pathways

5.8.3.1 Ryst Kuil group of mining operations

The Ryst Kuil group consists of Ryst Kuil Main, Ryst Kuil Extension, Ryst Kuil Abante, the CPP and the TSF.

Table 5-16 lists the dose for the three age groups for each of the sensitive receptors locations. The age group for which the maximum annual dose was calculated is the "infant" group located at R29 (Kat Doorn Kuil), receiving 0.479 mSv/yr.

The most sensitive age group for mining activities at Haanekuil is the infant age group. The maximum dose for all mining activities calculated for the infant age group is therefore measured against the regulatory dose constraint value of 0.250 mSv/yr.

The potential contamination of meat products is of specific concern to the Karoo farming communities. The dose calculations include the contribution from meat ingestion. The radioactivity concentrations calculated in meat is negligible compared to the natural occurrence of radioactivity. The concentration of Ra-226, for example, is approximately a thousand time smaller than the maximum measure value. The calculated results are included in Table 5-16.

Table 5-16. Maximum potential annual dose for the different age groups

Receptor	Infant (mSv/yr)	Child (mSv/yr)	Adult (mSv/yr)
R1 Kat Doorn Kuil	0.085	0.068	0.06
R2 Kant Kraal	0.127	0.098	0.088
R3 Klipstawels	0.094	0.076	0.068
R4 Klipkrans	0.134	0.11	0.099
R5 Eerstewater	0.092	0.072	0.064
R6 Ryst Kuil	0.028	0.023	0.02
R7 Lootsplaas	0.005	0.004	0.004
R8 Haanekuil	0.006	0.005	0.004
R12 Beaufort West	0.004	0.003	0.003
R13 Olive Grove	0.007	0.007	0.006
R16 Uitsig	0.008	0.007	0.006
R17 Retreat	0.009	0.008	0.007
R20 Saucy's Kuil	0.019	0.016	0.015
R21 Amosvlei	0.034	0.029	0.027
R22 Vaalkraal	0.052	0.044	0.041
R23 Blydskap	0.004	0.003	0.003
R24 Rooidam Farmstall	0.003	0.002	0.002
R27 Veerekuil	0.002	0.002	0.002
R29 Kat Doorn Kuil	0.479	0.321	0.249
R50 Neverset	0.004	0.003	0.003

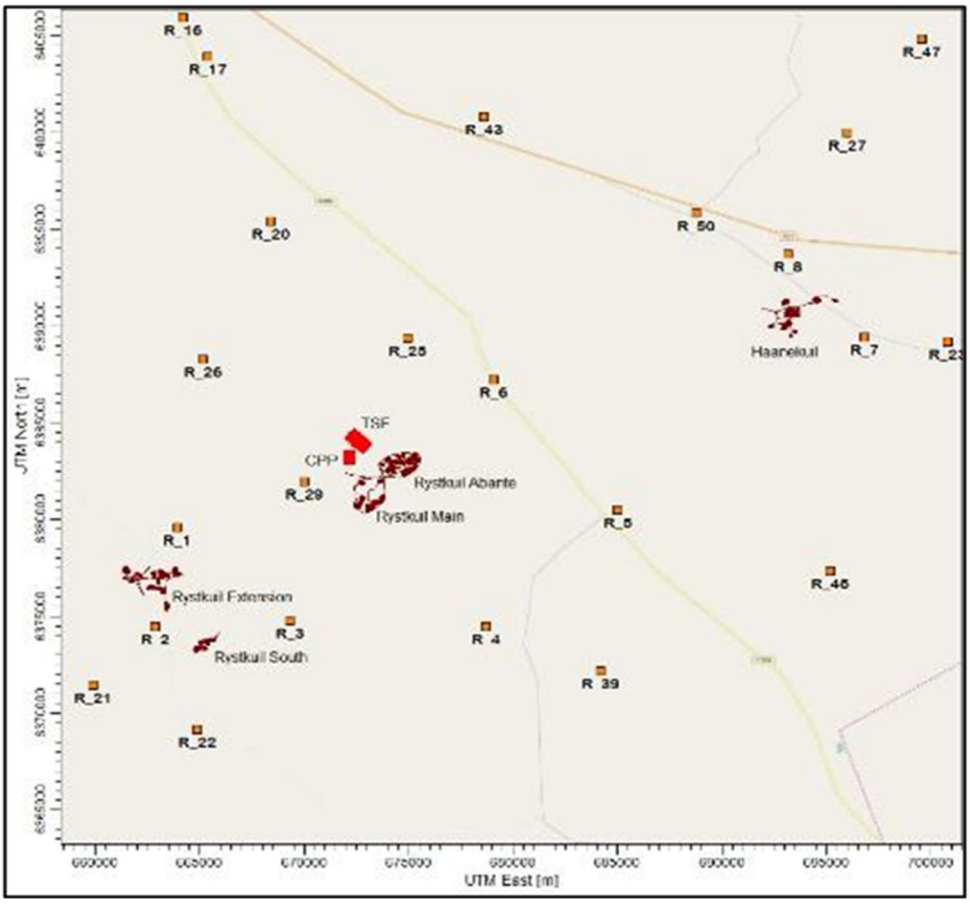


Figure 5-12. Sensitive receptor locations in the vicinity of Ryst Kuil and Haanekuil mine sites.

The potential contamination of meat products is of specific concern to the Karoo farming communities. The dose calculations include the contribution from meat ingestion. The radioactivity concentrations calculated in meat is negligible compared to the natural occurrence of radioactivity. The concentration of Ra-226, for example, is approximately a thousand time smaller than the maximum measure value. The calculated results are included in Table 5-17.

Table 5-17. Radioactivity concentration in samples (Bq/kg - fresh weight)

Nuclide	Mutton (Bq/kg)			Liver (Bq/kg)			Wool (Bq/kg)			Springbok venison (Bq/kg)
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	
U-238	2.15E-02	7.30E-03	4.66E-02	8.16E-02	2.65E-02	1.90E-01	3.82E+00	2.00E+00	5.30E+00	1.20E-02
U-234	2.17E-02	7.40E-03	4.70E-02	8.25E-02	2.67E-02	1.92E-01	3.85E+00	2.02E+00	5.35E+00	1.20E-02
Ra-226	5.35E-01	1.28E-01	1.61E+00	5.13E-01	9.53E-02	9.95E-01	3.11E+00	1.81E+00	3.73E+00	2.09E-01
Pb-210	9.60E-01	9.60E-01	2.60E+00	5.10E-01	5.10E-01	5.10E-01	2.72E+01	1.47E+01	3.97E+01	< MDA
Po-210	1.25E+00	4.00E-01	1.98E+00	1.46E+00	7.27E-01	1.84E+00	2.72E+01	1.47E+01	3.97E+01	2.10E+00
U-235	9.93E-04	3.40E-04	2.14E-03	3.76E-03	1.22E-03	8.76E-03	1.76E-01	9.20E-02	2.44E-01	5.40E-04
Th-232	-	-	2.00E-01	-	-	7.80E-02	3.65E+00	1.99E+00	5.16E+00	< MDA
Ra-228	1.31E+00	1.31E+00	1.31E+00	-	-	1.30E+00	4.28E+00	2.32E+00	5.17E+00	2.20E-01
Th-228	2.38E-01	6.00E-02	4.16E-01	5.76E-02	5.76E-02	5.76E-02	4.02E+00	2.19E+00	4.91E+00	< MDA

Nuclide	Mutton (Bq/kg)			Liver (Bq/kg)			Wool (Bq/kg)			Springbok venison (Bq/kg)
	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	
K-40	7.02E+01	5.54E+01	8.79E+01	6.60E+01	5.39E+01	8.70E+01	7.11E+02	3.39E+02	1.42E+03	9.35E+01

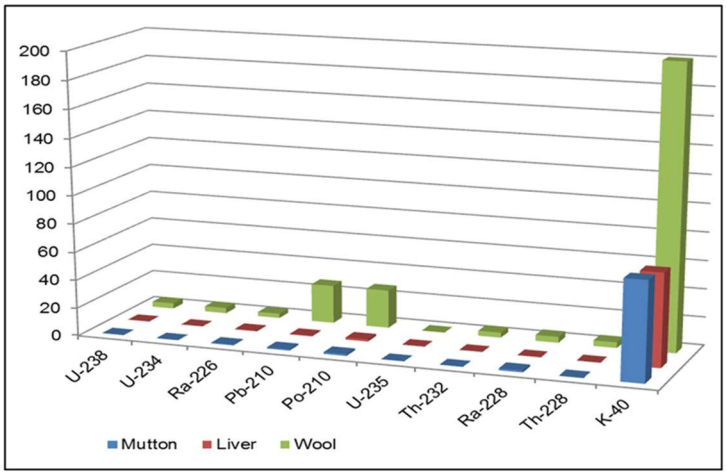


Figure 5-13. Radionuclide specific activities in sheep samples Bq/kg (average values).

Concentrations of radioactive potassium (K-40) are typical of concentrations reported in the literature and are normally high relative to the other radionuclide concentrations. Po-210 was not analysed for wool and mohair samples since they do not form part of the ingestion pathway. The Po-210 concentration is assumed to be in secular equilibrium with Pb-210 in wool and mohair samples.

The radioactivity concentrations in a single sample of venison (springbok) are at similar concentration levels to those recorded in the sheep samples.

The results for radioactivity in Karoo sheep can be compared with the results from two European studies. One of the studies determined the impact of natural radioactivity in animal products on the annual effective dose of a population group. The following radioactivity concentrations were reported for mutton samples:

- U-238: 0.010 - 0.024 Bq/kg
- Ra-226: 0.014 - 0.035 Bq/kg, and
- K-40: 65.2 - 99.5 Bq/kg.

These values are of the same order of magnitude as those of the Karoo samples.

5.8.3.2 Water pollution risks

The potential impacts on water resources are determined by mine and mitigation designs as well as environmental monitoring programmes. The mitigation measures to avoid off-site surface water pollution are discussed in detail in the LRP EIA. Measures include for example the following:

- groundwater monitoring will be by means of boreholes up- and downstream from operations;
- drains will be constructed around stockpiles to divert potential water run-off to a lined sump for evaporation;

- all stockpiles and the TSF will be located on engineered bases to prevent contamination of the groundwater; stockpile areas will be prepared in advance to avoid infiltration of seepage into the groundwater;
- pollution control dams will be constructed;
- storm water drains and trenches are included at material storage areas; and
- water collection provided at maintenance workshops;

The TSF is potentially the principal source of surface and groundwater impacts. The quantity of water seepage from a TSF that is required to be contained is dependent on seepage control measures, properties of the tailings, the nature of the groundwater in the area, and whether the TSF will be lined. Pollution of groundwater by seepage is unlikely when a TSF is constructed on impermeable natural clay formations or when an artificial liner is provided. The main contributors to a low seepage potential, apart from liners, are:

- high percentage of the water is returned to the CPP;
- a large fraction of the water in the tailings material is interstitial water that is retained; and
- a large surface area and a high net evaporation rate assure high evaporation losses.

Radium (Ra-226) occurs at a much higher radioactivity concentration in the TSF than uranium. Radium generally has a low mobility in tailings, moving much slower than water in the tailings and generally resulting in low concentrations in seepage water. Studies performed on waterborne Ra-226 radioactivity from old dry tailings deposits on the Central Rand mining areas show that Ra-226 is effectively retained.

5.8.3.3 The impact on radiological air quality when a TSF cover is provided

As assessment was performed of airborne radioactivity concentrations based on a scenario of a total dry TSF surface without a cover at the time of mine closure. The advanced atmospheric dispersion model CALPUFF was used. The release of airborne dust containing LL-alpha radioactivity from the TSF surface was modelled as a function of local wind speeds. Tailings material only becomes airborne when a threshold wind speed is exceeded. The dust source terms as a function of wind speed are listed in Table 4-78.

Table 5-18. TSF airborne dust source term as a function of wind speed

Wind speed interval (m/s)	0 - 2.4	2.5 - 4.4	4.4 - 6.9	6.9 - 9.6	9.6 - ≥12.4
Surface dust flux ($g/m^2.s$)	0	3.92E-07	9.68E-06	5.71E-05	2.08E-04
Scaling factor for increased dust from the surface as a function of wind speed	0	1.88E-03	4.65E-02	2.75E-01	1.00E+00

Radon was modelled using a continuous release rate equal to 12.8 $Bq/m^2.s$.

A dose assessment was also carried out using the MILDOS code for a hypothetical sensitive receptor group located 500 m downwind of the TSF. The dose was calculated for two cases:

(1) a TSF without a cover, and

(2) a TSF with an effective cover.

Table 5-19. Post-closure TSF annual airborne exposure pathway dose

Sensitive receptor located 500m downwind (direction ESE) of the TSF	Total dose (mSv/yr)
TSF with no post-closure cover to limit radon and radioactive dust	1.854
TSF with a cover limiting the radon flux to 0.74 Bq/m^2.s	0.142

The results are a further demonstration that the future TSF cover of high integrity and durability will be essential to ensure impacts on air quality and water quality. The TSF will be lined (Class C-liner minimum) dubble HDPE, as no clay is available in the area, with a leak detection system.

Simple mathematical tools exist to assess local materials for suitability as cover material and their ability to adequately reduce radon exhalation. Covers reduce radon flux density by increasing the time taken by radon in the tailings to be transferred to the surface, allowing for radon to decay before reaching the atmosphere. The effectiveness of a cover can be investigated as follows. One first has to determine the radon flux from the bare tailings. The flux can be assumed to be directly proportional to the radium activity concentration when the tailings thickness exceeds the radon diffusion length, as will be the case at LRP.

The effectiveness of a TSF cover in respect of radon can then be estimated. Assuming that the radon fluxes are fairly uniform above the stockpile surface areas, the cover does not add to the radon flux and radon diffusion is the only transport process, (cracks and voids within a surface cover may negate this assumption), the effectiveness as a radon barrier of materials can be assessed

Cover material studies should commence early in LRP operational life with the purpose to inform the development of closure designs.

5.8.4 External radiation from tailings material

External radiation, apart from dust and radon, is a radiological hazard associated with large surface areas of a TSF and mineralised rock dumps. An assessment was performed with the software RESRAD to investigate external radiation for different soil cover thickness layers consisting of soil with typical background NORM concentrations. The RESRAD computer code was developed under the sponsorship of the U.S. Department of Energy and the U.S. Nuclear Regulatory Commission for site-specific dose assessment of residual radioactivity.

A bounding radioactivity concentration of ≤ 16Bq/g for the U-238 decay chain was assumed. The results provide an indication of the relative shielding effect of different cover thickness. The sensitivity analysis is performed for a scenario where practically no cover (0.01 m) is provided, a 0.1m cover and a 1m cover. The results are shown in Table 5-21.

The conclusion that can be drawn is that a cover thickness of 1 m should provide adequate protection against external radiation. The cover soil characteristics will determine whether 1m is also adequate for radon protection.

Table 5-20. Shielding against external radiation on a TSF surface

External radiation sensitivity analysis of soil cover thickness		
m cover layer (mSv/yr)	m cover layer (mSv/yr)	1 m cover layer (mSv/yr)
24.27	8.24	< 1

Table 5-21. Annual discharges from LRP sources to the atmosphere used in the safety assessment, Bq/yr

Mine Area	Source	Rn-222	U-238	Th-230	Ra-226	Pb-210	Th-232
Ryst Kuil Group: Main, Extension, Abante	RK Main Pit 01	5.44E+12	1.08E+08	1.08E+08	1.08E+08	1.08E+08	8.98E+05
	RK Main Waste Rock	1.87E+13	2.45E+07	2.45E+07	2.45E+07	2.45E+07	1.32E+06
	RK Abante Waste Rock01	1.03E+13	1.34E+07	1.34E+07	1.34E+07	1.34E+07	7.17E+05
	RK Abante Waste Rock02	3.08E+12	4.05E+06	4.05E+06	4.05E+06	4.05E+06	2.16E+05
	RK Abante Waste Rock03	1.69E+12	2.21E+06	2.21E+06	2.21E+06	2.21E+06	1.18E+05
	RK Extension Waste Rock01	2.26E+12	2.96E+06	2.96E+06	2.96E+06	2.96E+06	1.58E+05
	RK Extension Waste Rock02	1.93E+12	2.54E+06	2.54E+06	2.54E+06	2.54E+06	1.36E+05
	RK Abante Pit03	7.24E+12	1.45E+08	1.45E+08	1.45E+08	1.45E+08	1.48E+06
	RK Extension Waste Rock03	4.90E+12	6.39E+06	6.39E+06	6.39E+06	6.39E+06	3.43E+05
	RK Extension Waste Rock04	5.00E+12	6.53E+06	6.53E+06	6.53E+06	6.53E+06	3.50E+05
	RK Extension Waste Rock05	3.43E+12	4.52E+06	4.52E+06	4.52E+06	4.52E+06	2.41E+05
	RK Extension Pit01	3.57E+12	7.14E+07	7.14E+07	7.14E+07	7.14E+07	7.51E+05
	RK Extension Pit04	1.51E+12	3.01E+07	3.01E+07	3.01E+07	3.01E+07	3.17E+05
	RK TSF	3.04E+14	3.98E+07	3.98E+08	3.98E+08	3.98E+08	3.43E+06
	CPP U Plant Drying Packing	0.00E+00	1.01E+10	5.07E+07	1.01E+07	1.01E+07	0.00E+00
	CPP Ore Pad	2.04E+13	2.67E+07	2.67E+07	2.67E+07	2.67E+07	2.11E+05
	CPP Crusher	5.71E+07	5.71E+08	5.71E+08	5.71E+08	5.71E+08	4.45E+06
	CPP Truck Unloading	0.00E+00	4.76E+08	4.76E+08	4.76E+08	4.76E+08	3.74E+06
Haanekuil	HK Truck Loading (in pits)	0.00E+00	1.87E+08	1.87E+08	1.87E+08	1.87E+08	1.25E+06
	HK Pit 05	2.25E+13	4.22E+07	4.22E+07	4.22E+07	4.22E+07	4.39E+05
	HK Pit 04	3.47E+13	6.46E+07	6.46E+07	6.46E+07	6.46E+07	6.70E+05
	HK Waste Rock	1.64E+13	2.15E+07	2.15E+07	2.15E+07	2.15E+07	1.15E+06

Drying and packing uranium: U_3O_8 Production rate; (t/yr)	**U-238 (Bq/yr)**	**≤ 0.1% Drying and packing plant stack release (Bq/yr)**			
		U-238	**Th-230**	**Ra-226**	**Pb-210**
1066	1.11E+13	1.11E+10	5.57E+07	1.11E+07	1.11E+07

The development of these source terms included the following information:

- elevation of discharges;
- area and location of discharges;
- discharge rates;
- radon and dust particle containing LL-alpha radioactivity size distribution; and
- meteorology and climatology (e.g. wind speeds, atmospheric stability and rainfall)

Source terms for ore loading, unloading and crushing are derived from US NRC and Australian NPI methodologies.

The TSF is normally the most important source of LL-alpha radioactive dust towards the end of mine life. It contains Th-230, Ra-226, and Pb-210, as well as a fraction of the U-238/234 not removed at the CPP. A TSF typically consists of a central wet area and a dry beach area on the periphery during its operational life. It is mainly the beach areas and dry side walls that give rise to airborne radioactivity. The dose assessment models in this report include the conservative assumption that the total TSF surface acts as a dust and radon source term as would be the case before remediation and closure. Studies have found that the effective TSF surface that acts as an airborne dust source, even in the case of poorly remediated surface areas, is normally smaller than a total barren surface area because of the following reasons:

- The length of exposed tailings along the direction of the wind (the so-called fetch) has an influence on the emission of fine particles since the dominant motion of sand particles is creeping or saltation.
- A high increase is seen for the first quarter of the exposed surface length, followed by a lower rate of release of particles.
- Half the length of the dry and exposed surface area contributes at most 20% to the dust emission; the effective source from dry and exposed TSF surface areas is, in most cases, reported to be 30%.

The TSF is also the most important source of atmospheric radon. The concentration of radon in air following its release from the TSF depends on several factors, for example:

- TSF properties in respect of moisture content, porosity, and radium-226 content; and
- meteorological conditions e.g. rainfall, temperature, pressure, and wind.

The beach areas of a TSF have tailings with a higher radon diffusion coefficient resulting from lower moisture content. Radon can diffuse from a depth of a few metres to the surface because of its relatively long half-life (3.8 days). However, the majority of the surface radon flux is due to Ra-226 in the top 500 millimetre thick layer of material. It is conservatively assumed that the TSF releases Rn-222 at a constant rate of 1Bq/m^2.s for every 1 Ra-226Bq/g activity, thus 12.8Bq/m^2.s from the total surface of approximately 80 hectares.

The CPP drying and packing plant of the yellowcake product, together with the TSF, are the principal potential sources of airborne radioactivity. The drying and packing plant is the dominant source term in respect of dose for receptors closest to the CPP plant. Table 5-16 illustrates the contribution to annual dose for receptor R29 – Kat Doorn Kuil, located nearest to the CPP, and receptor R50 (Neverset) that is approximately 20 km away. Radon gas released from the TSF becomes the main source term component over longer distances when compared to the dispersion of the uranium product (yellowcake).

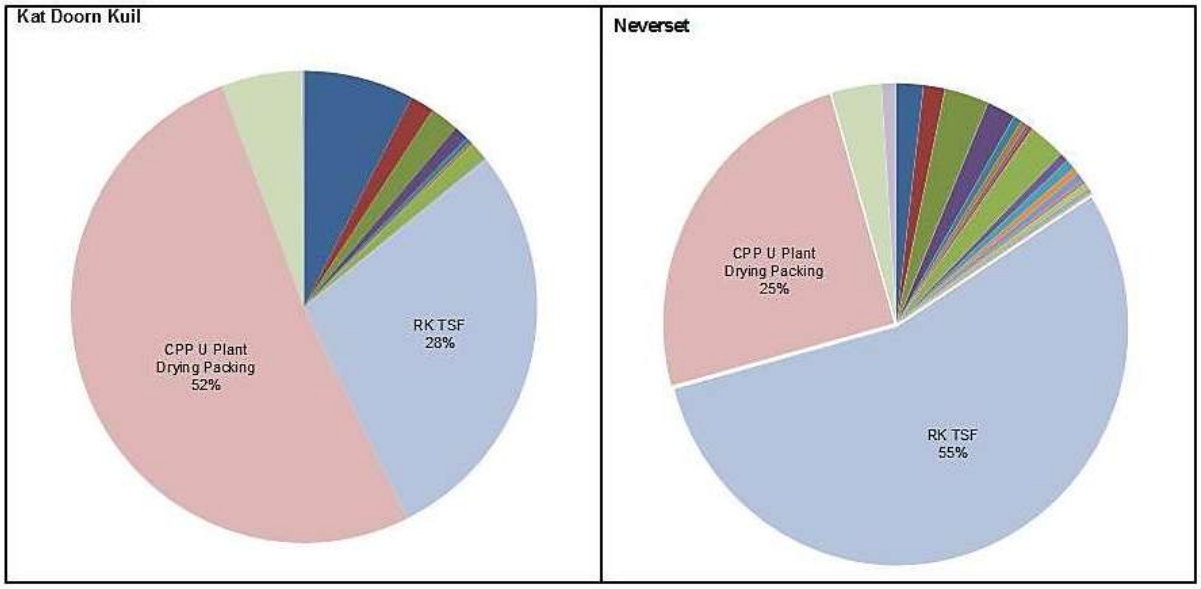


Figure 5-14. TSF and CPP relative contribution to dose at Kat Doorn Kuil and Neverset receptors.

Yellowcake drying and packing occur in sealed, negatively pressurized rooms to prevent dust escape, with dust extraction fans and filters minimizing environmental release. Due to unavailable design details, the safety assessment uses a conservative estimate—based on US NRC guidelines—that 0.1% of the product may be lost via ventilation. However, modern systems, such as rotary vacuum dryers, typically emit far less, with thermal drying designs estimated to release around 0.05% of the product.

Significance Rating	Site preparation/ construction	Mining operations	Decommission, rehabilitation and closure	Post-closure
Inadequate control of dust and water discharges from the mine; closure conditions not meeting site release criteria determined by the NNR	Low	Medium	Medium	High
Effective control of dust and water discharges from the mine and post closure conditions on the site that meet NNR release criteria.	Low	Medium	Medium	Medium

No significant radiological impacts are expected during site preparation and construction. Removal of top soil and waste rock during the early phases of the LRP, will pose low or no radiological hazards to the public. The highest radiological impact will occur when the actual uranium ore is mined and processed.

5.8.5 The impact on radiological air quality when a TSF cover is provided

As assessment was performed of airborne radioactivity concentrations based on a scenario of a total dry TSF surface without a cover at the time of mine closure. The advanced atmospheric dispersion model CALPUFF was used. The release of airborne dust containing LL-alpha radioactivity from the TSF surface was modelled as a function of local wind speeds. Tailings material only becomes airborne when a threshold wind speed is exceeded. The dust source terms as a function of wind speed are listed in Table 5-22.

Table 5-22. TSF airborne dust source term as a function of wind speed

Wind speed interval (m/s)	0 - 2.4	2.5 - 4.4	4.4 - 6.9	6.9 - 9.6	9.6 - ≥12.4
Surface dust flux (g/m2.s)	0	3.92E-07	9.68E-06	5.71E-05	2.08E-04
Scaling factor for increased dust from the surface as a function of wind speed	0	1.88E-03	4.65E-02	2.75E-01	1.00E+00

Radon was modelled using a continuous release rate equal to 12.8 Bq/m^2.s.

The results for radioactive dust deposition and radon are illustrated in Figure 5-15, Figure 5-16 and Figure 5-17. The results presented as concentration isopleths show that the impacts are localised and provide more realistic results than the dispersion model in MILDOS AREA.

A dose assessment was also carried out using the MILDOS code for a hypothetical sensitive receptor group located 500 m downwind of the TSF. The dose was calculated for two cases:

(1) a TSF without a cover, and
(2) a TSF with an effective cover.

Table 5-23. Post-closure TSF annual airborne exposure pathway dose

Sensitive receptor located 500m downwind (direction ESE) of the TSF	Total dose (mSv/yr)
TSF with no post-closure cover to limit radon and radioactive dust	1.854
TSF with a cover limiting the radon flux to 0.74 Bq/m2.s	0.142

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The results are a further demonstration that the future TSF cover of high integrity and durability will be essential to ensure impacts on air quality and water quality.

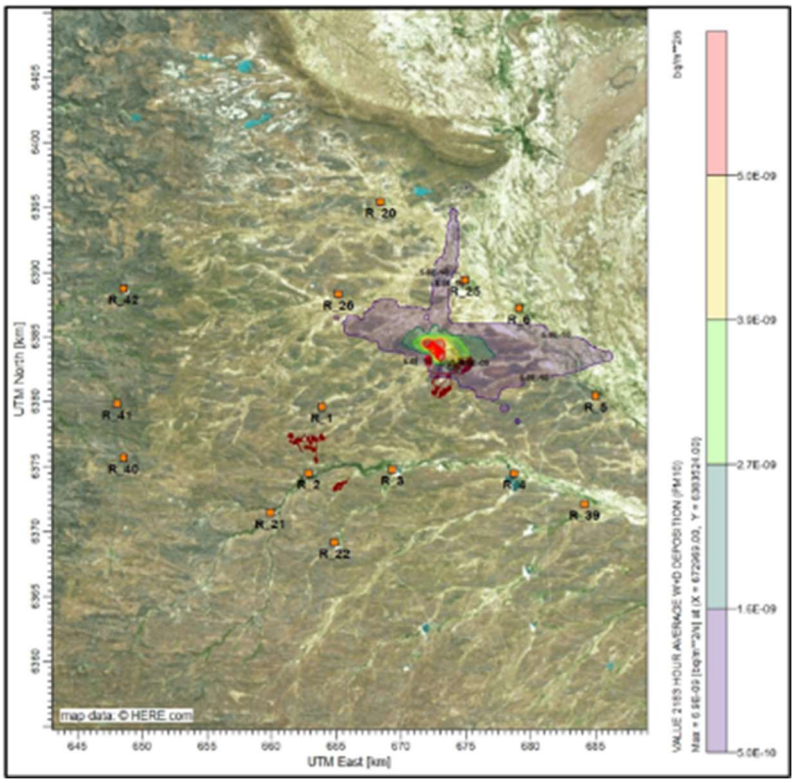

Figure 5-15. Deposition of radioactive dust released from the TSF.

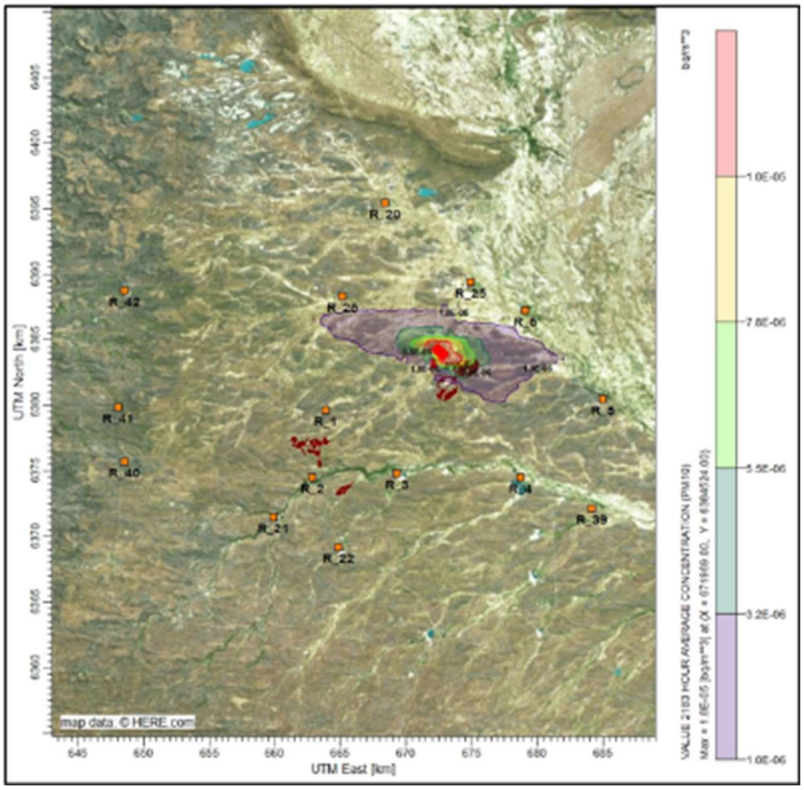

Figure 5-16. Air concentrations of radioactive dust released from a TSF with no post closure cover.

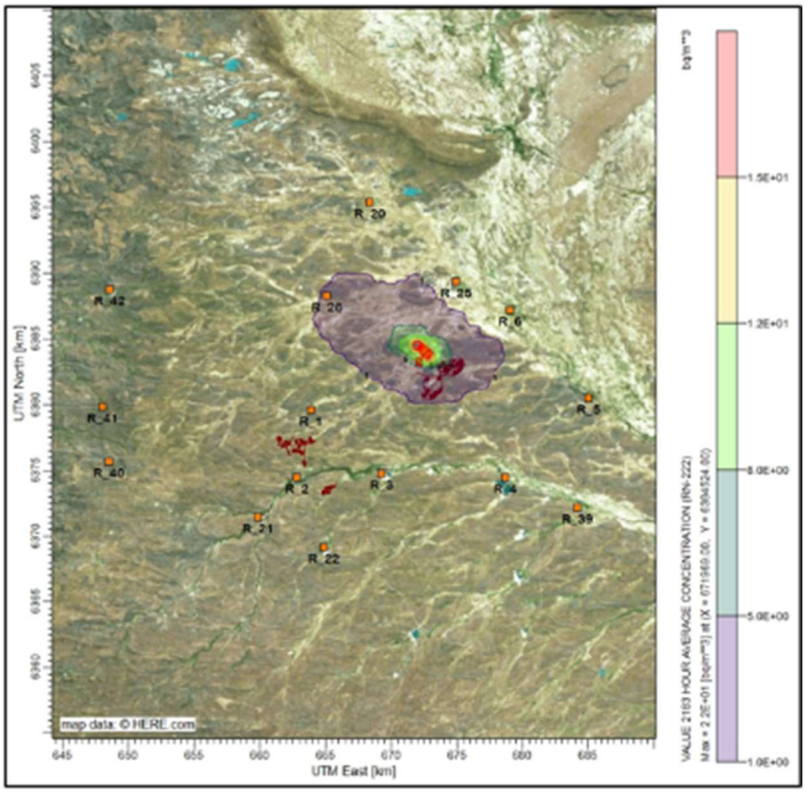

Figure 5-17. Air concentrations Rn-222 from a TSF with no post closure cover.

5.8.5.1 Identified Socio-Economic related impacts

5.8.5.1.1 Impacts identified through public participation

Stakeholder concerns may include some or all of the following:

- Changes in the demographics of the affected area:
  - Influx: A possible influx of migration workers with or without the necessary skills; destabilisation of the labour market, recruiting employees with the necessary skills from 'outside' the affected community;
  - Labour requirements: the number of job opportunities available and skills levels required;
  - Skills training: lack of skills of current unemployed labour force, the need for training of local population;
  - Temporary and permanent employment levels;
  - Recruitment: Transparent recruitment processes to be followed;
  - Social service: Effects of these changes on use of services such as schools and clinics.
- Opportunities for local businesses:
  - Use existing businesses and service providers for goods and services needed;
  - Impact on tourism;
  - Inability to conduct long term planning (farming investments) due to the unknown timeline for development of the mine.
- Social change:
  - Change in sense of place and character of the area, in turn affecting tourism
  - Traditional quiet lifestyles will be affected

- Increased traffic
- Increased crime and other social ills such as alcohol abuse and gambling
- Making a contribution to in poverty alleviation

- Pressure of social service and service delivery:
  - Housing: Ability to absorb increased need for accommodation;
  - Housing: Will remuneration of employees enable them to afford housing in the desired areas;
  - Spread of employees. Will employees live on their own or in the current communities;
  - Increased use of educational services as a result of influx. Learner teacher ratio already constrained and no busses from more rural areas;
  - Increased use of health services;
  - Increased taxation revenue to provide for service delivery;
  - Disturbance of livestock and game, increased poaching;
  - a 'boom and bust" scenario developing in the town as a result of speculation on, constraint on long term planning for land use by farmers and other industries.

These concerns are grouped together, the potential impact described and the significance, probability and duration of the impact is rated.

5.8.5.2 Construction

5.8.5.2.1 Demographics changes

5.8.5.2.1.1 Influx

Changes in the demographics of the population due to influx of workers both temporarily and permanently employed during construction of the mine. Although employment opportunities are not envisaged to exceed 30 either during construction or operational phases, the influx of hopeful employment seekers might far exceed the number of available jobs. Potential negative impacts may include an increase in social ills such as alcohol abuse, unlicensed gambling, predatory money lending services and sex trades. An influx of workers may also lead to the construction and erection of temporary and illegal housing.

5.8.5.2.1.2 Employment opportunities

Although employment opportunities are created by the proposed project, current skills levels and training of the community may not provide a good fit with the skills required at the mine. Skills development initiatives, described in the Social and Labour plan will also be implemented in order to ensure local employment opportunities. Potential positive impacts include these employment opportunities at various skills levels while potential negative impacts include skills levels that are not well matched with the mine requirements and employees with appropriate skills are brought from elsewhere. Tasman expressed the commitment to recruit all farm labourers directly affected by job losses.

Tasman will address current unemployment and any adverse impact on agriculture by means of a proposed Agri-Park. This will develop sheep breeding skills, benefit emerging farmers, develop knowledge and make land available on which to conduct this training. This will be located on the Neverset farm along the R61.

5.8.5.2.1.3 Economic displacement through land use restrictions

The proposed mine will not relocate any people or exhume any graves. Changes in land use will occur as a result of restricted access to mining sites. Farming activities will be disrupted within the mining areas and water use and land access may be impacted to varying degrees. Tasman undertakes to address any adverse events through consultation with the affected parties.

5.8.5.2.1.4 Infrastructure and services

Community access to infrastructure and services may experience minor changes as a result of the proposed project. Access to hospitals, educational facilities, piped water and emergency services may change to some extent, primarily due to more people making use of the facilities. Potential positive impacts may include an increase in the tax payer base enabling municipal development in line with the municipal development plans. There may be a slight increase in patients making use of health care facilities in the area.

5.8.5.2.1.5 Health

Tasman will ensure that employees receive nutrition and nutrition education, as this forms an integral part of the healthy productive workforce. This should be done by means of regular education and health screening of employees. This could be addressed by means of a disease management program for employees, an HIV policy in line with best practice, an HIV/AIDS prevention education program, and an annual HIV/AIDS awareness campaign.

5.8.5.2.1.6 Housing Need and Construction

Changes in number of people living/working in the area will lead to a demand for housing at the appropriate level/s of income. In some instances, this may result in more temporary housing being erected if not otherwise catered for, however, this may also lead to increased demand for accommodation in existing establishments during construction. This may present a business opportunity for development of housing, should the current supply not be sufficient. This may also lead to increases in need for rentals and houses on the market.

Temporary accommodation can be provided by the tourist accommodation providers in Beaufort West, however, it is recommended that permanent employees of the mine find permanent accommodation elsewhere in the town, not exceeding 3 months in any accommodation intended for normal tourism. This is to limit the impact of ‘crowding out’ tourists in the area. It is recommended that an accommodation audit be conducted once the operation phase of the mine is entered to ensure that employees does not make use of tourist accommodation as permanent homes.

A potential negative impact is that new housing development that does not support the character of the area, negatively impacting on the character of the area and as a result the long-term tourism potential. Insufficient housing may lead to urban sprawl or informal settlements.

5.8.5.2.1.7 Increase in Economic Activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

5.8.5.2.1.8 Changes in Cultural Heritage and Identity – "Sense of place" affecting Tourism

Tourism in the surrounding areas is based on the character of the towns. Tourism is a major economic contributor in the area as well (Atkinson, 2009, 2015; Toerien et al, 2016). Potential positive impacts include increased use of accommodation service providers in the tourism industry for temporary workers and consultants. This may also lead to a crowding out of tourists due to excessive use of tourist accommodation as temporary accommodation for mine workers. These changes may impact on the 'sense of place' for population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation); potentially leading to a decrease in the tourism industry, resulting in job losses over the long term. The planned mining operations are situated far out of town and it is not anticipated to have a pronounced impact on the town of Aberdeen. Mitigation measures include recommendations to employees to avoid making use of tourist accommodation for longer than three months at a time and that once operation of the mine has commenced that all accommodation should be of a permanent/rented basis excluding all tourism accommodation. Buffer zones around existing tourism accommodation providers in the vicinity of the proposed site should be at least 10km (Scholes et al, 2016).

5.8.5.3 Operation phase

During operation phase the mine is envisages to attract 16 new employees into the area, the impact during construction is based on this increase in population.

5.8.5.3.1.1 Demographic changes: Stabilised employment

Stabilised employment is expected during the operational phase. Although people with scarce skills may be sourced from outside of the development area, training during construction phase will allow more relevant skills in the local community during recruitment for operational phase.

5.8.5.3.1.2 Infrastructure and services

Community access to infrastructure and services may change as a result of the proposed project.

Long term accommodation: Housing

There is a potential increase in the permanent formal housing stock available in the towns. *Potential positive impact:* Development of formal housing of good standard. *Potential negative impact:* Failure to address permanent formal housing need, may result in development of 'out of character' houses, negatively impacting on the character of the town

5.8.5.3.1.3 Economic activity

An increase in the employment levels and/or income earning population in the towns may cause an increase in economic activity in the towns.

5.8.5.3.1.4 Changes in cultural heritage and identity – 'Sense of place' affecting tourism

Tourism in the vicinity of Aberdeen and Beaufort West is based on the character of the towns. Tourism is an economic contributor. The component of external specialists / highly skilled persons that will reside in either Aberdeen or Beaufort West during the construction and operational phase is expected to create a positive impact on the local economy. This will occur primarily through local salary spend. During the construction phase, it is anticipated that local accommodation will be one of the significant benefactors of this economic stimulation.

Potential positive impacts: Increased use of accommodation providers in the tourism industry for temporary workers and consultants. Development of modern housing using the local vernacular architecture to increase accommodation for workers.

Potential negative impacts: Changes to the 'sense of place' for population and tourists (such as noise, dust, air quality, light pollution and visible degradation in vegetation). Decrease in the tourism industry, resulting in job losses over the long term. However, since the proposed operation is located outside of the identified tourism routes / areas as well as its small scale and its isolated setting this impact is anticipated to be less significant.

5.8.5.4 Decommissioning

5.8.5.4.1.1 Reduction of employment opportunities

During decommissioning, employment opportunities will most probably decrease during de-commissioning and closure phases.

5.8.5.5 Identified Traffic related impacts

5.8.5.5.1.1 Identified Construction Phase Impacts

It is not expected that the construction phase will generate a significant number of vehicles. Some large pieces of equipment need to be delivered to the site, which typically includes the following:

- Haul trucks (30ton),
- Face shovels,
- Wheeled loaders, Dozers, Graders, Water bowsers
- Crushers and conveyors
- Construction Site Vehicles (These vehicles and equipment will also be used during the operational phase):
- Tractor, Trailer Power Bin & Container
- 6 Tractor Trailer Skips
- 6 ton Fork Lift
- Mobile Crane
- Telescopic Handler

- 6 Pick-up trucks
- 4 Skid Steer Loaders
- Fuel Bowser
- 2 Toyota Quantums (or similar).

The following activities will probably occur during the construction phase:

- Construction of haulage and access roads,
- Stripping and moving of topsoil,
- Excavation and construction of the waste rock pads,
- Construction of the office buildings and workshops, and
- Water management infrastructure (berms, PCD, bunded areas).

The access roads will be constructed mainly of local materials sourced from the mining site and borrow-pits in the area. There are existing borrow-pits in the area, but it is not known if these are open. Licences will be required to utilise these borrow-pits for the construction of the access roads. For private access roads, the developer can determine the specification for the access roads. The planned access roads are 4.5m wide and will have bypass areas at regular intervals to accommodate heavy vehicles. The layer works of these access roads will vary depending on the quality of the in-situ material as well as the duration of the mining activities at the respective mining areas. The typical layer work design for this type of access road is a 300mm gravel layer with a 100 to 150mm wearing course. The wearing course is optional, but will minimise the maintenance required on the access road. The wearing course will probably have to be sourced from a commercial source. The volume of material required for road construction purposes can only be determined during a more detailed design process, but based on the information above it can be roughly 2 000m³ gravel and 1 000m³ wearing course material per one kilometre of road.

The mining equipment and other building material will be trucked to site and it is expected that most of the construction traffic will come via the N1 through Beaufort West. It is expected that during the peak of the construction phase of the Karoo Uranium Project the number of additional trips on the road network will be less than 100 trips during an average eight hour day, which includes an estimated 20 percent truck traffic. This means that that the estimated construction traffic during the peak construction period will be approximately 12 additional vehicular trips (10 light & 2 heavy) per hour during the typical week day on the road network. These traffic volumes are low in terms of the intersection and road network operation and the impact is more related to a nuisance factor with regards to possible noise and dust pollution. A recommended mitigation measure to reduce the possible dust pollution is to spray the access roads with a water based surfactant on a regular basis during the peak construction period. Non-potable water should be sourced for this purpose.

5.8.5.5.1.2 Operational Phase

Equipment

Based on information received from the developer and information sourced from other similar projects it is estimated that the following equipment will be required on site during the operational phase.

Mining Equipment

- Haul Trucks (30t)
- Face Shovels
- Wheeled front end Loaders
- Dozers
- Graders, and
- Crusher and Conveyors (Fixed).

Trip Generation

Estimates of the peak hour vehicle trips for new developments are typically based on empirical observations at similar land uses. The estimates summarised in Table 5-24 are based on information provided by the developer. These assumptions are based on the expected production during the operational phase and are considered the worst-case scenario.

Table 5-24. Expected Public Road Generated Trips during the Operational Phase

Activity/Component	Rate for LRP
Chemicals	15 trucks per day
Staff	4 buses/ 8 minibuses/ 20 private vehicles per day
Fuel	2 trucks per month
Blasting and Drilling	8 bakkies/ 8 trucks per month
Ore haulage between mines and processing plant	14 trucks 10 round trips/day
End product shipment	4 truck per month
General mining vehicles	16 bakkies/ 3 minibuses per day

Based on the information above it is expected that the overall mining operations will generate approximately 400 new daily trips of which most will be truck traffic during the peak operational phase. On average the mining operations will occur at three sites simultaneously and the 400 trips includes 280 trips of the haulage trucks between the mine sites and the CPP. The mine sites will generate approximately 100 trips each with an additional 100 trips to/from the CPP in the Ryst Kuil application area. The haul trips to/from the mining areas within the Ryst Kuil application area will all be on private roads. Based on the information above the maximum number of trips on any public road will not exceed 200 vehicles per day. Based on an average of 20 hour operational time per day it means 10 new trips on public roads during any hour of the day.

Trip Distribution and Assignment

It is expected that all of the operational trips to/from the processing plant and the different mining areas will come from Beaufort West and Aberdeen via the existing road network. Most of the trucks delivering the equipment and components are also expected to come via the N1 through Beaufort West. The trucks transporting the ore between the mines and the processing plant during the initial mining phase will use a

section of the R306, a section of the R61 and sections of Provincial Divisional and Minor Roads in the site vicinity. Refer to Figure 3-13 for a layout indicating the initial mining infrastructure and haul routes.

Transport Impact

Based on the expected number of construction and operational trips generated by the proposed Karoo Uranium Mine the existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.

Based on the trip generation estimate the mining operation will result in 100 truck trips (50 loaded/50 returning) per day along each of the haul routes. This is approximately 5 truck trips per hour if it is assumed that the mining operation will run for 2 shifts within every 24hr cycle. The majority of the ore mined in the Ryst Kuil section will not be transported on public roads. The impact of the additional truck trips as a result of the mining operation will be insignificant in terms of capacity and operation of the intersections along the surrounding road network. The current annual daily traffic volume (ADT) along the R61 is approximately 680 vehicles. The additional mining trips will result in a 15 percent increase in ADT along the R61, which is insignificant in terms of the capacity of the road. The Roads Authority has recently implemented speed over distance measurement along sections of the R61, which has reduced speeding along the road and improved safety. The speed differential between the trucks along the R61 at the haul route access points and the through traffic along the R61 in a possible concern. However, the sections of the R61 at the access points are straight and flat and there is sufficient stopping sight distance along the R61 for through traffic along the R61 to see trucks way in advance. Proper warning signs should be erected along the section of the R61 at the access points to warn motorists of slow moving and turning trucks.

Gravel roads such as the R306 can accommodate between 300 and 400 vehicles per day, depending on the type of vehicles. During construction and operational phases, it is expected that road surface of the gravel roads will require maintenance at regular intervals. It is recommended that the access roads be sprayed with a water based surfactant at least once a day to reduce dust pollution. Non-potable water should be sourced for this purpose.

The initial mining activity will occur over approximately 12 years. Based on the project phasing as indicated in Table 3-2 it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day. As the mining activity expands to other mining sites production at the initial mining sites will reduce and the net impact on any public road is not expected to exceed 200 vehicles per day.

All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area. No specific upgrades are recommended along the general road network.

Gravel Loss

Several methods are available for the prediction of gravel loss on gravel roads based on traffic volumes and wearing coarse characteristics. The guideline document TRH20 provides the following model for the estimation of gravel loss:

$$AGL=3.65\ [ADT(0.059+0.0027N-0.0006P26)-0.367N-0.0014PF+0.0474P26]$$

Where:

AGL = annual gravel loss

ADT = average daily traffic (per direction)

N = Weinert N-value = 7.5 for this area based on weather and rainfall.

P26 = percentage passing the 26,5mm sieve

PF = product of plastic limit and percent passing 0.075mm sieve

The average annual gravel loss was estimated based on the above model and the results are included in Table 5-25**.** From the results of the analysis it is evident that the increase in gravel loss along these roads will be significant.

Table 5-25. Gravel Loss Estimates

Measure	Existing Traffic	Total Traffic With Development	Difference
MR411:			
ADT	64	255	191
N	7.5	7.5	
P26	89%	89%	
PF	10	10	
AGL (mm)	11.3	29.4	***18.02***
Measure	**Existing Traffic**	**Total Traffic With Development**	**Difference**
DR2358:			
ADT	9	200	191
N	7.5	7.5	
P26	89%	89%	
PF	10	10	
AGL (mm)	6.1	24.2	***18.02***

5.9 Identified Water related impacts

The identified surface and ground water related impacts have been summarised in the table below with their applicable ranking.

5.9.1 Predicted groundwater impacts

5.9.1.1 Inflows

Mining is assumed to commence in the second model stress period. The active mine periods are a 'quarter of a year' / 'three months' in length such that there are thirty-three model periods, covering 9.25 years of mining. This is followed by four model stress periods representing the 10 years of recovery post-mining. The particular OP or UG in operation is highlighted in yellow and blue, respectively. The number shown in each cell per pit area and time period is the average approximate inflow rate in units of L/s. Note that this inflow rate is calculated from an 'integrated average volume' over the period of active mining of the specified area. The final columns show the total inflows per time period, in units of L/s and m^3/hr. The following key points are noted:

Upper Envelope (S of 0.01)

- An estimated cumulative inflow rate of >100 L/s occurs during Year(Y)4 Quarter(4) to Y8Q3 at Ryst Kuil Main OP1, 2 and 3 and Haanekuil OP3 and UG3, peaking at c.140L/s during Y5Q2 and Q3. This is mainly a result of the depth of mining, i.e. c.130m below the natural groundwater level.

Lower Envelope (S of 0.001)

- The highest estimated cumulative inflow rate of c.60 – 70 L/s occurs during Y6Q1 to Y8Q3, mainly at Ryst Kuil Main OP1, 2 and 3 and Haanekuil OP3 and UG3. This is mainly a result of the depth of mining, i.e. c.130m below the natural groundwater level.

5.9.1.2 Drawdowns

Figure 5-18, Figure 5-19, Figure 5-20 and Figure 5-21 show the modelled drawdown zones for periods of 1 year, 5 years, 9.25 years mining and 10 years post-mining for the upper and lower envelopes and zoomed in over the Ryst Kuil and Haanekuil areas, respectively. Drawdowns >5m are considered significant in terms of potential effect on local private groundwater users and thus the contours commence at -5m and continue in 5m intervals. The outlines of the mining areas are shown in colours and are labelled.

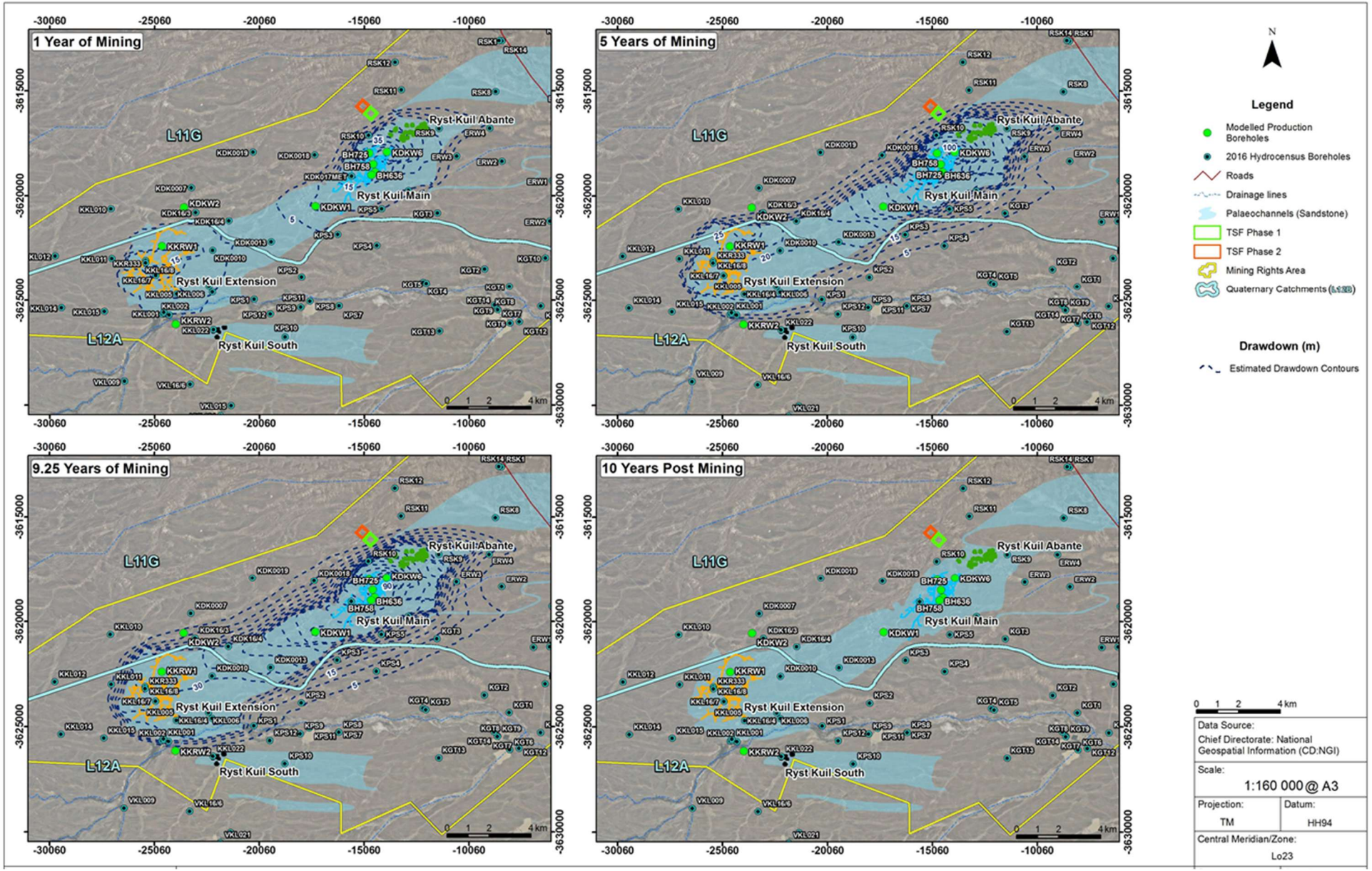

Figure 5-18. Potential Drawdown near Ryst Kuil (Scenario 1 – With Backfill).

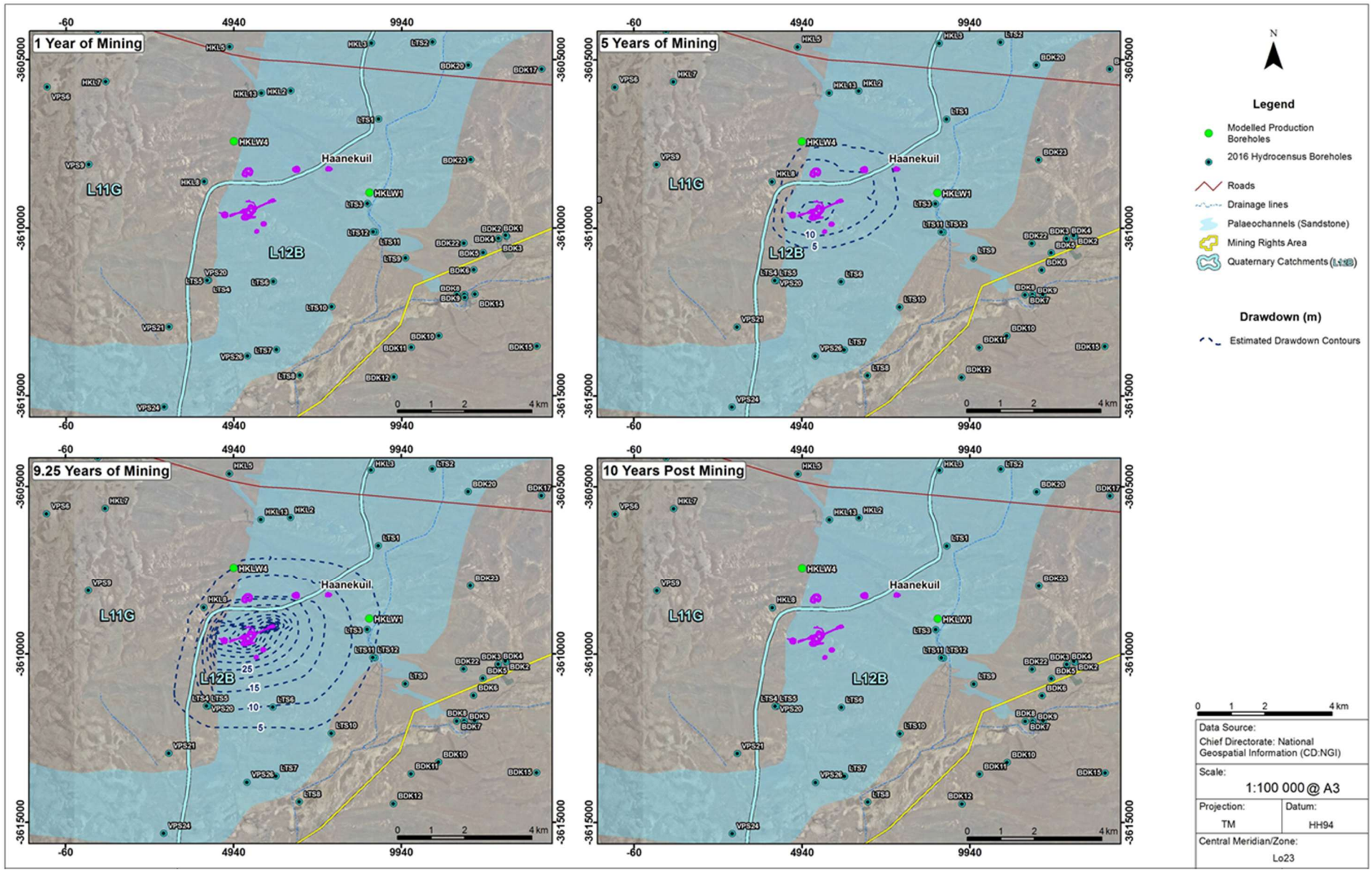

Figure 5-19. Potential Drawdown near Haanekuil (Scenario 1 – Channel Sandstone S = 0.001).

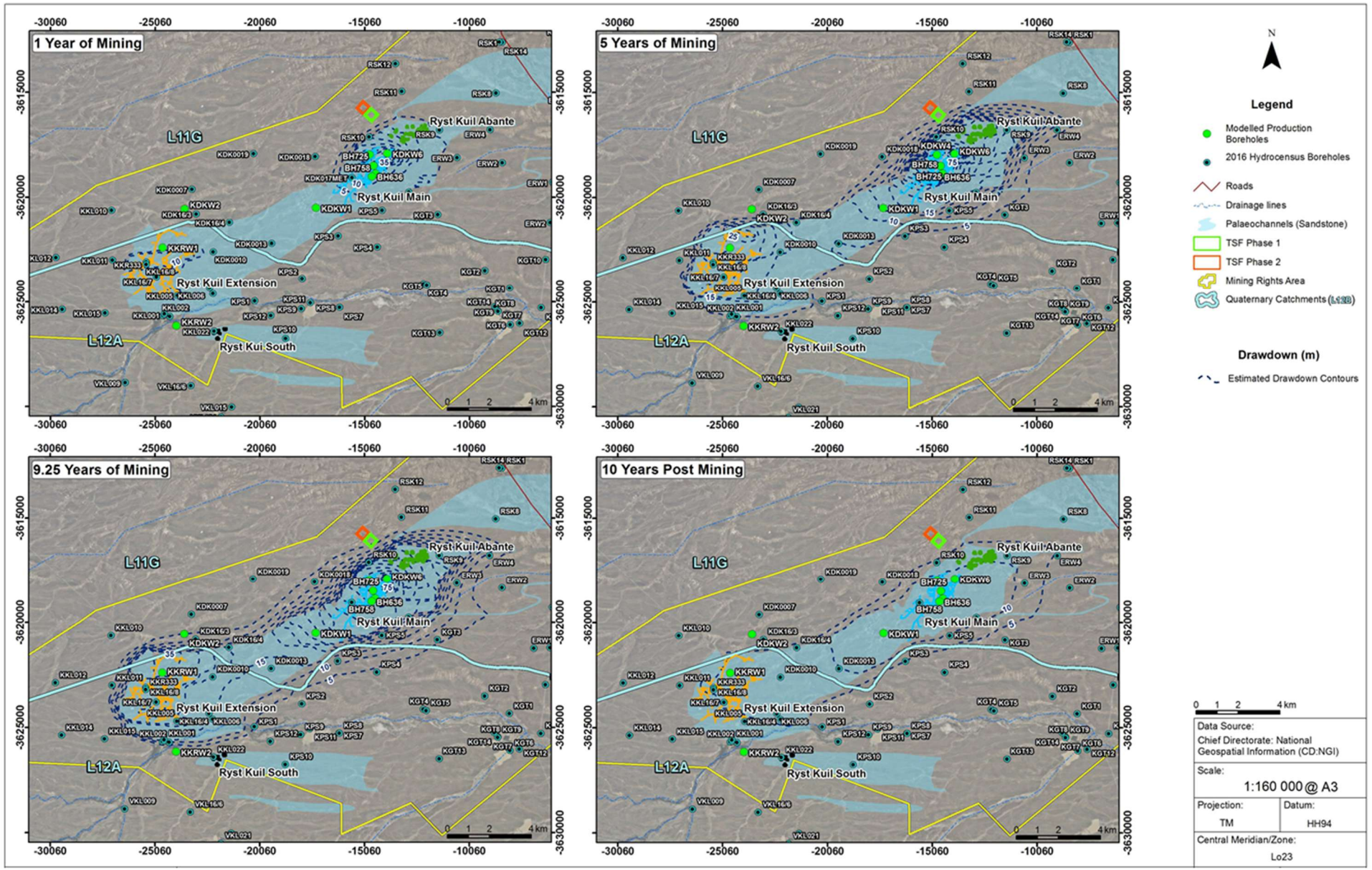

Figure 5-20. Potential drawdown near Ryst Kuil (scenario 2 – channel sandstone s = 0.01).

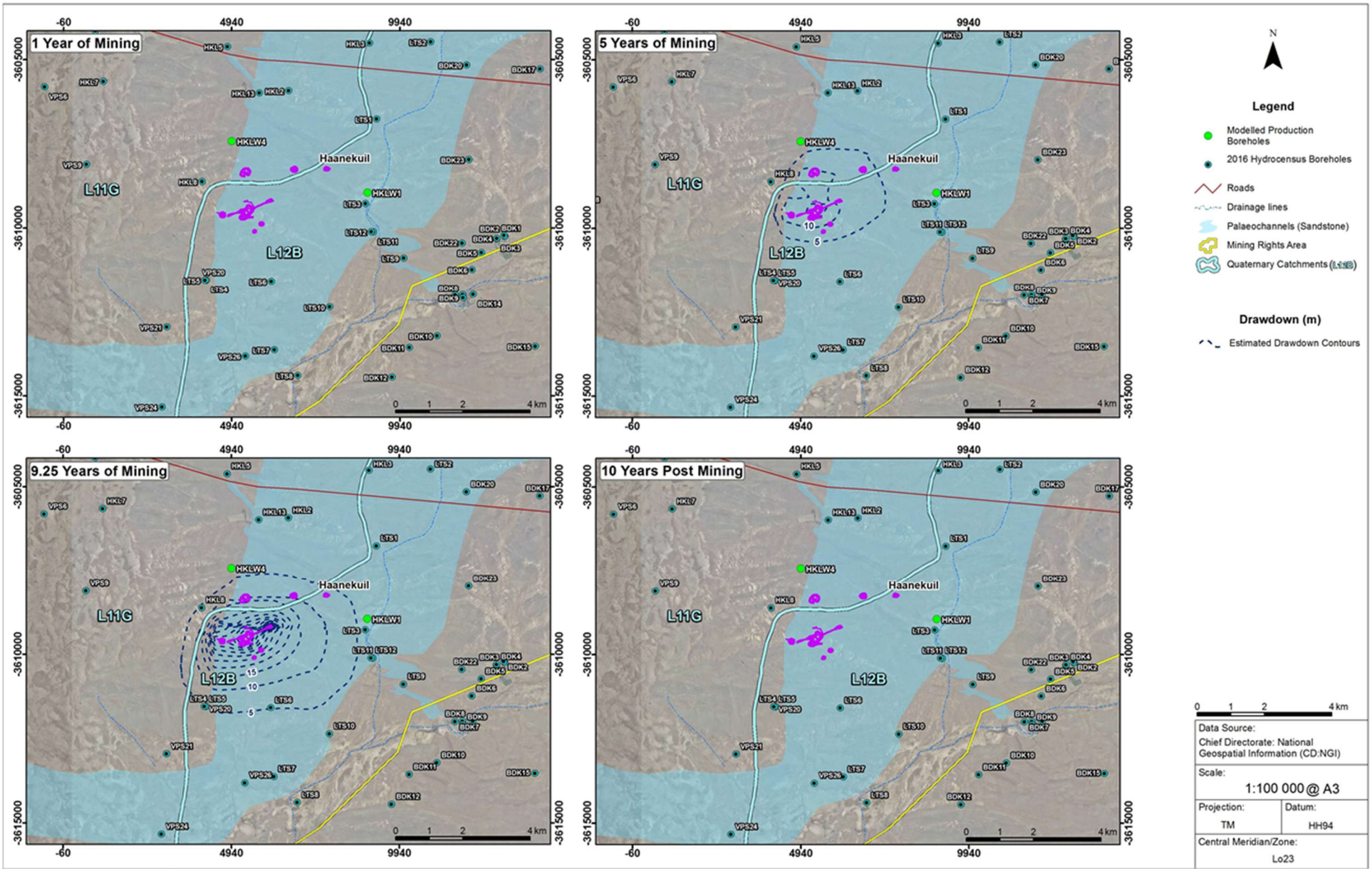

Figure 5-21. Potential drawdown near Haanekuil (scenario 2 – channel sandstone s = 0.01).

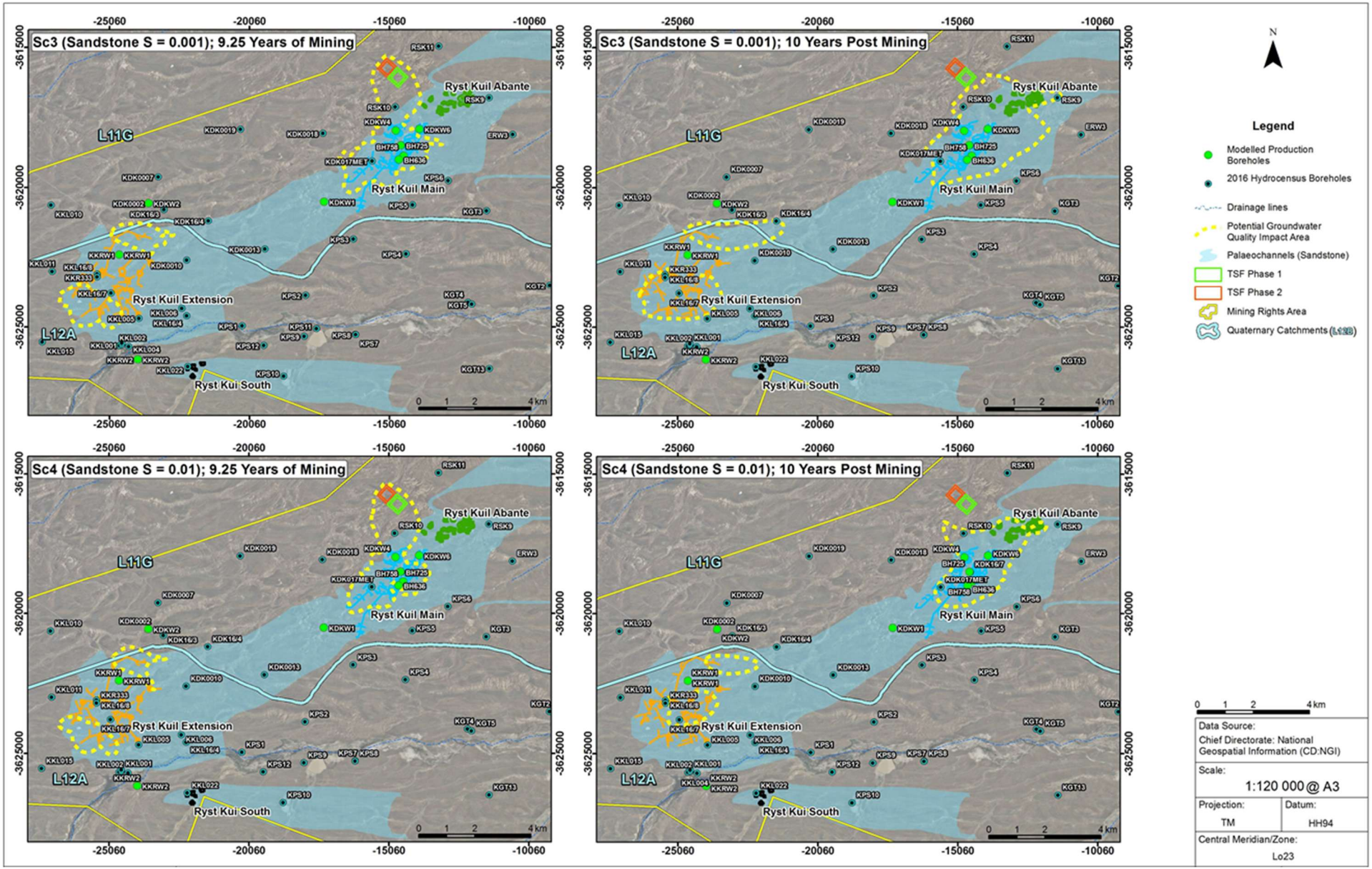

Figure 5-22. Potential groundwater quality impact area in Ryst Kuil area for 'all pits backfilled' scenarios.

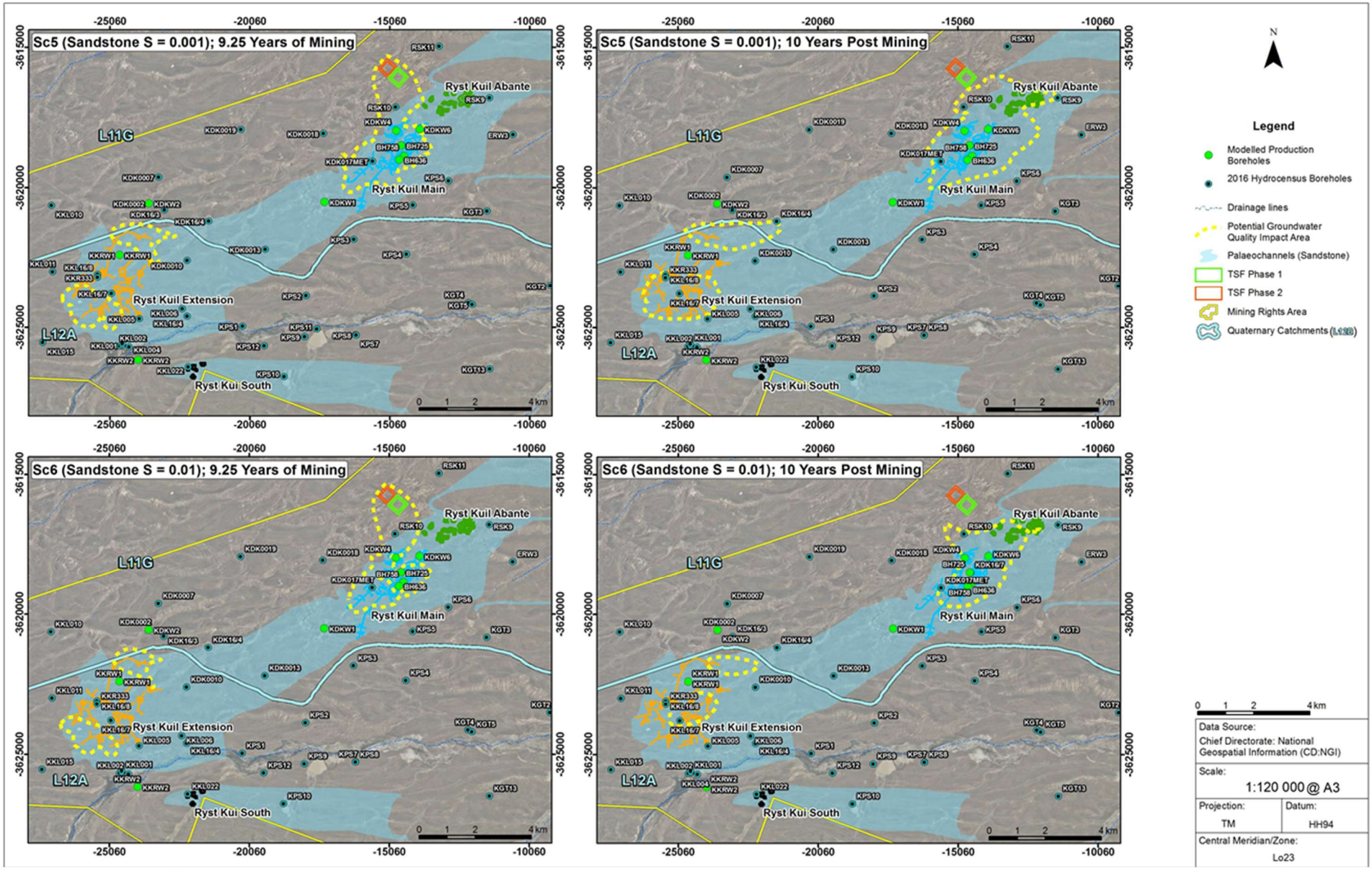

Figure 5-23. Potential groundwater quality impact area in Ryst Kuil area for 'one pit per area not backfilled' scenarios

The following key points are noted:

Upper Envelope (S of 0.01)

- The >5 m drawdown zone expands to a maximum of c.19km (NE-SW) x c.6km (NNW-SSE) in the Ryst Kuil sub-areas after 9.25 years of mining, with a preferential expansion along the channel sandstone aquifer and mining areas. Twenty currently privately-owned boreholes could be temporarily affected by >5m drawdowns, which might impact on yields and possibly water quality;
- At Haanekuil the >5m drawdown zone expands pseudo-radially to a radius of c.2km after 9.25 years of mining. Three currently privately-owned boreholes could be temporarily affected by >5m drawdowns, which might impact on yields and possibly water quality;
- It is likely that the actual drawdown will not reach the extent shown, due to lack of interconnectivity between individual fractures;
- Recovery of the drawdown zone in the Ryst Kuil sub-areas is significant in terms of depth and area (c.50%) 10 years after cessation of mining, with backfilling, and is complete at Haanekuil; and
- With no backfilling, the drawdowns will recover more slowly and to a lesser extent because of high evaporation from the exposed pit lakes, which is taken into account in the modelling.

Lower Envelope (S of 0.001)

- The >5m drawdown zone expands to an essentially similar extent in the Ryst Kuil sub-areas and Haanekuil, as drawdown is more strongly affected by changes in T rather than S/Sy;
- It is likely that the actual drawdown will not reach the extent shown, due to lack of interconnectivity between individual fractures;
- Recovery of the drawdown zone (>5m) in the Ryst Kuil sub-areas and Haanekuil is essentially complete 10 years after cessation of mining, with backfilling; and
- With no backfilling, the drawdowns will recover more slowly and to a lesser extent because of high evaporation from the exposed pit lakes, which is taken into account in the modelling.

5.9.1.3 Groundwater Quality

Figure 5-22 and Figure 5-23 show the potential groundwater quality impact area near Ryst Kuil, for the scenario of that which follows immediately after 9.25 years of mining, and then a further 10 years of recovery post-mining for the scenarios of backfilling all pits versus allowing for pit lake formation in one defined pit per area, respectively. The yellow dashed contours indicate the maximum estimated extent of the affected area. The following key points are noted:

- Potential contamination can arise from the open pits due to interaction of rainwater through waste rock, (increased exposed area for mineral dissolution), evaporation of inflow and surface runoff water concentrating salts and reaction with exposed areas of ore;
- At mining, there is a small potential impact area around Ryst Kuil Extension, Ryst Kuil Main and the TSF. Potential impacts from other areas are captured by the drawdown zone of the dewatered pits;
- Ten years post-mining, and with backfilling in all pits, the potential impact areas can be seen to contract slightly, with the potential to slightly change water quality at a maximum of four currently privately-owned boreholes;
- If a pit lake is allowed to form at one downgradient pit in all areas, then the modelling shows a slight decrease in impacted area linked to the pit lakes showing a continuous drawdown of c.5m below natural

groundwater levels / recovery levels in the area (due to the effects of evaporation) and thus local groundwater advective flow is inward, which would therefore serve as a potential contaminant 'trap' or 'sink' and pits would never 'overtop';

- Upper and lower envelopes of storativity result in very similar groundwater impact areas, thus showing a relatively low sensitivity of the contaminant transport model to storativity assigned to the channel sandstone; and
- Water quality monitoring in and around the trial mine shows no indication of residual acid rock drainage or a contamination plume.
- Five years post mining, potential contaminant plumes near Haanekuil migrate southwards from the Haanekuil pits in an ellipsoid shape to a maximum distance of c.500 m. However, these plumes dilute to background levels by ten years post-mining;
- If a pit lake is allowed to form at one down-gradient pit in all areas, then the modelling shows a slight decrease in plume area linked to the pit lakes showing a continuous drawdown of c.5 m below natural groundwater levels / recovery levels in the area (due to the effects of evaporation) and thus local groundwater advective flow is inward, which would therefore serve as a potential contaminant 'trap' or 'sink' and pits would never 'overtop'.

The following mitigatory measures are proposed:

- Carry out further site-specific investigations before mining commences for pit/underground mine geological structures, groundwater monitoring and to establish a groundwater supply and determine specific mine groundwater management requirements, e.g. dewatering boreholes, sub-horizontal drain holes and sumps. A Water Use Licence Application will be required.
- Install 'early warning' boreholes so that any negative effects of mining can be identified before they cause interference with privately-owned boreholes.
- Do not backfill the "downstream" open pit in each mining area so that it acts as a "sink" to capture any contaminated groundwater.
- Prepare contingency plans to maintain current water supply (volumes) and quality to potentially adversely affected landowners.

Based on the information provided and conclusions of this report, the following is recommended:

- Investigate the practicality, effectiveness and cost of groundwater control measures such as grouting of fractures, dewatering boreholes, and re-use options such as artificial recharge using excess water made from mining and supply of excess water to affected and/or other existing/potential groundwater users.

Update the numerical modelling (possibly using a fracture-flow modelling code) to refine scenario predictions if new data become available on mine plans, geological structures and from monitoring and to include the above groundwater control measures and extension of the mining duration.

5.10 Identified Green House Gas Related Impacts

As climate change has risen the international socio-political agenda, awareness and knowledge of the potential consequences of climate change caused by increasing levels of GHGs, such as carbon dioxide (CO_2), in the

atmosphere, has expanded. International initiatives such as the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) prescribe carbon emission targets for industrialised countries and introduced market mechanisms to help countries achieve these targets, e.g. by trading carbon credits.

Building on two decades of negotiations, the Paris Agreement, adopted by consensus on 12 December 2015 at the 21st Conference of the Parties, marked a significant milestone towards further political acknowledgement of the need to address the causes and consequences of climate change. As of June 2017, the Paris Agreement has been signed by 195 countries. South Africa has been an active stakeholder to the UNFCCC since the onset. The country has pledged to peak its GHG emissions between 2020 and 2025, first at 34% and then at 42% of a business-as-usual emissions trajectory, then plateau for approximately a decade and decline in absolute terms thereafter; subject to adequate provision of financial resources, technology transfer and capacity building support provided by developed countries (UNFCCC, 2011, cited in Montmasson-Clair, 2016).

Against that engagement, South Africa's economy is historically structured around the affordable and abundant supply of coal-based electricity and the domination of energy-intensive mining value chains (Fine and Rustomjee, 1996, cited in Montmasson-Clair, 2016). In 2012 South Africa emitted some 462.6 Mega tonnes Carbon Dioxide equivalent (Mt CO_2-e) (or 1.07% of global GHG emissions) (WRI, 2015) and was the 12th-largest GHG emitter in the world because it was / is dependent on coal for ~95% of its electricity generation (Mail & Guardian, 2013). Electricity generation (by Eskom) accounted for more than 60% of the country's GHG emissions over the 2000 – 2010 period (Montmasson-Clair, 2016), or 391.8 Mt CO_2-e in 2012 (WRI, 2015).

Industrial activities, including mining, accounted for some 6% of direct emissions to South Africa's GHG emissions over the 2000 – 2010 period. The mining sector is a significant indirect GHG emitter, as it consumes about 15% of Eskom's annual electricity output. Gold (47% of the total) and platinum

(33%), i.e. the two main underground minerals mined in the country, are the heaviest users. Other indirect GHG emissions arise from the sector's use of transportation networks (e.g. Transnet) (Montmasson-Clair, 2016).

Quantification of Greenhouse Gases:

The LRP will emit GHG from several sources. The most significant sources are:

- Fuel consumption by vehicles used to transport ore, product, staff and materials to and from the mines and processing plant;
- Fuel consumption by mine equipment / plant / machinery;
- Fuel consumption by generators providing power at open pit mines; and
- Electricity consumption to operate ventilation systems and conveyers at the underground mines and the processing plant. Electricity obtained from Eskom is generated by coal-fired power plants.

Emissions from fuel consumption fall within Scope 1 (direct) emissions, while emissions from electricity consumption are Scope 2 (indirect) emissions. Scope 1 emissions are all direct GHG emissions, i.e. emissions from sources that are owned or controlled by the reporting entity. Scope 2 emissions are indirect GHG emissions from consumption of purchased electricity, heat or steam. Scope 3 emissions cover 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 (e.g. transmission and distribution losses) not covered in Scope 2, outsourced activities, waste disposal, etc. (GHG Protocol).

Based on information provided by the applicant, it is anticipated that the mine operations will consume some 87 million litres of diesel over the 9-year Life of Mine (LoM) (see Table 5-26). In the same period, mine operations will consume some 512.3 million kWh of grid electricity generated by coalfired power plants.

Table 5-26. Estimated diesel consumption (litres) by the LRP

Year	Ore hauling and mine machinery	Transportation of materials, staff, product	Open pit mine generators	Total
Year 1	6,409,022	1,879,836	-	8,288,858
Year 2	8,609,952	2,525,393	-	11,135,345
Year 3	9,566,209	2,805,873	-	12,372,082
Year 4	9,805,623	2,876,096	-	12,681,719
Year 5	9,822,425	2,881,024	-	12,703,449
Year 6	10,264,650	3,010,734	-	13,275,384
Year 7	7,544,144	2,212,779	1,050,000	10,806,923
Year 8	3,693,578	1,083,367	55,000	4,831,945
Year 9	678,293	198,951	-	877,244
Total	66,393,896	19,474,053	1,105,000	86,972,949

Table 5-27. Estimated grid electricity consumption (kWh) by the LRP

Year	Ventilation systems and conveyers at underground mines
Year 1	22,934,992
Year 2	49,323,650
Year 3	66,701,184
Year 4	70,807,722
Year 5	73,967,650
Year 6	75,549,818
Year 7	71,228,654
Year 8	66,481,790
Year 9	15,289,995
Total	**512,285,455**

The following emission factors were applied to calculate the CO_2-e emissions from the above diesel and electricity consumption:

- Burning of one litre of diesel emits on average 2.2 kg of CO_2-e (EPA, 2005); and
- Electricity generated in South Africa produces approximately 1.04 tonnes of CO_2-e (tCO_2-e) per MWh (Eskom, 2012).

The project will emit an estimated 191,340tCO_2-e direct Scope 1 GHGs over the LoM, through consumption of diesel. Consumption of procured coal-derived electricity for mine operations will emit approximately 532,777t CO_2-e Scope 2 GHGs; generation of these is not under the direct control of the project. Together, Scope 1 and Scope 2 GHG emissions are equivalent to some 724,117t CO_2-e over the LoM.

Table 5-28. Estimated CO_2-equivalent project emissions

Aspect	Consumption	Emission factors	tCO_2-e
Scope 1: Diesel consumption (kilolitres)	86,973	2.20	191,340
Scope 2: Electricity consumption (MWh)	512,285	1.04	532,777
Total			724,117

The estimated annual LRP GHG emissions are provided in Table 5-28, Figure 5-24. Emissions quickly increase in Years 1-4, peak in Year 6 and quickly reduce in Year 9, when mining is expected to have ceased and final ore stocks are processed in the processing plant.

Table 5-29. Estimated annual CO_2-equivalent project emissions (in t CO_2-e)

Year	Scope 1 emissions	Scope 2 emissions	Total GHG emissions
Year 1	18,235	23,852	42,088
Year 2	24,498	51,297	75,794
Year 3	27,219	69,369	96,588
Year 4	27,900	73,640	101,540
Year 5	27,948	76,926	104,874
Year 6	29,206	78,572	107,778
Year 7	23,775	74,078	97,853
Year 8	10,630	69,141	79,771
Year 9	1,930	15,902	17,832
Total	**191,340**	**532,777**	**724,117**

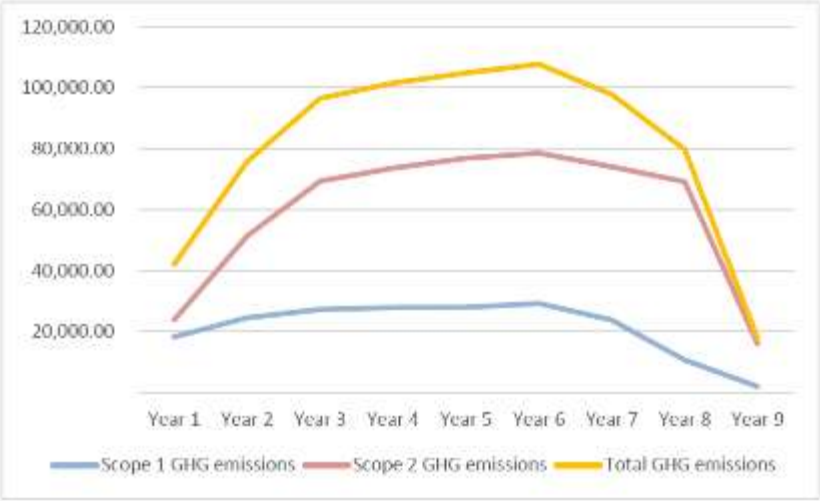

Figure 5-24. Estimated annual CO_2-equivalent project emissions (in tCO_2-e).

5.10.1 Impact Discussion:

Scope 2 emissions account for 74% of total (combined) Scope 1 and 2 emissions by the LRP, directly attributable to South Africa's carbon-intensive electricity generation. However, Scope 1 (transportrelated) emissions by the project are relatively high - with a contribution of 26% - compared to a contribution of less than 10% at South Africa's main platinum companies (Montmasson-Clair, 2016). This is likely a reflection of long hauling distances, as mine pits are spread over a significant area. The combined Scope 1 and 2 GHG emissions from the project are the approximate equivalent of:

- About 0.0016% of total South African GHG emissions;
- The GHG emissions of 100 000 Cape Town residents (at ~7.8 tCO_2-e per person, Cape Town Green Map);
- The GHG emissions of 57 000 South African households (12.8 tCO_2-e per household, City of Cape Town);
- 28% of the GHG emissions of South Africa's smallest power station Komati (2.6 million tCO_2 e, Eskom, 2012); or
- The CO_2 stored in 724 000 mature trees (at ~1 tCO_2-e per tree, Platbos).

The effects of climate change are global, and GHGs are emitted worldwide from a number of sources. Seldom is any one source a significant emitter, but combined they emit enormous quantities of GHGs. As such, it is difficult to meaningfully rate the contribution of the project as a single emission source, and the impact has not been rated formally. The GHG emissions associated with the project are significant, notably using coal-based electricity that accounts for the bulk of project emissions, but which are formally reported in Eskom emissions inventory. Measures to reduce the GHG emission volumes associated with the project can include:

- Operational changes, including increasing energy and fuel efficiency and substituting coal-derived grid power with renewable energy; and
- Offset measures, such as the support of carbon-reducing schemes.

However, the implementation of such measures is expected to require operational adjustments at the project that might not be technically or financially feasible. The slow-paced decarbonisation of South Africa's electricity system, which would address the bulk of GHG emissions from the mine, is largely out of the control of the industry (Montmasson-Clair, 2016).

The estimate of GHGs that will be emitted by the LRP over its lifetime is relatively coarse and based on the key emission sources, notably estimated volumes of fuel (Scope 1 emissions) and electricity (Scope 2 emissions) consumption. The estimated GHG emissions amount to 724 117 tCO_2-e over the LoM, which is the equivalent of 0.0016% of South African GHG emissions. If one adopts a precautionary, conservative approach and applies a factor of +50%, GHG emissions of approximately

1.1 Mt CO_2-e would equate to approximately 0.0024% of South African GHG emissions. Scope 2 emissions account for 74% of GHG emissions by the LRP, directly attributable to South Africa's carbon-intensive electricity generation regime.

Despite the high contribution of Scope 2 emission, which are not under the direct control of the project, it is recommended that emissions are reduced where possible.

The National Greenhouse Gas Emission Reporting Regulations (Notice 275 of 2017) in terms of the National Environmental Management: Air Quality Act 39 of 2004, list a range of Activities in Annexure 1 for which GHG emissions must be reported. Based on our understanding of the project, this does not apply to the LRP, as it does not operate a stationary combustion plant with a combined capacity of 10 MW or more on site.

On 8 January 2016, the Minister of Environmental Affairs declared her intention to declare GHG as priority air pollutants, and production processes listed in Annexure A would be required to prepare and submit a pollution prevention plan for approval. In its current form, this would not apply to the LRP.

Note: The mined uranium is in part intended for nuclear power production, which will have the effect of significantly reducing emissions vis-a-vis coal. However, this report does not report on such reductions, which are discussed in the motivation of the project in the EIA.

5.10.2 Identified Electricity Distribution Related Impacts

The external supply of electricy from the Eskom grid to the CPP has been addressed. An application for a 15MVA, 11kV point of supply at the CPP will be submitted to Eskom. The estimate makes provision for a 45km 132kV overhead line from the Eskom substation near Beaufort West to a new outdoor 132/11kV Eskom substation at the CPP. The estimate makes provision for two 20MVA 132/11kV transformers. The environmental authorisation process for this overhead line will be initiated only if mining right approval is granted and no construction may be initiated prior to authorisation.

The internal distribution of electricity has been considered in terms of the potential impacts associated with the installation of such a distribution network to each mining site as well as the required maintenance of such networks. The planned internal distribution requires a single gum pole installation which requires short drilled holes due to the hard rock environment of the Karoo. It is proposed by the project engineers to align the electricity distribution alongside the planned haul road alignments. This would enable access for installation as well as maintenance without impacting on additional veld surface area. For these reasons this infrastructure is not discussed further in this EIA.

5.10.3 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.

Activities	Initial Proposed Layout	Final Layout	Discussion
Operational area	Ryst Kuil Extension ~298ha Ryst Kuil Main & Abante = ~1,111ha Haanekuil = ~1070ha CPP = ~ 34ha TSF = ~192ha	Ryst Kuil Extension ~298ha R Ryst Kuil Main = ~218ha Ryst Kuil Abante = ~196ha Haanekuil = 353ha CPP = ~ 40ha TSF = ~ 79ha	The advantages of a reduced operational area are numerous. • Reduced biodiversity impact • Reduced impact on surface water drainage • Reduced impact on agricultural activities This reduction in operational surface area is not deemed to have any disadvantages.
Stockpiles	Ryst Kuil Extension =~53ha Ryst Kuil Main = ~18ha Ryst Kuil Abante = ~26ha Haanekuil = ~114ha	Ryst Kuil Extension ~34.6ha Ryst Kuil Main ~ 29.8ha Ryst Kuil Abante ~ 27.8ha Haanekuil ~27.4ha	The advantages of a reduced stockpile area are numerous. • Reduced biodiversity impact • Reduced clearance of local vegetation • Back-filling of pits would reduce impact of pollution plume formation and migration. • Reduced impact on surface water drainage

			This reduction in stockpile surface area is not deemed to have any disadvantages.
Road alignment	Road alignment 1 ~ 133.5km Alignment 2 = ~108.8km Alignment 3 = ~143.6km Alignments 1, 2 & 3 will cross drainage line;	Alignment 1 selected as the preferred option as it mostly follows the existing roads and track, with fewest drainage line crossings.	All alignments 2 and 3, constitue section of road that would be newly constructed. The various road alignments do cross some drainage lines which would necessitate te development of a culvert or bridge. The existing track (alignment 1 and parts of alignment 2) is currently 3m wide, the width would be increased to 4.5m. This results in a reduced impact on vegetation clearance, drainage areas in comparison with alignments 2 and 3. Improved management on security through access control. Improved condition of access road surface.
Diesel storage	Various Diesel storage tanks at the various pits	Central storage facility at the office complex	The potential of spillage during refuelling is limited and can effectively be managed through implementation of bunded surfaces.
Ablution facilities	Ablution facilities at all pits	Change house at the office complex with Chemical toilets at the pits.	The advantage of a formal change house (containerized) is the improvement of sewage management.
Operational pits	Ryst Kuil Extension ~40.6ha Ryst Kuil Main ~31.3ha Ryst Kuil Abante ~59.2ha Haanekuil ~63.4ha	Ryst Kuil Extension ~33.27ha Ryst Kuil Main~ 21.65ha Ryst Kuil Abante ~49.42ha Haanekuil ~ 27.23ha	The advantages of a reduced operational area are numerous. • Reduced biodiversity impact • Reduced impact on surface water drainage • Reduced impact on agricultural activities This reduction in operational surface area is not deemed to have any disadvantages. Although possible underground operations are no longer planned at this site due to the outcomes of the mine planning, underground operations may be pursued in future. This will require an update to this document as well as DMR approval.
Pit dewatering / Water management infrastructure	Collection in pit- sump and pumped to standard lined PCD	Collection in pit-sump pumped to 1.9ML steel tank with rubber lining.	The advantage of the steel storage dam is reduced loss of water through evaporation and infiltration. Water can be used for dust suppression. No additional abstraction for this purpose.

5.10.4 The possible mitigation measures that could be applied and the level of risk.

Issues raised by I&APs are included in Appendix 2. However, throughout the consultation process the issues of greatest concern to I&APs are as follows:

- The reduction in groundwater availability
- The contamination of ground water
- Radiation
- Dust
- Impact on agriculture and tourism
- Stock theft

AIR QUALITY

It is important that an emissions control and reduction strategy is designed and implemented, ensuring that the contribution to ambient concentrations is minimised. To this end, recommendations to further control and mitigate particulate matter emissions during construction, operation and decommissioning are included for consideration in the EMP.

Table 5-30. Mitigation measures

Construction

Mitigation:

Action/control	Responsibility	Timeframe
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unsurfaced roads e.g. by limiting vehicle speeds and restricting traffic volumes. Unpaved road surfaces could be sprayed with a surfactant to bind the silt.	Responsible Person: Construction Project Manager	Time: During construction
Stabilise open areas with dust palliative, gravel or similar	Construction Project Manager	During construction

Operations

Mitigation:

Action/control	Responsibility	Timeframe
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads e.g. by limiting vehicle speeds and restricting traffic volumes.	Site Manager	During operations
Application of chemical surfactant to bind road surfaces be maintained on on-going basis.	Site Manager	During operations
Waste rock stockpiles should be monitored on a monthly basis evaluating fines erosion into the toe of dump.	Site Manager	During operations

The low-grade ore stockpile could be lightly moistened to reduce wind-entrained dust.	Site Manager	During operations
Top-soil berms should be gently compacted through the use of a TLB during construction of the berms and as and when required during routine maintenance.	Site manager	Construction - operation
Stabilise open areas with dust palliative/ surfactant, gravel or similar	Site Manager	During operations
Dust fallout monitoring is suggested on site boundaries in the vicinity of populated areas to determine impacts of particulate emissions on ambient environment.	Site Manager	During operations
Use of dust covers are suggested on vehicles transporting rock and ore to reduce particulate generation.	Site Manager	During operations

Decommissioning

Mitigation:

Action/control	**Responsibility**	**Timeframe**
Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads e.g. by limiting vehicle speeds and restricting traffic volumes. Unpaved road surfaces could be sprayed with a surfactant to ensure high moisture content which will bind the silt.	Site Manager	During decommissioning
As far as possible the top of the tailings dam must be kept wet in order to minimise fugitive dust generation.	Site manager	During decommissioning
Waste rock stockpiles should be constructed in such a way that no erosion from the side walls takes place.	Site Manager	During decommissioning
Top-soil berms should be gently compacted through the use of a TLB during construction of the berms and as and when required during routine maintenance.	Site manager	Construction - operation
Stabilise open areas with dust palliative, gravel or similar	Site manager	During decommissioning
Rehabilitation of mine roads is recommended to reduce wind-entrained particulate generation	Site manager	During decommissioning

The exposure of employees to excessive dust concentration is an occupational risk that may be associated with poor environmental dust control. Although personal protective equipment (PPE) is required the primary mechanism for control is the reduction of fugitive dust emissions from mine related sources. It is important therefore for the applicant to be aware of the potential correlations between the efficiency of dust suppression

and the potential exposure of employees to excessive levels of respirable dust. This is also governed under the Mine Health and Safety Act,1996 (Act No. 29 of 1996).

BIODIVERSITY

Impact: Loss of habitat and floral species of conservation concern due to removal of vegetation

Embedded Controls:

- Planning in the placement of construction camps and laydown areas to exclude sensitive habitats;
- Preservation of high value plant species in situ through a pre-construction walkover and botanical survey;
- Relocation of Red and Orange Listed species;
- Soil and sediment management to limit effects of erosion arising from vegetation clearing; and
- Rehabilitation of cleared areas by the planting of indigenous species after construction phase.

Impact: Possibility to introduce and/or enhance the spread of alien and /or invasive species

Embedded Controls:

- No specific embedded controls exist for the management of alien and/or invasive species. This occurs in part because of the unpredictable nature of alien species colonisation which should be managed using adaptive methods in response to the severity of site specific infestation.

Impact: Loss of Fauna (bush-meat and pet trade) and loss of targeted high value flora species (tradable species e.g. succulents)

Embedded controls:

- A Biodiversity Protection Policy with action plans to prevent any and all unauthorised removal of biodiversity from the project area.

Impact: Direct Mortality of faunal species though vehicles (or vehicle related) collision

Pre-mitigation Impact Significance:

The quantification matrix of the impact shows that the significance of this impact will be High throughout the project but for the operational phase especially. Susceptible species have been described above. It must be stated that due to the presence of fences, even areas not allowing high speeds of vehicles exhibit High significance due to the susceptibility of the faunal species as well as the presence of fences.

Embedded controls

- All vehicle speeds, through the use of satellite tracking should be limited to 80 km/h (maximum);
- Tracking devices to identify exceedances and speed limits and facilitate corrective measures; and

- Speed humps need to be placed at pre-determined locations to force project vehicles to reduce speed.

Impact: Disruption / alteration of ecological life cycles (breeding, migration, feeding) due to lighting, noise and dust

Embedded controls:

- Equipment with low noise emissions will be procured;
- Loud work stations will have sound insulation;
- A grievance mechanism for IAP complaints about construction noise and dust generation will be established, filed and handled;
- A dust monitoring system will be implemented;
- Water or dust control agents will be used in working areas; and
- Haul roads will be sprayed on a regular basis in designated susceptible areas.

Impact: General contamination of water, pan, habitat and food resources through the potential release of radioactive material

Embedded Controls:

- Dust suppression control measures;
- Correct product treatment, storage and transport with appropriate emergency procedures;
- Soil and sediment management to limit effects of erosion on drainage channels;
- Real time monitoring probes linked to remote sensing base stations need to be place in areas of sub-surface and surface water flow in order to immediately detect elevated levels of contamination in order to initiate emergency measures; and
- Emergency measures such as engineering solutions designed to prevent contamination must be implemented in accordance with best practice standards for uranium ore extraction and processing.

Impact: The indirect impact of alteration of hydrological regimes as a mitigation measure for the prevention of surface water contamination

Embedded Controls:

- Placement of construction camps and laydown areas to exclude sensitive habitats such as rivers etc.;
- Soil and sediment management to limit effects of erosion on drainage channels; and
- Rehabilitation of cleared areas by the planting of indigenous species after construction phase (erosion control).

Impact**:** Sensitive habitat contamination/ destruction as a result of chemical spills or uncontrolled erosion/ sedimentation

Embedded controls:

- Product stockpiles will be kept as small as possible and established away from surface water drainage lines / waterways;
- Sediment traps will be constructed according to industry best practice;
- The use of flocculants will be minimised;
- Silt fences will be implemented where necessary;
- Mulch or tackifiers and topsoil will be used where needed to rehabilitate open areas;
- Construction vehicles and machinery will be serviced regularly and away from sensitive habitats;
- Dirty water runoff will be discharged after sediment and pollutants have been trapped;
- Erosion prevention and sediment control measures will be implemented through best construction management practices (BMPs);
- Dust suppression source water should be free of contaminants;
- Major machinery and vehicle repairs and services will be done off-site away from watercourses / drainage lines;
- A dedicated storage facility according to industry best practice will be constructed away from sensitive habitat types;
- Accidental hydrocarbon spills will be cleaned rapidly;
- SOP's will be developed and enforced for handling of hydrocarbons;
- Water quality monitoring around potential spill areas will be carried out;
- Hydrocarbon collection and separation systems according to industry best practice will be installed at required areas;
- All drainage lines, pans and wetlands will be protected by 100 m buffers indicated on construction drawings for activities relating to potentially hazardous chemicals or involving large quantities of hydrocarbons; and
- Drip trays and oil absorbents will be used on all areas where construction equipment is stored.

Impact: Light pollution

Mitigation: Light pollution can be reduced fairly easily by shielding lights properly, by only using light when and where it is needed, by only using the amount that is needed, by using energy efficient bulbs, and by using bulbs with appropriate spectral power distributions for the task at hand.

- Direct light to where it is needed.
- Use reflectors outside to help light any pathways
- Direct outdoor lights downward.
- Warmer lighting, such as those with yellow or orange hues.

SURFACE AND GROUND WATER

The following are examples of mitigation measures that could be applied to reduce water resource impacts of a project depending upon site- and project-specific conditions. Impacts to water resources are related to the

project footprint (e.g., land disturbance, erosion, changes in runoff patterns, and hydrological alterations), project emissions (e.g., sediment runoff, acid mine drainage, and water releases), and resource use (e.g., water extraction). Many impacts can be reduced or avoided when considered during the siting and design phase.

The recommendation would be to develop a final set of mitigation measures for any project in consultation with the appropriate government resource management agencies and stakeholders. Conduct these consultations early in the project development process and preferably prior to final project siting and design.

Siting and Design Mitigation Measures

Siting and design considerations that mitigate impacts include:

- Identify and avoid unstable slopes and local factors that can cause slope instability (groundwater conditions, precipitation, seismic activity, slope angles, and geologic structure);
- Identify areas of groundwater discharge and recharge and their potential relationships with surface water bodies and groundwater quality. Avoid creating hydrologic conduits between two aquifers;
- Minimize the planned amount of land to be disturbed as much as possible;
- Use special construction techniques in areas of steep slopes, erodible soils, and stream crossings;
- Construct drainage ditches only where necessary. Use appropriate structures at culvert outlets to prevent erosion;
- Do not alter existing drainage systems, especially in sensitive areas such as erodible soils or steep slopes;
- Permanent impoundments, including seep discharges, must meet the performance standards, including having water quality suitable for the intended post-mining use; and
- Handle earth materials and runoff in a manner that minimizes the formation of acid mine drainage, prevents adding suspended solids to stream flow, and otherwise prevents water pollution. Construct sedimentation structures near the disturbed area to impound surface water runoff and sediment. Maintain as necessary, including discharge of water meeting applicable water quality standards, so as not to exceed designed storage capacity.

General Mitigation Measures

General mitigation practices and principles that could apply to any or all phases of a uranium mining project include:

- Apply erosion controls relative to possible soil erosion from vehicular traffic;
- Save topsoil removed during mining and decommissioning activities and use to reclaim disturbed areas;
- Avoid creating excessive slopes during excavation and blasting operations;
- Closely monitor activities near aquifer recharge areas to reduce potential contamination of the aquifer;
- Dispose of excess excavation materials in approved areas to control erosion and minimize leaching of hazardous materials;
- Reclaim or apply protective covering on disturbed soils as quickly as possible;

- Clean and maintain catch basins, drainage ditches, and culverts regularly;
- Limit pesticide use to non-persistent, immobile pesticides;
- Grouting of faults and fractures to decrease the inflow of water into holings;
- Back-fill or re-contour strip-mined or contour-mined areas with excess excavation material generated during construction; and
- Obtain borrow material from authorized and permitted sites only.

Effects of grouting

Grouting was successfully used to help control large groundwater inflows (~55-70 L/s) from individual fractures during excavation of the decline/trial mine in 1978/79. According to maps on file a quite extensive grout 'curtain' was injected for this purpose. Despite this, high yielding boreholes were drilled in this area during the 2007/08 SRK investigation for Uramin so the effects of the grouting were either very local or diminished with time, or both. Economic considerations indicate that the smallest possible effective injection of grout will be used thus ensuring only local effects on groundwater flow.

If a cement-based grout is used then there will be a local and short-lived increase in groundwater pH to ~10-12. Care must be taken in selecting the grout agent to avoid the introduction of toxic constituents into the environment. Again, water quality monitoring in and around the trial mine shows no residual effects of that grouting.

HERITAGE

Palaeontological Recommendations

- The first phase of the mining operations at Ryst Kuil will occur over a 17year period, thus ongoing monitoring by a palaeontologist will not be possible;
- Rubidge (2008) and Almond (2025) recommend that a palaeontologist show the geologists from the mining companies how to recognize fossils and that they monitor excavations for any possible fossil discoveries;
- It is recommended by Almond (2025), that the Fossil Protocol is implemented and a copy of the latest HWC Fossil Protocol is attached to this HIA;
- If any fossils are uncovered, they should be reported to a recognized South African Palaeontological Research Centre, so that they can be excavated and stored for future research purposes.

Archaeological Recommendations

- It is recommended that a small section of the haulage road linking Haanekuil with the main haulage road, should be moved slightly to avoid impact on a ruined stone building at a stockpost (Site D2017-027);
- No impacts are expected to the Ryst Kuil cemetery as the proposed haulage road runs some 100m to the south;
- If any human remains are uncovered during construction, the ECO should have the area fenced off and contact HWC (Tel: 021 483 5959) immediately;

- If there are any significant changes to the layout of the facilities, the new designs should be assessed by a heritage practitioner.

Built Environment Recommendations

- The EMP must ensure that there are no indirect impacts to the Neverset farm house which is situated next to a haul road. This will include making the farm houses off limits to mining crews to prevent vandalism;
- No demolition or modification of any farm buildings older than 60 years may be undertaken without an assessment of the significance of the buildings by the heritage authority;
- If farm buildings of Neverset or Kat Doorn Kuil are used for mining accommodation, then the approval of the relevant heritage compliance authority is necessary if any building alterations are undertaken.

Visual Recommendations

Stead (2008 & 2025) makes no specific recommendations with respect visual mitigation in his Baseline Assessment and the following recommendations are extracted from his report:

- Avoid visual impacts to the R61 which runs to the north of the Ryst Kuil mining areas. While the route will have a potential view corridor across the mining operations, it is important to note that the R61 is not rated as having scenic qualities and is commonly used as a short cut to the N1;
- "Avoid visual impacts to Karoo farmsteads and Karoo landscapes that have outstanding rural qualities". However, only two farmsteads of potential Grade IIIC significance were identified within the study area. They are Kat Doorn Kuil, at least 2km from the Ryst Kuil Extension mining area, and Neverset on the junction of the R61 and the haulage roads. Both of these farm houses are abandoned;
- Avoid impacts on visually prominent ridgelines and skylines on the property. However, the flat nature of the landscape means that there are no prominent ridges to avoid.
- If there are any significant changes to the layout of the facility, the new design should be assessed by a heritage practitioner.

NOISE

There are various ways in which the noise impact of the mining activities can be mitigated.

This includes one or more of the following:

- Allowing a setback (buffer zone) of at least 500 meters between the closest mining activities and sensitive receptors at night. The selected haul- and transportation routes have taken this into account during the mine planning process;
- Reducing the number simultaneous activities (operation planning and management);
- Ensuring that all equipment and machinery are well maintained and equipped with silencers (where possible);

- Considering the noise emission characteristics of equipment when selecting equipment for a project/operation; and
- A combination of the above options.
- The risk of employee exposure to levels of noise that could induce hearing loss must be considered by the applicant and incorporated into the occupational health and safety plan as required by the Mine Health and Safety Act, 1996 (Act No. 29 of 1996).

RADIATION

The dose limit and the results of the significance rating for the different phases of the mine with and without adequate and effective controls in place are listed in the impact table. Effective controls include dust control, access control to the site and safe transport of ore in accordance with the International Atomic Energy Agency regulations. Effective controls are also legally required in terms of the ALARA programme the mine will implement. An ALARA (As Low As Reasonably Achievable) programme requires that the mine continuously monitor and optimise performance in terms of radiological safety.

The screening assessment shows that lichen and brycophytes may be at risk. The risk can be mitigated by rehabilitating the mine area so that waste rock containing radioactivity levels in the range of 150 to 200 ppm are back-filled to the pits as is currently planned.

Closure of the TSF will require that dust generation is controlled and that an adequate barrier to the emission of radon222 be constructed as a final capping layer. Various characterisation data are required to confirm the assumed current capping thickness of 1m, consisting of 0.7m of reconstituted mudrock and 0.3m of protection sandstone dumprock. This capping thickness is deemed conservative, but should additional characterisation indicate that a thicker cap is necessary, sufficient mudrock sandstone dumprock is available on site to accommodate this.

Radiation protection of workers are regulated by the National Nuclear Regulator (NNR) through the National Nuclear Regulatory Act [9]. Section 6(1)(c) of the National Nuclear Regulator Act provides to minimise the duplication of functions between the National Nuclear Regulator (NNR) and other organs of state and as such the review of worker protection and radiological environmental impact assessments falls within the ambit of the NNR.

The primary responsibility of the NNR is to provide for the protection of persons, property, and the environment against nuclear damage through the establishment of safety standards and regulatory practices. The NNR exercises regulatory control related to nuclear installations and other actions involving radioactive material. Regulations supporting the act are provided in “Regulations on Safety Standards and Regulatory Practices” (SSRP) [10]. The SSRP contains the principal radiation protection and nuclear safety requirements. It requires a prior safety assessment, also referred to as a prospective safety assessment.

As part of a regulatory nuclear authorisation process, a Certificate of Registration (COR) has to be issued by the NNR prior to mining. Most gold mines in South Africa, for example, operate under the conditions of a COR because of uranium associated with the gold reefs. A COR provides written permission for a mine to carry out activities that are specified in the COR. The COR is the principal mechanism connecting the legal framework of the regulatory system with the responsibilities of the principal parties; namely, the regulator and the mine operator. The conditions in a COR cover aspects of radiation protection such as the following:

- radiation hazard assessments for workers;
- operational radiation protection of the workforce;
- prospective and operational safety assessments to determine the impact on public health and the environment;
- radioactive waste management;
- transportations of radioactive material;
- physical security;
- occurrences and emergency planning;
- operational limitations; and
- a radiation protection quality management system.

The occupational exposures of workers and members of the public have to be controlled so that the regulatory dose limits are not exceeded."

SOCIO-ECONOMIC

The following mitigation measures are provided for the Construction Phase

- Clearly communicate of available employment to manage expectations and minimise population influx;
- Clearly communicate preference for local people to work in the mines;
- Verify that persons applying for work are from the region by requesting proof of address during the recruitment process.
- Clearly define and communicate the required number of jobs and skills so that relevant skills training can be implemented;
- Recruit, in a transparent manner, from the local community first, regardless of the required skills level;
- Establish a 'labour desk' to enable effective communication;
- A skills training programme would be implemented; and
- Use existing and local construction businesses as subcontractors.

The extent will be determined and mitigation measures will be included in the Social and Labour Plan.

- Establish Grievance procedure prior to the commencement of the project. Clearly communicate this procedure to the public, ensuring ongoing interaction with the community affected, building trust;
- Where strong water resources are identified, share information with farmers, improve use after rehabilitation;
- Take increased population into consideration during infrastructure planning in consultation with the local municipality;
- Integrate of both temporary and permanent employees into the community. Housing among existing housing, not removed from current economic hub will enable spending in the economic zone, avoid creation of housing that would not be used later on, or that does not fit in with the character of the town;
- Construction is a growing industry in the region, opportunities to provide adequate accommodation for mine employees pose a viable entrepreneurship avenue;
- Enlist current businesses and vendors;

- Explore the possibility of using local suppliers of goods and services by drawing up a list of services offered;
- Make information of required supplies and services available to the community to encourage tenders from the local area;
- Housing and development should occur within the town's 'urban edge' and uphold the character of the town, by contributing architecturally to the town;
- Architects and urban planners should be used when housing is developed/planned.

The following mitigation measures are provided for the Operational Phase:

- Training during construction phase will allow for local people to be employed during operational phase. Establishment of a training centre, to assist in appropriate skills development of locals;
- Municipal planning should take this into consideration;
- Due to the character of the towns, urban planning and architects should be used when housing is developed to improve on the existing nature of the town;
- Clearly identify and communication the additional housing need to construction companies and developers who may be able to take up the opportunity to develop new housing in the area;
- Compile a list of local suppliers of goods and services by drawing up a list of services offered. Continually source from local enterprises; and
- Housing and development should occur within the town's 'urban edge' and uphold the character of the town, by contributing architecturally to the town. Architects and urban planners should be used when housing is developed/planned.

The following mitigation measures are provided for the Decommissioning Phase

- Develop a retrenchment and training programme. Identify alternate developments using similar skills; and
- Development of skills, training and diversifying of business opportunities throughout the lifetime of the mine is recommended. This will ensure relevant qualification and experiences and enable better employment opportunities after decommissioning of the mine.

SOILS

Removal of all topsoil at open pit footprints

Soil and Land capability: The topsoil at open pit footprints will be removed to a depth of 200-300 mm, depending on the soil depth, and stockpiled at a suitable position. After the construction and or decommissioning phase the pits will be back-filled (assumed). The topsoil will be replaced and evenly spread over the back-filled pit footprint. Some reduction of the original soil quality and stability will however be unavoidable.

Land Use: By mitigating the soil impacts, the grazing land capability will be restored, but the grazing land use will not be restored if the vegetation is not re-established. The only mitigation for land use is to re-establish

vegetation. It is assumed that the vegetation will not be re-established and it will take many years after the decommissioning phase for natural succession of the vegetation, especially in such an arid climate.

Stockpile related impact and control:

Soil and Land capability: Contain the footprints of stockpiles as far as possible. Remove stockpiles as soon as possible. Ripping of the surface after removal of the stockpile to alleviate soil compaction.

Land Use: By mitigating the soil impacts, the grazing land capability will be restored, but the grazing land use will not be restored if the vegetation is not re-established. The only mitigation for land use is to re-establish vegetation. It is assumed that the vegetation will not be re-established and it will take many years after the decommissioning phase for natural succession of the vegetation, especially in such an arid climate.

Decommissioning

Soil and Land capability: For structures that will remain after the decommissioning phase such as the TSF, all topsoil should be removed at the footprint and stockpiled. During the operational phase the soil should be used to progressively rehabilitate the facility (if possible) or it should be stored until the decommissioning phase and rehabilitation should then be done as far as possible with the available amount of soil.

Land use: The viability of some species in such conditions can be evaluated.

TRAFFIC

The traffic impact analysis resulted in the following conclusions and recommendations.

Existing Traffic Conditions

- The current demand on the existing road network in the site vicinity is low and the road network and intersections operate at acceptable levels of service;
- The gravel surfaces of the Provincial Main Roads in the site vicinity are in fair condition;
- The road network will continue to operate at acceptable levels-of-service in the future during the worst peak hours of the year without the proposed development;
- The surface conditions of some of the gravel roads will continue to deteriorate without proper maintenance; and
- The gravel surfaces of the Provincial Main Roads are in fair condition and these roads can accommodate the expected growth in traffic volumes on these roads in the year 2020 Background conditions.

Construction Phase

- It is expected that the construction phase of the proposed development could generate approximately 100 vehicular trips during the average weekday of which approximately 20 percent will be heavy truck traffic;

- Regional transport routes are via the N1 through the town of Beaufort West and Rail transport is also possible via the existing Beaufort West Station;
- Access to the different mine sites are proposed via existing farm access roads and there are no access spacing or shoulder sight distance issues;
- During construction, it is expected that gravel road surfaces will require maintenance at regular intervals and it is recommended that a water based surfactant or dust suppressant be used on a regular basis during the peak construction period; and
- Some minor geometric upgrades might be required along some sections of the roads, specifically at the bridges, to accommodate abnormal load vehicles during the construction phase. However, the frequency of these abnormal load vehicles will be low and it is recommended that during the planning process for the transport of heavy equipment these areas/roads with the possible restrictions should be avoided if possible.

Operational Phase

It is expected that each of the mine sites will generate approximately 100 new daily truck trips during the peak operational phase. Based on the project phasing it is expected that the cumulative impact on any section of road in the site vicinity will not be more than 200 trips per day.

The impact of the additional truck trips as a result of the mining operation will be insignificant in terms of capacity and operation of the intersections along the surrounding road network. The Roads Authority has recently implemented speed over distance measurement along sections of the R61, which has reduced speeding along the road and improved safety. The speed differential between the trucks along the R61 at the haul route access points and the through traffic along the R61 in a possible concern. However, the sections of the R61 at the access points are straight and flat and there is sufficient stopping sight distance along the R61 for through traffic along the R61 to see trucks way in advance. Proper warning signs should be erected along the section of the R61 at the access points to warn motorists of slow moving and turning trucks. Public roads used for mine traffic shall be maintained within acceptable standards from a road safety and comfort perspective.

A gravel road can accommodate between 300 and 400 vehicles per day, which means that surfacing of these roads may not be required. However, the truck traffic between the mine sites and the processing plant will have a significant impact on the gravel road surfaces and it is recommended that the internal gravel roads be watered sufficiently to reduce gravel loss. Non-potable water should be sourced for this purpose.

Access to the different sites is proposed mostly via existing farm access roads. Access positions along Provincial roads are identified with a kilometre marks, where kilometre marks are not available the access position is identified with Google Earth coordinates.

Identified traffic related impacts

5.11 Socio-Economic Impacts

5.11.1 Impacts raised through Public Participation

A survey amongst Beaufort West residents in 2013 regarding the potential of uranium mining in the area showed that many of the residents consulted were very positive about "the economic implications of possible uranium mining" (Atkinson, Myles, van Rooyen and Nurizon, 2013, p. 75) and although some were concerned about the environment (21% thought it could be a health hazard) and social impacts (16% were concerned about drunkenness and moral decay), more people were positive about the possibility of more employment (38%), and the transfer of knowledge and skills (35%) (Atkinson et al, 2013; Van Rooyen, 2013).

Stakeholder concerns that have been raised include the following:

- A possible influx of migration workers with or without the necessary skills; destabilisation of the labour market, recruiting employees with the necessary skills from 'outside' the affected community
- The number of job opportunities available and skills levels required
- Lack of skills of current unemployed labour force, the need for training of local population
- Transparent recruitment processes to be followed
- Effects of these employment changes on use of services such as schools and clinics
- Opportunities for local businesses
- Use existing businesses and service providers for goods and services needed
- Impact on tourism
- Inability to conduct long term planning (farming investments) due to the unknown timeline for development of the mine
- Change in sense of place and character of the area, in turn affecting tourism
- Traditional quiet lifestyles will be affected
- Increased traffic
- Increased crime and other social ills such as alcohol abuse and gambling
- Contributing to poverty alleviation
- Pressure on social service and service delivery
- Ability to absorb increased need for accommodation
- Will remuneration of employees enable them to afford housing in the desired areas
- Will employees live on their own or in the current communities
- Increased use of educational services because of influx. Learner teacher ratio already constrained and no busses from more rural areas
- Increased use of health services
- Increased taxation revenue to provide for service delivery
- Disturbance of livestock and game, increased poaching
- A 'boom and bust" scenario developing in the town because of speculation on housing.

5.11.2 Assessment of impacts during construction

This section identifies the possible socio-economic impacts during the construction phase of the project.

5.11.2.1 Employment Opportunities

During the construction phase, a temporary influx of workers—both local and external—is expected, leading to a short-term population increase in the area. Due to the low skills base and limited construction sector in Beaufort West, many skilled and semi-skilled workers will likely need to be sourced from elsewhere, possibly even abroad. Although the project aims to employ local labour where possible, this will mostly be limited to low-skilled roles, which could provide temporary income relief to poor, unemployed residents.

Local procurement opportunities will be minimal due to the absence of a robust local construction supply chain. Specialized materials and equipment will be sourced from outside the region, with local procurement limited to basic goods and services such as building supplies, rentals, and security.

If most contract workers are brought in from outside, this could lead to local resentment, competition for jobs, and potential social tensions due to cultural differences. Therefore, skills development and on-site training are essential to build local capacity for future employment opportunities.

5.11.2.2 Influx of Workers and Work Seekers

The construction phase in Beaufort West is expected to bring an influx of both construction workers and potential job seekers. While the presence of temporary workers is not inherently problematic, their behavior can impact local communities, particularly through increased risks of social ills such as crime, substance abuse, prostitution, teenage pregnancies, and the spread of STDs. These issues are often linked to both unsuccessful job seekers and employed workers from outside the area.

The extent of uncontrolled in-migration depends on factors like site accessibility, local unemployment, the scale and type of construction, and recruitment practices. Proactive and managed labour recruitment can help limit negative socio-economic impacts and reduce influx-related risks. Employing local low- and medium-skilled workers, already integrated into the community, would further mitigate these risks.

Accommodation capacity in Beaufort West (estimated at 800–1200 beds) and surrounding towns should be sufficient for incoming workers, though demand could drive up tourism accommodation prices. This increased demand could benefit the hospitality and trade sectors. While strain on municipal services is a concern, it is considered a more significant issue during the operational phase of the project.

5.11.2.3 Impacts on Community Health, Safety and Wellbeing

The project area is a rural, sparsely populated region where communities are generally unfamiliar with large-scale developments. As a result, community safety and health risks are expected during the construction phase due to the presence of a sizeable workforce and construction vehicles.

Key concerns include:

Crime and Safety: The influx of workers may raise fears of increased crime, including the theft of goods or livestock.

Noise: Construction noise—especially from heavy vehicles and general site activities—may be intrusive due to the area's typically low ambient noise levels, though direct impact on nearby residents is expected to be minimal.

Traffic and Dust: Traffic increases, particularly during peak commuting hours, will mainly affect the N1 and are expected to be minor. Dust from untarred roads and vehicle movement will be assessed in air quality studies.

Fire Risk: The movement of vehicles and presence of a large workforce increases fire risk, requiring careful management.

Health and Safety: A comprehensive Health and Safety plan is essential. Measures such as fencing, lighting, cameras, and on-site security will help protect both workers and nearby landowners.

No Resettlement or Heritage Risks: No relocation of people or structures will occur, and no graves were found. A specialist heritage study will confirm this.

Worker Health Programs: Nutrition, health education, and disease management programs (including HIV/AIDS awareness and prevention) should be implemented to maintain a healthy workforce.

Overall, while certain impacts are anticipated, many can be mitigated through proactive planning and adherence to best practices.

5.11.2.4 Visual Impact and Sense of Place

The construction phase will cause temporary visual disturbances due to site clearance, equipment storage, and nighttime lighting. Given the flat Karoo landscape with sparse vegetation, construction structures and lights will be visible from long distances, potentially disrupting the local sense of place for nearby residents.

While this may concern locals, the project's remote location—over 40 km from Beaufort West and the N1, and over 20 km from the N12—means that it is unlikely to significantly affect tourists or tourism in the region. A specialist visual impact study has been conducted to further assess these impacts.

5.11.2.5 Attitudes and Sentiment towards Project

Local residents' attitudes toward the project will be shaped by both direct experiences and media coverage. Negative sentiments may arise if the recruitment process for local employment is perceived as unclear or unfair. To mitigate this, recruitment should be transparent and provide equal opportunities.

While main contractors will likely be hired from outside the area, the project intends to use local labor where possible and offer up-skilling for unskilled and semi-skilled workers to bridge skills gaps. Local procurement opportunities should also be well advertised to involve local businesses.

Ongoing, transparent communication through local and social media is essential to keep the community informed. A key source of local dissatisfaction is the lack of credible, timely information about the project.

5.11.2.6 Economic Activity

The construction activities are expected to affect the local economy in several ways:

- Negatively, through the loss of agricultural land used for the plant, access roads, services, and mining areas.
- Positively, by increasing local employment, particularly for unskilled and low-skilled residents, leading to more spending within the town.
- The influx of construction workers will boost demand for accommodation, meals, and other essentials.
- Local merchants may benefit from procurement opportunities related to the project.
- Increased spending by workers and businesses could stimulate growth or expansion of local enterprises.

5.11.2.7 Infrastructure and Services

The project may negatively impact community access to infrastructure and services. Increased population and activity could lead to busier hospitals, schools, emergency, and recreational facilities, causing delays and access difficulties. The municipal infrastructure in Beaufort West may face additional strain, risking breakdowns and capacity shortages. The local municipality will need to allocate sufficient budgets to maintain and service critical infrastructure, especially water supply, water treatment, and electricity.

5.11.2.8 Accommodation

The construction phase may increase demand for accommodation in existing establishments, creating a potential business opportunity for new housing developments if current supply is insufficient. Tourist accommodation in Beaufort West could provide temporary housing but may reduce availability for tourists, especially during peak seasons. It is recommended to conduct an accommodation audit before the project starts, in collaboration with the BWLM, to assess current capacity and future needs. Insufficient housing could lead to urban sprawl or informal settlements, particularly among unsuccessful job seekers.

5.11.3 Assessment of Impacts During Operational Phase

This section identifies the possible socio-economic impacts during the operational phase of the project.

5.11.3.1 Employment Opportunities

The project is expected to create up to 650 permanent jobs during its operational phase, potentially representing a 16% increase in total employment within the Beaufort West Local Municipality (BWLM), making it the second-largest local employer after the municipality itself. While most highly skilled workers will likely be sourced from outside the area, around 70% (approximately 450 jobs) are anticipated to be filled by local unskilled and semi-skilled residents. The company, Lukisa, has committed to recruiting directly affected farm laborers, although job losses are expected to be minimal. Ongoing training programs will help maximize benefits for the local community.

5.11.3.2 Infrastructure Services

An influx of people can strain municipal services, particularly when job seekers fail to find work and thus contribute little to municipal revenue through service payments. Conversely, those employed or relocating for jobs tend to have a positive financial impact, enabling the municipality to expand services. For this project, there is a potential risk of increased pressure on municipal services due to incoming job seekers.

5.11.3.3 Accommodation

Up to 30% of the workforce (around 200 families) may come from outside the area, creating increased demand for formal housing in Beaufort West. While tourist accommodations could serve as temporary housing, many workers will seek permanent homes. This demand could stimulate the local property market and raise prices for sales and rentals, benefiting property owners but making affordability more challenging for local residents.

If housing demand exceeds supply, local developers might build new accommodations, so the BWLM should plan accordingly and allocate budgets for infrastructure and services. A diverse range of housing options is needed to accommodate different income levels, including gap housing. The municipality must also manage the influx to prevent unplanned settlements and coordinate subsidy housing development to support orderly town growth.

5.11.3.4 Landowners and surrounding farms

The mining project is expected to significantly reduce property values on affected and nearby farms, partly due to uncertainty around the unfamiliar development. Lukisa is advised to engage early with landowners to clarify property arrangements (leasing, partial leasing, purchase, or no impact) to aid long-term planning.

The impact on adjacent farms without uranium deposits is likely limited, given their size and primary use for extensive livestock farming. Concerns about water use, quantity, and potential pollution affecting agriculture have been raised and are being addressed through specialist studies on groundwater, surface water, geochemistry, and radiation.

5.11.3.5 Local Economy

The project is expected to positively impact the local economy by creating 650 jobs and generating a monthly wage bill of R15 to R20 million, mostly spent locally. Additionally, operational procurement from the mine will support local business growth.

Tourism may experience minor negative effects such as increased traffic, noise, visual disturbances, and slight crowding, but these impacts are expected to be very limited due to the project's distance from key tourist sites. Mitigation measures will further reduce these effects.

While agricultural land loss will negatively affect farming, the impact is expected to be minimal because of the extensive livestock farming typical in the area. Overall, the mine will contribute to economic diversification and strengthen local economic resilience.

5.11.3.6 Visual

From a socio-economic perspective, there will potentially be a negative impact on surrounding landowners, but it is not considered to be significant due to the low population density and the location of homesteads to the facilities, thereby limiting the number of permanent observers. The visual impact will however be dealt with in a specialist study in considerably more detail.

5.11.3.7 Nuisance Factors

Neighbouring landowners may experience increased noise, particularly at homesteads, farmhouses, and settlements. However, the closest dwellings—approximately 2 to 2.7 km from key sites—are expected to remain within acceptable noise levels.

The rural community, unfamiliar with such projects, may be negatively affected by noise, dust, traffic, and other operational impacts. Noise from heavy vehicles and plant operations is likely, and given the low ambient noise, could be noticeable, though effects on nearby residents' quality of life are expected to be minimal due to distance.

Daily transport of workers will increase traffic, especially along the N1 during peak times, but this impact is considered minor. Potential increases in dust from operational activities and vehicle movement on untarred roads will be studied further, along with water impacts, in specialized reports.

5.11.3.8 Possible attitude formation against the project

As indicated in the construction phase, possible attitude formation against the project can occur due to the limited number of locals that are permanently employed for higher skilled jobs as a result of the discrepancy

between skills locally available and the skills required for specialised work. This aspect would thus apply to the operational phase as well.

The project proponent must continue to maximise local employment throughout the operational life of the facility. Up-skilling opportunities for unskilled and semi-skilled local workers and capacity building must continuously be undertaken to lessen any possible skills disparity between the local skills available and the requirements of the project.

5.11.3.9 Assessment of Impacts During Decommissioning Phase

This section identifies the possible socio-economic impacts during the decommissioning phase of the project.

5.11.3.9.1 Employment Loss

The permanent job opportunities created during the operational phase of the project will be lost once the project is decommissioned. This can impact approximately 650 households that will have to find alternative sources of employment and income. These families would possibly have to relocate if no other employment can be found in the area.

Decommissioning and its associated closure programmes must ensure that employees are not left stranded without alternative forms of livelihoods, with subsequent degradation of the communities' socio-economic quality of life.

5.11.3.9.2 Accommodation and Property Market

If the workforce cannot find alternative work opportunities, many households may decide to leave Beaufort West. This sudden departure of households will seriously affect the property market with many houses on the market at the same time and people desperate to sell. Property prices will drop significantly, and properties will remain in the market for longer.

5.11.3.9.3 Landowners and surrounding farms

The open cast mining areas and waste rock dumps will remain on the properties but through proper management the areas can be revegetated and could return to agricultural use after decommissioning. Access tracks and access roads may be retained, subject to landowner requests. As all infrastructure can be removed no visual impact will remain, other than vegetated mining areas and dumps which should blend into the landscape over time.

5.11.3.9.4 Local Economy

The project decommissioning is expected to have a significant negative impact on the local economy as 650 persons will lose their jobs and the estimated monthly wage bill of R15 to R20 million will no longer be spent in the town. The mines operational procurement expenditure will also cease to be spent in the local economy. The major decrease in expenditure in the town will adversely affect the local businesses and some may even have to close. The economy would also shrink and the economic diversity that mining provided will disappear.

5.11.3.9.5 Nuisance Factors

Decommissioning will result in similar impacts as the construction phase in terms of dust and noise pollution, as well as the movement of heavy vehicles and workers. These intrusions will be intermittent and of a short duration and can be mitigated.

5.11.3.9.6 Community Safety

The plant contains hazardous materials and therefore care should be taken during the decommissioning that the infrastructure is properly disposed of to avoid any possible contamination resulting in community health risks and soil contamination.

5.12 Motivation where no alternative sites were considered.

The total area covered by open pits, ore and waste rock stockpiles, and other infrastructure covers approximately ~1264 ha. The selected final site layout has been optimized based on the uranium mineralized zone as well as the topographical and bio-physical features. As discussed above, although no alternative mining locations can be considered, various alternatives were considered for haul road alignment, position of the waste rock dump, ablution facilities, water management strategies and other ancillary infrastructure.

The no-go option: Should this project not go ahead the current status quo would remain. Agricultural activities on the properties may continue as decided by the land owner. The potential of the project as discussed in the Need and Desirability section would not be realized. In addition, the no-go option has also been considered by the EAP as a potential recommendation based on any project fatal flaws. It can be concluded (as demonstrated in the impact assessments) that no project fatal flaws have been identified by the specialist team.

5.12.1 Statement motivating the alternative development location within the overall site.

The primary motivation for the selected alternatives is the reduced environmental impacts associated with these changes. This process has added significant value to the environmental impact assessment process.

The surface impact of the site was decreased where possible, which will impact on the grazing capacity of the farms with in the application area.

5.13 Project specific Biodiversity Mitigation

Below follows the summarised project specific mitigation mentioned in the previous report by Laurence *et al*., 2017. The mitigation in the report by Laurence *et al*., 2017 is still relevant.

5.13.1 Flora

Several plant mitigation measures to minimize the impact of mining activities on flora, especially species of conservation concern (SCC) and protected plants. The key plant mitigation measures include:

1. Minimize Disturbance Footprint
    - Carefully plan and demarcate the minimum required footprint for construction and operational activities (including parking, camps, laydown areas, etc.) to avoid unnecessary vegetation loss.
2. Pre-construction Botanical Survey and Search & Rescue
    - Conduct a pre-construction walkover and botanical survey to identify and preserve high-value plant species in situ.

- Implement search and rescue operations for Red- and Orange-Listed species, as well as *Nananthus* sp., within a 30 m buffer around new haul roads and other infrastructure. Relocate these plants where possible.

3. Soil and Sediment Management
    - Apply soil and sediment management practices to limit erosion and prevent further habitat loss following vegetation clearing.
4. Rehabilitation and Re-vegetation
    - Rehabilitate cleared areas by planting indigenous species after construction.
    - Establish a suitable ground cover of grass first, followed by appropriate shrubs and other species to restore habitat structure and function.
    - Use a nursery to propagate selected plant species for translocation and rehabilitation.
5. Exclusion of Livestock from Sensitive Areas
    - Fence off known localities of the potentially undescribed *Nananthus* sp. to protect them from grazing and trampling, using fencing that allows movement of native fauna like tortoises.
6. Adaptive Rehabilitation Trials and Monitoring
    - Undertake re-vegetation trials to determine the most suitable species for each habitat.
    - Develop and implement an operational monitoring program to assess the success of rehabilitation, control of alien/invasive species, and water quality in sensitive habitats.
7. Control of Alien and Invasive Species
    - Develop and enforce a policy for the control of alien and invasive plant species, using mechanical and chemical methods as appropriate, and monitor for new infestations.
8. Establishment of a Plant Propagation Facility
    - Set up a facility to propagate plants needed for rehabilitation and for the conservation of SCC, including *Nananthus* sp.
9. Ex Situ Conservation (as a Last Resort)
    - Consider ex situ conservation (translocation) only if all other mitigation measures fail, and only after careful planning and assessment of risks and feasibility.
10. Ongoing Monitoring and Adaptive Management
    - Continuously monitor the effectiveness of mitigation and rehabilitation measures, and adapt management strategies as needed to ensure long-term success.

These measures are designed to avoid, minimize, and rehabilitate impacts on plant communities, with a strong emphasis on protecting species of conservation concern and maintaining ecosystem functionality

5.13.2 Fauna

The document outlines several fauna mitigation measures to reduce the impact of mining activities on mammals, birds, reptiles, amphibians, and other wildlife. The key fauna mitigation measures include:

1. Minimize Habitat Loss and Fragmentation
    - Limit the construction and operational footprint to the minimum area necessary.
    - Use existing cleared areas and roads as much as possible to avoid new habitat disturbance.
    - Demarcate all activity areas in advance to prevent accidental encroachment into sensitive habitats.
2. Maintain and Enhance Habitat Connectivity

- Provide permeable fencing adjacent to known sensitive habitats to facilitate movement of faunal species.
- Construct fauna underpasses (e.g., large culverts or pipes) where roads cross sensitive habitats, especially for migratory and Red-Listed species.
- Remove or realign fences in sensitive areas or increase buffer zones to allow animal movement and escape from roads.

3. Reduce Direct Mortality
    - Implement speed limits (e.g., 40 km/h) for all vehicles within operational/private roads.
    - Install speed humps and conduct staff training to reduce wildlife-vehicle collisions.
    - Monitor and record all road mortalities and live animal observations to identify high-risk areas and adapt mitigation accordingly.
    - Use fauna barriers and underpasses to direct small animals safely across roads.
4. Protect Sensitive and Critical Habitats
    - Buffer and exclude sensitive habitats (e.g., drainage lines, pans, wetlands, rocky outcrops) from development.
    - Designate a 200 m protective buffer zone around drainage lines and wetlands, and a 50 m buffer around rocky outcrops.
5. Mitigate Impacts from Tailings Storage Facility (TSF) and Water Bodies
    - Fence off the TSF and Return Water Dam to prevent access by terrestrial fauna.
    - Use floating “shade balls” or bird deterrents on open water surfaces to prevent birds and insects from accessing contaminated water.
    - Remove shoreline vegetation and potential roosts around TSF and RWD to reduce attraction for wildlife.
    - Monitor and record all fauna mortalities around TSF and RWD, and adapt mitigation as needed.
6. Control Alien and Invasive Fauna
    - Implement rodent and pest control around camps and infrastructure, using targeted trapping and safe poison protocols to avoid harm to native species and predators.
    - Enforce a zero-tolerance policy for the trade or transport of fauna by staff and contractors.
7. Reduce Disturbance from Noise, Light, and Dust
    - Use low-noise equipment and sound insulation where possible.
    - Minimize exterior lighting, use non-UV and downward-facing lights, and avoid “up lights” to reduce attraction and disorientation of nocturnal fauna and birds.
    - Implement dust suppression measures to protect sensitive habitats and food resources.
8. Prevent and Respond to Pollution and Spills
    - Store and handle chemicals and hydrocarbons away from sensitive habitats.
    - Use spill kits and train staff in spill response, especially near aquatic habitats.
    - Monitor water quality in and around sensitive habitats.
9. Monitor and Adapt
    - Develop and implement a monitoring program for fauna activity, mortalities, and habitat use.
    - Adapt mitigation measures based on monitoring results and changing site conditions.
10. Education and Awareness

- Provide environmental induction and ongoing training for all staff and contractors on wildlife protection, speed limits, and reporting of incidents.

These measures are designed to avoid, minimize, and rehabilitate impacts on fauna, with a focus on maintaining ecological connectivity, reducing direct mortality, and protecting sensitive species and habitats.

5.13.3 Habitats

The report recommends several habitat mitigation measures to minimize the impact of mining activities on sensitive environments and maintain ecological integrity. The key habitat mitigation strategies include:

1. Minimize Disturbance and Footprint
    - Carefully plan and demarcate the minimum required footprint for all construction and operational activities (including roads, camps, laydown areas, etc.) to avoid unnecessary habitat loss.
    - Maximize the use of existing disturbed areas and infrastructure to reduce new impacts.
2. Buffer and Exclude Sensitive Habitats
    - Establish and maintain buffer zones around sensitive habitats:
        1. 200 m buffer for natural seasonal pans, riparian areas, and wetlands.
        2. 50 m buffer for rocky outcrops.
    - Exclude these high-sensitivity areas from development and infrastructure placement.
3. Maintain Habitat Connectivity
    - Design infrastructure and fencing to allow for the movement of fauna between habitats, maintaining ecological corridors and landscape connectivity.
    - Use permeable fencing or wildlife underpasses where roads or fences intersect important movement routes.
4. Soil and Erosion Control
    - Implement soil and sediment management practices to limit erosion and sedimentation, especially after vegetation clearing.
    - Use ground cover and indigenous vegetation to stabilize soils and prevent degradation.
5. Rehabilitation and Restoration
    - Rehabilitate cleared or disturbed areas by planting indigenous species appropriate to the local habitat type.
    - Conduct re-vegetation trials to determine the most suitable species for each habitat.
    - Establish a nursery or plant propagation facility to support restoration efforts.
6. Hydrological Management
    - Design stormwater and surface water management systems to maintain natural hydrological processes and prevent alteration of flow regimes, especially in areas linked to aquatic ecosystems.
    - Construct berms or other engineering controls downstream of the Tailings Storage Facility (TSF) to intercept and contain runoff, preventing contamination of sensitive aquatic habitats.

7. Monitoring and Adaptive Management
    - Develop and implement a monitoring program to assess the effectiveness of habitat mitigation and rehabilitation measures.
    - Adapt management strategies based on monitoring results and changing site conditions.
8. Search and rescue for SCCs
    - Conduct pre-construction surveys and implement search-and-rescue operations for plant and animal species of conservation concern within areas to be disturbed, relocating them to suitable habitats where possible.
9. Control of Alien and Invasive Species
    - Monitor and control the spread of alien and invasive plant species in disturbed and rehabilitated areas to protect native habitat integrity.

These measures are designed to avoid, minimize, and rehabilitate impacts on habitats, with a strong emphasis on protecting sensitive areas, maintaining ecosystem functionality, and supporting long-term ecological resilience.

5.13.3.1 Assessment evaluation

The Terrestrial Biodiversity Assessment for the Ryst Kuil Mining Right Application evaluates the ecological baseline, potential impacts, and necessary mitigation measures. The project area lies within the largely intact and least threatened Gamka Karoo vegetation type and hosts diverse flora and fauna, including several species of conservation concern (SCCs).

Key impacts include habitat loss, fragmentation, spread of alien species, fauna mortality (from vehicles and contaminated water), and cumulative land-use effects. While the project design does not fully avoid sensitive areas, the assessment concludes that, with full implementation of mitigation—such as avoidance, restoration, SCC rescue efforts, and robust rehabilitation—the impacts can be reduced to acceptable levels.

The affected area represents only a small portion of the regional ecosystem, and SCCs, including a possibly undescribed Nananthus species, are not at significant risk if mitigation is rigorously applied. The main residual concern is fauna exposure to contaminated TSF water, for which strict controls and monitoring are advised.

Overall, the assessment identifies no fatal flaws. A biodiversity offset is not required, and the project may proceed if all mitigation and monitoring measures are strictly implemented.A main contributing factor to the difference in 'sensitivity' changes from 2017 to 2025 is the new SEI methodology as well as the changes in threat statuses of the recorded flora and fauna (Table 5-31).

Table 5-31. Summary of the comparison between the previous and the updated studies

Aspect	Ferret/Enviro-Insight 2017	TBC 2025 Ryst Kuil Report
Scope	Multi-area, multi-year, broad EIA	Ryst Kuil-focused, update, single season
Methodology	Multi-season fieldwork, detailed GIS	Desktop + single field season, screening tools
Baseline Findings	Extensive species/habitat inventories	Validates 2017, updates threat statuses
Impact Assessment	Detailed, risk-based, site-specific	Confirms 2017, regulatory focus, mitigation hierarchy
Regulatory Context	2012–2017 frameworks	2020–2025 frameworks, screening tool
Recommendations	Mitigation, monitoring, adaptive management.	Same, plus no offset required, compliance focus

5.14 Freshwater Mitigation Measures

Uranium mining can significantly impact riverine and wetland systems by degrading water quality, disturbing groundwater and surface water, altering habitats and channel form, increasing flood risk, and reducing aquatic biodiversity, while also posing health risks to humans and ecosystems. Mitigation for uranium and molybdenum mining should therefore focus on responsible extraction practices that limit the scale and intensity of mining, protect and rehabilitate instream and riparian habitats, and monitor both physical and biological conditions of receiving environments. Overall, mitigation should aim to minimise impacts on air, water, land, ecology, and human health—especially where mining occurs within or near wetlands and watercourses—to maintain the ecological integrity of affected water resources.

5.14.1 Overarching Design and Planning Principles

The following mitigation measures are aimed to protect and conserve watercourses during the life of mine:

- Apply the mitigation hierarchy as follows:
    - Avoid: Keep open pits, waste rock dumps, TSFs and process plants outside delineated pans, wetlands, drainage lines and their buffers.
    - Minimise: Where complete avoidance is impossible, minimise the spatial footprint and duration of disturbance and use the most benign technologies available.
    - Rehabilitate/Restore: Implement concurrent and progressive rehabilitation; avoid deferring all rehabilitation to closure.
    - Offset: If any irreplaceable features (e.g. high-EIS pans) are unavoidably lost, commit to like-for-like or better offsets.
- Respect legal buffers and regulated areas:
    - No residue deposits, dams or sanitary facilities within the 1:50/1:100 year floodline or 100 m of watercourses and pans, in line with GN 704.
    - Treat the 500 m zone around pans/wetlands as a regulated area for NWA Section 21(c) & (i) activities; motivate any infrastructure within this zone carefully in the WUL.
- Design for semi-arid extremes:
    - Use site-specific water balance models that include: very low average rainfall, extremely high evaporation, and occasional intense storm events with high runoff.
    - Size containment and diversion structures for rare but intense storms (e.g. ≥1:50 or 1:100 year events, depending on authority requirements).
- Protection of pans and ephemeral systems:
    - Treat pans and high-EIS wetlands as No-go areas for excavation, infilling or waste placement.

- Maintain natural micro-catchments feeding pans; avoid intercepting or concentrating flow away from them.
- Where pans are close to disturbed areas, install low berms and silt fences to prevent sediment and contaminated runoff entering the basins.

- Ephemeral drainage lines:

  - Do not straighten, canalise or infill valley-bottom drainage lines; preserve their natural morphology where possible.
  - Only use armouring or gabions where necessary to protect critical infrastructure; otherwise maintain natural substrates and roughness.

5.14.2 Mine Layout and Infrastructure Siting

- Avoidance of sensitive freshwater features:
  - Place pits, underground portals, waste rock dumps and TSFs outside all mapped pans, valley-bottom depressions and ephemeral drainage lines.
  - Maintain ecological conservation buffers from the edge of drainage lines and pan basins.
  - Locate haul roads and conveyors parallel to, and upslope of, drainage lines, not across them, wherever possible.
- Crossings and access routes:
  - Where crossings of drainage lines are unavoidable, use single, consolidated crossings instead of multiple small ones.
  - Design crossings as low-impact structures (e.g. culverts with natural bed material, armoured drifts) that maintain hydrological connectivity and do not impede flow during storm events.
  - Avoid any crossings over pans; re-route around basins.
- Processing plant and ancillary facilities:
  - Place leach plants, reagent storage, fuel depots and workshops on high-lying, geotechnically stable ground, outside regulated areas.
  - Ensure all such areas drain to engineered pollution control dams (PCDs), not directly into natural drainage.

5.14.3 Water and Tailings Management

- Clean–dirty water separation:
  - Implement a fully separated stormwater system:
    - Clean water (up-gradient catchment) diverted around the mine via lined diversion channels and berms.
    - Dirty water (contact water from pits, TSFs, plant, haul roads) collected and routed to PCDs.
  - Avoid any long-term channel diversions unless absolutely necessary; if required, design them as geomorphologically stable and lined or armoured.
- Pollution control dams (PCDs):
  - Design PCDs with:
    - Adequate freeboard for design storm events.
    - Liners (synthetic and/or compacted clay) to minimise seepage.

        - Emergency spillways routed to low-risk receivers, never directly into pans or high-EIS wetlands.
    - Operate PCDs to maintain sufficient capacity prior to the wet season; incorporate water reuse to reduce freshwater abstraction.
- Tailings Storage Facility (TSF) design:
    - Use double-lined TSFs with leak-detection and under-drain systems where feasible, especially for uranium-bearing tailings and acidic leach residues.
    - Design TSF paddocks, embankments and return water dams to:
        - Prevent overtopping under extreme rainfall.
        - Minimise wind erosion and dust emissions from dry beaches.
    - Incorporate seepage cut-off trenches or cut-off walls down-gradient where sensitive aquifers or receptors occur.
- Process water and leach circuits:
    - Fully contain sulphuric acid leach circuits within bunded, concreted areas draining to PCDs.
    - Avoid any unlined channels for process water; use piped systems with leak detection.
    - Implement closed-loop water recycling as far as practicable to approach zero-liquid discharge, subject to geochemical and radiological constraints.

5.14.4 Radiation and Contamination Control

- Source and pathway control:
    - Minimise the volume of material with elevated radioactivity stored above ground by:
        - Optimising cut-off grades to reduce low-grade stockpiles.
        - Returning low-grade, non-economic ore to backfilled pits where geochemically acceptable.
    - Prevent any direct discharge of mine water or tailings supernatant into natural watercourses or pans.
- Containment of radioactive materials:
    - Store all uranium-bearing concentrates, reagents and contaminated consumables in bunded areas with lined floors.
    - Maintain double containment for any pipelines or tanks carrying highly contaminated or acidic solutions (e.g. pipe-in-pipe, leak trays, sumps with alarms).
    - Implement strict housekeeping and spill control so that contaminated solids and sludges do not accumulate in unlined areas.
- Radiation protection for workers and public:
    - Apply ALARA principles (As Low As Reasonably Achievable) to exposure via:
        - Engineering controls (enclosed handling of concentrates, local extraction ventilation).
        - Administrative controls (time limits in high-dose areas, restricted zones).
        - PPE (respiratory protection, dosimetry).
- Fence and signpost all TSFs, ore stockpiles and process areas as controlled radiation zones, with access restricted.

5.14.5 Air Quality: Dust, Radon and Wind-Blown Contaminants

- Dust control on semi-arid sites:
    - Keep ore and tailings surfaces moist where feasible and environmentally safe to do so, avoiding excessive ponding that increases seepage risk.

- Use chemical dust suppressants or surface armouring (gravel, vegetation) on long-term exposed areas.
- Apply graded wind breaks and berms on dominant wind directions around TSFs and stockpiles.

- Radon and radioactive particulates:
  - Minimise exposed surfaces of high-grade ore and tailings; keep them in covered or enclosed storage where practicable.
  - Use enclosed conveyors or transfer points for high-uranium materials to limit dust and radon release.
  - Monitor ambient radon levels and gamma dose rates at site boundaries and in worker areas; implement additional shielding or ventilation as thresholds approach licence limits.

5.14.6 Open-pit and Underground Mining Mitigation

The following mitigation measures are aimed to protect and conserve watercourses during the excavation of the mine pits and underground mining:

- The extent of the mine pits should not differ from the extent of the approved and authorised shapefile shared with the consultants and Competent Authority;
- Install groundwater monitoring wells around mining sites to allow for early detection of contamination plumes. Grouting and sealing of underground mine shafts and boreholes can prevent the migration of contaminated water into aquifers that may intermittently recharge surface water systems;
- Implement measures to prevent the formation of acid mine drainage by isolating sulphide-bearing waste from oxygen and water, such as through dry covers, encapsulation, or underwater storage of reactive waste in the event that sulphide bearing rocks are discovered/encountered;
- Use active or passive water treatment systems (e.g., constructed wetlands, lime neutralization, ion exchange) to remove uranium, heavy metals, and radionuclides from mine-impacted water before discharge or reuse;
- Employ controlled blasting and excavation techniques to minimize the disturbance of surrounding rock and reduce the generation of fine particulate matter that could be transported to water bodies;
- Apply dust suppression methods, such as water sprays, chemical stabilizers, or covering of ore and waste piles, to prevent wind-blown contaminants from entering ephemeral streams during rainfall events;
- Design and maintain stormwater management systems to capture and treat runoff from mine sites, especially during infrequent but intense storms common in semi-arid regions;
- Constructing lined tailings storage facilities and water retention ponds is essential to prevent seepage and runoff of contaminated water into ephemeral streams and groundwater. The use of impermeable barriers and regular inspection of containment structures can minimize the risk of leaks, especially during rare but intense rainfall events typical of semi-arid climates;
- Implement water-efficient mining and ore processing techniques, such as dry stacking of tailings and closed-loop water recycling systems. This reduces the demand for scarce water resources and limits the volume of contaminated water requiring treatment and disposal;
- Only if applicable and authorised then diverting clean surface water away from mining areas using diversion channels and berms to prevent the mixing of uncontaminated water with mine-impacted water may be practiced.
- Erosion control measures, such as revegetation of disturbed areas and the use of sediment traps, further reduce the transport of sediments and associated contaminants into ephemeral water bodies;

- All infrastructure components (i.e., stockpiles, haul roads, buildings etc) associated with the mining activities must be located within the extent of the proposed MRA shared with the consultant;
- Backfill underground mine voids with inert material to reduce the risk of subsidence and limit pathways for water movement and contaminant migration;
- Segregate and selectively handle potentially acid-generating or uranium-rich waste rock to ensure it is stored in lined, contained facilities away from watercourses;
- Basic rock cladding must be applied to areas characterised by signs of erosion within and around the relevant watercourses and drainage lines;
- Develop and regularly update emergency response plans for accidental spills, leaks, or extreme weather events to minimize the risk and impact of acute contamination incidents;
- Continuous monitoring of water quality in both surface and groundwater, especially during and after rainfall events, ensures that any contamination is detected early and can be addressed promptly. Adaptive management strategies should be in place to respond to monitoring results and changing environmental conditions;
- Implement long-term post-closure water management strategies, including ongoing monitoring, maintenance of containment structures, and periodic assessment of water quality to ensure the continued protection of aquatic resources after mining ceases; and
- Involve local communities and stakeholders in water management planning, monitoring, and decision-making to ensure transparency and address site-specific concerns.

5.14.7 Processing Plant

- Full Containment and Bunding of Acid and Process Circuits:
  - All sulphuric acid storage tanks, leach tanks, reagent make-up areas and pipelines must be located on impervious, bunded surfaces draining to a sump.
  - Bunds must be sized to contain at least 110% of the volume of the largest tank plus 25% of the total volume of all other containers in the bunded area.
  - Floors should be constructed of acid-resistant concrete with sealed joints to prevent seepage into soil and groundwater.
- Double-Containment for High-Risk Pipelines and Transfer Lines:
  - All pipelines conveying concentrated sulphuric acid or uranium-bearing leach solutions must be double-contained (e.g. pipe-in-pipe systems) over any area where leaks could reach soil, pans, drainage lines or PCDs.
  - Install leak-detection systems (e.g. pressure monitors, sump alarms) in interstitial spaces, with automatic shutdown protocols for abnormal readings.
- Dedicated, Lined Pollution Control Dams (PCDs) for Plant Effluents:
  - All process water, floor washings, spillage collection and stormwater from the plant footprint must drain to lined PCDs (synthetic liner and/or compacted clay) with leak detection and sufficient freeboard.
  - No direct discharge of plant effluents to natural drainage lines or pans may occur; all water must be recycled to the plant or treated to an agreed standard under the WUL before any controlled release.
- Strict Acid and Reagent Handling Procedures:
  - Implement standard operating procedures (SOPs) for the delivery, storage, transfer and dilution of sulphuric acid and other reagents (oxidants, flocculants, extractants).

  - Off-loading areas must be bunded, with drive-on/drive-off containment and quick-connect couplings to reduce spill risk.
  - Only trained and authorised personnel may handle bulk acid; regular refresher training and competency assessments must be conducted.
- Spill Prevention, Contingency Planning and On-Site Spill Response Capacity:
  - Equip the processing plant with appropriately sized spill kits (acid-neutralising materials, absorbents, PPE) at all transfer and storage points.
  - Develop and test a plant-specific Spill Response Plan, including clear internal reporting lines, immediate containment procedures, and requirements for clean-up, disposal and incident investigation.
  - Maintain an incident register and implement corrective and preventive actions following any spill.
- Air Emission, Ventilation and Worker Exposure Controls:
  - Provide adequate local exhaust ventilation over leach tanks, acid storage and transfer points to capture acid mists and any volatile process components.
  - Install scrubbing systems where necessary to treat off-gases before release to atmosphere.
  - Implement a personal exposure monitoring programme (e.g. sulphuric acid mist, radionuclides in air) and enforce the use of appropriate PPE where engineering controls alone are not sufficient.
- Segregation and Management of Solid and Liquid Wastes:
  - All solid wastes and sludges contaminated with acid or uranium (e.g. filter cakes, spent resins, maintenance wastes) must be handled as hazardous waste and routed to the TSF, a lined hazardous waste cell, or licensed off-site facilities as appropriate.
  - Segregate radioactive and chemically hazardous wastes from general waste to prevent dilution and uncontrolled disposal.
  - Maintain a waste inventory and tracking system to demonstrate proper handling, storage and disposal in line with NEMWA and WUL conditions.
- Stormwater Management and Clean–Dirty Water Separation at the Plant:
  - Implement clean–dirty water separation across the plant platform:
    - Upslope clean runoff diverted around the plant via lined channels.
    - Plant area and any potentially contaminated zones drain to PCDs.
  - Design stormwater systems for semi-arid intense-storm events, ensuring that bunds and drains cannot be overtopped by infrequent but severe rainfall, which could otherwise flush acid or radionuclides into nearby pans or drainage lines.
- Emergency Power and Instrumentation for Critical Safety Systems:
  - Provide backup power (e.g. diesel generators or UPS) for critical containment and safety systems: pumps returning contaminated water to PCDs, scrubbers, leak-detection alarms and control valves.
  - Implement automated interlocks to shut down acid dosing, leach circuits and relevant plant sections in the event of loss of power, pump failure or detected major leaks.
- Comprehensive Monitoring and Integration with WUL and Radiation Licence:
  - Establish a monitoring programme for plant-related impacts, including:
    - pH, EC, sulphate and metals/uranium in plant PCDs and down-gradient groundwater.
    - Ambient air quality (dust and acid mist) and radiation (gamma dose rates, radionuclides in dust).

- Link monitoring results to predefined trigger thresholds with corresponding responses (operational changes, increased treatment, temporary shutdowns).
- Ensure all plant design, operational controls and monitoring are aligned with EA, WUL and nuclear/radiation licence conditions, with regular reporting to authorities.

5.14.8 Operation of Vehicles, Heavy Machinery and Equipment

- Vehicles, heavy machinery and equipment are only permitted within the no-go areas when being actively operated under supervision of the ECO, and otherwise must be stored outside of the no-go areas on level impervious ground. The same applies to the servicing thereof. This is best practice as it limits their duration within sensitive freshwater areas and thereby minimising impacts. Any activity within an unauthorised area must first seek the prior approval of the ECO, except under emergency procedures;
- The operation activities must be subjected to seasonal restrictions to support aquatic wildlife breeding periods;
- Existing access roads/jeep tracks/haul roads must be used as far as possible to prevent additional disturbance to the riparian zone and overall upgradient catchment. New routes must be carefully planned and advised by the ECO so as to avoid freshwater and generally sensitive habitats as far as feasibly possible. In the event of a new access route traversing a riparian zone, the proponent must look into using machinery with low ground pressure to minimise soil compaction and damage to riparian vegetation. Tracked vehicles or specialised low-ground-pressure tyres can be used if feasible/available;
- Non mobile machinery must be equipped with attachments like swamp mats or bog mats to distribute weight and minimise disturbance to the watercourse areas;
- Vehicle and heavy machinery must be equipped with drip trays to prevent the spill of hydrocarbons and other contaminants into the environment. An emergency spill remediation response plan must be in place in the event of an unforeseen spill, as affected through the training of operational staff and the acquisition of spill contaminant materials that must be readily available on-site. It is the responsibility of the contractor to immediately action spill cleanups and remove hazardous material off site;
- Operators must be trained in operating machinery in wetland/sensitive environments and be aware of the sensitivity of the area;
- Sensitive areas must be demarcated so as to guide operators, labourers and contractors;
- Use machinery with low ground pressure to minimise soil compaction and damage to wetland/riparian vegetation. Tracked vehicles or specialised low-ground-pressure tyres can be used if feasible/available;
- Implement sediment and erosion control measures such as silt fences, erosion control blankets, or sediment traps to prevent soil runoff into water bodies associated with vehicular movements and disturbed/hardened surfaces;
- Servicing, washing and refuelling of vehicles may not take place within the no-go areas;
- All Hazardous Chemical Substances (HCS) should be stored within suitable secondary containment structure and may not be stored within the watercourses or their buffer zones;
- Develop spill prevention and response plans to address potential leaks or spills of fuels, oils, or other hazardous substances;
- Have spill containment materials readily available on-site and train personnel in proper spill response procedures;
- The contractor is responsible for cleaning up any spillages (e.g. concrete, oil, fuel), immediately;

- Leaking equipment shall be removed from site immediately to facilitate repair;
- Contaminated soils and waste materials must be removed and disposed of in accordance with local regulations and guidelines;
- Properly manage waste generated during operations, including fuel, lubricants, and construction debris, to prevent contamination of the wetland/riparian areas;
- Implement an Incident Register to report any incidents or deviations from the planned operations to the ECO;
- Tarpaulins must be used to cover the loaded material to prevent the spill and spread of sand during transport; and
- Develop a restoration and rehabilitation plan to mitigate any long-term impacts of operating heavy machinery in wetlands and/or riparian areas.

5.14.9 Water Quality Impairment

- All contractors and employees must undergo induction which is to include a component of environmental awareness. The induction is to include aspects such as the need to avoid littering, the reporting and cleaning of spills and leaks and general good “housekeeping”;
- Vehicle washing and refuelling must take place outside of the no-go area to avoid the runoff of hydrocarbons and other contaminants into watercourses;
- No radioactive materials should be introduced into the aquatic environment;
- A Remediation Plan should be commissioned for accidental and/or prolonged introduction of acidic waters and/or radioactive isotopes into the aquatic environment;
- All chemicals and toxicants must be stored in bunded areas; and
- The contractors used for the project should have spill kits available to ensure that any fuel or oil spills are clean-up and discarded correctly.
- Baseline and predictive studies:
    - Conduct baseline groundwater quantity and quality surveys (including radionuclides, major ions, metals) prior to mining.
    - Use numerical groundwater models to predict drawdown cones, seepage plumes from TSFs/PCDs, and potential connectivity with pans and drainage lines.
- Monitoring network:
    - Install up-gradient and down-gradient monitoring boreholes around pits, TSFs and PCDs.
    - Monitor key indicators: water level, pH, EC, sulphate, uranium and other relevant radionuclides, metals, and major ions.
    - Define action levels and trigger-based responses (e.g. increased pumping, barrier installation, treatment) if trends exceed thresholds.

5.14.10 Erosion, Sediment and Soil Management Measures

The following erosion, sediment soil management measures are applicable to semi-arid Karoo conditions and soil types.

5.14.10.1 Stockpiling and Topsoil Management

- Location of stockpiles:
    - Do not place any soil, overburden or waste stockpiles within watercourses, pans, wetlands, or their buffer zones/regulation areas.

- Locate stockpiles on flat or gently sloping ground, outside natural drainage paths, to minimise runoff concentration and erosion.

- Protection of stockpiles:
  - Surround stockpiles with low earth bunds, rock berms or sandbags to prevent eroded material entering ephemeral channels or pans.
  - Protect longer-term stockpiles using mulch, straw, or brush-packing; where feasible, seed with indigenous, drought-tolerant grasses to stabilise surfaces.
- Topsoil stripping, storage and reuse:
  - Strip topsoil separately from subsoil and waste rock, and store in designated, low-slope, bunded stockpiles outside regulated areas.
  - Keep topsoil stockpiles low (preferably <2–3 m) to reduce compaction and preserve seed banks and soil biota.
  - Record and document the soil profile (topsoil/subsoil horizons) during stripping, and re-apply soils in the same horizon order during rehabilitation.
  - Ensure topsoil is appropriately stored and re-applied as the uppermost layer during backfilling and rehabilitation.

5.14.10.2 Earthworks, Backfilling and Compaction

- Backfilling practices:
  - Backfill excavated areas with suitable material and compact to geotechnical specifications appropriate for local Karoo soils, avoiding over-compaction that inhibits revegetation.
  - Re-establish natural micro-topography where possible to avoid creating artificial flow paths that channel runoff into sensitive pans or drainage lines.
- Immediate response to erosion:
  - Inspect exposed earthworks and stockpiles regularly, especially after storm events.
  - Address any signs of erosion immediately (e.g. rills, gullies, slope failures) using appropriate stabilisation measures to prevent further degradation of soils and infrastructure.

5.14.10.3 Erosion and Energy Dissipation Structures

- Stabilisation of fine-textured Karoo soils - stabilise all new embankments, cut slopes, TSF walls and drain banks using a combination of:
  - Rock armouring or riprap on steeper/lower slopes or outlets.
  - Geotextile or erosion control blankets on critical surfaces.
  - Fast-establishing indigenous grasses or shrubs suited to semi-arid conditions for longer-term stability.
- Energy dissipation at outlets:
  - Install energy dissipaters (e.g. riprap aprons, drop structures, stilling basins) where clean or dirty water is discharged from pipes, culverts or spillways to prevent scouring and undercutting.
  - Avoid concentrating runoff from large catchments onto small, unarmoured outlets that can rapidly erode and incise into ephemeral drainage lines or pans.
- Targeted structural measures:
  - Use gabions, rock check dams or brush-packed barriers at key access points through vegetation or across minor drainage lines to slow flows and trap sediment.

- Where appropriate, use silt fences or small sediment traps below disturbed areas and along drainage lines around stockpile zones; design them for short-term use and maintain regularly.

5.14.10.4 Stormwater Management (Construction and Operation Phases)

- Temporary stormwater controls:
  - Install temporary stormwater management systems (e.g. diversion berms, interceptor ditches, small retention/detention basins) around active work areas and stockpiles to capture and slow runoff.
  - Where preferential runoff channels form downslope of disturbed areas, infill or line them with aggregate, brush-packing, or logs/branches to dissipate energy and limit erosion and sediment delivery.
- Drainage line protection:
  - Keep natural ephemeral drainage lines intact; do not infill or straighten them.
  - Where runoff must cross drainage lines, use armouring (rock, gabions) and small sediment trapping berms to protect the channel bed and banks and to trap coarse sediment before it enters downstream pans or wetlands.

5.14.11 Rehabilitation and Vegetation

- Rehabilitation must be done concurrently and progressively with the mining operations, and according to a Rehabilitation Plan approved by the Competent Authority.
- Rapid stabilisation of exposed soils:
  - Any exposed earth (cut slopes, backfilled areas, old tracks) should be rehabilitated promptly with:
    - Mulching or brush-packing immediately after construction to protect soil from raindrop impact and wind erosion.
    - Seeding or planting of vigorous, indigenous, drought-tolerant grasses and shrubs as soon as seasonal conditions allow.
- Landscape and re-vegetate all cleared and disturbed areas as soon as practically possible, prioritising areas upslope of drainage lines and pans.
- Use locally sourced indigenous species and, where possible, soil with an intact seed bank to accelerate recovery and reduce the risk of invasive species.
- Monitor revegetation success; re-seed or re-plant areas where vegetation cover remains inadequate to control erosion.
- An alien invasive plant management plan needs to be compiled and implemented by the ECO prior to the authorisation of the MRA to control and prevent the spread of invasive alien vegetation due to disturbance of the wetland and riparian zones;
- Vegetation should be removed sparingly and must be overseen by an ECO, who must prioritise the removal of alien invasive species over indigenous vegetation; and
- Alien vegetation must be removed to a registered facility as soon as possible and must not be stockpiled, burned or mulched on site, ultimately to prevent the spread of alien invasive vegetation.

5.14.12 Operational Monitoring, Reporting and Adaptive Management

- Integrated monitoring programme:
  - Regularly monitor surface water, groundwater, sediments, air quality (PM10/PM2.5 and radionuclides) and biota (where water is present) against WUL and EA conditions.
  - Include targeted sampling at pans, ephemeral channels, and down-gradient receptors.

- Adaptive management:
  - Establish early-warning indicators (e.g. rising uranium in down-gradient boreholes, decreased pH in PCDs, increased gamma dose at boundary).
  - Pre-define contingency measures: increased treatment, changes to TSF operation, further containment, temporary shutdowns if necessary.
- Transparency and governance:
  - Report monitoring results to regulators and stakeholders at agreed intervals.
  - Maintain an on-site Environmental/Radiation Management Plan that integrates EA, WUL and nuclear/radiation licence requirements.

5.14.13 General

- Wetland areas (and associated buffers) must be avoided, and where avoidance is not feasible then all disturbed areas and sensitive habitats must be offset and/or rehabilitated;
- An Ecological Compliance Officer (ECO) that is a competent freshwater ecologist must be appointed to ensure compliance to the mitigation measures listed below;
- The ECO must clarify the sensitive areas with all operational staff, notwithstanding providing overall environmental awareness training of the catchment and general high importance of estuarine environments, as is particularly relevant to this project;
- Mining activities must be limited to the proposed MRA, with the bounding coordinates demarcated on the ground using wooden poles. The areas outside of the demarcated MRA are to be treated as a no-go area for all aspects of the mining operation. The non-definitive list, comprises the operation of machinery, vehicles and equipment, construction camps/laydown yards and staff pedestrian movement to name some;
- Mining activities must avoid the watercourse areas as far as possible, considering these habitats provide ecosystems services to aquatic biota;
- Adequate sanitary facilities and ablutions on the servitude must be provided for all personnel throughout the project area. Use of these facilities must be enforced (these facilities must be kept clean so that they are a desired alternative to the surrounding vegetation);
- All domestic and general waste that is produced daily must be contained and may not be buried of burned on site. Waste containers must be emptied regularly and removed from site to the nearest official waste disposal site to prevent littering on site;
- Access routes and other infrastructure areas must be rehabilitated;
- Measures must be implemented where environmental alterations are made (including at existing structures or activities) to 1) prevent detrimental changes to the breeding, nesting or feeding patterns of aquatic biota, including migratory species (if present), 2) allow for the free up and downstream movement of aquatic biota, including migratory species (if present), and 3) prevent a decline in the composition and diversity of the indigenous and endemic aquatic biota;
- All link roads from the mining area to the main road must be continuously sprayed to suppress dust and prevent the potential smothering of aquatic vegetation in the form of wind-blown dust. Regular compaction and grading of the haul roads to clear accumulation of loose material will further assist to suppress dust.

5.14.14 Mine Closure and Long-Term Stewardship

- Progressive rehabilitation:

    - Backfill pits where feasible, re-contour to approximate natural topography, and re-establish indigenous vegetation adapted to semi-arid conditions.
    - Re-shape TSFs to landforms compatible with long-term stability; cover with low-permeability layers and a growth medium to reduce infiltration and radiation exposure.
- Post-closure water and radiation management:
    - Continue groundwater and surface water monitoring for an agreed post-closure period (often decades for uranium mines).
    - Maintain any necessary passive treatment systems (e.g. constructed wetlands) and ensure they do not themselves become secondary sources of contamination.
- Preventing legacy impacts:
    - Decommission and remove all unnecessary infrastructure, including pipes, tanks, and temporary dams, leaving no uncontrolled radioactive materials on site.

Secure and signpost any residual high-risk areas, ensuring responsibilities and funding for long-term care are clearly allocated.

5.15 Full description of the process undertaken to identify, assess and rank the impacts and risks the activity will impose on the preferred site (In respect of the final site layout plan) through the life of the activity.

The process to identify, assess and rank the impact and risks of the proposed mining activities have been provided by the specialist responsible for each environmental aspect. The assessment methodologies specific to each environmental aspect differ as they are appropriate to the discipline concerned as well as the relevant legislative context.

Impact assessment identification was conducted through the following means:

- Anticipated standard open cast impacts;
- Site visit to the planned open cast pit areas;
- Review of engineering designs of the open cast areas and associated infrastructure;
- Review of historic mine data; and
- Experience of the specialists.

The evaluation distinguishes between significantly adverse and beneficial impacts and allocates significance against national regulations, standards and quality objectives governing:

- Health and Safety
- Protection of Environmentally Sensitive areas
- Land use
- Pollution levels

Irreversible impacts are also identified.

It should be noted that the core impact assessment methodology was uniform throughout the various specialist studies with some variation in presentation format and terminology specific to each discipline.

5.16 Assessment of each identified potentially significant impact and risk

This section provides a summary compilation of the various impact assessments conducted by the specialist team. It should be noted that the nature of each specialist field dictates the variation in the impact assessment methodology as well as the outcome presentation format.

Table 5-32. Summary compilation of impact assessments

	Activity	Identified / possible Environmental Impact	Pre-mitigation quantification and qualification of Impact					Mitigation	Post- mitigation Quantification and qualification of Impact				
			Probability	Extent	Duration	Magnitude	Significance points		Probability	Extent	Duration	Magnitude	Significance points
Construction Phase													
Air Quality Impact assessment													
Air quality	All construction related activities	Fugitive dust generated by construction and decommissioning related activities	4	1	1	2	16	Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unsurfaced roads e.g. by limiting vehicle speeds and restricting traffic volumes. Unpaved road surfaces could be sprayed with a surfactant to bind the silt. Stabilise open areas with dust palliative, gravel or similar	2	1	1	1	8
Radiological Imapct Assessment													
Radiological Impacts	Clearing of footprint areas for mine infrastructure	Radiological exposure of residual waste rock material from historical mining activities	2	2	2	2	12	Impact is negligible. No mitigation required.	2	2	2	2	12
Radiological Impacts	Removal of topsoil and soft overburden	Radiological exposure from radiological nucleotides occurring in trace amount in overburden material	2	2	2	4	16	Impact is negligible. No mitigation required.	2	2	2	4	16
Radiological Impacts	Construction of mine infrastructure	Radiological exposure from residual waste rock material from historical mining activities	2	2	2	2	12	Impact is negligible. No mitigation required.	2	2	2	2	12
Traffic Impact Assessment													
Impacts of Traffic	Ligth and heavy vehicle movement	Deterioration of existing access/gravel road surfaces	3	2	2	6	30	Conduct weekly maintenance on existing access and gravel roads. This entails importing gravel from waste rock dumps. Provide sufficient road signs to prevent speeding.	2	2	2	4	16
Impacts of Traffic	Ligth and heavy vehicle movement	Dust	5	2	2	6	50	Conduct dust mitigation by means of applying supression methods, such as water or adequate quality of chemicals. Speed l imited to 30km	2	1	2	4	14
Impacts of Traffic	Ligth and heavy vehicle mo The traffic impact assessment indicates that the **existing road network is sufficient to accommodate the increased traffic** associated with both the construction and operational phases of the proposed Lukisa Mine without requiring major upgrades. The gravel and tarred roads in the vicinity are in fair condition, and traffic volumes are currently low, with **ample spare capacity**. During construction, the projected 100 daily vehicle trips—20% of which will be heavy trucks—can be managed using existing infrastructure, although **routine maintenance of gravel roads and regular watering** will be necessary to control dust and road degradation. In the operational phase, the estimated **120 daily**	Overutilization of national/provincial roads	2	2	2	4	16	Consult with traffic department of local municipality to determine road design capacity	1	2	2	2	6

	truck trips remain within road capacity limits, with no need for road surfacing, though continued dust suppression and signage at access points are recommended for safety. The **transportation routes, including the N1 and nearby rail infrastructure**, support logistical feasibility. Given the limited viable alternatives to mining—namely, livestock farming and eco-tourism—the proposed development represents the most **economically and technically viable land use**. **Conclusion:** From a traffic and transportation perspective, the proposed mining development poses **no significant impact** on existing road infrastructure and can be supported **without major upgrades**, provided maintenance and mitigation measures are implemented. Thus, the development is **acceptable and recommended for approval** on traffic grounds. vement													
Heritage Impact Assessment (archaelogy)														
Impacts on Heritage (archaelogy) Character	Construction of waste rock stockpile footprint area	Damages caused to archaelogical remains	5	1	5	8	70	Remove archaelogical remains before construction is initiated. Consult an archaelogist to collect remains.	2	1	1	2	8
Visual Impact Assessment														
Impacts on Visual Site Attributes	Movement of mine machinary during civil works, establishment of temporary buidlings	Impact on the sense of place and landscape character due to low landscape absorption capacity	4	2	2	6	40	• If at all possible, design the blast such that vertical plumes are limited. • Clear communication with surrounding property owners on when blasts will take place. • Ensure that post-closure, the pits are well fenced off to ensure that security is maintained to reduce the risk of injury from those seeking recycling metals.	4	2	2	6	40
Noise Impact Assessment														
Impacts on Acoustics (Noise)	Traffic movement	Increased noise levels at sensitive receptors	3	2	2	4	24	Limited mitigation available, Regular vehicle servicing	3	2	2	4	24
	Blasting	Increased noise levels at sensitive receptors	3	3	2	6	33	Minimise the volume of blast material required for an effecive blast, minimise the frequency of blasts, correct tamping of blast holes, minimue the number of blast holes for each blast, thereby reducing the SPL and air blast as well as vibration associated with the blast.	3	2	2	4	24
Socio-economic Impact Assessment														
Impacts on socio-economic conditions	Influx of People	Increase in social ills, erection of illegal housing	5	2	4	6	66	•Contractors should maximise the use of local labour, especially for the semi-skilled to unskilled employment categories as this would limit the negative impacts associated with a sudden population increase and to avoid possible conflict arising between locals and the outside workforce •The local labour procurement strategy as well as proof of residence required should be clearly communicated in the local community and broader regional media well in advance of the construction phase •Clear communication of available employment to minimise population influx. •Clearly communicated preference for local people to work at the Ryst Kuil operations. •Publicised recruitment of farm workers directly affected by job losses.	5	2	4	4	44
Impacts on socio-economic conditions	Employment opportunities	Skill levels not match mine requirements, and employees with appropriate skills will be sourced from elsewhere.	5	3	2	6	60	•Clearly define and communicate the required number of jobs and skills. •Recruit from the local community first, regardless of the required skills level. •Establish a 'labour desk' to enable effective communication. •The skill requirements should be communicated to the local community leaders and community based organisations •Provide up-skilling opportunities for unskilled and semi-skilled local workers to lessen any possible skills disparity.	5	3	3	6	66

								•Use existing and local construction businesses as subcontractors						
Impacts on socio-economic conditions	Economic displacement through land use restrictions	Change in land use will occur. Farming being disrupted, water, and land use being disrupted.	2	2	2	4	16	The extent will be determined and mitigation measures will be included in the social and labour plan. Establish grievance procedure prior to the commencement of the project. Clearly communicate this to the public, ensuring ongoing interaction with the community affected, building trust. Where strong water sources are identified, share this with farmers, improve use after rehabilitation.	1	2	2	2	6
Impacts on socio-economic conditions	Increased pressure on infrastructure and services	Influx of people to hospitals, clinics etc. More people making use of services.	4	3	2	4	36	Take increased population into consideration during infrastructure planning in consultation with the local municipality.	3	2	2	4	24
Impacts on socio-economic conditions	Housing need during construction	Increased demand for housing, which may cause the erection of illegal houses. Development of houses that does not represent character of area, urban sprawl.	4	3	2	6	44	•Contractors to ensure that workers from outside the local area reside in suitable facilities and not establish informal houses. •Due to the size of the construction workforce, a contractors accommodation facility can be considered. •In the event that a contractors accommodation facility is constructed, the contractors must ensure that all relevant legislation is adhered to. •Housing and development should occur within the town's 'urban edge' and uphold the character of the town, by contributing architecturally to the town.	3	3	2	5	30
Impacts on socio-economic conditions	Increased economic activity	Increased economic activity in towns (changes in demand and supply ratio). Influx of people will result in an increased demand for goods and services). Local infrastructure and servicews	4	2	2	4	32	Enlist current business and vendors. Explore the possibility of using local suppliers of goods and services by drawing up a list of services offered. Make information of required supplies and services available to the community to encourage tenders from the local area. •Take increased population into consideration during infrastructure planning in consultation with the local municipality. •Integrate into existing municipal systems •Assist BWLM if required with skills and equipment to ensure services are well maintained and able to handle the increased loads from additional population •See also accommodation mitigation	4	2	2	4	32
Impacts on socio-economic conditions	Community Health, Safety and Wellbeing	Concerns include a potential rise in local crime and the area becoming a target for stolen goods and livestock. Noise impacts are also likely, particularly from heavy vehicles and construction operations. While noise may be intrusive due to the area's typically low ambient levels, the impact on nearby residents' quality of life	3	2	2	4	24	•The construction area should be fenced or access to the area should be controlled to avoid unauthorised entry •Employ permanent security personnel for the duration of the construction period •Adhere to the Occupational Health and Safety Act (Act 85 of 1993) through the development of an Occupational Health and Safety Plan. •Develop and Implement an Occupational Health and Safety, Community Security and Emergency Preparedness and Response Plan •To protect employees during the construction of the project, only qualified personnel undertaking tasks relevant to their duties must be allowed •Personal Protection Equipment (PPE) must be provided to all construction workers and contractors •Adhere to the National Veld and Forest Fire Act (Act 101 of 1998) •A Fire/Emergency Response and Management Plan should be developed and implemented. •Contractors and construction workers must be trained with regards to the implementation of the Fire/Emergency Response and Management Plan •Regularly review the functionality and efficiency of these plans in conjunction with the local emergency teams, management, community representatives and neighbouring landowners •Appropriate fire-fighting equipment should be on site and construction workers should be appropriately trained for fire fighting •All construction vehicles should be in a good condition and adhere to the road worthy standards •Implement regular safety briefings, road signage as well as speed control measures •Speeding of construction vehicles must be strictly monitored •Sufficient warning signs should be erected at the public road crossing and turn-offs. See also relevant specialist reports •Consider public transport of workers to and from the site on a daily basis •Restrict the activities and movement of construction workers and vehicles to the immediate construction sites and existing access roads. •Ensure that all temporary employees, sub-contractors and contractors understand and are aware of the requirements and adhere to the EMPr •Transgressions to be dealt with through verbal instructions, then written communication and contract notices (in the case of serious transgressions). •A Complaints Register must be available at the security office •The mitigation measures of the Noise and Air Quality Impact Assessments are relevant. See also relevant specialist reports •Dust suppression measures should be applied when necessary. See also relevant specialist reports •Install low-impact lighting on the exterior of the site where night-time lighting is essential. See also relevant specialist reports	3	2	2	3	21

								•The stakeholders (through a forum) should be kept informed of the construction schedules and activities. •Ensure that road use is limited through towns and does not impact on other road users on main roads. •Retain natural vegetation adjacent to the development footprints. •Make use of existing access roads where possible. •Limit the construction of roads and plan location of additional roads required in such a way that clearing of vegetation is minimised and that limited cut and fill requirements would be necessary. •Limit erosion risks as erosion scarring can create areas of strong contrast which can be visible from far distances.					
Impacts on socio-economic conditions	Changes in heritage and cultural identity	Potential decrease in tourisms activity,	3	3	2	6	33	Housing and development should occur within the town's urban edge and uphold the character of the town, by contributing architecturally to the town. Consult urban planner and architects when development houses for employees.	3	3	2	4	27
Soil, Land Capability, and Land Use Impact Assessment														
Impacts on Soil Quality, Land Capability, and Land Use	Removal of topsoil for open cast operations	Disturbance of natural soil structure and density	5	1	5	6	60	The reestablishment of vegetation will be critical to promote soil aggregate formation	4	1	2	6	36
Impacts on Soil Quality, Land Capability, and Land Use	Removal of topsoil for open cast operations	Loss of soil quality (hydrocarbon spillages)	5	1	5	8	70	All machineries must be inspected on a daily basis for leakages. Also, refuelling should only occur at designated maintenance areas. All spillages must be cleaned up and impacted areas remediated as soon as possible.	2	1	5	8	28
Impacts on Soil Quality, Land Capability, and Land Use	Removal of topsoil for open cast operations	Disturbance and loss of stream bed and riperean zone soil and sediment	5	2	4	8	70	No mitigation can be provided to prevent disturbance to the stream bed and riparian zone. Stream diversion will have to be conducted for the operational life of the mine. The removal and stockpiling of riparian zone soil and sediment to be stockpiled separately. Disturbed riparian zone to be rehabilitated to at least a pre-mining standard. Stream diversion to be included in WULA.	5	2	4	8	70
Impacts on Soil Quality, Land Capability, and Land Use	Waste rock dump and pollution control dam construction	Compaction of soil profile from overlying infrastructural weight	5	1	4	6	55	Soil must be ripped and revegetated after decommissioning.	5	1	4	4	45
Impacts on Soil Quality, Land Capability, and Land Use	Waste rock dump and pollution control dam construction	Leaching of contaminants from waste rock dump and/or PCD into soil profile	4	2	4	8	56	Acid base accounting indicated that waste rock has a low acid generating potential, and leaching of radioactive nuclides is highly unlikely. Install a liner for PCD.	3	2	4	4	30
Impacts on Soil Quality, Land Capability, and Land Use	Waste rock dump and pollution control dam construction	Spillages or leakages from polluction control dam	3	2	5	6	39	Ensure PCD is operated at designed capacity. Conduct regular monitoring of dam levels.	2	1	5	4	20
Impacts on Soil Quality, Land Capability, and Land Use	Haul road construction	Loss of soil quality (hydrocarbon spillages)	5	1	5	8	70	All machineries must be inspected on a daily basis for leakages. Also, refuelling should only occur at designated maintenance areas. All spillages must be cleaned up and impacted areas remediated as soon as possible.	2	1	5	8	28
Impacts on Soil Quality, Land Capability, and Land Use	Haul road construction	Compaction of soil profile	5	1	4	6	55	Soil must be ripped and revegetated after decommissioning.	5	1	4	4	45
Impacts on Soil Quality, Land Capability, and Land Use	Construction of other mine facilities (ablution, offices, storage, laydown areas, crusher)	Compaction of soil profile	5	1	4	6	55	Soil must be ripped and revegetated after decommissioning.	5	1	4	2	35
Impacts on Soil Quality, Land Capability, and Land Use	Construction of other mine facilities (ablution, offices, storage, laydown areas, crusher)	Leaching of poor quality run-off water into soil profile	3	2	5	6	39	Clean-dirty water seperation facilities must be constructed to separate clean water run-off from dirty water.	3	2	4	2	24
Impacts on Soil Quality, Land Capability, and Land Use	Soil stockpiling	Mixing of topsoil and subsoil	4	1	4	6	44	Topsoil and subsoil must be stockpiled seperately. A Soil Standard Operating Procedure will be developed for soil management.	2	1	3	4	16
Impacts on Soil Quality, Land Capability, and Land Use	Soil stockpiling	Loss of soil organic carbon	4	1	4	6	44	Topsoil and subsoil must be stockpiled seperately. A Soil Standard Operating Procedure will be developed for soil management.	2	1	3	4	16

Impacts on Soil Quality, Land Capability, and Land Use	Soil stockpiling	Loss of soil volume due to erosion	4	1	4	6	44	Stockpiled soil must be vegetated to prevent loss during peak rain events or wind storms. Stockpiles must be designed at a stable slope length and angle.	2	1	3	4	16
Impacts on Soil Quality, Land Capability, and Land Use	Soil stockpiling	Collection of alien invasive seeds during stockpiling period	4	1	4	6	44	An alien invasive management plan will be developed.	2	1	3	4	16
Biodiversity Impact Assessment													
Impacts on biodiversity (floral)	Removal of topsoil with associated vegetation	Disturbance of sensitive habitat with associated sensitive floral species (specifically, stream bed and riparian zones)	5	1	4	8	65	Avoidance of Sensitive Areas:All High SEI habitats and buffer zones outside of proposed infrastructure must be avoided.Road crossings over High SEI drainage areas are permitted only with due consideration of aquatic reports; use existing roads wherever possible.In Rocky and Stoney habitats, limit access to existing roads.Site Preparation and Construction:Clearly demarcate all areas to be developed or disturbed.Indigenous vegetation may not be cleared outside the authorised development footprint within the PAOI.Practice phased clearing to prevent erosion; cleared topsoil and plants must be preserved for on-site rehabilitation. Conduct search and rescue operations for indigenous plants before clearing.Permits and Plant Protection:Obtain necessary permits before clearing any Species of Conservation Concern (SCCs) or protected plants. Mark protected plants with visible flags and incorporate their protection into environmental awareness training.Access and Vehicle Use:All personnel and vehicles must use existing roads and paths.Minimise vegetation clearing and confine activities to authorised areas.Fire and Rehabilitation Management:Consult a fire expert and implement a fire management plan.Develop and execute a rehabilitation plan from project initiation.Replant disturbed areas with indigenous vegetation.Practice progressive rehabilitation to facilitate natural recovery and minimize invasive species. Exclude grazing animals from rehabilitated areas.Dust and Material Handling:Implement dust suppression measures; avoid non-environmentally friendly dust suppressants. EO must supervise vegetation clearing.Do not store materials long-term within the PAOI; use prefabricated or recyclable structures.Laydown areas are the only permitted zones for equipment and vehicle storage.Spill and Hydrocarbon Management:Implement a hydrocarbon spill management plan. Use drip trays and absorbent materials under equipment. Avoid on-site servicing; if necessary, only in demarcated zones. Treat or remove contaminated soil appropriately.Contain all fuel and chemical storage to prevent environmental contamination.All re-fuelling and maintenance must occur outside the PAOI.	2	1	4	4	28
Impacts on biodiversity (floral)	Removal of topsoil with associated vegetation	Development of mine footprint areas could cause alien invasive plants to establish	4	1	4	6	44	An alien invasive management plan will be developed and implemented on a bi-annual basis for the duration of the mine.	2	2	4	6	24
Impacts on biodiversity (faunal)	Removal of topsoil with associated vegetation	Loss of sensitive faunal species (direct (vehicle collision) and indirect (loss of habitat))	5	1	4	8	65	Sensitive fauna habitats must be avoided. All disturbed areas must be reinsated at least to a pre-mining state. A biodiversity action management plan must be developed.	3	1	4	6	33
Impacts on biodiversity (faunal)	Removal of topsoil with associated vegetation	Distribution/alteration of ecological life cycles (breeding, migration, feeding)	4	2	4	8	56	No mitigation possible.	4	2	4	8	56
Impacts on biodiversity (faunal)	Removal of topsoil with associated vegetation	Indigenous habitat contamination	4	1	4	8	52	All forms of contaminated areas must be remediated to at least a pre-disturbance/contamination state	2	1	4	8	26
Water related Impact Assessment													
Ground water	Mining	Dewatering operational areas. Changes in groundwater quantity and changes in groundwater level, which influence the decant volume.	4	2	4	6	60	Monitoring of the water level should be performed on a continuous basis. The original topography should be restored with water draining away from the adits and mine openings.	4	1	2	2	14
Ground water	Hydrocarbons from machinery and vehicles	Changes in groundwater quality, i.e. contamination of groundwater. Contamination could refer to the source, e.g. oil spills etc., or to changing water qualities during pollution plume migration.	4	2	4	6	60	Continuous monitoring of the groundwater quality, as well as the removal of possible sources of pollution, e.g. soils contaminated with hydrocarbon substances. Bunding of chemicals in storage areas. Determine pollution sources and isolate or remove such sources	3	2	3	6	48
Surface water	Clearing of vegetation; Excavations based on construction designs	Erosion from disturbed open ground areas during construction (Disturbed and unconsolidated soil and stockpiles)	4	2	4	6	60	Implement a practical water management plan that would include berms positioned upstream from the operational areas. implantation of flow control measures upstream of a construction site (through berms) and limiting sediment from being eroded from stockpiles (through silt fences) Furthermore, drains are to be positioned in strategic locations. Outside the berms to deflect clean water out to the veld. 1) Ryst Kuil Main – 16.2 Mm3 2) Ryst Kuil Extension – 10.9 Mm3 3) Abante – 12.1 Mm3 4) Haanekuil – 12.2 Mm3	4	1	1	4	24
Surface water	Construction of access roads	Altering the characteristics of catchment areas	1	1	2	6	24	Natural vegetation should be re-established to represent the previously undisturbed environment as closely as possible.	1	1	1	4	12
Surface water	Storage and erection of temporary structures to facilitate construction phase	Impeding or diverting the flow of water in a watercourse	4	1	3	4	32	Storm water management infrastructure development such as diversion berms, channels and silt management	2	1	1	2	8

Surface water	Hydrocarbons from machinery and vehicles Cement based products suspended in water		3	2	1	6	36	The storage/handling of fuel, lubricants and chemicals will require special attention due to their hazardous nature as is the case with the laydown areas. These areas are required to be secured and managed on impermeable floors with appropriate bunding, sumps and roofing. Spill management	1	1	1	4	12
Surface water	Landscaping / Grassing	Disturbance to vegetation cover thus reducing the site's natural ability to biofilter the surface runoff and groundwater reaching downstream drainage lines	4	1	2	4	28	Retention or rehabilitation of the natural land-cover and drainage of the site (post construction or decommissioning)	4	1	2	4	28
Surface water	Partial Flooding of site	Impeding flow	3	1	3	4	28	Diversion channels and berms are proposed near the buildable area, and the construction camp/laydown area. These areas are unlikely to impede the natural flow of water across the site	2	1	2	4	20
Surface water	Construction of the settling (PCD) dams.	Runoff of dirty water into the environment	5	1	3	4	40	appoint a civil engineer to oversee the construction of the Pollution control dams and the storm water collection berms and trenches. The civil engineer will approve and confirm the construction of the settling dam, the storm water collection berms and trenches to design specifications. Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed. Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction. The surface area of the settling dam will be approximately 1.3 ha. The appointed civil engineer will sign off the constructed settling dam and the storm water berms/trenches after completion. All the design specifications and plans will be submitted to the Department of Water and Sanitation during the applications of water use licenses.	3	2	4	4	30
Surface water	Open pit	Decreace of annual runoff.	5	1	2	4	35	An initial box-cut will be constructed on the northern section on the reserve. The box-cut will be approximately 28m wide and 90m long. Topsoil will be stripped to its maximum depth. Hard overburden material will be drilled, blasted and removed to the overburden stockpile. Berms to divert inflow.	4	1	2	2	20
Surface water	Construction of infrastructure	Changes in surface water quality may distribute pollution	4	2	4	6	48	Continuous monitoring is essential in the management of the surface water pollution and migration of pollution.	4	1	2	2	20
Operational Phase															
Radiological Impact Assessment															
Radiological Impact	Ore removal from open cast pit	Radioactive risk to mine personnel	3	1	5	10	48	Ensure safe handling procedure of radioactive material is followed.	2	1	5	6	24
Radiological Impact	Ore handling at Central Processing Plant (CPP)	Radioactive risk to mine personnel	4	1	5	10	64	Ensure safe handling procedure of radioactive material is followed.	3	1	5	6	36
Radiological Impact	Stockpiles and dams	Leaching of radioactive material to soil profile and groundwater	3	3	4	8	45	Ensure that run-of mine is placed on designated platforms. Any potential spillage must be cleaned and the necessary remediation implemented.	1	3	4	8	15
Radiological Impact	Stockpiles and dams	Surface run-off of radioactive material during high rainfall events	3	3	4	8	45	Implement berms to accumulate any run-off from the mine.	1	3	4	8	15
Radiological Impact	Movement of mine machinery, blasting, crushing, and screening of ore	Dust fallout at sensitive receptors (Beaufort West, farms, CBA)	4	3	4	6	52	Implement dust suppression methods at all potential dust sources	1	1	4	6	11
Radiological Impact	Seepage to groundwater from waste rock dump and associated PCD	Flow of contaminated groundwater to sensitive receptors	3	3	5	10	54	Ensure PCD is lined. Geochemical results are indicative that waste rock is mostly inert.	1	1	5	4	10
Radiological Impact	Surface water run-off from all mine facilities	Accumulation of radioactive particles in dams	3	3	4	8	45	Ensure no surface run-off from mine occurs. Berms to be installed to catch any surface run-off from the mine.	1	1	4	8	13
Radiological Impact	Surface water run-off from all mine facilities	Leaching of radioactive material to soil profile and groundwater	3	3	4	8	45	Ensure no surface run-off from mine occurs. Berms to be installed to catch any surface run-off from the mine.	1	3	4	8	15
Air quality impact assessment															

Air quality	emissions from the mine	The inhalation of PM10, PM2.5 CO, NOx and SO2 at concentrations exceeding health-based air quality standards; and which are greater than the permitted number of exceedances per year, may result in negative health impacts. Acid deposition is caused by SO3 emissions to the atmosphere, which react with moisture to form acidic compounds. This is associated with corrosion of exposed surfaces, damage to plant and vegetation life and acidification of water resources	4	2	4	6	60	• Roads could be tarred or traffic control measures implemented to limit vehicle-entrained dust from unpaved roads e.g. by limiting vehicle speeds and restricting traffic volumes. • Application of chemical surfactant to bind road surfaces could be utilised. • The sidewalls of the tailings dam could be vegetated as they rise, and the cover maintained to reduce the exposed area and limit wind entrainment. • The top of the tailings dam should be kept moist to bind the surface dust and prevent wind entrainment of dust. • Waste rock stockpiles could be vegetated as they rise, and the cover maintained to reduce the exposed area and limit wind entrainment. • The ore stockpile could be lightly moistened to reduce wind-entrained dust. • Consider the use of dust suppression or particulate filtration for underground workings to reduce particulate emissions vented to the atmosphere • Stabilise open areas with dust palliative, gravel or similar • Abatement measures are suggested for the dryer. This includes consideration of design parameters, and control technology such as fabric filtration. • Dust fallout monitoring is suggested on site boundaries in the vicinity of populated areas to determine impacts of particulate emissions on ambient environment • Use of dust covers are suggested on vehicles transporting rock and ore to reduce particulate generation • On-road and off-road machinery of EURO classification rating higher than four (EURO IV) could be utilised. • Abatement equipment could be utilised to reduce end-of-pipe emissions from equipment • Cleaner fuel, such as diesel with sulphur content less than 50 ppm, could be utilised for machinery • Measures to improve equipment efficiency and reduce unnecessary fuel usage could be introduced	2	1	3	4	24
	All operational phase related activities	Fugitive dust generated by open pit mining activities, vehicle and equipment entrained dust and other exposed surface.	5	2	2	6	50	use dust suffactant Zebra spray: water cart operation Speed limit, limit the number of trips.	4	1	2	2	20
Water Impact Assessment														
Surface water	Stockpiles and dams	Stockpiles creating of poor quality groundwater and/or poor quality seepage to surface;	2	1	3	2	12	Stockpile areas to be prepared in advance to prohibit infiltration of seepage into the groundwater. Drains around the stockpiles to deliver potential run-off to a lined sump for evaporation or to be used as dust suppression. All stockpiles at the plant area need to be positioned on a geo-membrane with an engineered base to prevent infiltration of contaminated water.	2	1	2	2	10
Ground water	Dewatering of workings	Changes in groundwater quantity and changes in groundwater level, which influence the decant volume.	4	2	4	6	60	Monitoring of the water level should be performed on a continuous basis. The original topography should be restored with water draining away from the mine open pits.	3	2	2	4	24
Ground water	Mining	Changes in groundwater quality, i.e. contamination of groundwater. Contamination could refer to the source, e.g. oil spills etc., or to changing water qualities during pollution plume migration.	4	2	4	6	60	Continuous monitoring of the groundwater quality, as well as the removal of possible sources of pollution, e.g. soils contaminated with hydrocarbon substances. Hazardous chemicals and petroleum products will be removed from the property and disposed of by means of licensed waste disposal companies or it will be sold to recycling companies were applicable. Hazardous chemicals will be stored onsite within bunded areas (SANS 310-1) at the plant.	3	2	2	4	24
Ground water	Waste rock storage	Infiltration from the waste rock dump footprint area.	4	1	4	4	36	The PCD should be lined as discussed above. Waste rock would be inert as potential uranium sources would be removed before disposal.	2	2	2	6	20
Ground water	Stockpiles and dams	The ROM stockpiles could have an impact on groundwater in the long term, however the stockpiles are temporary. Discard is also stored temporary until taken off site to Opencast mines.	5	2	2	4	36	All stockpiles in the plant area will be lined in order to prevent infiltration. Inert discard will be used for the backfilling of the opencast pits.	3	2	2	4	24
Ground water	Transportation of ore	Uranium ore spillages may cause deterioration in surface water quality, groundwater quality, soil and air quality.	4	1	1	4	24	Clean spills immediately.	2	1	1	2	8
Contaminated plume	Exposing sulphide bearing minerals within the open cast pits and waste rock dump to the atmosphere.	Oxidation of sulphide bearing minerals that leads to the development of a contamination plume from the open cast pits.	5	2	5	2	24	Monitoring boreholes will be drilled downstream of the proposed mining operations. Quarterly monitoring will be conducted. These monitoring boreholes can be used as scavenger boreholes, should the water quality become unacceptable.	2	2	5	2	18
Ground water	Pollution control dam	Potential leakages of contaminated water to soil profile and groundwater	2	2	4	8	64	Ensure PCD is lined or substrate is compacted sufficiently to eliminate any potential for leakage	1	1	4	4	9
Ground water	Mining	Changes in groundwater quantity and changes in groundwater level, which influence the decant volume.	4	2	4	6	60	Monitoring of the water level should be performed on a continuous basis. The original topography should be restored with water draining away from the mine open pits.	4	1	4	1	24

Ground water	Vehicle breakdowns and maintenance	Changes in groundwater quality, i.e. contamination of groundwater. Contamination could refer to the source, e.g. oil spills etc., or to changing water qualities during pollution plume migration.	4	2	4	6	60	Continuous monitoring of the groundwater quality, as well as the removal of possible sources of pollution, e.g. soils contaminated with hydrocarbon substances. Hazardous chemicals and petroleum products will be removed from the property and disposed of by means of licensed waste disposal companies or it will be sold to recycling companies were applicable. Hazardous chemicals will be stored onsite within bunded areas (SANS 310-1) at the plant.	4	1	4	1	24
Ground water	Waste rock stockpile	Infiltration from the waste rock dump footprint area.	4	1	4	4	36	The PCD should be lined as discussed above. Waste rock would be inert as potential uranium sources would be removed before disposal.	2	1	4	5	20
Ground water	ROM Stockpile at CPP	The ROM stockpiles could have an impact on groundwater in the long term, however the stockpiles are temporary. Waste rock is also stored temporary until taken off site to Opencast mines.	5	2	2	4	36	All stockpiles in the plant area will be lined in order to prevent infiltration. Inert waste rock will be used for the backfilling of the opencast pits.	4	1	2	3	24
Ground water	Ore spillage	Uranium ore spillages may cause deterioration in surface water quality, groundwater quality, soil and air quality.	4	1	1	4	24	Clean spills immediately.	2	1	1	2	8
Ground water	Dewatering of workings	Dewatering of the aquifer	5	3	2	8	80	Will return to natural level as operation ceases.	4	1	4	1	24
Surface water	Run off and infiltration	Changes in water volumes may give rise to flooding events.	4	2	4	6	60	Implement a practical water management plan, as discussed above.	4	1	4	1	24
Surface water	Storage of materials	Changes in surface water quality due to spillage at stockpiles and storage facilities may distribute pollution	4	2	4	6	60	Separation of clean and dirty water by the use of berms and drains. Continuous monitoring is essential in the management of the surface water pollution and migration of pollution. Berms constructed to divert water away from stockpile areas.	2	2	4	6	24
Surface water	PCD operation	Storage of run-off in unlined pollution control dam	5	2	4	6	66	Line pollution control facilities at the plant.	3	2	4	6	36
Surface water	Mining	Impeding or diverting the flow of water in a watercourse	4	2	3	4	36	implementation of Storm water management plan, and proposed diversion berms / channels In order to minimize the inflow of groundwater into the pit areas fractures and faults responsible for the inflow should be grouted, All available pit water should be utilized where necessary to minimize evaporation High volumes could be used to augment the Beaufort West water resources (after verifying acceptable quality through monitoring) This water could be utilized for the irrigation of 15 – 28ha crops.	3	2	2	8	36
Surface water	Mining	Water accumulating in the pit area	5	1	2	6	48	In pit water will be pumped to the rubber lined steel dam to be used in mining procedures (dust suppression, etc). Ground water would be used to augment water stored in the steel dam.	4	1	2	4	28
Surface water	Berm and overburden placement	The placement of overburden, waste rock and plant residues back into the pit if this material is considered possibly polluting.	5	1	3	6	54	Berms around overburden, waste rock and stockpiles to prevent inflow of water.Regular testing of the waste rock material to ensure inert backfill.	2	1	3	6	20
Surface water	Infrastructure and services	Placement of any sanitary convenience, fuel depots, reservoir or depots for any substance which causes or is likely to cause pollution of a water resource.	3	1	2	4	24	Placed outside the 1:50 year flood-line of any watercourse. Proper bunding as per relevant SANS. Example, self-bunding fuel tanks for fuel storage. Chemical toilets at the pit will be serviced on a weekly basis. Water at the change house at the CPP will be collected in a septic tank and will be cleaned / serviced weekly or as required.	2	1	2	6	18
Surface water	Waste rock stockpile	Erosion of rock dump due to wind or water.	5	1	4	4	40	The berms around the waste rock dump will be constructed from the topsoil removed during the construction of the rock dump foot print. Where it is found that insufficient topsoil is available, the remainder of the berm will be constructed from of discard material.	4	1	2	2	20
Surface water	Mining	Clean water will be directed in a separate channel network.	5	2	3	4	40	Channels have been designed by engineers to prevent water flowing into operational areas. This network must open up in an area where the water can flow its course without becoming contaminated.	2	1	2	6	18
Surface water	Dust suppression	Dust suppression at pit areas resulting in run-off water.	3	1	2	2	12	Dust suppression using minimum flow or organic binding material.	2	1	2	2	10
Surface water	Mining	The few areas of open veld located amongst the mine infrastructure will be considered clean water.	3	1	2	2	12	The water will need to be guided away from contaminated sources by means of berms	2	1	1	2	8
Surface water	Mining	Run-off in the operational area	5	2	3	4	40	All dirty water run-off should be contained in the within the PCD's on site. Drainage system has been developed by engineers.	3	1	2	4	21
Surface water	Wash-bay	Washing of vehicles on unprotected soil	5	1	2	6	48	Collect the water arising within any dirty area, including water seeping from mining operations, outcrops or any other activity, into a dirty water system to be used for washing vehicles in a designed wash bay to collect the water. An oil separator to be installed at the wash bay.	2	2	4	6	24
Surface water	Water management	Overflow of Pollution control dams	2	2	2	8	48	Maintain free-board level of 0,8m at all times. Freeboard monitoring device and mechanism for reporting to be established.	2	2	2	6	20

Surface water	Water management	Runoff from waste rock dumps and stockpiles.	4	1	4	6	54	Run-off to be collected in dams. Dams will need to be lined properly, and inspected to ensure effectiveness of lining and adequate operation. Areas designed for the washing of vehicles should be clearly indicated and only these areas may be used for this purpose, to refrain from unnecessary spreading of oil contaminated water	2	1	2	6	18
Surface water	PCD operation	Siltation of Pollution control dams	4	1	3	8	64	See description above.	2	1	3	8	24
Surface water	Material storage	Erosion of stockpiles and tailings storage facility	5	2	5	8	96	Prevent the erosion or leaching of materials from any residue deposit or stockpile from any area and contain material or substances so eroded or leached in such area by providing suitable barriers, evaporation dams or any other effective measures to prevent this material or substance from entering and polluting any water resources.	3	1	3	6	30
Surface water	TSF operation	Changing the direction of natural drainage at the TSF	5	2	5	8	96	Prevention measures would include the establishment of gently sloping berms to redirect clean storm water around waste rock walled TSF. These berms should be actively vegetated which must include the placement of rocks removed with top soil. Seeding and irrigation of these berms must be executed under the supervision of an appropriate specialist to mitigate erosion.	5	1	4	6	55
Surface water	TSF operation	Over topping of the return water dam	2	2	3	8	56	Daily manual or digital free board monitoring. 100% redundancy of pump availability for the return of water from the RWD to the CPP and/or TSF beach wetting.	2	1	1	6	16
Surface water	TSF operation	Breach of the liner in the impoundment wall of the TSF	1	2	3	8	48	Weekly visual inspection of impoundment wall perimeter with appropriate record keeping and reporting. Weekly visual inspection of leak detection system manhole. The chemical sampling of boreholes on a quarterly basis. The TSF design manual shall be at the TSF to inform deposition at all times. Compliance assessment of the TSF development related to the TSF design manual	1	1	1	4	6
Surface water	CPP	Impact of the CPP on drainage	5	2	4	4	44	Concrete or similar trapezoidal panels. The following has been allowed for on the plant terrace to adequately deal with surface run-off within the plant area: · Concrete or similar lined trapezoidal channels for contaminated surface run-off · Precast concrete pipe culverts for in-plant road crossings · Concrete or similar lined silt trap with cleaning access ramp · HDPE line pollution control dam with concrete inlet and outlet spillway (10 000 m3)	3	1	2	4	21
Surface water	ROM Stockpile at CPP	Storage of ROM changing drainage direction and quality.	5	2	4	8	88	Within 6 months of the operation of mining, leach test on the mined material or ROM must be conducted to ensure the 15cm G5 lining material is suitable to prevent leach and run-off. Cut-off trenches around the perimeter must be constructed with an appropriately sized sump for the containment of run-off from the pad.	2	1	3	8	24
Surface water	Hydrocarbon storage	Hydrocarbon contamination due to spillage at:Workshop• Plant area• Washing bay• Fuelling points	5	1	2	6	48	Concrete floors at workshopsDrains to collect run-off at workshopsOil-water separators to collect hydrocarbons re-sell to supplier / service provider Fuel stored in self-bunded areas. Drip trays at maintenance and refuelling points.Spill kits to absorb any hydrocarbon spillage at maintenance areas.	3	1	1	4	18
Traffic Impact Assessment														
Impacts on Traffic	Light and heavy vehicle movement	Deterioration of existing access/gravel road surfaces	4	2	3	6	44	Conduct weekly maintenance on existing access and gravel roads. This entails importing gravel from waste rock dumps.	4	1	2	6	36
Impacts on Traffic	Light and heavy vehicle movement	Dust	4	3	3	8	56	Conduct dust mitigation by means of applying dust suppression methods, such as water or environmentally safe chemicals.	2	2	3	4	18
Impacts on Traffic	Light and heavy vehicle movement	Overutilization of municipal roads	2	2	3	4	18	Consult with traffic department of local municipality.	1	2	3	2	7
Noise Impact Assessment														
Noise	Drilling and Blasting	Increased noise levels at sensitive receptors	4	3	3	6	48	Limited mitigation available. General mitigation includes: routing access roads so that they are at least 850 m from any sensitive receptors, set limits on vehicular speed, ensure all machines are equipped with noise damping equipment, such as exhaust silencers, consider acoustics rating of all equipment, prevent mining in the evening, limit number of activities occurring simultaneously.	4	2	3	4	36
Noise	Topsoil and soft overburden stripping, loading and stockpiling	Increased noise levels at sensitive receptors	4	2	3	4	36	Fit machinery with exhaust silencers, put limits on engine revving, adhere to speed limits.	4	2	3	2	28
Noise	Infill and exploration drilling	Increased noise levels at sensitive receptors	4	2	3	6	44	No mitigation for drilling	4	2	3	6	44
Noise	In pit loading of extracted mineral resource	Increased noise levels at sensitive receptors	4	2	3	4	36	Fit machinery with exhaust silencers, put limits on engine revving, adhere to speed limits.	4	2	3	2	28
Noise	Hauling of extracted resource	Increased noise levels at sensitive receptors	4	2	3	4	36	Fit machinery with exhaust silencers, put limits on engine revving, adhere to speed limits.	4	2	3	2	28
Noise	Crushing	Increased noise levels at sensitive receptors	4	3	3	6	48	No mitigation for crushing	4	3	3	6	48
Noise	Ventilation fans	Increased noise levels at sensitive receptors	4	3	3	4	40	Use noise dampers, consider wind direction during instalment of fans	4	2	3	4	36
Noise	General vehicular movement	Increased noise levels at sensitive receptors	4	2	3	4	36	Fit machinery with exhaust silencers, put limits on engine revving, adhere to speed limits.	4	2	3	2	28
Visual Impact Assessment														
Visual and aesthetic	Open Pits.	Landscape degradation from Open Pits	5	2	3	4	40	design the blast such that vertical plumes are limited. • Clear communication with surrounding property owners on when blasts will take place. • Ensure that post-closure, the pits are well fenced off to ensure that security is maintained to reduce the risk of injury from those seeking recycling metals.	5	2	3	2	20

Visual and aesthetic	Waste Dumps.	ten waste rock dumps proposed around the open pits where the over-burden, or low grade ore rocks are dumped. These will become established overtime, as the large dump trucks dump ore onto the heap. This does result in an increase in ambient dust in the locality, increasing dust haze effects	5	2	3	6	60	• In most cases, the WRDs have been designed to break up strong lines generated by large flat surfaces created by the sides of the WRD. However, there are some WRDs that still depict long line features. Review the design of these WRDs such that they do not have overly straight lines that create pyramid/ non-organic shapes. • If possible during the design phase, the WRD should have an average height of 25m above ground level and should not exceed 30m in height (avg. height above ground level). • The height of the WRD should also vary in height so as to not create a visible platform height for the clusters of dumps. • Continuous dust suppression management on all major haul roads.	5	2	3	4	40
Visual and aesthetic	Processing Plant.	Light spillage from security and operational lights at night are likely to extend the ZVI of the mine.	4	1	3	6	48	• Topsoil (if any) should be removed from the site and stockpiled for later use in rehabilitation of areas impacted during construction that are outside the working footprints of the operational phase.• It is recommended that the plant is painted in grey or grey-brown colours (example: RAL 9007 or RAL 1014). This colour blends well with the surrounding landscape so as to contain the mine ZVI.• It is recommended that any stacks are painted a mid grey colour.• All lighting must be kept to an efficient minimum while still keeping within the safety norms required by the mine.• Dust mitigation measures need to be implemented on access roads to minimise the negative effects of wind blown dust.• Monitoring will need to be undertaken by the ECO on a regular basis to ensure that dust is adequately managed.• Littering is to be strictly controlled and be a finable offence. A six-foot mesh wire fence needs to be constructed around the mine camp to catch wind blown litter, and litter cleaned on a monthly basis.	3	1	3	4	28
Visual and aesthetic	Tailings Storage Facility.	colour of the TSF is likely to be darker	5	1	4	3	30	• Topsoil (if any) should be removed from the site and stockpiled for later rehabilitation of areas impacted during construction that are outside the working footprints of the operational phase. • Continuous rehabilitation on the walls by the planting of water-hardy ground cover vegetation to reduce the burden of the post closure restoration as well as reduce erosional risk from exposed cover soils (subject to rehabilitation specialist's findings). • Dust mitigation measures need to be implemented on all roads to minimise the negative effects of wind blown dust. • All lighting must be kept to an efficient minimum while still keeping within the safety norms required by the mine (refer to generic guidelines in the Addendum). • Monitoring will need to be undertaken by the ECO on a regular basis to ensure that dust is adequately managed. • Littering is to be strictly controlled and be a finable offence. • Desert colours are utilised for any structures located on top of the TSF so as to minimise the colour contrast as seen from the surrounding areas, without compromising safety.	2	1	4	2	14
Visual and aesthetic	Access Roads.	increased movement of trucks though the areas, with associated dust blumes from the moment of the vehicle drives on gravel roads	4	1	4	6	54	• Dust mitigation measures need to be implemented on all roads to minimise the negative effects of wind blown dust. • Monitoring will need to be undertaken by the ECO on a regular basis to ensure that dust is adequately managed. • Littering along the road should be strictly controlled and be a finable offence.	2	1	4	4	28
Socio-Economic Impact Assessment														
Socio-Economic	Infrastructure and services	Community access to infrastructure and services may change because of the proposed project.	5	4	3	8	96	•Municipal Planning should take this into consideration •Take increased population into consideration during infrastructure planning in consultation with the local municipality. •Integrate into existing municipal systems •Assist BWLM if required with skills and equipment to ensure services are well maintained and able to handle the increased loads from additional population •See also accommodation mitigation	3	3	3	2	24
Socio-Economic	Long-term accommodation: Housing	Potential increase in the permanent formal housing stock available in the towns. Failure to address permanent formal housing need may result in development of out of character houses of the town.	3	3	3	4	30	•Due to the character of the towns of Beaufort West, urban planning and architects should be used when housing is developed to improve on the existing nature of the town. •Assist permanent employees to secure housing and/or to achieve home ownership •Housing and development should occur within the town's 'urban edge' and uphold the character of the town, by contributing architecturally to the town. •If additional housing is required, identify and communicate the additional housing need to construction companies and developers who may be able to take up the opportunity to develop new housing in the area.	3	3	3	2	24
	Landowners and surrounding farms	negative impact on the property values properties will be leased, only portions leased, purchased or not affected, to enable longer term planning water use/quantities and potential pollution of water resources	5	3	2	6	60	•Ensure that sufficient safety and security measures are in place at the site •Employ permanent security personnel •Install low-impact lighting on the exterior of the site where night-time lighting is essential •The facility should be managed according to international best practice •Establish communications with adjacent landowners to register and resolve issues related to the operations of the mine •Landowners affected by the project must be appropriately compensated for sterilisation of their land or the land should be purchased. The process should include identifying and negotiating with the multiple landowners across the project site to acquire the sections of land enabling the optimal site design and layout. •It must also be considered if the farmers will be able to continue their farming activities on the land between the development	5	3	2	4	40

	Economic activity		5	4	2	6	66	•Compile a list of local suppliers of goods and services by drawing up a list of services offered. Continually source from local enterprises. •Project should create conditions that are conducive for the involvement of entrepreneurs, small businesses, and SMME's during the operational phase for rendering ancillary services to the proposed facility •The following areas have been identified as opportunities where local business entrepreneurs can be supported: oSecurity oOre transport oTransport of employees	5	4	3	8	96
	Employment opportunities		5	4	3	6	72	•Training during construction phase will allow for local people to be employed during operation phase. •Establishment of a training centre, to assist in skills development of locals. •Clearly define and communicate the required number of jobs and skills. •Recruit from the local community first, regardless of the required skills level. •Establish a 'labour desk' to enable effective communication. •The skill requirements should be communicated to the local community leaders and community based organisations •Provide up-skilling opportunities for unskilled and semi-skilled local workers to lessen any possible skills disparity. •Use existing and local businesses as suppliers and service providers	5	4	3	8	96
Socio-Economic	Changes in cultural heritage and identity: " Sense of place" affecting tourism	Changes to the "sense of place" for population and tourist (such as noise, dust, air quality, light pollution and visible degradation). Decrease in the tourism industry, resulting in job losses over the long term.	4	3	3	6	48	Housing and development should occur within the town's urban edge and uphold the character of the town	3	3	3	4	30
Soil, Land Capability, and Land Use Impact Asessment															
Soil, Land Capability, and Land Use	Stockpiling of soil	Loss of stockpiled soil through wind or water erosion	5	1	5	8	70	Ensure that stockpiles are designed according to best practice slope length and angle. Vegetate and maintain soil stockpiles until rehabilitation commences.	2	1	5	8	28
Soil, Land Capability, and Land Use	Stockpiling of soil	Loss of soil organic carbon	4	1	4	6	44	Topsoil and subsoil must be stockpiled separately. A Soil Standard Operating Procedure will be developed for soil management.	2	1	3	4	16
Soil, Land Capability, and Land Use	Stockpiling of soil	Investation of alien and invasive species	4	1	4	6	44	Develop an alien invasive management plan	2	1	3	4	16
Soil, Land Capability, and Land Use	Haul road operations	Compaction of soil profile	5	1	4	6	55	Conduct deep ripping and re-instate vegetation upon mine cessation.	4	1	4	4	36
Soil, Land Capability, and Land Use	Haul road operations	Loss of soil quality (hydrocarbon spillages)	5	1	5	8	70	Conduct immediate clean-up of spillages. Conduct regular machinery inspections to identify and prevent oil/diesel leakages. Only conduct maintenance or refuelling in the maintenance yard.	2	1	5	8	28
Soil, Land Capability, and Land Use	Waste rock dump and pollution control dam operation	Leaching of contaminated water to soil profile	4	2	4	8	56	Acid base accounting indicated that waste rock has a low acid generating potential, and leaching of radioactive nuclides is highly unlikely. Install a liner for PCD.	3	2	4	4	30
Soil, Land Capability, and Land Use	Waste rock dump and pollution control dam operation	Spillages of contaminated water from PCD to soil profile	3	2	5	6	39	Ensure PCD is operated at designed capacity. Conduct regular monitoring of dam levels.	2	1	5	4	20
Soil, Land Capability, and Land Use	Waste rock dump and pollution control dam operation	Compaction of underlying soil profile	5	1	4	8	65	Footprint area of waste rock dump and PCD must be ripped to alleviate the degree of compaction. The surface must also be rehabilitated to at least a pre-mining state.	2	1	4	4	18
Soil, Land Capability, and Land Use	Other mine facilities (ablution, storage, laydown, crusher)	Leaching of poor quality run-off water into soil profile	3	2	5	6	39	Clean-dirty water separation facilities must be constructed to separate clean water run-off from dirty water.	3	2	4	4	30
Biodiversity															

Biodiversity	Mine operations	Establishment of alien invasive plants on disturbance footprints	4	1	4	6	54	Invasive Alien Plant (IAP) Control: Develop and implement an Alien Invasive Management Plan, updated bi-annually. Monitor for invasive species quarterly (first 2 years) and bi-annually thereafter. Remove or control IAPs using approved methods. No plant species (indigenous or exotic) may be brought into or taken from the PAOI except for approved rehabilitation purposes. Vegetation and Rehabilitation: Implement a Rehabilitation Plan, including follow-up rehabilitation of denuded areas with local indigenous species. Avoid disturbing High SEI areas. Develop post-mining landscapes aligned with regional development plans and compatible with natural habitats. Erosion and Stormwater Management: Install run-off control features on access roads and cut-off berms downslope of disturbed areas. Repair any erosion immediately using suitable control structures and revegetation. Incorporate green/soft engineering stormwater solutions; avoid creating preferential surface flows. Prevent uncontrolled surface and subsurface water flow from dumps and low-lying areas. Use cut-off trenches to protect watercourses from contamination. Water Resource Protection: Water management plan Hydrocarbon and Spill Management: Implement a Hydrocarbon Spill Management Plan and TSF operational plan. Keep emergency spill kits on-site; all contractors must be trained in their use. Use drip trays under stationary equipment; do not service machinery on-site unless necessary. Store hazardous materials in bunded areas to prevent leaks into the environment. Contaminated soil must be treated or removed properly. Waste and Pest Management: Implement a Solid Waste Management Plan with weekly waste removal. Apply a Pest Control Plan—no poisons permitted. Operational Controls: Do not clean or service vehicles or equipment in/near water resources. Leaking equipment must be fixed immediately or removed from site. Conduct stormwater quality monitoring and manage discharge to avoid erosion. These measures aim to minimize ecological degradation, control pollution, prevent invasive species spread, and ensure responsible mine site management throughout the project lifecycle.	2	2	3	4	28
Biodiversity	Mine operations	Impacts on surrounding undisturbed areas due to unplanned spillages, specifically with regard to the planned open cast pit in the non-perennial stream for which a stream diversion is planned.	4	2	4	8	80	Conduct daily inspections of all mine infrastructure to ensure optimal functionality. Develop emergency clean-up procedures to prevent spillages from impacting on surrounding areas outside the mine premises.	2	2	4	4	32
Biodiversity	Mine operations	Disturbance of sensitive flora and faunal life cycles (artificial lighting)	4	2	4	8	80	• Any outside lighting should be designed and limited to minimize impacts on fauna. Lighting fixtures should be fitted with baffles, hoods or louvres and directed downward. Outside lighting should be directed away from highly sensitive areas such as the wetlands. Fluorescent and mercury vapor lighting should be avoided and sodium vapor (yellow) lights should be used wherever possible;• Where feasible, motion detection lighting must be used to minimise the unnecessary illumination of areas• No vehicle traffic nor the use of vehicle lights should be permitted during the night.• Noise must be kept to a minimum from dusk to dawn to minimize all possible disturbances to amphibian species and nocturnal mammals• All personnel and contractors must undergo Environmental Awareness Training and must include awareness about not harming or collecting species.	1	2	4	2	14
Biodiversity	Mine operations	Permanent/temporary migration of fauna to surrounding areas due to mine operations	4	3	4	6	66	Develop and implement biodiversity action plans to track changes in local fauna. (see above) • Any fauna threatened by the maintenance and operational activities should be removed to a safe location by an appropriate individual. • All vehicles accessing the site should adhere to a max 30 km/h max to avoid collisions. Appropriate signs must be erected. • Collisions, especially considering tortoises, should be monitored on a weekly basis.	2	3	4	4	36
Biodiversity	Mine operations	Faunal fatalities caused by moving machinery	3	2	5	8	80	All machinery must adhere to speed limits.	2	2	4	4	32
Decommissioning Phase														
Geology	Geology	No new impact during this phase	1	1	1	2	4	None	1	1	1	2	4
Air quality impact assessment														
	All decommissioning related activities	Fugitive dust generated by decommissioning related activities	4	1	1	2	16	Various mitigation measures described in Section 6 of the Air Quality Report.	2	1	1	1	8
Water														
Ground water	Open cast mining	Contaminated plume from backfilled open cast pits.	5	2	5	4	55	Monitoring boreholes will be drilled downstream of the proposed mining operations. Quarterly monitoring will be conducted for a period after mining (to be confirmed with Department Water and Sanitation). These monitoring boreholes can be used as scavenger boreholes, should the water quality become unacceptable.	2	2	5	2	18

Surface water	Waste rock stockpiles	Waste Rock dump long term management	4	2	3	6	44	During decommissioning operations, the slopes of the waste rock dump should be inspected by a competent person to ensure the slope angle does not result in erosion of fines off the toe of the dump. If required, the slope angle should be dozed to correct excessive slope. The perimeter topsoil berm and/or hards berm should be maintained until such time that the monitoring data indicates that the berm is no longer required. The berms can then be pushed up the toe of the rock dump and seeded. This mitigation should be reviewed in the annual RSIP with the applicable monitoring data and submitted to DMR and DWS.	4	2	5	8	60
Ground water	Open pits	Inflow water into pits.	4	2	3	6	44	During the operational phase of mining completed pits will be consecutively backfilled to pre-mining topography. During decommissioning finer overburden material, should be placed and compacted on the backfilled pit footprint before the re-placement of topsoil. The final pit should be partially backfilled to remove any high-wall dangers and shaped to provide a final topographical depression. This pit should not be top soiled and will act as a ground water sink reducing the impact of pollution plume development.	4	1	4	8	52
Ground water	Stockpiles and dams	Seepage from waste residue and water storage facilities	5	2	4	6	60	The PCD's must be assessed by a competent person to determine the appropriateness of their removal and footprint rehabilitation versus their long-term benefit. This decision making must be driven by the monitoring data available. An additional soil assessment may be required to augment routine water monitoring data.	4	2	4	4	40
Ground water	Open pits	Seepage from opencast mining areas	5	2	4	6	60	No seepage to emanate from the backfilled open pits as the evaporation rate would be higher than the infiltration rate.	4	1	4	2	28
Ground water	Open pits	Decant from opencast mining areas	5	2	4	6	60	No decanting is expected due to the low permeability of the rocks in the area, as well as high evaporation rates.	3	1	5	4	30
Surface water	Spillage	Domestic water, hydrocarbon contamination and waste disposal could also affect the groundwater quality	4	1	2	4	28	Removal of all bundings and disposal thereof at the hazardous waste site.	2	1	3	2	12
Surface water	Drainage crossing and transportation on haul roads	impeding the flow during transportation on haul roads	3	2	4	8	42	Bridges and/or culverts	4	1	3	2	24
Surface water	PCD	Back Filling and Rehabilitation of Pollution Control Dams.	5	1	2	6	45	The PCD's must be assessed by a competent person to determine the appropriateness of their removal and footprint rehabilitation versus their long-term benefit. This decision making must be driven by the monitoring data available. An additional soil assessment may be required to augment routine water monitoring data.	2	1	5	4	20
Surface water	Pits and stockpiles	Reconfigured landforms can result in changed hydrologic regimes (e.g., altered water table position; interrupted groundwater flow diverted to surface systems; increased water temperatures; changes in the timing of runoff; unintentional artificial wetlands; and restricted or altered channels which can result in altered streambed materials)	5	1	2	6	45	Minimize impact area, divert run-off around pit areas to minimize infiltration into back filled pits; Backfill of pits would minimize loss of groundwater, while capturing polluted ground water if required. Backfill and shaping of pits to prevent excessive infiltration. Shaping of waste rock stockpile to prevent erosion. Revegetation of impacted areas (specifically haul road areas) Removal of infrastructure.	2	2	3	6	22
Surface water	Use of haul roads	Altered streamflow, particularly the timing and intensity of high and low flows Contaminant emissions (e.g. oil, fuel, metals, or other chemicals), may extend into roadside vegetation for varying distances, resulting in changes in species composition and contaminated soil, plants, animals, and water.	5	1	2	8	55	Identify the most serious problems by assessing road systems at watershed scale, followed by field reconnaissance Give extensive thought to road routes, road design, drainage, and road-stream crossings such as culverts and bridges Relocate or realign roads to improve degraded riparian areas Restrict traffic (perhaps during the wet season) or close roads to manage sediment runoff. Construct lead-out ditches and rock aprons to disperse water-flow energy and reduce erosion After road construction, seed, mulch, terrace, or combine treatments to control erosion. Plant native plants to help control invasive alien plants. Use appropriate construction, upgrading, and maintenance methods to manage drainage and minimize erosion and sedimentation Ensure storm water management planning allows for the opportunity to conserve water and make it available to the public for beneficial use. Ensure the planning undertaken by engineers appointed takes cognizance of the responsibility to preserve the natural environment.	4	1	3	2	24
Surface water	Vehicle and equipment maintenance	Spillage of hydrocarbons during construction and operation.	5	1	2	6	45	Train employees and contractors on the correct handling of spillages and precautionary measures that need to be implemented to minimize potential spillages. Employees should record and report any spillages to the responsible person. All earth moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability. No repairs may be undertaken beyond the contractor laydown area. An Emergency Preparedness and Response Plan will be developed and implemented should an incident occur. Access to storage areas on site must be restricted to authorized employees only. Contractors will be held liable for any environmental damages caused by spillages.	2	1	3	6	20

Surface Water		Use of vehicles and machinery • Increase in surface runoff from soil compaction Works next to or near watercourses • Change in flow velocities • Increased flood risk Earthworks • Increased erosion and changes in bed and bank stability • Increased sedimentation of watercourses Physical presence of bridge • Upstream potential impediment to flow, decreased water velocity and increased depth – increased flood risk • Change in deposition regime upstream, caused by changes in flow and potential flood risk • Downstream potential increased water velocity, and turbulence and erosion • Increase in surface runoff from bank areas during decommissioning due to soil compaction • Possible increased flood risk	5	1	2	6	45	Mitigating the impacts of construction activities WULA. Construction and site preparation activities have the potential to affect all environmental receptors. However, the following list summarizes the mitigation measures of most relevance for these types of engineering structures: • storage of fuel, equipment and construction materials so as to minimize the risk of soil contamination or water; • setting the route and timing of construction traffic so as to avoid sensitive human receptors; • use of techniques to minimize compaction of soil, such as restricting access during wet conditions, and using protective boarding and low ground pressure machinery. If necessary, soil should be carefully removed and stored for subsequent reinstatement; • use of dust control strategies; • phasing of construction work to minimize disturbance to wildlife at sensitive times of year, such as during the breeding season or when young are being raised; • access roads should avoid riparian zones and should be built using appropriate construction materials. Mitigating the impacts of the operational phase Although sensitive siting and design of a development for bridges and culverts are the primary means for avoiding or reducing its environmental impacts, further measures can be introduced to minimize impacts occurring from the ongoing management of the site. An overall consideration is that the design and operation of the development are in accordance with planning conditions, the Environmental Protection (Duty of Care) Regulations and other relevant legislation. The measures have been arranged according to their primary receptor, however, it should be noted that many of the following mitigation measures are interrelated. For example, correct storage, use and disposal of chemicals used for site maintenance would reduce the risk of soil contamination, pollution of surface and groundwater, and harm to terrestrial and aquatic ecology	3	1	2	4	21
Surface Water	Hydrocarbon management	Contamination	5	1	2	6	45	• It must be ensured that a credible company removes used oil after vehicle servicing. • A sufficient supply of absorbent fibre should be kept at the site to contain accidental spills • Store all potential sources in secure facilities with appropriate storm water management, ensuring contaminants are not released into the environment.	3	1	2	4	21
Surface water	Infrastructure removal	Change in drainage pattern	5	1	2	8	55	• Separating clean and dirty water for appropriate treatment and disposal; o A channel and berm configuration is proposed for the eastern edge of the property, which would prevent run-off outside of the premises. Furthermore, this channel would feed the storm water to the pollution control dam located on the premises; o Stockpiling upstream to minimize inflow into workings o One large dam would fulfil the function of preventing spillage of storm water originating in Catchment of storm water;o The pollution control dam collecting the water from the Catchment would serve as an evaporation and pollution control dam;• Sustainable use of storm water for dust suppression operations during the operational lifetime of the facility;• Minimising the risk of environmental damage.	2	1	3	6	20
	Bridges and culverts	Bridges / culverts for haul roads crossing drainage lines: Earthworks · Pollution from suspended material · Disturbance of contaminated soil and subsequent pollution of watercourses Materials management · Pollution from spills or leaks of fuel, oil and construction materials Physical presence of bridge / culvert · Upstream impounded waters will reduce oxygenation · Downstream water quality may be reduced by increased turbidity. · Pollution of surface water by fuel and oil · spillages from vehicular activities	5	1	2	8	55	Protecting the water environment In order to minimize potential impacts on the water environment in the design and running of bridge and culverting operations, Tasman will ensure that: · watercourses should not be deepened or widened up or downstream of culverts; · artificial bank reinforcement should be avoided if possible; · with regard to bridges, open parapets should be used to allow some over-deck flow in the event of the bridge opening becoming blocked in a major flood event; · with regard to bridges, open parapets should be used to allow some over-deck flow in the event of the bridge opening becoming blocked in a major flood event; · bridge soffit levels and flood spans should be at least 1 meter above the maximum known flood level to allow floating debris to pass freely through the structure; · an appropriate water management system is used during the construction period, including, for example, efficient land drainage and the use of constructed ponds for receiving site runoff to reduce the impact of runoff on nearby watercourses; oil interceptors or drip trays are used in vehicle parking areas, and are inspected and cleaned regularly; · a risk assessment is carried out for each substance to be used or stored on site, and the appropriate containment measures installed	2	2	4	6	24
Socio-Impact Assessment															
Impacts on socio-economic status	Employment Loss	During decommissioning, opportunities will decrease.	5	4	3	10	120	Develop a retrenchment and training programme. Identify alternate developments using similar skills. •Project to assist employees, prior to the decommissioning, during and after closure of the project to be marketable for other positions. This could include undergoing a skills development programme in advance of the proposed retrenchment dates. •Retrenchments to be phased over a period as the project prepares for decommissioning	5	4	3	8	96

								•Aid employees to source jobs in similar sectors within the municipal area and beyond •Assist with growing and diversifying the economy to be able to better absorb the retrenched workers					
Impacts on socio-economic status	Local Economy	Loss of income for those whose businesses are dependent on the mine	4	3	3	6	60	Development of skills, training and diversifying of business opportunities throughout the lifetime of the mine is recommended. This will ensure relevant qualification and experiences and enable better employment opportunities after decommissioning of the mine. •Alternative projects should be identified and implemented to provide employment to retrenched employees •LED unit should identify projects and start implementation while the mine is operational to assist in funding. The growth and expansion of these projects could provide additional employment	4	2	3	4	36
	Accommodation and Property Market		5	3	3	8	88	•With phased retrenchments the properties that enter the market will also be phased and prevent a glut in the market •Estate agents could look at alternative markets for potential buyers such as weekend holiday makers or retirees to stimulate the market	5	3	3	4	44
	Landowners and surrounding farms		3	2	2	4	28	•Mined areas should be revegetated soon after mining is completed •Revegetated areas can be returned to agricultural use as soon as possible •Interested employees can be trained in agriculture and could farm the revegetated areas	3	2	2	4	28
	Community Safety		3	2	2	4	28	•See mitigation during construction •See mitigation measures in specialist reports	3	2	2	2	14
Visual and aesthetic	Waste Dumps.	ten waste rock dumps proposed around the open pits where the over-burden, or low grade ore rocks are dumped. These will become established overtime, as the large dump trucks dump ore onto the heap. This does result in an increase in ambient dust in the locality, increasing dust haze effects	5	2	3	6	60	• In most cases, the WRDs have been designed to break up strong lines generated by large flat surfaces created by the sides of the WRD. However, there are some WRDs that still depict long line features. Review the design of these WRDs such that they do not have overly straight lines that create pyramid/ non-organic shapes. • If possible during the design phase, the WRD should have an average height of 25m above ground level and should not exceed 30m in height (avg. height above ground level). • The height of the WRD should also vary in height so as to not create a visible platform height for the clusters of dumps. • Continuous dust suppression management on all major haul roads.	5	2	3	4	40
Visual impact Assessment														
Visual and aesthetic	Waste Dumps.	ten waste rock dumps proposed around the open pits where the over-burden, or low grade ore rocks are dumped. These will become established overtime, as the large dump trucks dump ore onto the heap. This does result in an increase in ambient dust in the locality, increasing dust haze effects	5	2	3	6	60	• Early appointment of landscape architect to provide input into the final shaping of the resultant landforms. • Shaping of final landform such that the crests are rounded and appear more natural in the landscape. • Shaping of the top of the WRDs to allow for hydrological run-off such that ponding does not occur. • Removal of all structures on top of the WRDs. • Rehabilitation and restoration as per the rehabilitation specialist's recommendations.	2	2	3	4	28
Visual and aesthetic	Processing Plant.	Light spillage from security and operational lights at night are likely to extend the ZVI of the mine.	5	1	3	8	72	• All structures associated with the plant must be broken down and dumped into the pit and covered with rock (unless they contain contaminated material which then needs to be addressed in terms of South Africa legislation). • The impacted landscapes need to be shaped to appear natural and to allow for natural hydrological flow.• Rehabilitation of access routes such that a natural vegetation cover takes place to reduce wind blown dust (with the exception of the routes that will not be required for long term monitoring).• Continuing with dust mitigation measures as per the recommendations defined by the ECO until full mine closure has been achieved.• Littering is to be strictly controlled and be a finable offence.	1	1	3	2	10
Visual and aesthetic	Tailings Storage Facility.	colour of the TSF is likely to be darker	3	1	4	6	48	• All structures associated with the TSF must be broken down and dumped into the pit and covered (unless they contain contaminated material which then needs to be addressed in terms of South African legislation). • Rehabilitation and restoration of the TSF as per the rehabilitation specialist recommendations. • Rehabilitation of access routes such that a natural vegetation cover takes place to reduce wind blown dust (with the exception of the routes that will not be required for long term monitoring). • Continuing with dust mitigation measures as per the recommendations of the defined by the ECO until full mine closure has been achieved. • Littering is to be strictly controlled and be a finable offence.	2	1	4	4	28
Visual and aesthetic	Access Roads.	increased movement of trucks though the areas, with associated dust blumes from the moment of the vehicle drives on gravel roads	4	1	1	4	24	• Rehabilitation of access routes such that a natural vegetation cover takes place to reduce wind blown dust (with the exception of the routes that will not be required for long term monitoring). • Continuing with dust mitigation measures as per the recommendations of the defined by the ECO until full mine closure has been achieved. • Littering is to be strictly controlled and be a finable offence.	2	1	1	4	16
Radiological Impact Assessment														
Radiological Impact Assessment	Public access to mined sites after closure, specifically the open cast pits	Potential for radioactive exposure	3	1	4	6	33	Ensure mined areas are rehabilitated to at least a pre-mining standard. No residual radioactive waste material will be present on the surface that could cause radioactive health exposure. Pits to be backfilled with overburden material and capped with topsoil as soon as ore is removed.	1	1	4	4	9

Radiological Impact Assessment	Footprint areas of mine infrastructure (waste rock dump, PCD, haul roads, crushing and screening plant).	Radioactive exposure from mine footprint areas, specifically waste rock dump, PCD, crushing and screening plant, and haul roads	4	1	4	8	52	All footprint areas to be rehabilitated to at least a pre-mining state. All radioactive waste to be dispose-off according to appropriate hazardous waste handling procedures. Radioactivity of all footprint areas to meet regulatory standards post closure.	1	1	4	4	9
Biodiversity Impact Assessment															
Biodiversity Impact Assessment	Mine closure	Decommissioning activity will likely lead to direct mortality of fauna due to earthworks, vehicle collisions and persecution. Destruction of vegetation, encroachment and displacement of the natural vegetation community due to alien invasive plant species, erosion and edge effects;	**5**	**2**	**4**	**2**	**22**	Fauna Protection: Conduct environmental inductions to raise awareness about fauna protection. Daily pre-work site sweeps by two individuals to give animals a chance to escape. Qualified personnel must safely relocate any threatened fauna. Limit vehicle speed to 40 km/h with appropriate signage to prevent collisions. Hazard and Site Management: Store hazardous materials properly to avoid site contamination. Promptly clean up any chemical, fuel, or oil spills. Avoid leaving open excavations for extended periods; excavate only when necessary and refill promptly. Restrict activity to designated footprint and infrastructure areas—declare all other areas as 'no-go' zones for vehicles. Dust and Vegetation Control: Control dust through soil wetting and enforced speed limits. Rehabilitate disturbed areas using indigenous vegetation. Replace removed vegetation and prevent grazing to support ecological recovery. Rehabilitation Planning and Implementation: Implement a rehabilitation plan from the start of operations and conduct concurrent rehabilitation. Review and update the plan every 3 years. Align post-mining land use with regional development and habitat restoration plans. Monitor rehabilitation annually for 5 years post-closure, adjusting actions as needed. Backfill erosion features like gullies and shape land to match natural topography.	**2**	**2**	**3**	**2**	**14**
Biodiversity Impact Assessment	Mine closure	erosion and alien plant invasion for several years	3	4	4	4	44	• Rehabilitation in accordance with the Rehabilitation Plan for the development must be undertaken in areas disturbed during the decommissioning phase. • Monitoring of the rehabilitated area must be undertaken at quarterly intervals for 3 years after the decommissioning phase. • All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. • There should be follow-up rehabilitation and revegetation of any remaining bare areas with indigenous flora.	3	2	2	2	14
Residual impact after closure															
Groundwater Impact	Backfilled open cast pits	Groundwater plume emanating from open cast operations	5	3	5	4	60	Monitoring boreholes will be drilled downstream of the proposed mining operations. Quarterly monitoring will be conducted. These monitoring boreholes can be used as scavenger boreholes, should the water quality become unacceptable.	2	2	5	2	18
Socio-Economic Impacts	Cessation of mining activities	Reduction of employment opportunities	5	3	5	6	70	Develop training programmes during operational phase to embed sufficient skills, knowledge and experience	5	3	5	4	60
Socio-Economic Impacts	Cessation of mining activities	Changes in economic benefit	5	3	5	6	70	No Mitigation	5	3	5	6	70
Socio-Economic Impacts	Cessation of mining activities	Higher supply versus demand of services and infrastructure	4	3	4	6	52	Discuss with local municipality to ensure sustainable development	3	2	3	4	27
Impacts on traffic	Residual impacts from construction and operational phase	Damaged gravel roads	4	2	4	8	56	Rehabilitate all used roads to at least pre-mining state	2	2	2	2	12
Impacts on Soil, Land Capability, and Land Use	Disturbance footprints of all mining activities (open cast pits, waste rock dump, haul roads, laydown area, crusher, pollution control dam)	Depleted soil quality (hydrocarbon spillages, waste water spillages, contaminated water spillages, leachate from waste rock dump, PCD, and other mine facilities)	4	1	5	8	56	Conduct immediate clean-up of spillage areas, remediate impacted sites to at least pre-mining environment, line PCD, develop clean-dirty water separation facilities	2	1	5	2	16
Radiation	TSF closure	Dust, radiation and Radon emission	4	3	5	8	96	Cover with 1 meter comacted soil	1	1	5	2	14

5.16.1 Impact statement

5.16.1.1 AIR QUALITY STATEMENT

Total particulate emissions from all activities at the mine are high, influenced predominantly by the contribution from blasting. Blasting generates approximately 95% of TSP emitted at the mine, however, it is episodic in nature. A similar influence is noted for PM_{10} and $PM_{2.5}$ emissions. Vehicle entrainment from unsurfaced roads and underground ventilation fans also generate notable quantities of particulate matter. All activities at the mine generate approximately 32 000 tons of TSP, 16 000 tons of PM_{10}, and 1 000 tons of $PM_{2.5}$. Total SO_3 emissions are low and only generated by acid leaching activities. Emission standards for acid leaching are complied with, however, drying activities, as currently defined without mitigation, are non-compliant with minimum emission standards and require abatement measures. NO_x emissions are elevated due to diesel usage by generators and vehicle exhaust.

Table 5-33. Total estimated emission rates for all activities

	Emission rate (tons per annum)							
Source	**TSP**	**PM_{10}**	**$PM_{2.5}$**	**SO_3**	**CO**	**NMVOCs**	**NOx**	**SO_2**
All activities	32,465	16,400	967	0.2	221	46	364	7

The impact of dust is more of a nuisance nature and does not typically pose a health risk due to its typically coarse size. The impact of dust from the construction and decommissioning activities on air quality is expected to be relatively short lived, i.e. limited to the duration of the construction or decommissioning. The impacts are also expected to be localised and limited to the area adjacent to the activity. The impacts from the construction and decommissioning phases are not evaluated further.

Total ambient impacts comprise activities from mining, processing, waste storage, fuel combustion, and vehicle entrainment on roads. Ambient impacts from blasting are not included in the aggregated concentrations. This is due to the episodic nature of blasting and emission profile around the blast radius, which results in sporadic emission generation clearing efficiently in a short timescale. The aggregated ambient concentrations of PM_{10} and $PM_{2.5}$ for all sources are presented with vehicle entrainment from unsurfaced roads, and thereafter excluding this source. This highlights the significant contribution to PM_{10} and $PM_{2.5}$ levels from unsurfaced roads. It also allows an interpretation of the contribution from other activities at the mine, at a lower scale.

5.16.1.2 BIODIVERSITY STATEMENT

The proposed development affects only 0.014% of the Gamka-Karoo vegetation type, which remains 99.5% intact over a large area, making the transformation impact negligible. While the primary concerns include habitat loss and fauna displacement, significant mitigation and embedded best practices—especially for radioactive material handling—are expected to reduce impacts to a low significance level.

Certain parts of the development area have high sensitivity (SEI), requiring infrastructure adjustments to avoid these zones. The project has applied the mitigation hierarchy effectively, including spatial planning revisions and

seasonal construction constraints. As a result, no biodiversity offset is required, and no fatal flaws have been identified.

The project can proceed favourably, provided all prescribed mitigation measures are implemented and considered by the Competent Authority during authorisation.

Table 5-34. The mining recommendations for the delineated systems

Habitat	Sensitivity	Recommendation
Rocky and Stoney Habitat	High	Mitigated mining permitted, with concurrent rehabilitation.
Sedimentary Community	Medium	Mining Permitted
Degraded Shrubland	Low	Mining Permitted, Ancillary infrastructure should preferably be allocated within these areas
Modified	Vey Low	Mining Permitted, Ancillary infrastructure should preferably be allocated within these areas

Freshwater

The proposed mining activities present low to high risks before and after mitigation across the construction, operational, and decommissioning phases. The highest risks relate to direct mining within watercourse areas—including drainage areas and valley floor depression wetlands—and the potential contamination of watercourses and ecosystems by radioactive materials. Moderate risks are linked to activities near watercourses, such as altered drainage patterns from roads and crossings, clearing of riparian and terrestrial vegetation, stormwater management challenges, excavation within wetland and riparian zones, machinery operation in or near watercourses, alien vegetation spread, maintenance of roads and crossings, erosion and sedimentation, and hydrocarbon contamination. Overall, impacts from mining out watercourses are considered difficult to manage and largely impractical to mitigate, because the planned pits and waste rock dumps overlap directly with wetland and riparian habitats.

5.16.1.3 HERITAGE STATEMENT

In general terms, the proposed activity will have a low to medium impact on the built heritage, including farm houses, roads and landscapes. The waste dumps and the TSF on Ryst Kuil will not be visible from the N1 or the N12, and they will be slightly visible from the R61.

5.16.1.4 NOISE STATEMENT

Although the baseline noise character of the project area will be impacted on by the proposed mining, the large distances between the operations and the identified receptors in the area is expected to adequately mitigate this impact.

5.16.1.5 RADIATION

Humans and all other living organisms on earth are continuously being exposed to natural background ionising radiation. Activities such as the proposed LRP could potentially add to the levels of existing background radiation

and human exposure. Uranium mining in South Africa is regulated by the National Nuclear Regulator (NNR) in accordance with the provisions of the National Nuclear Regulator Act. Regulations require a prospective radiological impact assessment before mining may commence. The assessment must demonstrate that radiation dose criteria for the safety of members of the public, are met at all times.

The radioactivity in regulated discharges from the mine site consist of elevated levels of naturally occurring radioactive material, abbreviated as NORM, which could result in low levels of exposure of members of the public by means of various pathways such as:

- external radiation;
- inhalation of radon and its short half-life decay products;
- inhalation of airborne dust;
- consumption of drinking water; and
- consumption of food produce in which bioaccumulation of radioactivity occurred.

The results of the screening radiological safety assessment indicate that the additional radiation doses to members of the public above the existing background radiation dose will meet the NNR regulatory dose criteria with a large margin.

5.16.1.6 SOCIO-ECONOMIC STATEMENT

Although many potential impacts are identified and mitigation measures are suggested, not all of the impacts may be expressly experienced in the application area situated in the Eastern Cape. These include the potential influx, increased economic activity in the area due to higher employment rates as a result of the Ryst Kuil application area and changes in the use of infrastructure and available housing. However, due to the integrated nature of any changes in the socio-economic fabric of any population, this report also highlights the cumulative socio-economic impacts of the proposed mine in the whole district and not the Ryst Kuil area only.

5.16.1.7 SOIL, LAND CAPABILITY AND LAND USE STATEMENT

The impacts on soils and land capability can be reduced to acceptable levels by replacement of the topsoil after the lifespan of facilities. The impact of current land use is hard to mitigate because the re-establishment of vegetation in such an arid climatic area is hardly possible.

5.16.1.8 TRAFFIC STATEMENT

- Access to the different mine sites is proposed via existing farm access roads and there are no access spacing or shoulder sight distance issues.
- During construction, it is expected that gravel road surfaces will require maintenance at regular intervals and it is recommended that the gravel roads be watered on a regular basis (once a day) during the peak construction period. Non-potable water should be sourced for this purpose.

During the operational phase

- The existing road network has sufficient capacity to accommodate the additional trips from an operational perspective.
- A gravel road such can accommodate between 300 and 400 vehicles per day, which means that surfacing of these roads will not be required. However, the truck traffic between the mine sites and the processing plant will have a significant impact on the gravel road surfaces and it is recommended that the gravel roads be watered once or twice a day to reduce gravel loss.
- Based on the project phasing it is not expected that the cumulative impact on any section of road in the site vicinity will be more than 200 trips per day.
- In the long term, as the mining areas to the north of Beaufort West becomes active, some of the gravel sections of the Provincial Roads in the site vicinity will need to be upgraded to accommodate the additional truck traffic associated with the mining activity.
- All the tarred National and Provincial Roads are in a fair condition and the additional traffic associated with the mining activities in the area will be well within the capacity of the roads in the area.

5.16.1.9 Visual statement

the proposed mining activities will result in a definite and largely irreversible negative visual impact, particularly at the local scale, where significant alteration of natural landforms and the introduction of industrial elements will degrade the landscape character. While the regional impact is moderated by the site's remoteness and limited number of receptors, the Zone of Visual Influence remains extensive due to the dispersed layout of mining clusters and the episodic presence of blast plumes. Visual significance is rated Medium to High without mitigation, especially during construction. However, with effective WRD shaping, dust control, and rehabilitation efforts, the residual impact can be reduced to Medium. Despite the limited mitigability and low reversibility of the pit voids, careful visual management and closure planning will be essential to minimise long-term degradation, particularly given the site's location within a sensitive Karoo landscape.

5.16.1.10 WATER STATEMENT

5.16.1.10.1 Groundwater

- The main aquifer is a channel sandstone, a fractured rock aquifer, which has a variable thickness up to ~45 m to depths of up to ~120 m below surface. The uranium ore body is also hosted within this sandstone;
- Aquifer transmissivity and borehole yields are highest in the south-west and decrease to the north-east. This is a function of sandstone lithology, thickness and structure. There is also a fairly strong east-west anisotropy with respect to transmissivity, which is caused by folding and fracturing related to the Cape Fold Belt to the south;
- A groundwater monitoring network of 13 boreholes, established along the mineralised zone in November 2007, shows mostly very low amplitude (~0.1 m) fluctuations in groundwater levels. Greater fluctuations (<1 m) occur in response to pumping from nearby (<500 m) farmer's boreholes and filling of dams with surface water runoff;
- Generally, the shallower groundwater levels (<30 m bgl) respond quickly to good local rainfall events, whilst boreholes with deeper groundwater levels appear to indicate a time lag of approximately three years between good rainfall events and rising groundwater levels;

- Farms were visited in 2016 and re-visited again in 2025, and 248 boreholes recorded, with sparse information on depth, yield and use obtained from the owners;
- Groundwater is mostly used for stock watering, domestic supply and irrigation;
- Water levels range from near-surface (<10 mbgl) to shallow (<30 mbgl) to deep (>30 mbgl);
- Groundwater quality is very variable, with electrical conductivity mostly ranging from c.90 – 300 mS/m but up to 516 mS/m in places. The water is hard to very hard and of a mixed calcium/magnesium/sodium-bicarbonate/chloride/sulphate type, with often high fluoride and nitrate content;
- Most groundwater samples exceed WHO drinking water screening levels of 0.5 Bq/L for gross α activity; and
- There is no evidence (based on hydro-census and monitoring data) of depletion of aquifer groundwater levels despite the recent drought conditions and the area being classified on a regional scale as one with a water deficit.

Ryst Kuil

All developments impact surface water through modification of infiltration rates by increasing the extent of hardened surfaces. Apart from reducing natural recharge to the shallow and deep groundwater zones, the increased runoff and altered storm hydrograph will also impact areas downstream or downslope where the flow is concentrated. Destabilization of watercourses due to increased flow causes erosion and change in channel character or dimensions, destroys riparian vegetation, raises the floodplain water table, alters bed roughness and causes eroded sediment to be deposited downstream. Any change in sediment type or water depth can result in significant changes in the vegetation type and growth form within the channel that will impact the flow of floodwaters and probably cause more regular overbank flooding. River diversions also change the overall gradient and therefore the flow rates and impact flood discharge and erosion/sedimentation patterns at the site and downstream.

- The Karoo is characterized by the scarcity of surface water. For this reason, groundwater forms an integral part of the development and general activities in the area;
- The mean annual runoff (MAR) for the different rivers was not measured. The reason is the fact that these rivers referred to in the above text are all dry for the greater part of the year. They only flow episodically for a short period of time after a rainstorm. It was thus not possible to measure the MAR for these specific rivers;
- From a surface water perspective, there appears to be no fatal flaws in the approach towards mining the various uranium orebodies.

Based on the information provided and conclusions of this report, the following is recommended:

- To keep clean water separate from dirty water, a set of berms should be designed and placed in the appropriate positions next to the open pits by a certified civil engineer. Management of the stormwater flow during a flash flood is important to prevent the dissipation of potential pollutants;
- Continue the existing groundwater monitoring programme, with continuous groundwater level measurements and bi-annual quality sampling and datalogger information download;
- Initiate surface water monitoring and inspection programme;

- Update water balances on an annual basis;
- Water use licenses would be required for relevant section 21 uses;
- Obtain additional details on location, ownership, depths, yields, water levels, use and groundwater quality of the potentially affected privately-owned boreholes;
- Prepare contingency plans to maintain current water supply (volumes) and quality to potentially adversely affected landowners;
- Unless convincingly motivated for other reasons (e.g. potential visual or other impacts of waste rock dumps), do not fully backfill the 'downstream' open pit in each mining area so as to retain a long-term but localised 'sink' to 'capture' any potential local groundwater contamination.

5.16.2 Final Site Map

The final map is provided below.

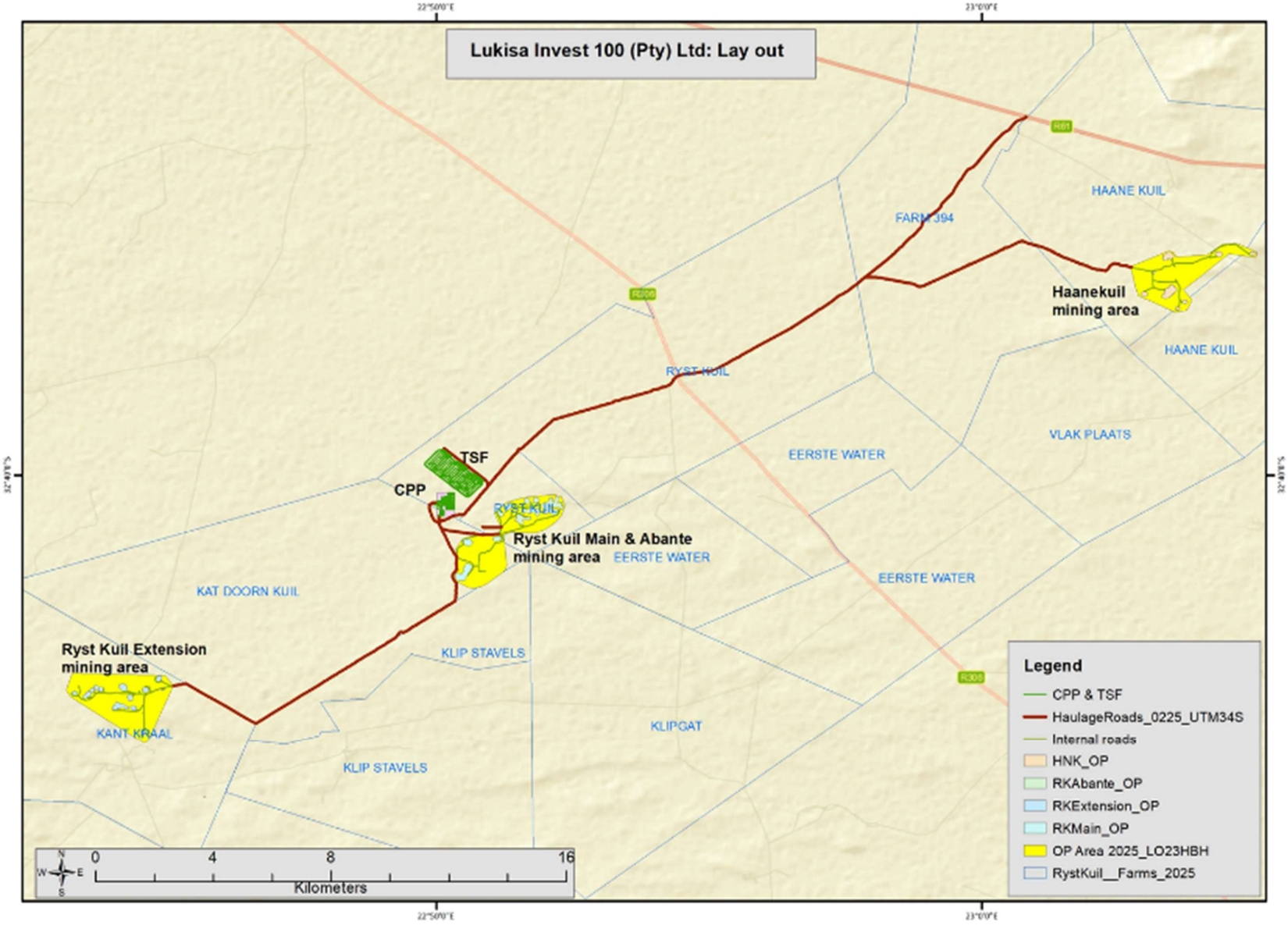

Figure 5-25. Final lay-out plan.

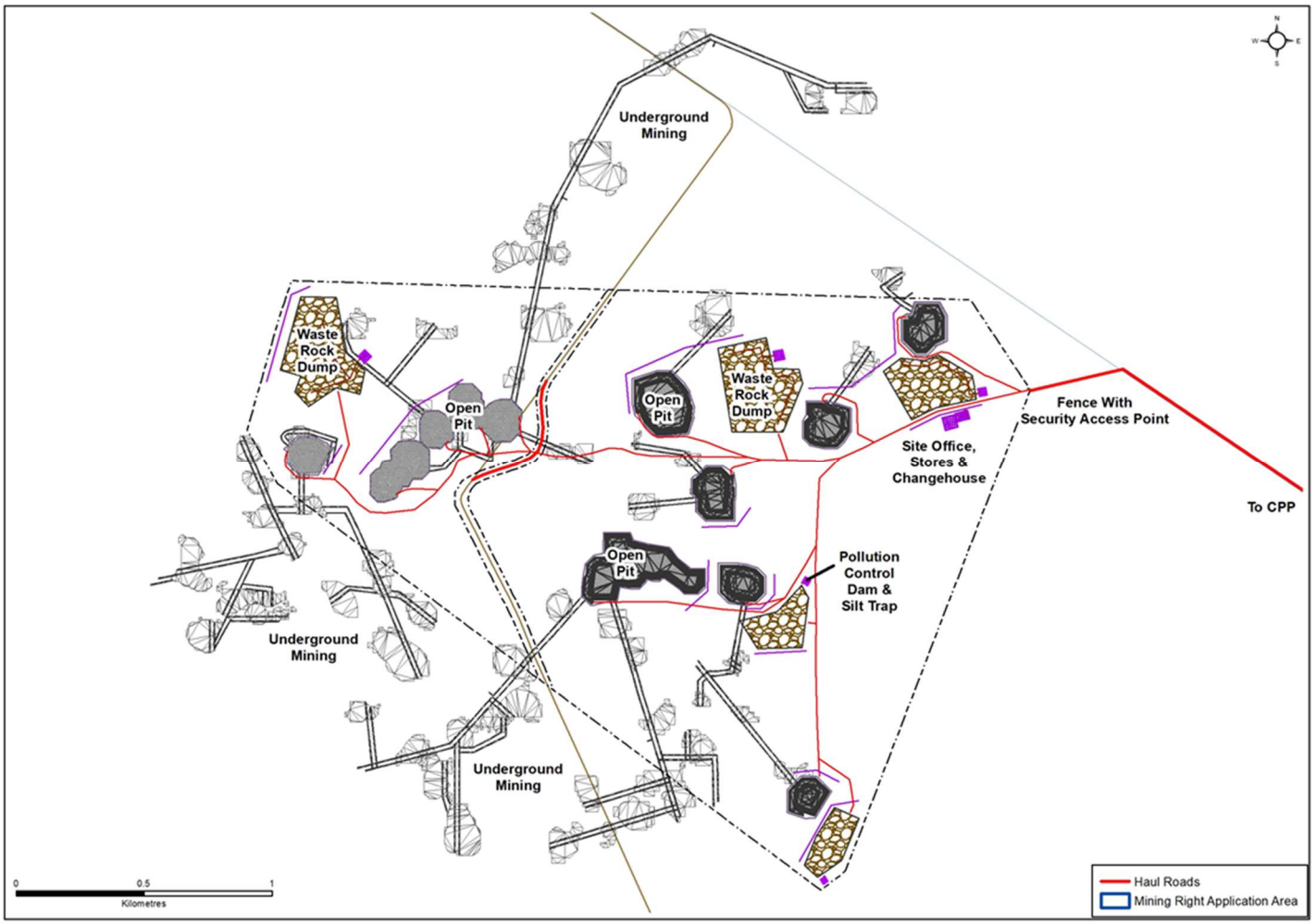

Figure 5-26. Ryst Kuil Extension pit complex lay-out Feb-2017.

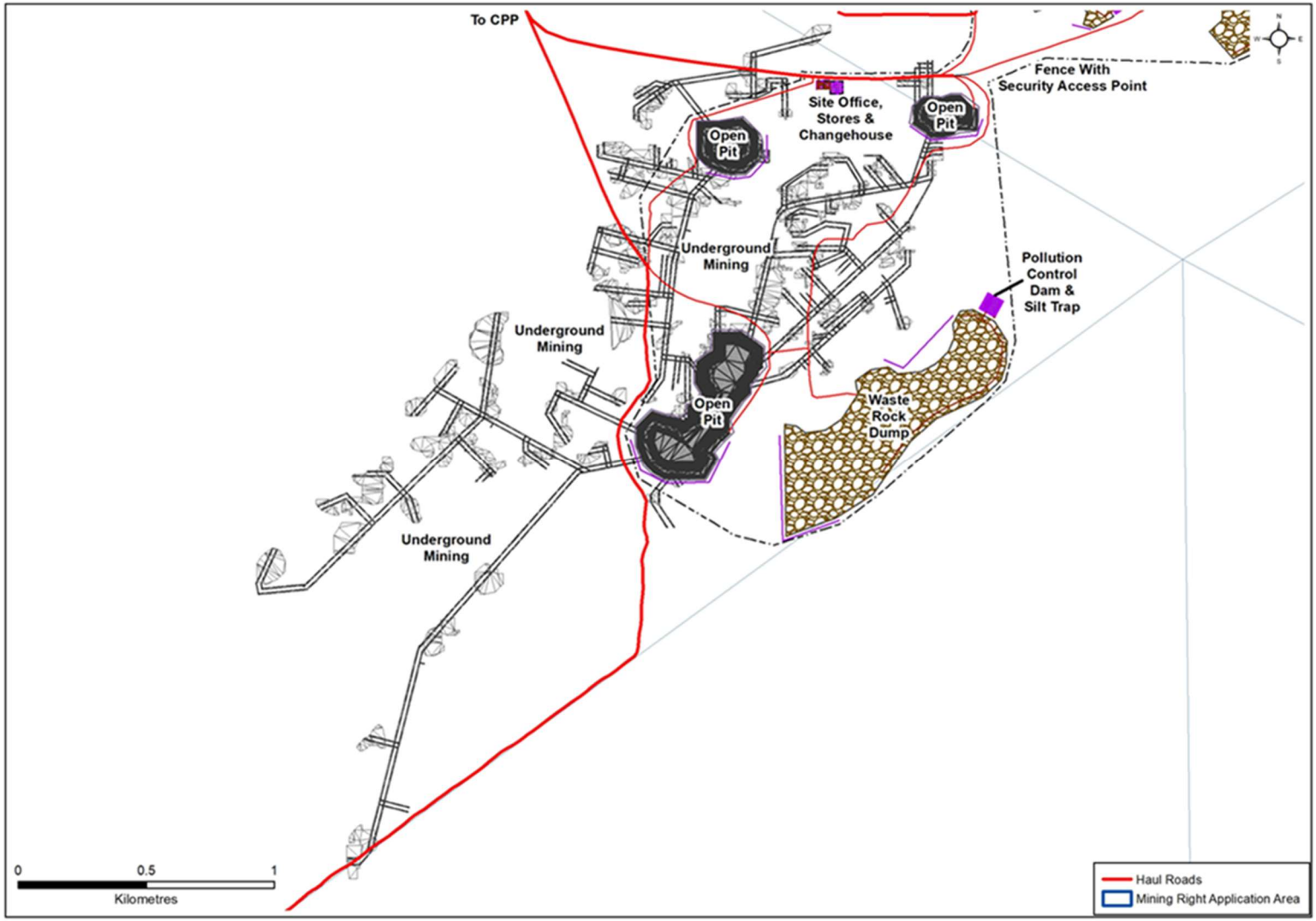

Figure 5-27. Ryst Kuil Main infrastructure lay-out.

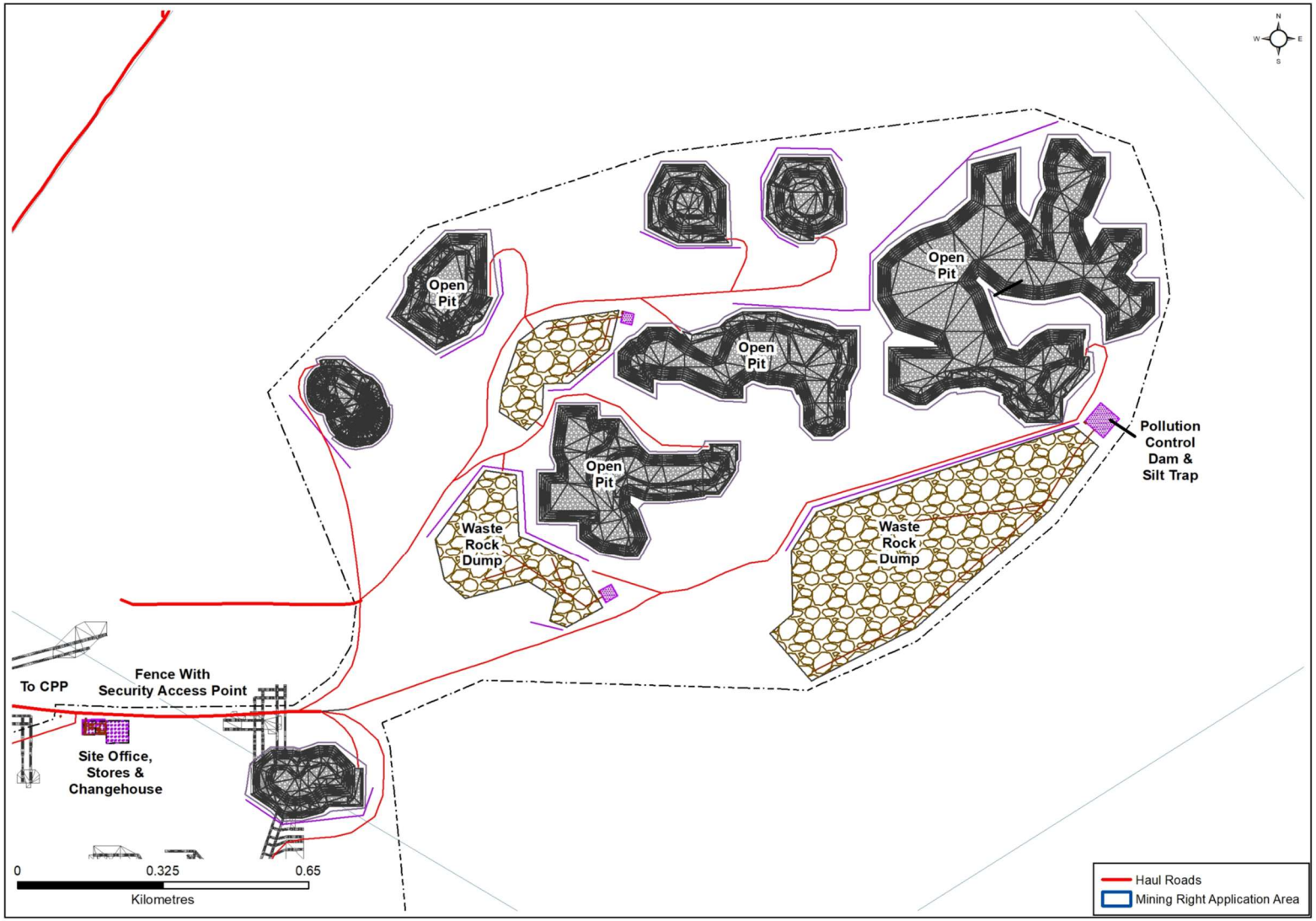

Figure 5-28. Ryst Kuil Abante infrastructure lay-out.

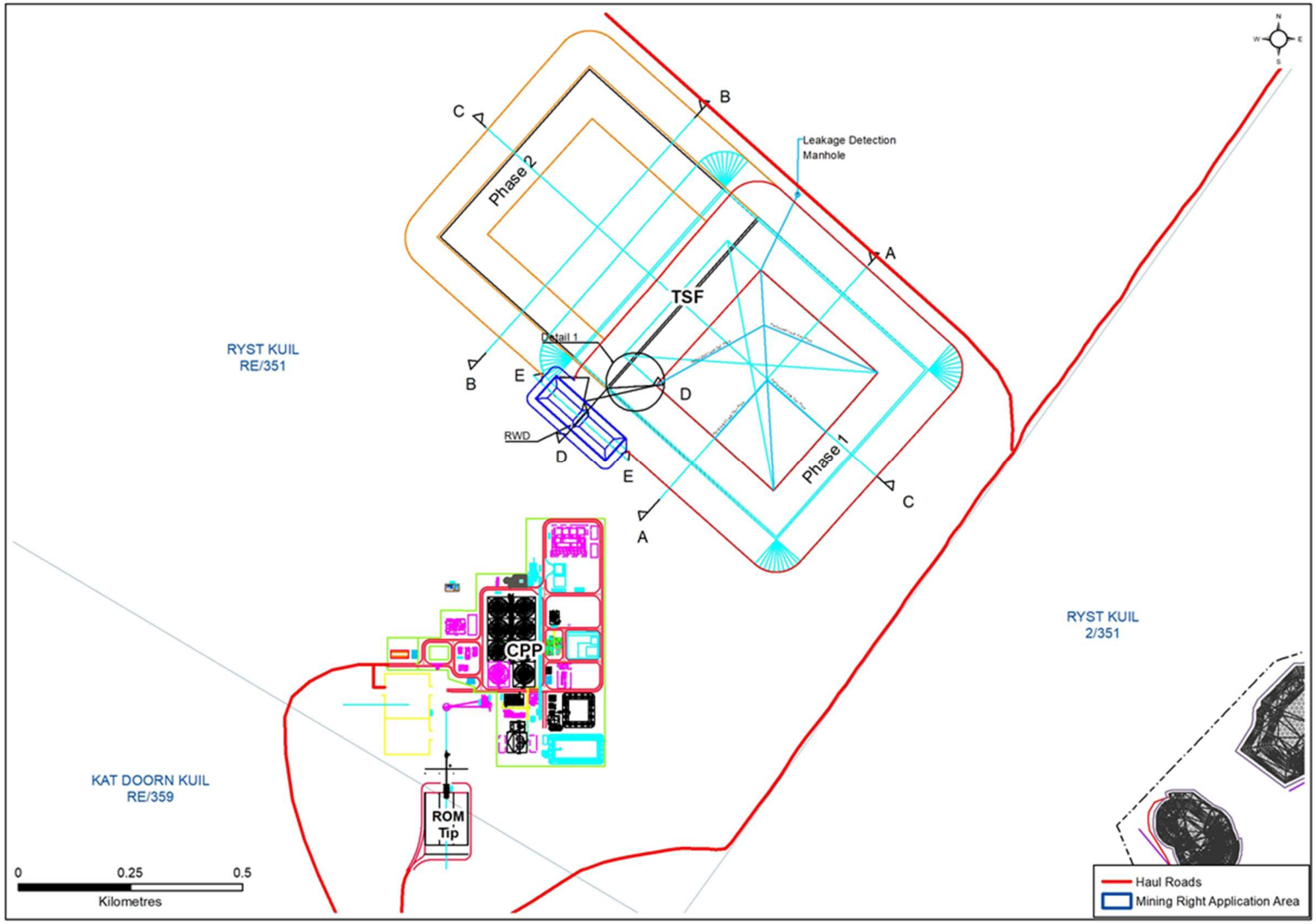

Figure 5-29. Infrastructure at the CPP and TSF.

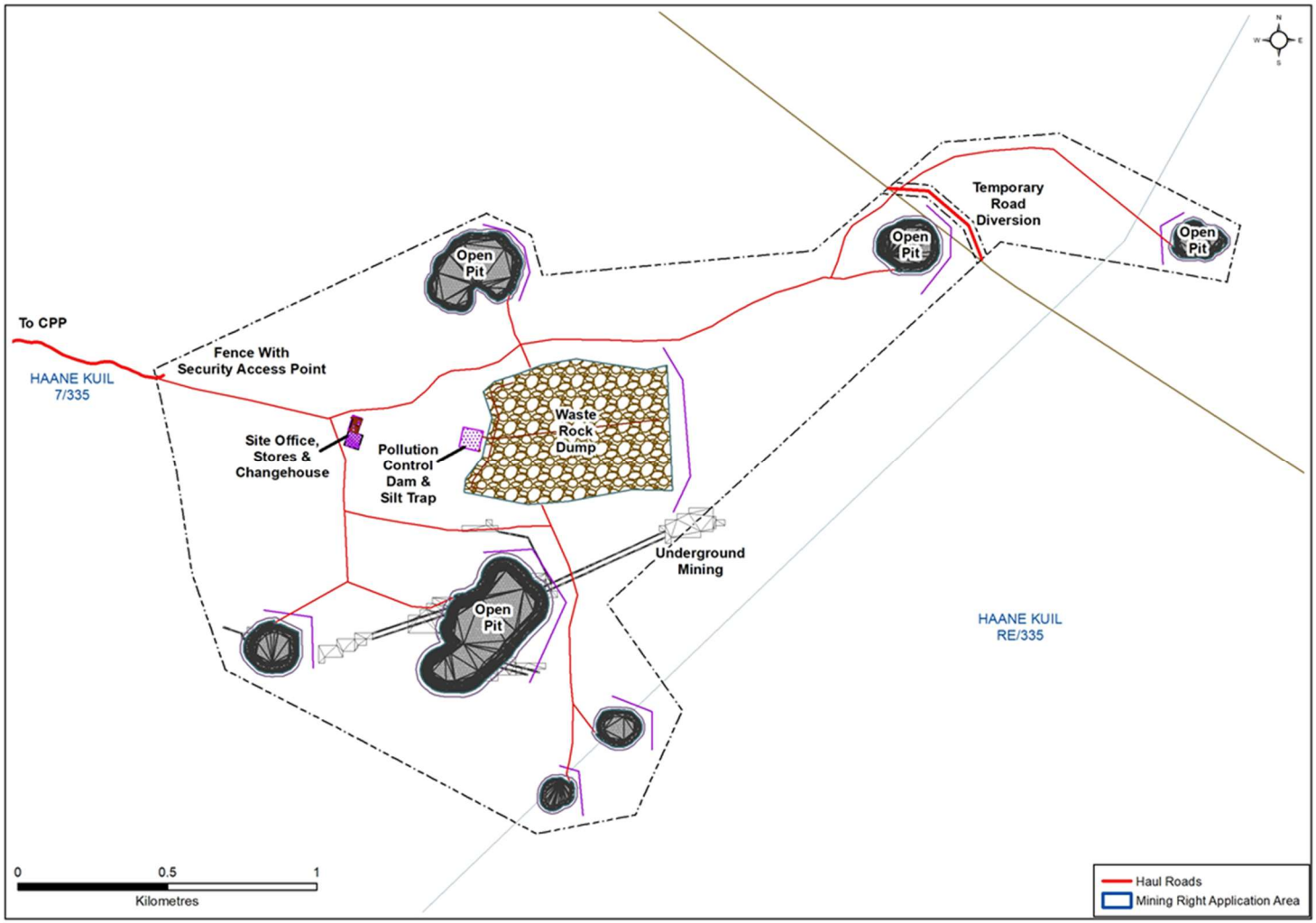

Figure 5-30. Infrastructure at the Haanekuil operational area.

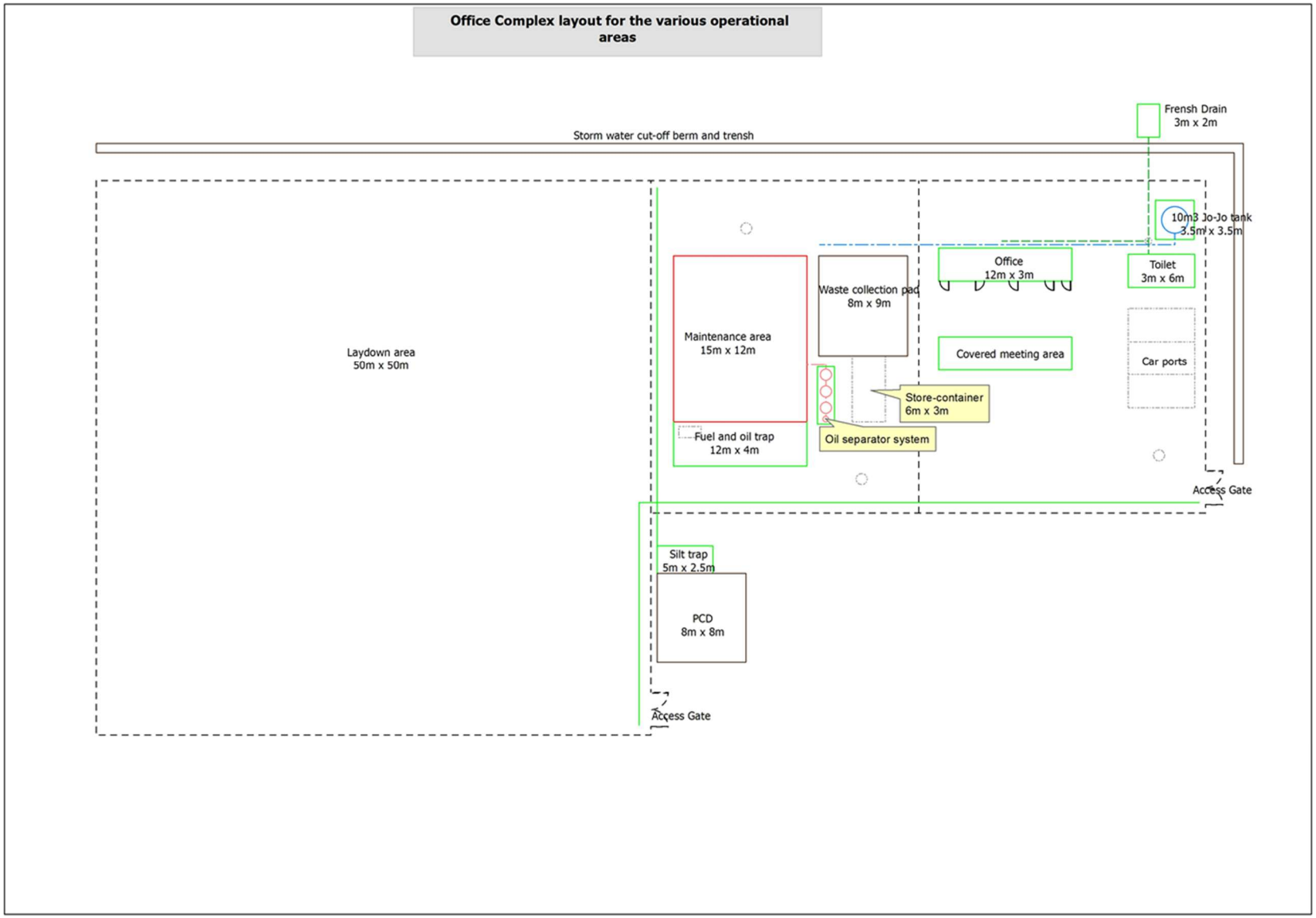

Figure 5-31. Proposed Office complex (Extention, Main and Haane Kuil) lay-out.

5.16.3 Summary of the positive and negative implications and risks of the proposed activity and identified alternatives;

In summary the potential positive impacts of this project are as follows:

- Direct foreign investment in the local economy
- Job creation
- Small business development and knock-on increase in economic activity
- Community benefit through SLP implementation
- Tax contribution to National Fiscus
- Revenue from export of the mining product

In summary the potential negative impacts of this project are as follows:

- Impact on Karoo sense of place
- Impact on local air quality
- Increased environmental noise in vicinity of operations
- Groundwater draw-down adjacent to mining areas
- Possible surface and ground water contamination
- Fauna and Flora impact within development footprints
- Fauna loss through alien species introduction, direct vehicle collision
- Impact on unpaved roads through increased traffic

5.16.4 Potential cumulative impacts of development projects in the area

A Cumulative Impact Assessment (CIA) or a Cumulative Effects Assessment (CEA) refers to the combined results of past, current and or future activities on a receiving environment. It can be assessed as various activities which form part of a single development that can have a cumulative impact on the receiving ecosystem. This is well illustrated in various specialist studies conducted for this project. For example, the Impact Assessment Methodology as well as the Impact Assessment results in the Biodiversity specialist study addresses the cumulative impacts of the various project aspects.

However, for the purposes of this section of the EIA/EMP process, the cumulative impact of this proposed Ryst Kuil uranium mine development within the context of the whole project area as well as other known developments that are at varying stages of maturity. These have been identified as the following:

- Lukisa Ryst Kuil project;
- Renewable Energy projects (Wind), and;
- Eskom transmission lines.

<u>Lulisa Ryst Kuil Project (LRP)</u>

The cumulative impacts of the Ryst Kuil mining right application area are considered within the regional context of mining uranium in the Karoo. The cumulative impacts between mining areas within the Ryst Kuil mining right

application area require consideration. Specific concerns have been raised by IAP's relating to the cumulative impacts of ground water drawn down. In this regard, the following is provided by the groundwater specialist:

The Ryst Kuil-Haanekuil ore bodies are situated on a northeast-southwest trending palaeochannel sandstone. There is an approximate 20 km distance between each of these three proposed mine areas. Numerical modelling indicates that there will be a cumulative effect of drawdowns caused by open pit and underground workings in the Ryst Kuil areas (Abante & Main and Extension) along the strike of the channel sandstone. However, the drawdowns from the former areas do not reach the Haanekuil area and vice versa. There will not be any cumulative impact on groundwater quality between the three mine areas because of the groundwater flow patterns. There could be a cumulative impact from the Ryst Kuil areas as flow from the two main areas converges to the south. However, any such effects will be attenuated over the lengthy flow paths.

Impacts such as socio-economic factors and traffic are considered holistically since the Karoo Uranium Project is considered as a whole in these specialist assessments.

The potential of a change in the viewshed should all waste rock stockpiles (remaining at 20m high – worst case scenario) as well as the TSF at 25m. The colouring of the stockpile would however resemble that of the surroundings thus limiting the impact of the scenic value. Given the remoteness of the site and the ZVI's orientation away from primary tourist routes, cumulative landscape degradation leading to land use change is rated Medium to Low. However, intervisibility between the three mining clusters may compound visual impacts, particularly in the central area. Careful management of colour contrasts, dust, and light spillage—while maintaining mining safety standards—will be essential to minimise cumulative effects.

Solar Energy and Wind Energy

As renewable energy projects, these are dealt with together. Various solar and wind energy projects at various stages of development are known within the broader area. Some came to light through land owner interaction during the consultation process while the bulk of the information was not available, we were informed that a Wind farm is proposed on Kantkraal. Discussions is underway for the utilization of electricity from the wind farm. No information was received from any potential renewable energy developers through direct consultations from their side.

A Strategic Environmental Assessment commissioned by the Department of Environmental Affairs, undertaken by the CSIR, identified Renewable Energy Development Zones (REDZs) (Department of Environment Affairs). These are gazetted geographical areas in which several wind and solar PV development projects will have the lowest negative impact on the environment while yielding the highest possible social and economic benefit to the country. The project is located in the REDZ11 and within the Central Powerline Corridor. While this is not a renewable energy project, the regional landscape is likely to become more associated with wind farming, solar PV as well as powerline infrastructure.

Should any of the above projects proceed from the planning stage to the feasibility stage where information regarding project scale, infrastructure design, access roads etc. is available, then a cumulative impact assessment can be conducted. The variables/unknowns with regard to these projects makes even a scenario based impact assessment unreasonable.

Lukisa and AMDA Developments (Pty) Ltd ("AMDA") has entered into an agreement where AMDA agrees not to develop or operate renewable energy projects in the Lukisa Mining Area and Lukisa undertake not to engage in

prospecting or mining in the AMDA Project Area. Any future changes to mineral rights under Section 102 of the MPRDA would not affect the agreement or the AMDA Project Area.

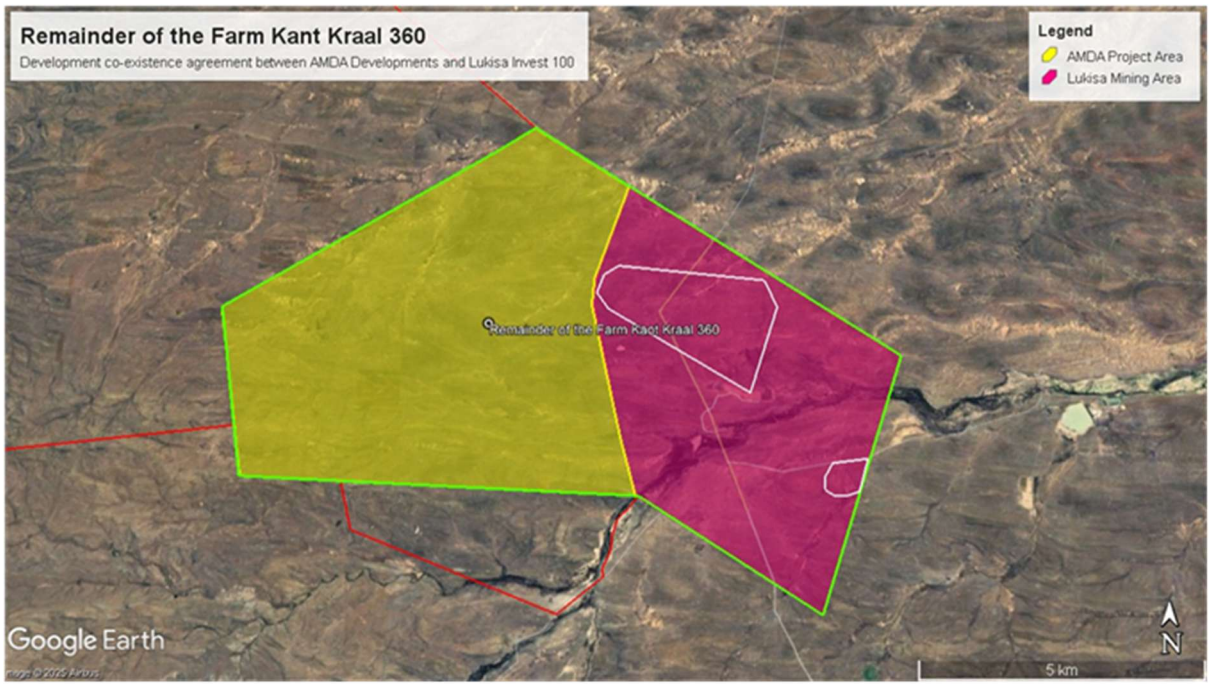

Figure 5-32. Co-existence agreement between AMDA and Lukisa on Kant Kraal 360.

Landscape Sterilisation Risks from Mining Infrastructure

Across all mining infrastructure types, landscape sterilisation—the long-term loss of land productivity and aesthetic value—is a key concern. However, this risk is generally limited due to the remoteness of the site and natural topographic screening.

1. Open Pits:
    - Pose a residual sterilisation risk due to their permanent nature.
    - Impact on surrounding land uses (primarily agricultural) is expected to be negligible, owing to location remoteness and visual shielding from main roads.
2. Waste Rock Dumps:
    - Similar sterilisation risks due to post-mining landscape degradation.
    - Visual and cumulative impacts are mitigated by distance from tourist routes and topographical screening.
3. Processing Plant:
    - Potential for some sterilisation, but unlikely to impact surrounding land uses significantly.
    - Located outside the southern tourist-related Zone of Visual Influence (ZVI), with few nearby receptors.
4. Tailings Storage Facility (TSF):
    - Also poses a moderate risk of landscape sterilisation.
    - Remoteness and position outside the ZVI reduce likely impact on land use.
5. Access Roads:
    - Some landscape sterilisation possible near isolated farmsteads, but few such receptors exist near the main access routes due to the region's remoteness.

While landscape sterilisation is a shared concern across components, its cumulative and visual effects are generally limited due to the site's remote location, sparse population, and natural topographic barriers

A decline in catchment water quality—resulting from repeated or frequent localised spills of hydrocarbons or hazardous materials, or ongoing runoff of contaminated water—could lead to broader, potentially irreversible impacts on nearby freshwater ecosystems. When combined with other existing and proposed developments in the area, this mining operation is likely to contribute cumulatively to changes in the surface runoff regime, primarily due to widespread vegetation clearance and soil disturbance.

Although the results show that the impact of the Ryst Kuil project alone will not cause an exceedance of the ambient air quality standards off-site from the project area, it should be borne in mind that air quality is cumulative and other sources in the region may contribute significantly to the ambient air quality in the region.

5.16.5 Greenhouse Gas Emissions

According to the 2014 Intergovernmental Panel on Climate Change (IPCC), the Global warming potential of selected electricity sources in terms of their cradle to grave emissions (Life cycle CO_2 equivalent, including mining of the raw materials) were compared. The table below illustrates that nuclear energy contributes the second lowest on the medium and maximum scale of current commercial technologies.

Table 5-35. Life cycle CO_2 emission comparison from selected electricity supply technologies

Life cycle CO_2 equivalent (including albedo effect) from selected electricity supply technologies. Arranged by decreasing median (gCO_2eq/kWh) values.			
Currently commercially available technologies			
Technology	**Min**	**Median**	**Max**
Coal – PC	740	820	910
Biomass – cofiring with coal	620	740	890
Gas – combined cycle	410	490	650
Biomass – dedicated	130	230	420
Solar PV – utility scale	18	48	180
Solar PV – rooftop	26	41	60
Geothermal	6.0	38	79
Concentrated solar power	8.8	27	63
Hydropower	1.0	24	2200
Wind offshore	8.0	12	35
Nuclear	3.7	12	110
Wind onshore	7.0	11	56
Pre-commercial technologies			
CCS – Coal – PC	190	220	250
CCS – Coal – IGCC	170	200	230
CCS – Gas – combined cycle	94	170	340
CCS – Coal – oxyfuel	100	160	200
Ocean (tidal and wave)	5.6	17	28

The GHG aspects of the Ryst Kuil project have been evaluated and discussed earlier in this document in greater detail.

Existing Agriculture

Grazing capacity can differ substantially over short distances depending on climate, soil depth and type, surface rockiness, vegetation type, species composition, slope and aspect. In order to determine accurate grazing capacities, and subsequent loss of livestock production, a rangeland specialist should do detailed vegetation and species composition assessments of the areas to be withdrawn due to the mining activities. Very little public information is available on grazing capacity within the application areas. The most accurate information was obtained from farmers themselves, whom have farmed in the area for many years. The average grazing capacity obtained from the farmers was 6-8 ha per small stock unit.

The application area within Ryst Kuil is almost entirely used for agriculture. The only known exception is the historical trial mine area which has been inactive for 40 odd years. The cumulative impacts of agriculture is difficult to assess since the impacts of grazing on different farms and within different camps is dependent on many factors such as localised vegetation conditions, precipitation, stocking rates, type of stock animals etc. In essence, over grazing remains the most significant potential impact of agriculture on the receiving environment and is discussed in greater detail in the Biodiversity Specialist Report. The anticipated cumulative impact of agriculture along with the proposed LRP is greatly mitigated by the fact that planned exclusive use mining areas would not be used for agriculture during mining operations. Post closure return of rehabilitated sections of land to agriculture will have to be assessed at the time and be based on the conditions and success of rehabilitation within each mining area.

5.17 Final proposed alternatives.

The Final proposed site layout is provided in Figure 5-25. Mitigation measures are provided in section D of this report.

Table 5-36. Final proposed site layout.

Activities	Initial Proposed Layout	Final Layout	Discussion
Operational area	Ryst Kuil Extension ~298ha Ryst Kuil Main & Abante = ~1,111ha Haanekuil = ~1070ha CPP = ~ 34ha TSF = ~192ha	Ryst Kuil Extension ~298ha Ryst Kuil Main = ~218 Ryst Kuil Abante = ~196ha Haanekuil = 353ha CPP = ~ 40ha TSF = ~ 79ha	The advantages of a reduced operational area are numerous. • Reduced biodiversity impact • Reduced impact on surface water drainage • Reduced impact on agricultural activities This reduction in operational surface area is not deemed to have any disadvantages.
Stockpiles	Ryst Kuil Extension =~53ha Ryst Kuil Main = ~18ha Ryst Kuil Abante = ~26ha Haanekuil = ~114ha	Ryst Kuil Extension ~34.6ha Ryst Kuil Main ~ 29.8ha Ryst Kuil Abante ~ 27.8ha Haanekuil ~27.4ha	The advantages of a reduced stockpile area are numerous. • Reduced biodiversity impact • Reduced clearance of local vegetation • Back-filling of pits would reduce impact of pollution plume formation and migration. • Reduced impact on surface water drainage This reduction in stockpile surface area is not deemed to have any disadvantages.

Road alignment	Road alignment 1 (red) ~ 133.5km Alignment 2 (green) = ~108.8km Alignment 3 (yellow) = ~143.6km Alignments 1, 2 & 3 will cross drainage line;	Alignment 1 selected as the preferred option as it mostly follows the existing roads and track, with fewest drainage line crossings.	All alignments 2 and 3, constitue section of road that would be newly constructed. The various road alignments do cross some drainage lines which would necessitate te development of a culvert or bridge. The existing track (alignment 1 and parts of alignment 2) is currently 3m wide, the width would be increased to 4.5m. This results in a reduced impact on vegetation clearance, drainage areas in comparison with alignments 2 and 3. Improved management on security through access control. Improved condition of access road surface.
Diesel storage	Various Diesel storage tanks at the various pits	Central storage facility at the office complex	The potential of spillage during refuelling is limited and can effectively be managed through implementation of bunded surfaces.
Ablution facilities	Ablution facilities at all pits	Change house at the office complex with Chemical toilets at the pits.	The advantage of a formal change house (containerized) is the improvement of sewage management.
Operational pits	Ryst Kuil Extension ~40.6ha Ryst Kuil Main ~31.3ha Ryst Kuil Abante ~59.2ha Haanekuil ~63.4ha	Ryst Kuil Extension ~33.27ha Ryst Kuil Main~ 21.65ha Ryst Kuil Abante ~49.42ha Haanekuil ~ 27.23ha	The advantages of a reduced operational area are numerous. • Reduced biodiversity impact • Reduced impact on surface water drainage • Reduced impact on agricultural activities This reduction in operational surface area is not deemed to have any disadvantages. Although possible underground operations are no longer planned at this site due to the outcomes of the mine planning, underground operations may be pursued in future. This will require an update to this document as well as DMR approval.
Pit dewatering / Water management infrastructure	Collection in pit- sump and pumped to standard lined PCD	Collection in pit-sump pumped to 1.9ML steel tank with rubber lining.	The advantage of the steel storage dam is reduced loss of water through evaporation and infiltration. Water can be used for dust suppression. No additional abstraction for this purpose.

5.18 Aspects for inclusion as conditions of Authorisation.

Any aspects which have not formed part of the EMPr that must be made conditions of the Environmental Authorisation

Within six months of the approval of this mining right the applicant must initiate a waste rock characterization specific to the Ryst Kuil mining right area. The resulting geochemistry report must be submitted to the DMR within 30 days of completion of the study and six months before initiation of mining.

Should this mining right be granted no mining activities may be initiated prior to the granting of a site and activity specific water use license. Condition of the water use license must be adhered to.

No mining may be initiated without the required Certificate of Registration (COR) issued by the NNR.

5.19 Description of any assumptions, uncertainties and gaps in knowledge.

It has reasonably been assumed that the geochemistry of the various mine sites does not differ significantly from the geo-chemistry at Ryst Kuil. This assumption should however be confirmed through a site-specific waste rock analysis.

The potential role that this prospective mining right holder can play in the local stock theft prevention programmes must be assessed. This assessment must be done in conjunction with all relevant land owners and role players.

Update the numerical modelling to refine scenario predictions as new data become available on mine plans.

5.20 Reasoned opinion as to whether the proposed activity should or should not be authorised

5.20.1 Reasons why the activity should be authorized or not.

If this proposed mining is not authorised the following applies:

- No further economic gain (both local and national) from the mineral resource will be realised.
- No further direct or indirect employment will be generated.

5.20.1.1 Air Quality

The study of the dispersion of air pollutants from the Ryst Kuil project operations was based on design capacities and internationally published emission factors. The outcome showed that the impact of PM10 and PM2.5 emissions will only exceed ambient air quality standards within the project area. The area over which the standards will be exceeded is significantly larger for PM10 as the primary contributor to particulate emissions are the haul roads.

The main area of impact is on the Ryst Kuil mining rights area where occupational health standards should apply. The use of personal protective equipment (PPE) will contribute to a reduction of risk for employees active in the mining operations. The main public road passing through the area, the R61 is not significantly affected by the operation. The R306 does however pass through areas where the ambient air quality standards will potentially be exceeded.

There may be a substantial degree of uncertainty in the estimated emissions and concomitant impact on air quality.

However, it must be borne in mind that the air quality study did not account for dust suppression measures on the road surfaces, due to the distances involved. To reduce emissions and air quality impact, effective dust suppression measures will be required.

5.20.1.2 Biodiversity

The following is a summary of the reason opinion, assimilated from previous reports and current information.

- The proposed mining activities will affect only a very small fraction of the extensive and largely intact Gamka-Karoo vegetation type, so the overall transformation of this ecosystem is considered negligible.
- The potentially undescribed *Nananthus* species, although present in the area, is not at significant risk due to its wider distribution and the presence of suitable habitat outside the mining zones. Mitigation measures such as search-and-rescue and protection from grazing are recommended to further reduce risk.
- The most significant potential impacts to biodiversity are related to radioactive dust and contaminated water from the Tailings Storage Facility (TSF) and Return Water Dam (RWD). However, modelling indicates that radiation exposure from dust will be well below regulatory limits, and ongoing monitoring is planned.
- The greatest risk to fauna is from ingestion or exposure to contaminated water in the TSF. Comprehensive mitigation measures are proposed, but further modelling and a non-human biota impact study are recommended to fully assess and manage this risk.
- The final design of the TSF cover will be developed during operations, with additional safeguards (such as berms) recommended to prevent contamination of sensitive aquatic ecosystems in the unlikely event of a TSF failure.
- Overall, if all embedded controls and mitigation measures outlined in all reports are implemented and regularly monitored, the proposed mining activities are not expected to pose a significant risk to regional biodiversity.
- From a freshwater ecological perspective, the specialist concludes that the project could be authorised, but only with strict caution and full implementation of mitigation measures. Medium- and high-impact mining activities must be relocated outside watercourses and buffer zones, with assurance that acidic water and radioactive materials will not contaminate the environment. Sensitive freshwater habitats and their buffers should be avoided as far as possible, supported by a remediation plan, contamination prevention measures, rehabilitation of disturbed watercourses, and wetland offsets where necessary. High-sensitivity areas are considered no-go zones for high-impact activities, while low- and medium-sensitivity areas may be used for mining subject to environmental authorisation, mitigation, rehabilitation, and offsets.

5.20.1.3 Groundwater

The groundwater impact significance is rated as Low with a high degree of confidence in the predictions.

Overall, it can be summarised that groundwater RWLs and quality have been maintained or enhanced despite the periodic droughts that afflict the area and that the channel sandstone aquifer is resilient to stress.

5.20.1.4 Surface water

It is envisaged that if the mitigation measures are implemented, the risk of negatively impacting upon the water resources and ecosystem functionality downstream of the project site will be largely reduced.

5.20.1.5 Radiation

Based on the surveys done on site post remediation in 2022, the projected radiation exposures at Ryst Kuil site currently presents low levels of radiation, therefore the current radiological impact to members of the public and the environment is lower than the NNR public dose limit of 1mSv/a.

5.20.1.6 Traffic and Transportation

The traffic impact assessment indicates that the existing road network is sufficient to accommodate the increased traffic associated with both the construction and operational phases of the proposed Lukisa Mine without requiring major upgrades. The gravel and tarred roads in the vicinity are in fair condition, and traffic volumes are currently low, with ample spare capacity.

During construction, the projected 100 daily vehicle trips—20% of which will be heavy trucks—can be managed using existing infrastructure, although routine maintenance of gravel roads and regular watering will be necessary to control dust and road degradation. In the operational phase, the estimated 120 daily truck trips remain within road capacity limits, with no need for road surfacing, though continued dust suppression and signage at access points are recommended for safety.

The transportation routes, including the N1 and nearby rail infrastructure, support logistical feasibility. Given the limited viable alternatives to mining—namely, livestock farming and eco-tourism—the proposed development represents the most economically and technically viable land use.

From a traffic and transportation perspective, the proposed mining development poses no significant impact on existing road infrastructure and can be supported without major upgrades, provided maintenance and mitigation measures are implemented. Thus, the development is acceptable and recommended for approval on traffic grounds.

5.20.1.7 Visual

The findings of the Landscape and Visual Impact Assessment support the authorisation of the proposed mine with appropriate mitigation measures in place. Owing to the site's remoteness and the undulating regional topography, the visual extent of most mining infrastructure and landform changes is expected to result in lower levels of visual intrusion, with the blast plume/ dust from moving vehicles representing the most visually prominent and regionally influential element. While the broader Karoo landscape holds regional significance, the immediate site area is relatively flat and lacks distinctive landforms, reducing its sensitivity to visual change. Furthermore, the mine is located at a considerable distance from major roads, approximately 2 km (avg.) from the R61 and 13 km from the N14, and is surrounded by a sparse distribution of rural receptors, particularly within the Foreground to Midground viewing zones. As such, the anticipated visual changes are not considered a Fatal

Flaw, provided that mitigation measures are implemented to address key visual elements such as blast plumes, Waste Rock Dumps (WRD) shaping, and dust and light management.

It is the opinion of this EAP that no critical risks have been identified for the proposed mining project that cannot adequately be mitigated and/or controlled. Therefore, it is recommended that this proposed mining project be authorised in order to realise the identified economic benefits.

5.20.2 Conditions that must be included in the authorisation

5.20.2.1 Specific conditions to be included into the compilation and approval of EMPr

A specific condition recommended is for the initiation of a Water Forum for the Project to meet in Beaufort West on a periodic basis. Within this forum, the client (mine) should present existing and updated water quality data as well as draw down data. Information and/or anomalies can be discussed and the forum can provide a platform to address impacts. The forum must be open to land owners, neighbouring farmers, the municipality and any interested affected party.

Any change to the mine plan as presented herein will be subject to additional Environmental Authorization's where applicable.

5.20.2.2 Rehabilitation requirements

The following rehabilitation criteria have been recommended by the various specialists:

AIR QUALITY

- Rehabilitation of open and exposed surfaces is assumed as a component of the mine decommissioning process to mitigate on-going impacts post-closure.
- Rehabilitation of waste rock stockpile and tailings dam site are recommended to reduce ongoing future impacts.
- Rehabilitation of mine roads is recommended to reduce wind-entrained particulate generation

BIODIVERSITY

Implement a construction handover plan in which rehabilitation measures are defined and budgeted for. Re-vegetation trials must be undertaken to determine the most appropriate species for a particular habitat. Species should be selected on a basis of adaptive management. i.e. perform trial runs on several species and select those species most suitable in achieving the desired result of establishing ground cover and increasing habitat functionality. A nursery should be established to propagate selected plant species for translocation and rehabilitation. Specific planting plans and schedules for each habitat type must be determined where rehabilitation will be required;

Development of an operational monitoring programme to assess success and sustainability of rehabilitation and reclamation procedures applied. This monitoring programme will aid in continuous adaption of the

rehabilitation process and will demonstrate whether the rehabilitation procedures in place are successful. Critical components that need to be monitored are:

- Re-vegetation success. It is essential to ensure that the re-vegetated areas are successfully proliferating and not dying or succumbing to alien invasive plant competition;
- Control of alien and invasive species. It is very important to ensure that continued control of alien and/or invasive species is taking place after the construction phase and during the operations phase and this must therefore be monitored adequately;
- Water quality monitoring. Runoff into seasonal pans should be monitored to ensure that rehabilitation procedures have sufficiently controlled any pollution and sedimentation likely to occur in the surrounding water dependent habitats.
- Establishment of a functional plant propagation facility with the capacity to supply the required trees and plants needed for minimization of soil erosion and other rehabilitation measures.

SOIL, LAND USE AND LAND CAPABILITY

Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction.

The following site-specific rehabilitation requirements are recommended:

- Where possible roll over rehabilitation should be implemented.
- Where roll over rehabilitation is not possible, stockpiling of overburden should be kept to the smallest possible footprint.

RADIATION

A safety assessment of exposure scenarios after closure, as well as potential scenarios in the distant future, will have to be approved by the NNR at the end of mining in these areas.

WATER

The PCD's must be assessed by a competent person to determine the appropriateness of their removal and footprint rehabilitation versus their long-term benefit. This decision making must be driven by the monitoring data available. An additional soil assessment may be required to augment routine water monitoring data.

With sealing of adits and backfilling in all pits, the potential contaminant plumes can be seen to expand slightly, with the potential to slightly change water quality at a maximum of one currently privately-owned borehole. Unless convincingly motivated for other reasons (e.g. potential visual or other impacts of waste rock dumps), do not fully backfill the 'downstream' open pit so as to retain a long-term but localised 'sink' to 'capture' any potential local groundwater contamination.

5.21 Period for which the Environmental Authorisation is required.

30 years

5.22 Financial Provision

5.22.1 Explain how the proposed financial provision was derived.

The Financial Provision calculated and committed to this mining right application for Year 1 of mining amounts to: **R 80 781 807.00 excl VAT.** The quantum calculation for year 1 of mining is included below. The explanations for each item are provided in the table below.

CALCULATION OF THE QUANTUM July 2025 **Base Date :** 31 March 2015

LRP Yr 1

No.	Description	Unit	RATES	A	E
No.	**Description**	**Unit**	**RATES**	**Quantity**	**Amount (Rands)**
				LRP YR1	
1	Dismantling of **processing plant and related structures** (including overland conveyors and powerlines)	m^3	20,30	140212,00	R 2 845 959,76
2(A)	Demolition of **steel buildings and structures**	m^2	282,74	9347,46	R 2 642 873,74
2(B)	Demolition of **reinforced concrete buildings and structures**	m^2	416,67	2717,50	R 1 132 287,69
3	Rehabilitation of **access roads**	m^2	50,60	4200,00	R 212 499,25
4(A)	Demolition and rehabilitation of **electrified railway lines**	m	416,67	0,00	R -
4(B)	Demolition and rehabilitation of **non-electrified railway lines**	m	267,86	0,00	R -
5	Demolition of **housing and/or administration facilities**	m^2	565,47	3385,00	R 1 914 130,18
6	**Opencast rehabilitation** including final voids and ramps	ha	296 427,53	21,65	R 6 417 656,01
7	Sealing of **shafts, adits and inclines**	m^3	151,79	60,00	R 9 107,11
8(A)	Rehabilitation of **overburden and spoils**	ha	197 618,35	6,45	R 1 274 638,38
8(B)	Rehabilitation of processing waste **deposits and evaporation ponds (basic, salt-producing waste)**	ha	246 130,09	31,40	R 7 728 484,73
8(C)	Rehabilitation of processing waste **deposits and evaporation ponds (acidic, metal-rich waste)**	ha	714 878,44	45,62	R 32 612 754,39
9	Rehabilitation of **subsided areas**	ha	165 475,61	0,00	R -
10 (A)	**General surface rehabilitation - Topsoil**	ha	135 130,48	14,86	R 2 008 038,89
10 (B)	**General surface rehabilitation - Seeding**	ha	13 167,28	34,00	R 447 687,61
11	**River diversions**	ha	156 249,45	0,00	R -
12	**Fencing**	m	178,57	8307,10	R 1 483 405,50
13	**Water management**	ha	59 523,60	2,60	R 154 761,36
14	2 to 3 years of **maintenance and aftercare**	ha	20 833,26	25,49	R 531 039,80
15A	Specialist study	Sum	500 000,00	1,00	R 500 000,00
15B	Specialist study	Sum	500 000,00	1,00	R 500 000,00
					R 62 415 324,39
				(Sum of items 1 to 15 above)	

1	Preliminary and General weighting factor	10,0% 1,05		of Subtotal 1	R 6 553 609,06
2	Administration and supervision costs	0			R -
3	Engineering drawings and specifications	2,0%			R 1 248 306,49
4	Engineering and procurement of specialist work	2,5%			R 1 560 383,11
5	Development of a closure plan	2,5%			R 1 560 383,11
6	Final groundwater modelling	Sum			R 100 000,00
	Sub Total 2				R 11 022 681,77
					R 73 438 006,16
7	Contingency			0,10	R 7 343 800,62
	SubTotal 3 **(Subtotal 2 plus contingency)**				**R 80 781 806,78**
	Add Vat (15%)				R 12 117 271,02
	GRAND TOTAL **(Subtotal 3 plus VAT)**				**R 92 899 077,80**

The Financial Provisioning has been calculated according to the quantum provided by the DMR in February 2015. Adjustments have been made to the master rates in this quantum utilising CPIX for inflationary adjustment of relevant March CPI per annum of the Master Rates from February 2015 to July 2025.

An annual update of the provisioning is required.

Factors considered for the Financial Provisioning Quantum calculation:

Table 5-37. Tabulated explanation of financial provisioning parameters

NOTE		It is important to note that by Quarter 4 of Year 1 (i.e. Year 1 Quantum) only Ryst Kuil Main will be in operation.
1	Dismantling of processing plant and related structures (including overland conveyors and power lines)	Only mobile crushing units will be utilised within the mining sites which require no dismantling. No overland conveyors will be used. A single power line will feed power into the CPP and is planned to remain in-situ post closure. By month 12 of construction, it is anticipated that ~50% of the CPP would be constructed. An average elevation was applied to the varied CPP plant infrastructure.
2 (A)	Demolition of steel buildings and structures	No steel buildings or structures will be used on mining sites. Offices will be mobile units. Steel buildings and structures as ancillary to the CPP have been allocated a factor 0.2 of the CPP structure surface area.
2(B)	Demolition of reinforced concrete buildings and structures	Reinforced concrete will be used for the construction of the V-trench at the waste rock dumps. The area specific values for these trenches are listed below. The V-trench for each office complex (236,5m²), the waste pad (72m²), maintenance area (180m²) and the refuelling and oil area (48m²) contribute a total of 536.5m². Totals then for Year 1: Main (shared with Abante) = 2171m² + 536.5m² =2717.5m² Additional values for LOM: Extension = 3277m² + 536.5m² = 3813.5m² Abante = 4500m² + 536.5m² =5036m² Haanekuil = 2383m² + 536.5m² =2920m²
3	Rehabilitation of access roads	All access roads rehabilitated to just 2.5m wide to allow access for long term post closer monitoring. For Year 1 the access roads for Main, the CPP and the TSF are included. For LOM all access roads have been included.
4 (A)	Demolition and rehabilitation of electrified railway lines	No electrified or non-electrified railway lines are planned for Ryst Kuil.
4 (A)	Demolition and rehabilitation of non-electrified railway lines	No electrified or non-electrified railway lines are planned for Ryst Kuil.
5	Demolition of housing and/or administration facilities	No housing is planned at any sites. All mining offices, stores etc. will be mobile units. At the CPP the total surface area of ancillary buildings is 3385m²
6	Opencast rehabilitation including final voids and ramps	According to the mine schedule the following pits require rehabilitation for year 1 of operations: Main: Pit1, 2 & 3 = 21,65 For the Life of Mine it is assumed all pits will be mined according to the presented mine schedule and that concurrent backfilling will be done as part of the mining process where adit access to UG operations is not hindered. Based on the recommendations of the ground water specialist study a single pit in each mining area may only be partially backfilled to provide for a ground water sink. However, for the purposes of this quantum and as a conservative position it is assumed that all open cast pits will be backfilled. For LOM the surface area of all open cast pits has therefore been budgeted for and totals 131,57ha.
7	Sealing of shafts adits and inclines	According to the mine schedule, Main: Pit1 & 2 Adit plug volume = 60 m³ For LOM a total of 14 adits is anticipated. This equates to a plug volume of 840 m³
8 (A)	Rehabilitation of overburden and spoils	For the Ryst Kuil operations and based on the mine schedule, the proposed overburden / waste rock dumps have been calculated with a footprint of 64,5ha. During the first 12 months and considering a life of mine of the waste rock dumps over a 9-year period it is anticipated that ~10% of the waste rock dump footprint will be utilised by Y1Q4. Therefore, 6,45ha will require rehabilitation by Y1Q4. LOM The full surface area of all Waste Rock dumps is 140ha. It must however be understood that backfilling of open pits forms part of the mine process as well as the

		construction of the TSF. It should however be noted that due to the 30-40% expansion/swell factor of overburden versus pit volume, this rock dump footprint is considered a final post closure landscape feature. For this reason, category 8(A) provision may never be required.
8 (B)	Rehabilitation of processing waste deposits and evaporation ponds (non-polluting potential)	The PCD's at the waste rock dumps are considered non-pollution producing (see the Geochemistry results presented in the Surface and Ground Water Report). The surface area for the PCD employed during the first year of operations is 31.4Ha. For the LOM calculation, the additional PCD's have been added to the above surface area and total 126.5ha
8 (C)	Rehabilitation of processing waste deposits and evaporation ponds (polluting potential)	The Office/lay down/service area PCD and Silt trap are considered polluting potential since hydrocarbons are expected to be trapped within this system. A total surface area of 0,00765ha is applicable. Such PCD and silt trap for hydrocarbon storage is planned for Main and the CPP = 0,0153ha Phase 1 of the TSF is scheduled to be built in the first year of operations and measures 44ha in size. Return Water Dam = 1,6ha For the LOM calculation both phases of the TSF are budgeted for which totals 78ha. The total for the mining area PCD and silt traps at the offices is 0,03ha. The total for LOM is therefore 80ha.
9	Rehabilitation of subsided areas	Based on hard rock mining and the planned UG mining depths no subsidence is anticipated.
10 (A)	General surface rehabilitation Top soil	After Year 1 of operations, general surface rehabilitation will include the final voids and ramps, overburden and spoils and processing waste deposits. The general surface rehabilitation for internal roads has been budgeted for here. At end of Y1 a total surface area of 14,86ha has been accounted for. For LOM the internal surface road area has been budgeted for as 31ha.
10 (B)	General surface rehabilitation Seeding	The area to be seeded include the pits, stockpile and infrastructure areas.
11	River diversions	No river diversions are required at Ryst Kuil.
12	Fencing	The perimeter fence around the mining pit complexes as well as the TSF will be required in perpetuity post closure and therefore does not form part of the premature or LOM closure calculations. The fence around the office complex's will be removed as part of the rehabilitation process as well as the CPP fence.
13	Water management	Due to the dry nature of the environment and the lack of surface water, the water management surface area that has been calculated includes the various waste rock dump PCD's as well as the service bay PCD's and the TSF RWD.
14	2 to 3 years of maintenance and aftercare	According to the mine schedule, Main: Pit1, 2 & 3 = 21,65ha Road = 3,84ha LOM – includes all pit surfaces of 131,57ha plus the road surfaces of 32,3ha and the surface area of the CPP 40ha. = 203.87ha
15 (A)	Specialist study	A Ground Water closure related specialist study has been costed.
15 (B)	Specialist study	A Soil and possible second closure related specialist study has been costed.

The Life of Mine Quantum addresses the rehabilitation costs over the life of mine in accordance with the schedule included in this document. This quantum also requires adjusting on an annual basis and must be re-submitted to the DMR annually. Concurrent rehabilitation will significantly reduce to LOM quantum, thus, annual review will be required.

CALCULATION OF THE QUANTUM July 2025 **Base Date :** Mar-15

LRP LOM

No.	Description	Unit	RATES	A	E
No.	**Description**	**Unit**	**RATES**	**Quantity**	**Amount**
					LRP (LOM)
1	Dismantling of **processing plant and related structures** (including overland conveyors and powerlines)	m^3	20,30	280414	R 5 691 717
2(A)	Demolition of **steel buildings and structures**	m^2	282,74	9347	R 2 642 744
2(B)	Demolition of **reinforced concrete buildings and structures**	m^2	416,67	16051	R 6 687 893
3	Rehabilitation of **access roads**	m^2	50,60	128308	R 6 491 726
4(A)	Demolition and rehabilitation of **electrified railway lines**	m	416,67	0	R -
4(B)	Demolition and rehabilitation of **non-electrified railway lines**	m	267,86	0	R -
5	Demolition of **housing and/or administration facilities**	m^2	565,47	3385	R 1 914 130
6	**Opencast rehabilitation** including final voids and ramps	ha	296 427,53	132	R 39 000 970
7	Sealing of **shafts, adits and inclines**	m^3	151,79	840	R 127 500
8(A)	Rehabilitation of **overburden and spoils**	ha	197 618,35	140	R 27 666 569
8(B)	Rehabilitation of processing waste **deposits and evaporation ponds (basic, salt-producing waste)**	ha	246 130,09	47	R 11 445 049
8(C)	Rehabilitation of processing waste **deposits and evaporation ponds (acidic, metal-rich waste)**	ha	714 878,44	80	R 57 190 275
9	Rehabilitation of **subsided areas**	ha	165 475,61	0	R -
10 (A)	**General surface rehabilitation - Topsoil**	ha	135 130,48	238	R 32 225 916
10 (B)	**General surface rehabilitation - Seeding**	ha	13 167,28	238	R 3 140 134
11	**River diversions**	ha	156 249,45	0	R -
12	**Fencing**	m	178,57	127	R 22 657
13	**Water management**	ha	59 523,60	4	R 219 047
14	2 to 3 years of **maintenance and aftercare**	ha	20 833,26	204	R 4 247 277
15A	Specialist study	Sum	500 000,00	1	R 500 000
15B	Specialist study	Sum	500 000,00	1	R 500 000
					R 199 713 603
				(Sum of items 1 to	

1	Preliminary and General weighting factor	10,0% 1,05		of Subtotal	R 20 969 928
2	Administration and supervision costs	0			R -
3	Engineering drawings and specifications	2,0%			R 3 994 272
4	Engineering and procurement of specialist work	2,5%			R 4 992 840
5	Development of a closure plan	2,5%			R 4 992 840
6	Final groundwater modelling	Sum			R 300 000
	Sub Total 2				R 35 249 880
					R 234 963 483
7	Contingency			10,0%	R 23 496 348
	SubTotal 3				**R 258 459 832**
	(Subtotal 2 plus contingency)				
	Add Vat (15%)				R 38 768 975
	GRAND TOTAL				**R 297 228 806**
	(Subtotal 3 plus VAT)				

5.22.2 Confirm that this amount can be provided for from operating expenditure.

Lukisa Invest 100 Pty. Ltd. will provide for this amount (**R 80 781 807.00 excl VAT**) and submit such to the DMR. Annual revision of the quantum will be provided to the DMR and applicable adjustments made to the guarantee.

5.23 Deviations from the approved scoping report and plan of study.

5.23.1 Deviations from the methodology used in determining the significance of potential environmental impacts and risks.

No deviation has taken place from the anticipated methodology and implementation from the Scoping Phase. Only a variation in presentation format and in some cases terminology used by the various specialists in order to apply the impact assessment methodology to their individual discipline.

5.23.2 Motivation for the deviation.

Not applicable.

5.24 Other Information required by the competent Authority

5.24.1 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). Include the:

5.24.1.1 Impact on the socio-economic conditions of any directly affected person.

The land owners of the Ryst Kuil area have been involved with the project since its inception and many have a signed contract with regard to the proposed mining.

The directly affected farm labourers will be considered for possible employment at the mine should they so wish.

5.24.1.2 Impact on any national estate referred to in section 3(2) of the National Heritage Resources Act.

The HIA Report summarised the following:

- A number of archaeological reports related to uranium prospecting have been conducted in this particular area over the last 10 years although not all the reports have been submitted to the heritage authorities because some were conducted as baseline studies;
- Surveys have identified scatters of ESA and MSA artefacts and occasional LSA material. Archaeological material is predominantly present in the form of isolated flakes and cores, which are difficult to ascribe to a particular time period and which do not occur in sufficient quantities to be termed a “site”. The majority were manufactured on indurated shales (hornfels) although some artefacts were manufactured from a chert band which crosses Ryst Kuil;
- References by Kinahan (2008) to Howieson’s Poort material on open sites in the interior of the Karoo could not be verified;
- No significant archaeological resources were identified;
- The archaeological heritage of the area is of low significance.

5.25 Other matters required in terms of sections 24(4)(a) and (b) of the Act.

Mining Areas:

a) the siting of open cast pit operations is dictated by the geological resource. No alternative location could be reasonably considered for these aspects of the proposed development.
b) The activity of mining and the methodology proposed by the applicant cannot reasonably be substituted considering the characteristics of the mineral deposit. This has been evaluated at great length by the mine engineering team.

Infrastructure Areas:

c) The siting of the proposed infrastructure (i.e. mine laydown areas, CPP, TSF, haul roads etc.) was initially based on both the proximity to the mining operations to reduce haulage time and therefore reduce diesel consumption as well as on the topography of the specific areas. Rocky ridges, sloping topography and drainage channels (episodic drainage lines) were avoided where possible. Various options were considered by the EAP in conjunction with the engineering team in order to select the best site option.
d) Latest available mining and processing technology is planned to be utilised by the applicant. Technologies that improve efficiencies will be investigated and where feasible such will be implemented.

Operational alternatives include the following:

- Shortest haul route calculation and ramp positioning to reduce diesel consumption
- Roll over rehabilitation wherever possible to reduce double handling
- Placement of overburden and ROM stockpiles to minimise additional handing and/or hauling.
- Reduction of road traffic through multi-load deliveries to the CPP.

Should this proposed mining activity not be implemented, the following will occur:

- The historical mining legacy will remain the responsibility of the South African government to rehabilitate.
- Loss of additional revenue provided to the South African fiscus through royalties and taxes.
- Loss of job creation opportunities.

PART B

ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT

6 Environmental management programme.

A. Details of the EAP,

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Tel No.: + 27834410239

Fax No.: 086 716 5576

e-mail address: erika@atox.co.za

6.1 Description of the Aspects of the Activity

The proposed mining operation is to be known as the Karoo Uranium Project and will be operated as a single entity, but with multiple production centres feeding a central processing plant (CPP) to be located near the main orebody in the Ryst Kuil area (a separate mining right application).

Mining at Ryst Kuil will be both open pit and underground and is planned for five (5) different areas. These areas are known as Extension (12 pits and 9 underground sections), Abante (7 pits), South (4 pits), Main (3 pits and 3 underground sections) and Haanekuil (7 pits and 2 underground sections)

6.1.1.1 Open Pit Mining

Open pit mining at Ryst Kuil will be carried out using traditional drilling, blasting and loading from open pits, which requires the removal of overburden and waste rock before accessing the ore material. Open pit surface mining will require standard open cast pit structures with access roads to a depth of not more than ±110 meters. Mining method will employ traditional drill, blast, load and haul using trucks to deliver the material to the processing plant.

Topsoil (if any) will be removed to a maximum depth of 30 cm where possible from all open pit and dump areas. This will be done by bulldozing the material onto windrows, loaded by an excavator and trucked to a topsoil stockpile for storage. No vegetation will be removed prior to this operation. All vegetation will be stockpiled together with the topsoil.

The hard overburden will be mined in benches of 10 m with a maximum slope angle of 65°. The benches will be drilled and blasted prior to an excavator and truck fleet loading and hauling to an appropriate dump site. The waste rock stockpile consists of ex-pit overburden dumps adjacent to the open pit and old mined-out open pits from which no mining is taking place or are planned to take place in future. Overburden on the last bench above the ore will only be drilled and blasted down to the ore/waste contact. Ore and overburden will not be drilled and blasted together.

Due to the thin tabular nature of the ore deposit and the small size of the various open pits, virtually all the overburden will have to be mined before any ore production from any given pit will be possible. Because no clear visual distinction is identified between the ore and waste material, strict grade control measure will need

to be implemented using radiometric measurements by the production geological department. All mined ore will be loaded by an excavator or front-end loader onto a truck and transported directly to the processing plant run of mine (ROM) tip.

6.1.1.1.1 Underground Mining

6.1.1.1.1.1 Mining Method Selection

The Karoo uranium underground orebody is exceptionally complex and scattered in nature. Dissimilar to the familiar average tabular orebody structure being mined across South Africa. It is best described as a flat-dipping, lens-like deposit. The average thickness is mostly 1.2 m with some areas at 1.8 – 3 m and occasionally up to 6.0 m thick. Depth to seam is mostly 35 – 80 m with a few deeper areas up to 110 m.

In general, the orebody characteristics appear to be ideally suited for Bord and Pillar mining using low profile (LP) trackless mining equipment (TME). In narrower mineable portions, other mining methods, deploying more conventional methods, had to be considered. This is necessitated mainly due to the excessive dilution factor associated with a higher trackless mining height.

The most appropriate alternate mining method is an on-reef hybrid stoping method. The method still uses the same TME fleet for on reef access development, and cleaning, Hand-held rock drills is used for face drilling and waterjets for in-stope ore cleaning LHD's will load the stoping production tonnes jetted into the on-reef drives, haul and dump it on the designated belt tipping points.

6.1.1.1.1.2 Development – Access Methodology

Development layout for the Karoo Uranium deposits will consist of high-wall access roadways from the floor of mined out open pits. It is suggested that the portal positions be finalised early in the life of each pit that will host an underground decline and that the wall geometry is altered to provide safe access to the declines. This is to be achieved, in the following manner:

- Increase the bench width on the bench above the level into which the portal will be created to allow sufficient space to place a substantial catch berm along the crease of the bench to prevent any scaling from upper benches to report to the portal / decline level;
- Ensure that the bench into which the portal will be established is of sufficient height to leave at least 4m brow of solid, fresh rock above the decline hanging wall;
- Prior to excavating the portal entrance (start the decline development):
- A 50mm thick layer of shotcrete is to be applied to the whole bench wall around the portal entrance, to at least 5.0m on either side of the planned excavation;
- Two rows of 4.5m long cable anchors (full column grouted) be installed into the brow above the planned decline portal on a 2m x 2m pacing and horizontally orientated (8 anchors).

Mined ore would be transported from the satellite operations to the Central Processing Plant (CPP) located on the farm Ryst Kuil for processing. Haul roads would connect the pits, waste rock sites and office complex. A haul road through a security access point would lead to the transportation route.

6.1.1.1.2 Drilling

Possible resource expansion is also done through the process of drilling. The description of infill, grade control and resource expansion drilling as applicable to the Ryst Kuil application area is provided in greater detail in Section ii below.

6.1.1.1.3 Infrastructure

Mobile office complex's will be established within the various production areas. Each production areas office complex would include a pre-fabricated/mobile office, change house with septic tank and French drain, bunded areas for 30m^3 diesel storage, oils, hydraulic fluid, emulsion silo, security access, lay-down area, wash bay, maintenance workshop. Chemical toilets would be added at the relevant pit area.

6.2 Composite Map

The applicable infrastructure has been superimposed over the sensitivity maps generated by the specialist team. In the Ryst Kuil application area only the biodiversity, surface and groundwater sensitivity maps are applicable in this case.

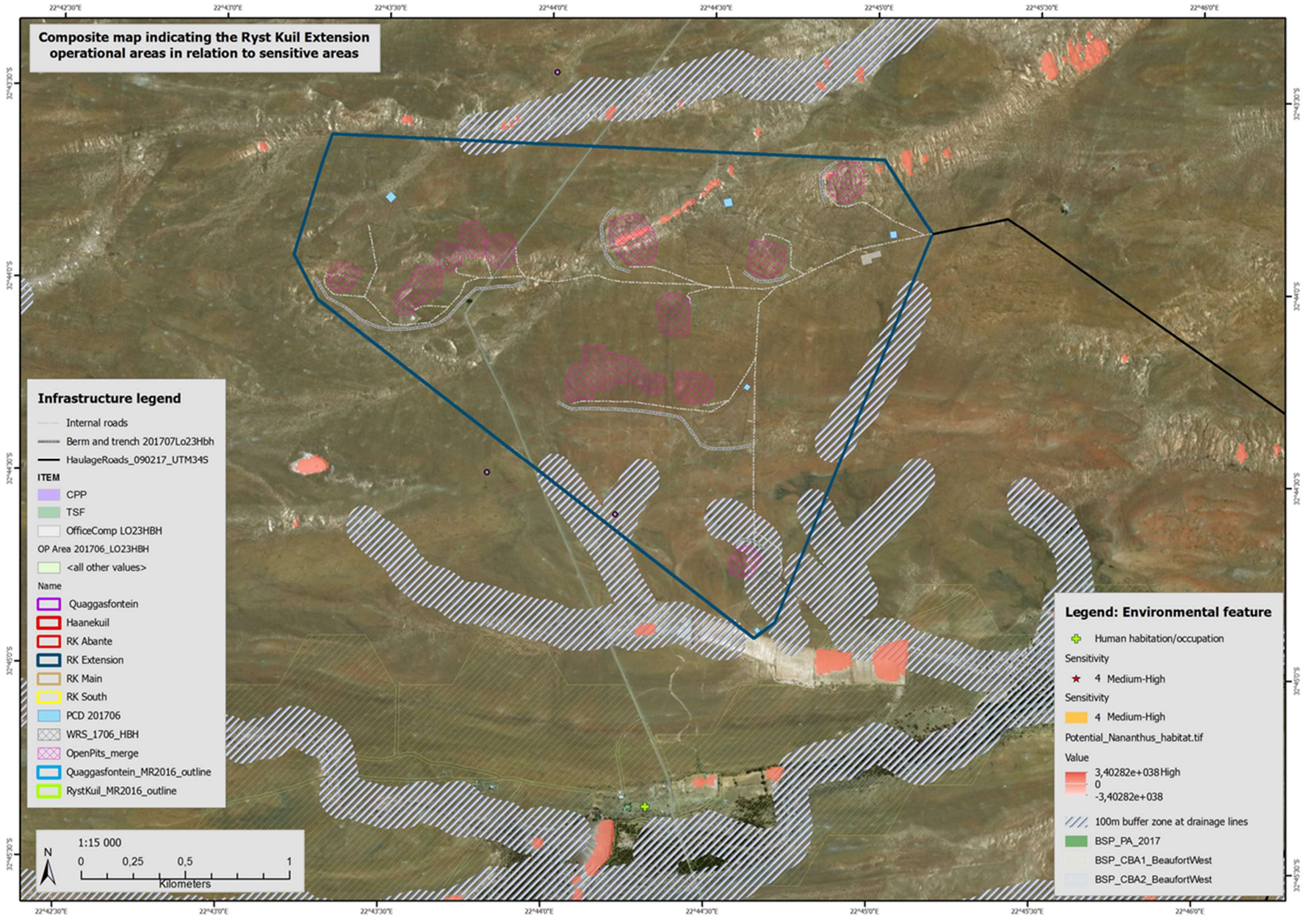


Figure 6-1. Composite plan of the Ryst Kuil Extension operational area in relation to sensitive areas.

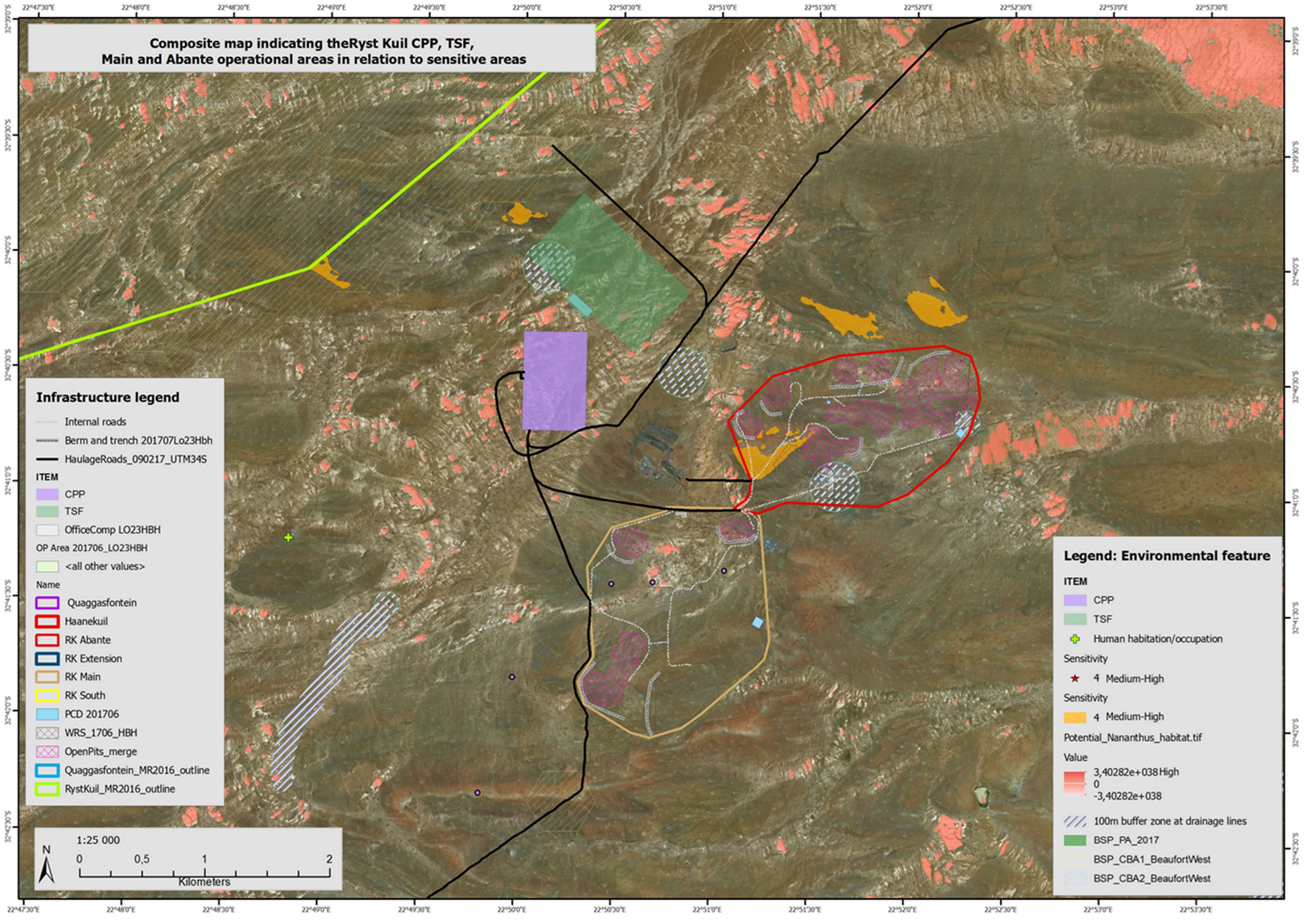


Figure 6-2. Composite plan of the Ryst Kuil Main and Abante operational area in relation to sensitive areas.

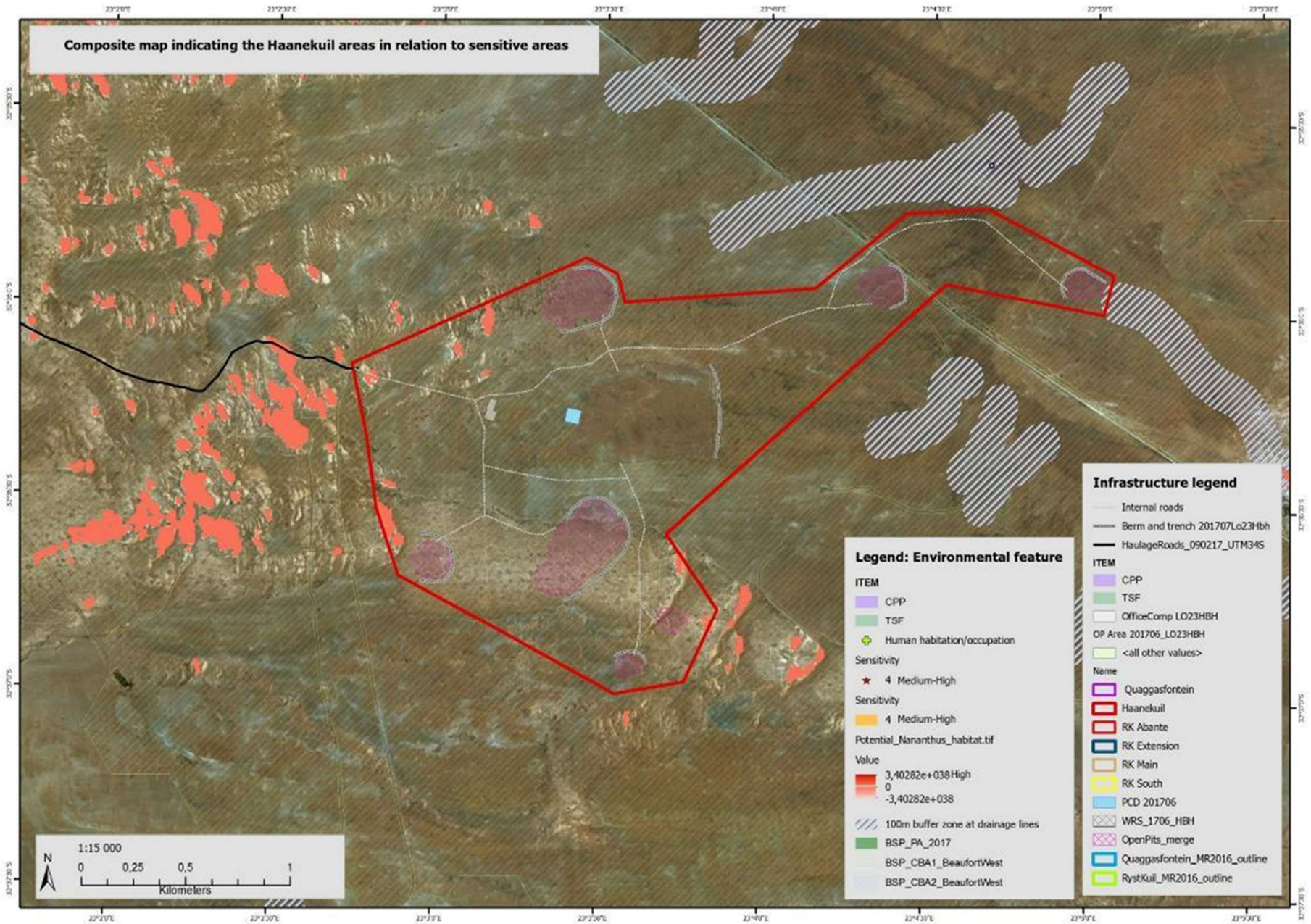


Figure 6-3. Composite plan of the Ryst Kuil Haanekuil operational area in relation to sensitive areas.

6.3 Description of Impact management objectives including management statements

6.3.1 Determination of closure objectives.

6.3.1.1 PRIMARY MINE CLOSURE OBJECTIVE

Objectives: To minimise all impacts of mining on the environment during and after the mine closure and to return the mining environment as close as possible to re-mining conditions taking into consideration the environmental and anthropogenic conditions.

6.3.1.1.1 Geology

The mining of uranium ore is a core function of the mine, thus the geological profile will be impacted upon. No mitigation measures can be implemented. However, all geological impact must be limited to the target mining area only.

6.3.1.1.2 Topography

Objective: To minimise the impacts of mining on the topography.

Specific goals:

- Ensure that the operations have a minimum impact on the topography of the area.
- Ensure that the formation of the waste and ROM stockpile has a minimum impact on the topography of the area.

Technical/Management Option:

The Mine Surveyor will conduct all surveys, and plot all data, timeously, and will, in conjunction with the Mine Manager or his appointed representative, ensure that stockpile heights remain within reasonable limits to reduce view shed impact.

Action plans	**Time schedule**
Ensure that the opening of box cuts has minimum impact on the topography of the area.	
The Mine Surveyor will survey open cast pits, berms, waste rock stockpile.	Monthly for the entire operational phase.
Mine Surveyor will also survey cuts to be constructed.	Prior to the construction of the cut.
Rehabilitation of the pits will be conducted concurrently with mining where possible. This will minimise the size of the void and therefore the volume of waste material being stockpiled.	During the operational phase of the mine.
The Mine Surveyor will survey back-filled cuts to ensure that these are filled and rehabilitated to surface and conform to natural runoff patterns and topography.	After back-filling of each cut during the operational phase of mine.

Ensure that the waste stockpile has minimum impact on topography of the area	
Waste rock (overburden) stockpile area will be surveyed to ensure that stockpiling is carried out at demarcated area.	During operational phase of the mine.
The stockpile will not exceed height of 10 meters.	During operational phase of the mine.

6.3.1.1.3 Air quality

Objective: To minimise the potential impacts on the atmosphere.

Specific goals:

- Ensure that impacts from diesel fumes generated by machinery on the atmosphere is minimised.
- Ensure that impacts from dust generated by wind over impacted surfaces is minimised.
- Ensure that impacts from dust generated by blasting, loading and vehicle and equipment movement is minimised through the use of well managed dust suppression.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that all machinery is maintained and in good repair. The Environmental Co-ordinator will ensure that dust suppression is undertaken as per the prescribed stipulations.

Action plans	**Time schedule**
Ensure that impacts from diesel fumes generated by machinery on the atmosphere is minimised.	
All machinery employed on site will be in good repair, and well maintained.	During construction phase and throughout life of mine.
All machinery will be fitted with the correct exhaust systems, which will be maintained and in good repair.	During construction phase and throughout life of mine.
Dust suppression will be undertaken and dust fall out monitoring must be implemented.	Twice daily throughout life of mine and if necessary frequency will increase.
Ensure that impacts from dust generated by blowing wind on the atmosphere is minimised.	
Dust suppression will be undertaken during the construction phase. Dust suppression will be undertaken by water cart.	Twice daily throughout life of mine and if necessary frequency will increase.
Water for dust suppression purposes will be obtained from the steel rubber lined dam. A chemical bonding agent (surfactant) should be used to minimise repeated wetting and increase the effectiveness of the suppression.	During construction phase and throughout life of mine.
Ensure that impacts from dust generated by blasting on the atmosphere is minimised.	
Blasting holes will be stemmed to ensure that minimal dust is produced.	During construction phase and throughout life of mine.

6.3.1.1.4 Soil

Objective: To minimise the impacts of mining on soil.

Specific goals:

- Ensure that diesel, oil and other hazardous chemical substances (HCS) spillages do not impact significantly on soils.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the mining plan is followed and topsoil and subsoil is utilised as required within the mining area. The ECO will ensure that the maximum amount of topsoil is removed from all areas to be affected, and that the topsoil is stockpiled separately.

Action plans	**Time schedule**
Ensure that diesel, oil & other HCS spillages do not impact significantly on soils.	
Vehicles will not be maintained on unprotected ground.	All the time during the operational phase.
All oil and diesel fluids will be stored on suitably designed protected areas.	All the time during the operational phase.
All diesel spillages must be handled as per recommended oil/diesel spill remediation protocol.	Whenever oil and diesel spillages occur.

6.3.1.1.5 Land capability and use

Objective: To minimise the impacts of mining on land capability and post closure use.

Specific goals:

- Ensure that soil movement does not result in severe reduction of land capability and post closure use.

Technical/Management Option:

The Mine Manager or his appointed representative (ECO) will ensure that the mining plan is followed when top soil stripping and rehabilitation is conducted.

Action plans	**Time schedule**
Ensure that soil movement does not result in severe reduction of land capability and use.	
Ensure full topsoil layer is stripped and stockpiled adequately during construction	ECO - daily
To ensure that the rehabilitated areas are free draining.	After rehabilitated workings are covered with topsoil.

6.3.1.1.6 Flora

Objective: To minimise the impacts of mining on natural vegetation.

Specific goals:

- Ensure all identified species in the biodiversity report that require removal and transplanting for future rehabilitation are treated accordingly. This is especially applicable to the Nananthus species identified in the Nananthus Report of June 2017.
- Containing all access and vehicle/equipment movement with designated footprint areas.
- Ensure that removal of all available top soil during the mining operation has minimum impact on natural vegetation by maintaining a viable seed bank.

Technical/Management Option:

The Mine Manager or the environmental control officer will ensure that daily inspections are carried out over construction and operational areas. A suitably qualified person will be employed to conduct vegetation surveys prior to topsoil stripping.

Action plans	**Time schedule**
Ensure that removal of soil during the mining operation has minimum impact on natural vegetation.	
Plant collection and nursery planting of species identified by botanist for preservation and rehabilitation.	Prior to construction
Identification and eradication of alien / invasive vegetation	During operation and decommissioning
Implementation of Biodiversity action plan	From pre-construction to mine closure
On-site inspections by ECO for compliance with development footprint	Daily
Vegetation cover inspection of rehabilitated land will be conducted.	Monthly during operational and post closure phase of mining.

6.3.1.1.7 Fauna

Objective: To minimise the impacts of mining on the existing fauna.

Action:

- All employees will be instructed that poaching will not be tolerated on the mining area and adjacent farms. Employees transgressing this will be subject to disciplinary action and possible dismissal (within Labour regulations).
- Environmental training will include the importance of avoiding road kill through adequate speed limit control, highlighting areas of elevated faunal activity/crossing and reporting of road kills seen by individuals within the road reserve to the ECO.

Management:

The Mine Manager will ensure that employees are aware and educated regarding the protected animals including those perceived to be dangerous.

Action plans	**Time schedule**
Limit the impact on fauna	
Implementation of Biodiversity action plan	From pre-construction to mine closure
On-site inspections by ECO for compliance with development footprint, road use	Daily
Environmental training: avoid road kill, report the presence of snakes and other endangered or threatened species	During induction and weekly 'tool box' talks
Inspection of fence lines and areas for animal crossing.	Daily during security inspection.

6.3.1.1.8 Surface water

Objective: To minimise the impacts of mining on surface water.

Specific goals:

- Ensure that construction of the pollution control dams and storm water diversion trenches have the least possible impact on the surface water runoff patterns, and thus loss of MAR within the catchments.
- Ensure that the excavation of the box-cut has the least possible impact on the surface water runoff patterns, and thus loss of MAR within all catchments.
- Ensure that all contaminated water is either piped or carried in a lined trench to the PCD.
- Ensure that all runoff from the waste stockpile facility during rainfall events is contained within the lined catchment drains to the PCD.

Technical/Management Option:

- The applicant must appoint a civil engineering team to oversee the construction of the pollution control structures (PCD and Bunding of HCS storage areas) and the storm water collection berms and trenches and all linings.
- The civil engineer will approve and confirm the construction of the pollution control dam, the storm water collection berms and trenches to design specifications.
- Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed.
- The appointed civil engineer will sign off the constructed PCD and the storm water berms/trenches after completion.
- All the design specifications and plans will be submitted to the Department of Water and Sanitation as part of the water use license application. A surveyor will ensure that the PCD, diversion berms/trenches and box-cuts are positioned and constructed according to design specifications.
- The Mine Manger or environmental contractor will ensure that the said structures are constructed and maintained during the operational phase.

Action plans	Time schedule
Ensure that construction of pollution control structures and storm water diversion trenches have the least possible impact on the surface water runoff patterns, and thus loss of MAR within the catchments.	
Storm water diversion trenches/berms will separate clean and dirty water on the mine.	Throughout life of mine.
Construction of pollution control structures, drains and trenches will occur under the supervision of a registered civil engineer, and signed off	Construction
Maintenance and monitoring of the said structures is done on a regular basis.	During construction phase and continued throughout life of mine.

6.3.1.1.9 Surface water quality

Objective: To minimise all potential impacts on surface water quality.

Specific goals:

- Ensure that potential impacts from any spillages on surface water quality are mitigated through correct storage on protected areas.
- Ensure that dirty water captured within the mine, does not interact with clean water within the site boundaries.
- Adequate spill remediation material must be stored on site for immediate action when required.

Technical/Management Option:

The Mine Manager will ensure that the services of a suitably qualified person are utilised for the installation of the diesel tank and oil separator according to supplier design specifications and operated accordingly. The Mine Manager or his appointed representative will ensure that the diversion trenches are constructed timeously, lined adequately and that the water quality monitoring program is initiated.

Action plans	Time schedule
Ensure that impacts from chemical leakages on surface water quality are minimised.	
All filling of machinery will be conducted at the diesel tank area and servicing of all mine equipment will be done on designated areas.	Throughout life of mine
Dirty water from the diesel tank area will be channelled to the oil separator.	Throughout life of mine.
Inspections will be conducted on the operation of the diesel tank and oil separator.	Throughout life of mine.
Ensure that dirty water captured within the mine, does not impact on surface water quality.	
Lined storm water diversion trenches will be constructed to separate clean and dirty water on the mine.	During construction phase.
Any dirty water captured within the box-cut (in-pit sump) will be pumped to the pollution control structures for dust suppression.	Throughout life of mine.

The water quality monitoring program will be initiated.	At least 12 months prior to commencement of the construction phase.
Surface and ground water monitoring points will be sampled during the operational phase.	Surface water on a monthly and ground water on a quarterly basis respectively.

6.3.1.1.10 Groundwater

Objective: To minimise the impacts of mining on groundwater.

Specific goals:

- Ensure that the impacts from lowering of groundwater levels during mining are minimised.
- Ensure that direct monitoring of ground water levels is implemented in appropriately selected monitoring boreholes.
- Ensure that groundwater quality is monitored quarterly with investigation and action (where applicable) into any anomaly.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that water within the pit and underground workings is directed and/or pumped into the pit sump before being pumped into either the steel reservoir dams or the PCD and that the structures are managed properly. Monitoring of the freeboard of the dirty water dams must receive high priority. The Mine Manager or his appointed representative will ensure that the groundwater monitoring programme is implemented, maintained and improved as new long-term data is recorded and interpreted.

Action plans	**Time schedule**
Ensure that impacts from lowering of groundwater levels during mining are minimised.	
The static groundwater levels in all boreholes identified through the hydro-census must be monitored.	On a quarterly basis.
Continuous monitoring of possible major structures of preferred groundwater flow during mining in accordance with geohydrologist guidance.	Throughout the operational phase of mining
Any major structures of preferred groundwater flow such as dykes and fault zones should be grouted if excessive groundwater inflow is encountered.	As soon as the structures are identified
In the event of unacceptable decrease in the yield of any affected boreholes, alternative water supply will be supplied to the affected parties.	Immediately after notice of decrease of yield of borehole.
Ensure that groundwater quality is less affected.	
Regular sampling of chemical analyses of groundwater to establish a management database.	On a quarterly basis.

If borehole is polluted beyond acceptable levels, alternative water to be supplied to the affected party.	During and beyond mining.
Monitoring of radio-nuclides bi-annually	Twice a year

6.3.1.1.11 Sensitive Landscapes

Construction and operational activities will avoid sensitive landscapes outside those authorised within the planned mine and infrastructure footprint. Within these areas all documented mitigation and control methods must be implemented and maintained.

6.3.1.1.12 Noise and vibrations

Objective: To minimise the impacts of noise and vibrations on the health/wellbeing of people and the environment.

Specific goals:

- Ensure that noise impacts on machine operators and/or residences/sensitive receptors proximal to the operations are minimised.

Technical/Management Option:

The Mine Safety Officer will ensure that hearing protection devices are issued and used. The ECO will ensure that any complaints from neighbouring land owners/occupiers are addressed promptly and the nuisance noise is evaluated by a suitably trained individual.

Action plans	**Time schedule**
Ensure that noise impacts on machine operators and/or residences are minimised.	
Machine operators will be issued with earplugs, and instructed on how to use them.	During construction phase and throughout life of mine.

6.3.1.1.13 Visual Aspects

Objective: To reduce the impacts on the overall visual and aesthetics of the area surrounding and within the proposed mining area to residences and landowners.

Specific goals:

- Ensure that dust generated by wind and movement of machinery is minimised to have minimum visual impacts.
- Elevation of overburden / waste rock stockpiles should be maintained in accordance with the design specifications as presented in the view shed analysis to minimise view shed impact.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the dust suppression program is initiated and kept up to date, that the LDV's and trucks obey the 40km/hr speed limits. All stockpiles will be maintained at required heights or lower.

Action plans	**Time schedule**
Ensure that dust generated by wind and movement of machinery is minimised.	
Dust suppression will be conducted on all haul roads and stockpiling areas where movement of machinery takes place.	Whenever is necessary.
All trucks transporting material on the proposed mining area will be required to obey a maximum 40km/h speed limit.	At any time during the construction phase of the mine.
The mine will adopt a clean-house policy. All stockpiles will be maintained at specified heights to reduce visual impact.	During operational phase and throughout life of mine.
Ensure that visual impacts from any mine infrastructure minimised	
Elevation of overburden / waste rock stockpiles should be maintained below 20m to reduce view shed impact.	During operational phase.

6.3.1.1.14 Socio-economic impacts

Objective: To maximise the positive impacts from the proposed mining while minimising potential negative impacts.

Specific goals:

- Maintain cordial relationships with all identified Interested and Affected parties.
- Ensure that visual, noise and dust impacts on surrounding landowners is minimised.
- Ensure that influx of labourers seeking employment is responsibly managed. It should be noted the Mining administrative office would be situated in Beaufort West.
- Ensure good communication with communities regarding the needs of the operation from small businesses and other potential service providers.
- Implementation of Social and Labour plan commitments
- Appointment of local people as employees as far as possible
- Focussed skills development resulting in portable skills
- Transferring employees between the various mining areas as the mining operations move from one area to another
- Establish employee forum.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all necessary measures are implemented to ensure that adequate communication takes place between the mine, land owners and communities.

Action plans	**Time schedule**

Ensure that visual and noise impacts on surrounding landowners is minimised.	
Implement adequate external communication plan. Maintenance of this plan.	During all phases of the life of mine.
Monitoring and reporting on SLP requirements	Annually
Local procurement as far as possible	Life of mine

6.3.1.1.15 Interested and Affected Parties

Objective: To minimise the negative impacts of construction on all Interested and Affected Parties.

Specific goals:

- Maintain cordial relationships with all identified Interested and Affected parties.
- Ensure that water, noise and dust impacts on surrounding landowners is minimised.
- Ensure that influx of labourers seeking employment is responsibly managed.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all machineries are maintained in good working order. The Mine Manger or his appointed representative will ensure that no labourers are housed on the mine premises. The Mine Manager or his appointed representative will attend all I&AP's forum meetings.

Action plans	**Time schedule**
Ensure that noise impacts on surrounding landowners is minimised.	
Noise levels will be reduced by maintaining all machinery in good repair.	During operational phase and throughout life of mine.
Ensure that influx of labourers seeking employment is reduced.	
The Mine will utilise people from the surrounding areas as far as possible, to minimise the influx of illegal labourers.	During operational phase and throughout life of mine.
No squatters will be allowed on the property.	During operational phase and throughout life of mine.
Maintain cordial relationships with all identified Interested and Affected Parties.	
Mine management will maintain an open-door policy, and adhere to management measures highlighted in the Environmental Management Program.	During operational phase and throughout life of mine.
The Mine Manager or his appointed representative will ensure that all monitoring programs are kept up to date, and that reports are submitted regularly and timeously.	During operational phase and throughout the life of mine.
An Interested and Affected Parties Forum will be established. Minutes of all meetings will be taken. These Minutes will include a record of all parties in attendance. All concerns raised during the forum meeting will be recorded and addressed.	Forum will convene every six months throughout life of mine.

Adjacent landowners within the identified potential affected area, which show decreased borehole yields resulting from this mining venture, will be compensated.	Groundwater levels will be monitored quarterly.
A complaint register should be available at security access and at the mine office. All complaints should be recorded and investigated. Feedback to the complainant should be given timeously. Record of all communication should be kept.	Life of Mine.

6.3.2 The process for managing any environmental damage, pollution, pumping and treatment of extraneous water or ecological degradation because of undertaking a listed activity.

6.3.2.1.1 Geology

The mining of uranium ore is a core function of the mine, thus the geological profile will be impacted upon. No mitigation measures can be implemented. However, all geological impact must be limited to the target mining area only.

The mine geologist must develop and implement a fossil find protocol (report to recognised South African Paleontological reseach centre and approved by HWC)

Should any significant changes to the mine layout occur the new design is to be assessed by a heritage practisioner and should an impact to the archeological and heritage resources on site be evident HWC should be informed thereof.

6.3.2.1.2 Topography

Objective: To minimise the impacts of mining on the topography.

Specific goals:

- Ensure that the operations have a minimum impact on the topography of the area.
- Ensure that the formation of the waste and ROM stockpile has a minimum impact on the topography of the area.

Technical/Management Option:

The Mine Surveyor will conduct all surveys, and plot all data, timeously, and will, in conjunction with the Mine Manager or his appointed representative, ensure that stockpile heights remain within planned limits to reduce view shed impact.

6.3.2.1.3 Air quality

Objective: To minimise the potential impacts on the atmosphere.

Specific goals:

- Ensure that impacts from diesel fumes generated by machinery on the atmosphere is minimised.
- Ensure that impacts from dust generated by wind is minimised.
- Ensure that impacts from dust generated by blasting and vehicle and equipment movement is minimised.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that all machinery are maintained and in good repair. The Environmental Co-ordinator will ensure that dust suppression is undertaken as per the prescribed stipulations.

6.3.2.1.4 Soil

Objective: To minimise the impacts of mining on soil.

Specific goals:

- Ensure that diesel, oil and other hazardous chemical substances (HCS) spillages do not impact significantly on soils.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the mining plan is followed and topsoil and subsoil is utilised as required within the mining area. The ECO will ensure that the maximum amount of topsoil is removed from all areas to be affected, and that the topsoil is stockpiled separately.

6.3.2.1.5 Land capability and use

Objective: To minimise the impacts of mining on land capability and post closure use.

Specific goals:

- Ensure that soil movement does not result in severe reduction of land capability and post closure use.

Technical/Management Option:

The Mine Manager or his appointed representative (ECO) will ensure that the mining plan is followed when top soil stripping and rehabilitation is conducted.

6.3.2.1.6 Flora

Objective: To minimise the impacts of mining on natural vegetation.

Specific goals:

- Ensure all identified species in the biodiversity report that require removal and transplanting for future rehabilitation are treated accordingly. This is especially important for the Nanathus species.
- Containing all access and vehicle/equipment movement with designated footprint areas.
- Ensure that removal of soil during the mining operation has minimum impact on natural vegetation by maintaining a viable seed bank.

Technical/Management Option:

The Mine Manager or the environmental control officer will ensure that daily inspections are carried out over construction and operational areas. A suitably qualified person will be employed to conduct vegetation surveys prior to topsoil stripping.

6.3.2.1.7 Fauna

Objective: To minimise the impacts of mining on the existing fauna.

Action:

- All employees will be instructed that poaching will not be tolerated on the mining area and adjacent farms. Employees transgressing this will be subject to disciplinary action and possible dismissal (within Labour regulations).
- Environmental training will include the importance of avoiding road kill through adequate speed limit control and reporting individual siting within the road reserve to the ECO.

Management:

The Mine Manager will ensure that employees are aware and educated regarding the protected animals including those perceived to be dangerous.

6.3.2.1.8 Surface water

Objective: To minimise the impacts of mining on surface water.

Specific goals:

- Ensure that construction of the pollution control dam and storm water diversion trenches have the least possible impact on the surface water runoff patterns, and thus loss of MAR within the catchments.
- Ensure that the excavation of the box-cut has the least possible impact on the surface water runoff patterns, and thus loss of MAR within all catchments.
- Ensure that all contaminated water is either piped or carried in a lined trench to the PCD.
- Ensure that all runoff from the tailings facility during rainfall events is contained within the lined catchment drains to the PCD.
- Provide for emergency lined overflow and containment dam for the PCD.

Technical/Management Option:

The applicant must appoint a civil engineering team to oversee the construction of the pollution control structures and the storm water collection berms and trenches and all lining. The civil engineer will approve and confirm the construction of the pollution control dam, the storm water collection berms and trenches to design specifications. Before a box-cut can be excavated the evaporation dam, storm water berms and trenches must have been constructed. A Geotechnical survey will be conducted on the soil and the results of the survey will be utilised to select appropriate material to be used during rehabilitation and construction. The appointed civil engineer will sign off the constructed settling dam and the storm water berms/trenches after completion. All the design specifications and plans will be submitted to the Department of Water and Sanitation. A surveyor will

ensure that the PCD, diversion berms/trenches and box-cuts are positioned and constructed according to design specifications. The Mine Manger or environmental contractor will ensure that the said structures are constructed and maintained during the operational phase.

6.3.2.1.9 Surface water quality

Objective: To minimise all potential impacts on surface water quality.

Specific goals:

- Ensure that potential impacts from chemical leakages on surface water quality are mitigated through correct storage on protected areas.
- Ensure that dirty water captured within the mine, does not interact with clean water within the site boundaries.
- Adequate spill remediation material must be stored on site for immediate action when required.

Technical/Management Option:

The Mine Manager will ensure that services of a suitably qualified person is utilised for the installation of the diesel tank and oil separator according to supplier design specifications and operated accordingly. The Mine Manager or his appointed representative will ensure that the diversion trenches are constructed timeously, lined adequately and that the water quality monitoring program is initiated.

Objective: Safe disposal of tailings to prevent or minimize the impact on surface and ground water.

Specific goals:

The TSF is located outside of the following influence zones (as per the MPRDA CI 73 and SANS 20286 Code of Practice) thus:

- The TSF is outside of 125 m from the plant;
- The plant (and mining infrastructure, as well as mining areas) are located outside of:
    - 125m (= 5 x TSF wall height) in an upslope direction;
    - 250m (= 10 x TSF wall height) perpendicular to the natural ground slope; and
    - 2,500m (= 100 x TSF wall height) in a downslope direction.
- The zone of influence described by the above three bullet points does not impact on the Critical Biodiversity Areas (CBAs).

The preliminary design in this report has been executed based on the design basis in Figure 5-5, and the following in particular:

It is confirmed that the tailings (waste) has a Type 3 waste classification and that the TSF design will therefore be a Class C Landfill, requiring a composite clay / HDPE lining system as indicated in Figure 5-5, with the following pertinent comments:

- Tailings ‘leachate’ will not be collected and the leachate collection system is ignored;
- The upper liner is a 1500-micron HDPE liner as required;

- There is no clay material on the site, and the proposed 600 mm clay liner is replaced with an HDPE (1000 micron) liner;
- The leakage detection system between the two HDPE liners, along with a separation/leakage detection sand layer, will ensure that leaks are detected and addressed.
- It has been shown that the waste rock marginally classifies as a Type 3 waste, but that a risk based approach could be taken to declassify this as a type 4 waste not requiring an underliner – this assumption holds for this TSF scoping exercise and no underliner has been considered for the tailings impoundment walls to be constructed from waste rock;
- It is proposed that the TSF be developed in a phased manner for the following reasons:
    - Design optimisation may be required during the project lifetime, and phasing allows design changes to be implemented for the latter phase;
    - It may prove technically feasible that tailings can be stored in-pit or underground as the project develops, and phasing will allow a change in tailings disposal strategy should this become feasible;
    - It is assumed that dust control will be a challenging operational issue and two smaller TSF facilities will make dust control easier as it is possible to keep the surface of the tailings material wet at all times on a smaller facility;
    - Challenges may exist in the closing of the TSF facilities, and smaller impoundments will be easier to gain access to for closure;
    - Abutting phases can share a return water dam (RWD) facility.
- The TSF site setting is such that protection layers will be required under the first HDPE liners for the following reasons:
    - The receiving natural ground is littered with angular sedimentary rock fragments that will damage the liner;
    - The TSF embankments will be constructed with angular sedimentary rock fragments that will damage the liner;
    - To maintain the integrity of the HDPE lining components, it has been assumed that waste mudrock produced form the open pit operations can be broken down (pulverised) into an effective (reconstituted) protection material and the design (and costing) assumes this;
    - As a final safeguard to the liner integrity, it is assumed that a geofabric protection layer will be required between the mudrock protection layer and the first HDPE liner.

6.3.2.1.10 Groundwater

Objective: To minimise the impacts of mining on groundwater.

Specific goals:

- Ensure that the impacts from lowering of groundwater levels during mining are minimised.
- Ensure that direct monitoring of ground water levels is implemented in appropriately selected monitoring bore holes.
- Ensure that groundwater quality is monitored monthly with investigation and action (where applicable) into any anomaly.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that water within the pit working is pumped into the sump before being pumped into either the reservoir dams or the PCD and that the structures are managed properly. The Mine Manager or his appointed representative will ensure that the groundwater monitoring programme is implemented, maintained and improved as new long-term data is recorded and interpreted.

Sensitive Landscapes

Construction and operational activities will avoid sensitive landscapes outside those authorised within the planned mine and infrastructure footprint. Within these areas all documented mitigation and control methods must be implemented and maintained.

6.3.2.1.11 Noise and vibrations

Objective: To minimise the impacts of noise and vibrations on the health of people and the environment.

Specific goals:

- Ensure that noise impacts on machine operators and/or residences are minimised.

Technical/Management Option:

The Mine Safety Officer will ensure that hearing protection devices are issued and used.

6.3.2.1.12 Visual Aspects

Objective: To reduce the impacts on the overall visual and aesthetics of the area surrounding and within the proposed operational areas to residences and landowners.

Specific goals:

- Ensure that dust generated by wind and movement of machinery is minimised to have minimum visual impacts.
- Elevation of overburden and ROM stockpiles should be maintained below 10m to reduce view shed impact.

Technical/Management Option:

The Mine Manager or his appointed representative will ensure that the dust suppression program is initiated and kept up to date, that the transport companies obey the speed limits, and that the clean-house policy is maintained. All stockpiles will be maintained at required heights.

6.3.2.1.13 Radiation

Objective: To minimize the potential of radiation exposure above the existing background levels and to maintain such exposure well within the limits set by the NNR for the LRP.

Specific goal: Effective controls include:

- dust control,
- Ventilation of underground operations,
- access control to the site; and
- safe transport of ore in accordance with the International Atomic Energy Agency regulations

Technical/Management Option:

Dust suppression and fall out monitoring and reporting. Ventilation maintenance and monitoring. Radon gas monitoring. Compliance with site access policy criteria. Monitoring and reporting of ore transport compliance.

6.3.2.1.14 Socio-economic impacts

Objective: To maximise the positive impacts from the proposed mining while minimising potential negative impacts.

Specific goals:

- Maintain cordial relationships with all identified Interested and Affected parties.
- Ensure that noise and dust impacts on surrounding landowners is minimised.
- Ensure that influx of labourers seeking employment is reduced.
- Ensure good communication with communities regarding the needs of the operation from small businesses and other potential service providers.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all necessary measures are implemented to ensure that adequate communication takes place between the mine, land owners and communities.

6.3.2.1.15 Interested and Affected Parties

Objective: To minimise the negative impacts of the LRP on all Interested and Affected Parties.

Specific goals:

- Maintain cordial relationships with all identified Interested and Affected parties.
- Ensure that noise and dust impacts on surrounding landowners is minimised.
- Ensure that influx of labourers seeking employment is reduced.

Technical/Management Option:

The Mine Manager or his appointed representative would ensure that all machineries are maintained in good working order. The Mine Manger or his appointed representative will ensure that no labourers are house on the mine premises. The Mine Manager or his appointed representative will attend all I&AP's forum meetings.

6.3.3 Potential risk of Acid Mine Drainage

The water quality monitoring results of the groundwater of the broader Ryst Kuil area show slightly elevated SO_4 concentrations (120 to 370 mg/L). These enhanced values are likely derived from the oxidation of pyrite that occurs rarely in the argillaceous rocks and in the joint network. However, the concentration of the pyrite is not high enough to pose any serious threat of the development of acid mine drainage. Thus, the potential risk associated with acid mine drainage is low. Other sources relating to the elevated SO_4 concentrations are the dissolution of gypsum and / or anhydrite which in turn, is associated with evaporates in the area (SRK, 1979). Furthermore, a result of incorporation of salts from evaporated surface water into the next recharge cycle, which is a common feature of arid areas.

The Total Acid Potential (TAP) was below 0.31 kg $CaCO_3$/t for all waste rock lithology's. The neutralisation potential of the waste rock lithology's ranges between 0.3 and 33.1 kg $CaCO_3$/t, resulting in NNP between -0.1 and 32.8 kg $CaCO_3$/t.

The Acid Rock Drainage (ARD) potential of the waste rock samples was evaluated using the commonly applied criteria indicated in the Prediction Manual for Drainage Chemistry from sulfidic geological materials (MEND Report 1.20.1, 2009). The criteria have been graphically represented in Figure 4-23 (of the Ground Water Report) and shows that with the exception of sample SRK8607 (Ryst Kuil Main Extension sandstone), all waste rock samples are classified as non-acid generating. The ARD potential of sample SRK8607 is potentially acid generating due to the low NP (0.26 kg $CaCO_3$/t) being lower than the detection limit for total sulphur in the sample.

Based on this data no AMD generation is expected.

6.3.4 Steps taken to investigate, assess, and evaluate the impact of acid mine drainage.

The steps that are taken to investigate, assess and evaluate the impact of acid mine drainage will be focussed within the regular monitoring of groundwater at the boreholes indicate in Appendix 11 of this report.

6.3.5 Engineering or mine design solutions to be implemented to avoid pollution or remedy acid mine drainage.

Geochemical assessment of waste rock from mining at Ryst Kuil was analysed and proved to be non-acid generating. However, Engineering and mine design options to minimize the impact of acid mine drainage will include the prevention of mine water emanating from surface workings to accumulate in unwanted areas. Ponding of water on haul roads and other operational areas should be prevented. A zero-release policy would be implemented. Thus, no water from operating areas would be released to the environment.

Designed pollution control solution:

- Floor of Waste rock stockpile – compacted layer works of 150mm G6 at 95% AASTHO and 150mm G7 at 93% AASTHO. Base layer insitu ripped and compacted to 93% AASTHO.
- Tailings Storage Facility (TSF) – double HDPE lined, as clay is not available in the area, with a leak detection system incorporated
- Pollution control dam – HDPE lined
- Storm water drains and trenches – 100mm concrete lined

- Maintenance workshop – concrete lined
- Vehicle and equipment wash bay – concrete lined
- Bunded chemicals and hydrocarbon storage area – reinforced concrete construction
- Sewage management system (septic tank and French drain at Abante, South, Haanekuil, Extension with package sewage plant at CPP and Main)

6.3.6 Measures that will be put in place to remedy any residual or cumulative impact that may result from acid mine drainage or other projects and activities in the area.

It is anticipated that the controls provided for ground and surface water contamination will adequately mitigate the potential risk of residual or cumulative impacts of AMD. However, should regular monitoring data demonstrate that AMD concentrations are increasing in specific locations, appropriate remediation action will be implemented by the applicant. There are no neighbouring/existing operations in the area that can be seen as cumulative from a AMD perspective.

All activities at the mine would be manage in such a way to minimize any impact on the environment. Mitigation measures as described in this document would be implemented. The result of the mitigation measures would be verified through monitoring as per the monitoring programme.

6.3.7 Volumes and rate of water use required for the mining, trenching or bulk sampling operation.

The ground and surface water balance has been calculated for each operational mining area with the Ryst Kuil mining right application area. The principles and assumptions utilised for the water balance calculations are as follows:

- Water protection and conservation is primary to water balance determination. Wherever water can be conserved and evaporation or other losses can be reduced such interventions should be implemented by the mining right holder.
- Pit and underground make water
  Make water within the pits has been calculated based on the SRK groundwater report for each individual operational area. The lower envelope (Table 4-84) flow rate has been utilised in the water balance calculations and a 0,75 factor has been applied to account for evaporation of water from the high walls and benches which reduces the amount of water that reaches each pit sump.
  Note: The upper envelope has not been used for water balance determination since the process of grouting high yielding fractures in the pits and underground is anticipated to reduce the pit and underground make water to within the lower envelope range. This is further motivated by the drive to minimise water consumption by mining operations.
- The water balances assume no grouting of high yielding areas. Where grouting is implemented during the construction and/or operational phase the water balance will be adjusted accordingly.
- Bowsers capacity for dust suppression has been set at 23m³/load based on current mine dust suppression experience.
- A rubber lined steel dam capacity for dirty water storage is set at 1 900m³. A commercially available steel dam design and size/volume was selected. A larger capacity steel dam could be used by the mine

operator. Where the storage capacity within the steel dam exceeded 120,000m³ per annum then 2 steel dams was planned.

- At Haanekuil the criteria selected for irrigation was based on a commercially available 400m centre-pivot irrigating 50ha with 4mm of water per day which would utilise 2ML/day.
- Surface storm water make within the open pits was calculated based on each pit surface area and a 1:50 year storm event (i.e. 95mm).
- Surface evaporation for the study area is 2250mm/a which is based on an actual average over 30 years.

The water balances for each Ryst Kuil operational area and the CPP is provided below.

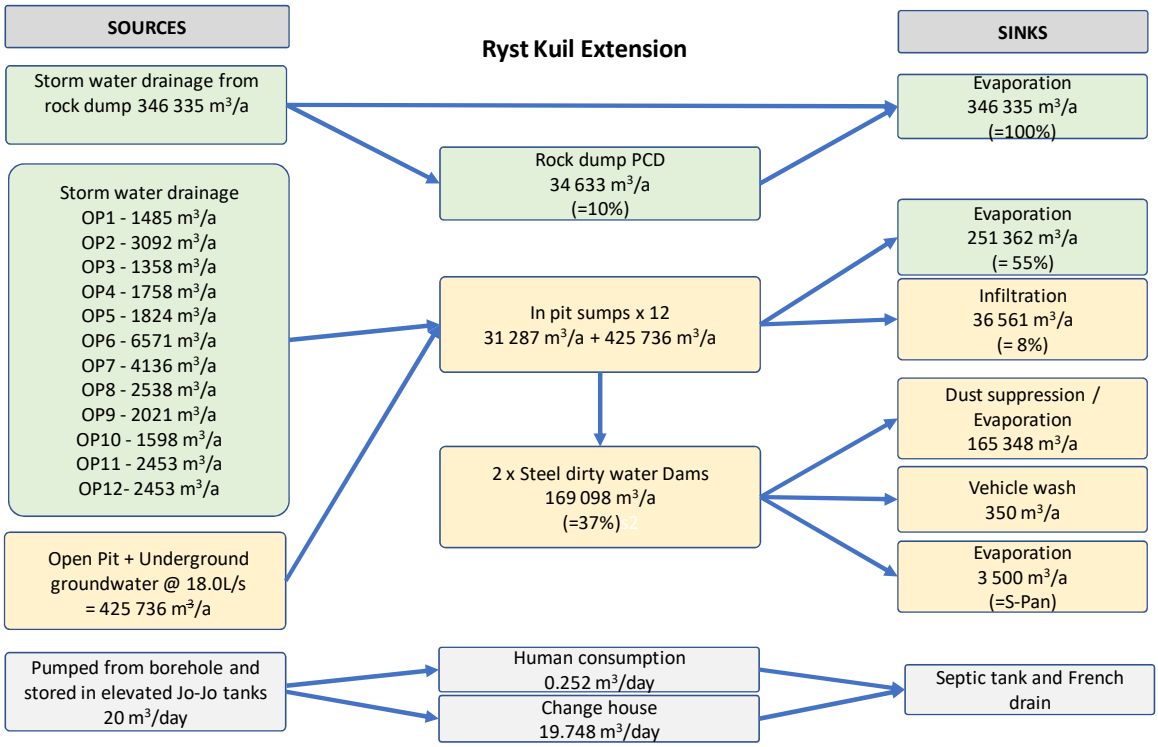


Figure 6-4. The anticipated Ryst Kuil Extension water balance.

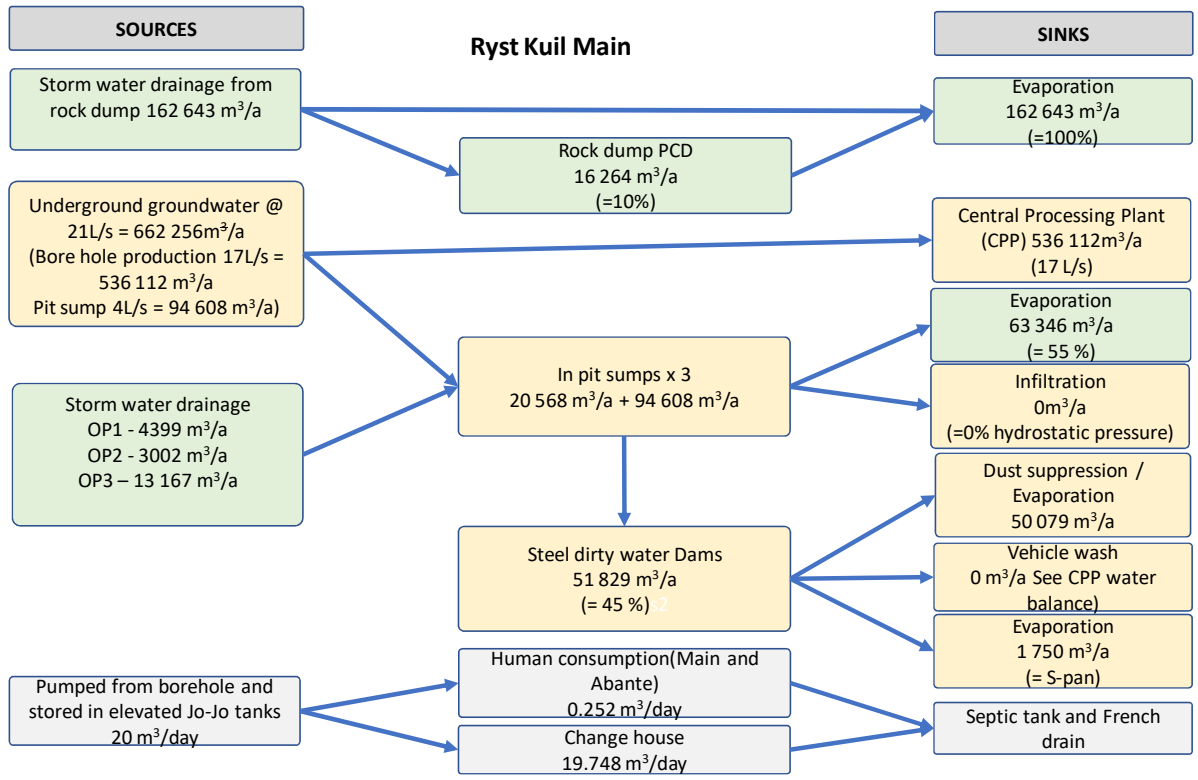


Figure 6-5. The anticipated Ryst Kuil Main water balance.

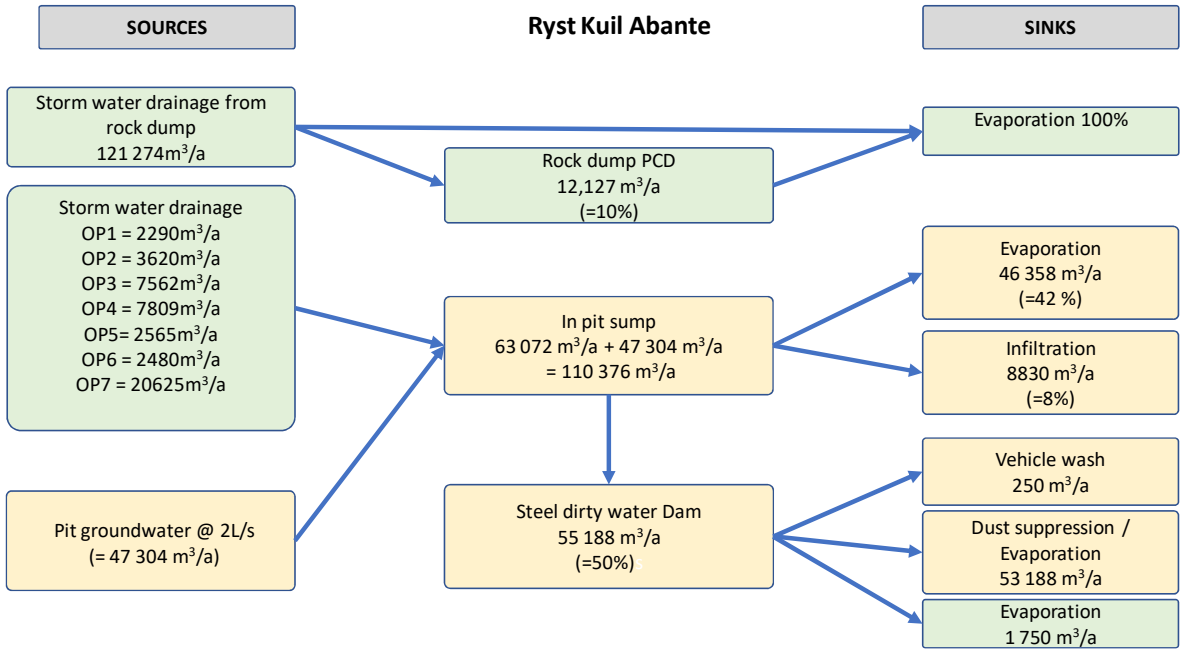


Figure 6-6. The anticipated Ryst Kuil Abante water balance.

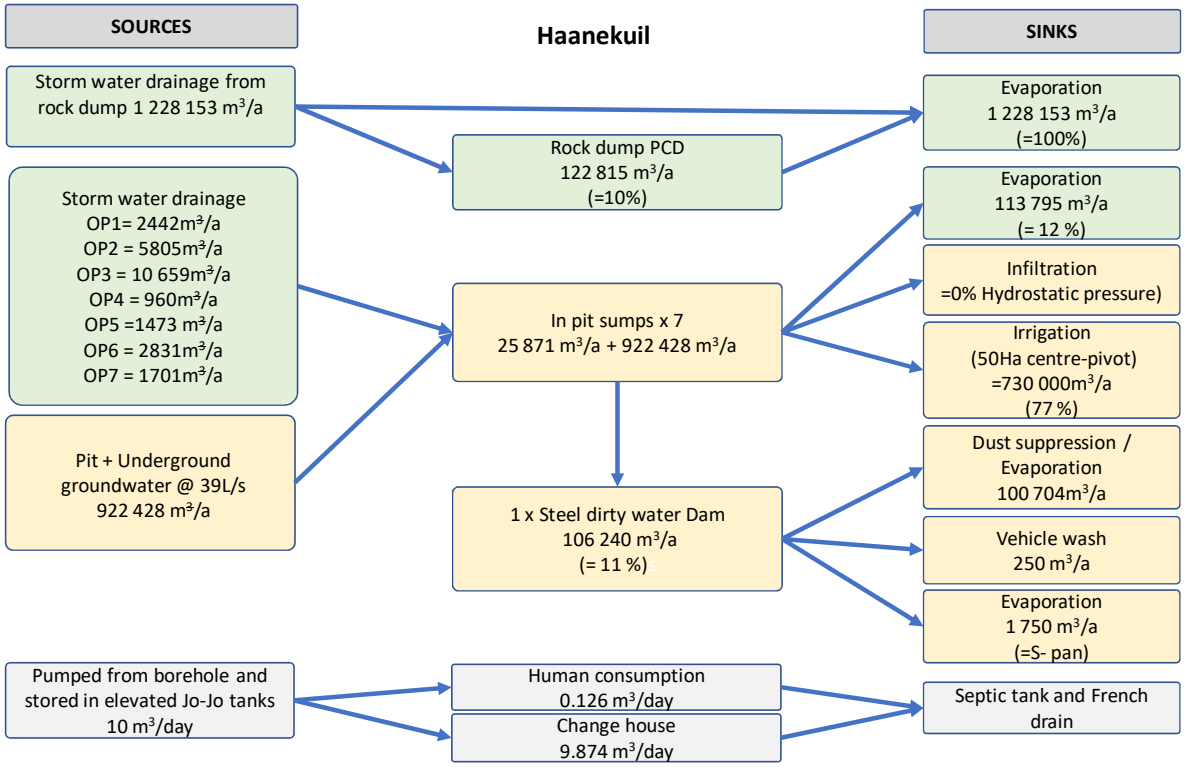


Figure 6-7. The anticipated Haanekuil water balance.

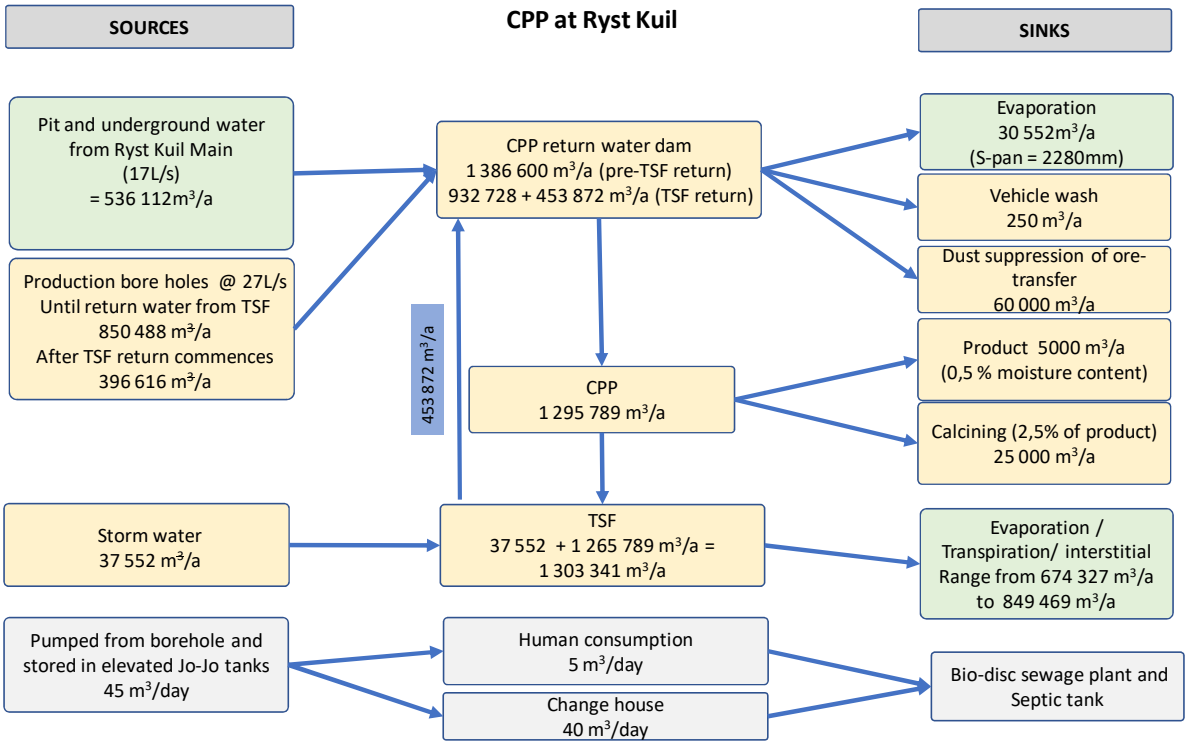


Figure 6-8. The anticipated CPP water balance.

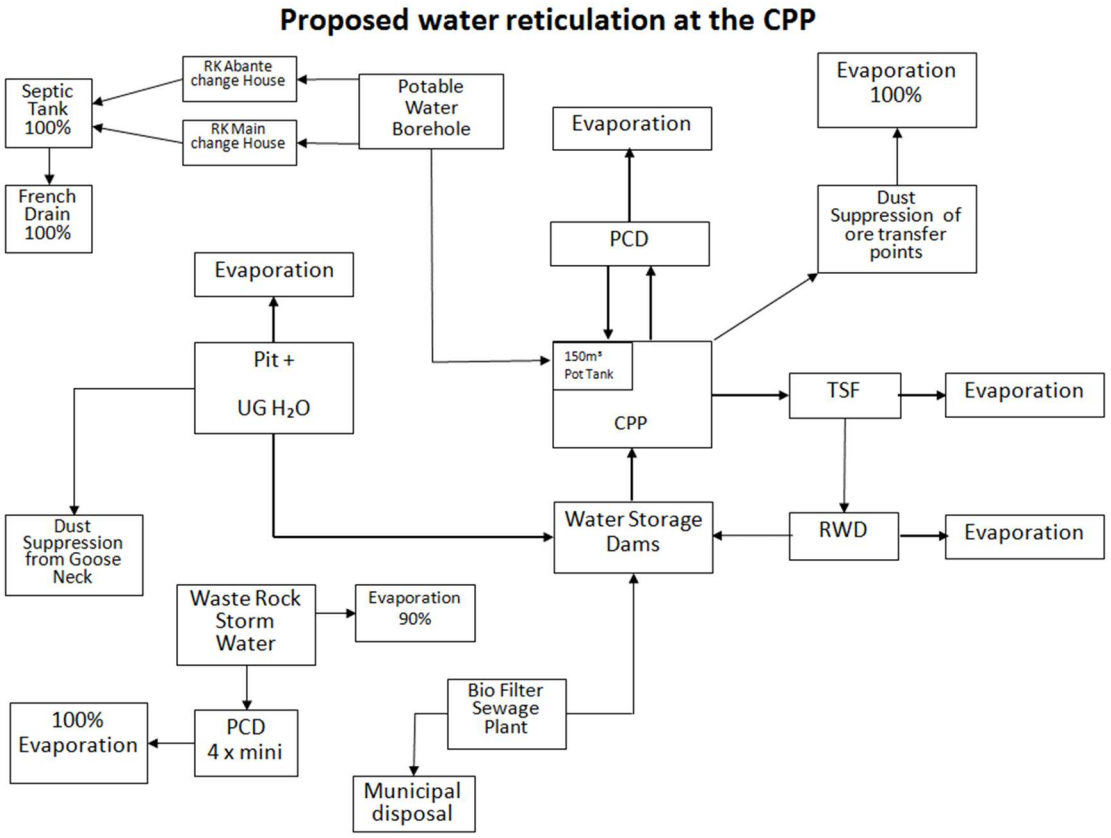


Figure 6-9. A schematic of the anticipated CPP water reticulation.

As indicated in the CPP water reticulation schematic above, compensation for those bore holes affected with ≥5m are referenced. The estimated volume of water compensation per annum has been recommended by the ground water specialist team.

Table 6-1. Boreholes likely to be affected by >5 m drawdown in Ryst Kuil sub-areas (9.25 years of mining)

Borehole no. (2016 hydrocensus)	Farm name	Potential drawdown (m)*	Depth** (m)	Estimated yield# (m^3/a)	Estimated decrease in yield## (%)	Approximate compensation volume (m^3/a)
KGT16	Klipkrans	5		800	10	80
ERW4	Eerste Water (Rooikop)	5		800	10	80
KPS1	Klip Stavels	5		600	10	60
KPS6	Klip Stavels	50		(700)	100	700
KKL001	Kant Kraal	15		17 500	60	10 500
KKL002	Kant Kraal	15		17 500	60	10 500
KKL004	Kant Kraal	20		(700)	80	560
KKL006	Kant Kraal	15		600	60	360
KKL011	Kant Kraal	5		(700)	10	80
KDK018	Kat Doorn Kuil	8		700	15	100
ERW2	Eerste Water (Rooikop)	15	40	1 100	100	1 100

KPS3	Klip Stavels	12		600	50	120
RSK9	Ryst Kuil	30		800	90	400
RSK10	Ryst Kuil	25		800	80	640
KPS5	Klip Stavels	25		600	80	480
KDK0013	Kat Doorn Kuil	13		700	50	350
KDK0010	Kat Doorn Kuil	20		700	80	560
KDK16/4	Kat Doorn Kuil	20		700	80	560
KDK16/3	Kat Doorn Kuil	10		600	50	300
KDK16/7	Kat Doorn Kuil	Mined-out		(700)	100	700
KKL16/4	Kant Kraal	20		(700)	80	560
KKR333	Kant Kraal	Mined-out		(700)	100	600
KKL16/8	Kant Kraal	Mined-out		600	100	600
KKL16/7	Kant Kraal	Mined-out		(700)	100	600
					TOTAL (L/s)	**1.00**

*Natural water levels assumed to be c.25 m below ground surface.
**Average borehole depth of 60 m assumed (mostly unknown).
Based on windpump cylinder sizes or table average (700), and two on area irrigated.
##Decreases in yield should be gradual and mostly after about 1-5 years of mining except with boreholes within specific mine areas.
If all boreholes become 'dry'/unusable, the total compensation amounts to *c*.1.65 L/s.

6.3.8 Has a water use licence has been applied for?

The process for a Water Use License Application (WULA) under Section 21 of the National Water Act has been initiated through the pre-application engagement with the DWS.

6.3.9 Impacts to be mitigated in their respective phases

Measures to rehabilitate the environment affected by the undertaking of any listed activity

ACTIVITIES	PHASE	SIZE AND SCALE	MITIGATION MEASURES	COMPLIANCE WITH STANDARDS	TIME PERIOD FOR IMPLEMENTATION
Indigenous vegetation clearance all sites	Construction Phase	Abante ~ 80ha Main ~ 160ha CPP & TSF ~ 119 ha Extension ~ 70ha Haanekuil ~ 28ha Roads ~ 35ha	Removal of identified species of conservation concern with nursery establishment. Only removal of top soils within demarcated operational areas.	National Environmental Management Biodiversity Act (Act 10 of 2004)	Prior to initiation of topsoil removal. Oversight by ECO during topsoil removal.
Transportation road	Construction, Operational, decommissioning and post closure phases	~ 51ha	• Road closures and speed limitation. • The construction of artificial nesting sites may prohibit them from needing to cross the road. • For snakes, artificial hibernacula can also be constructed to reduce distance travelled and the chances of road mortality. • Constructing alternative ways of crossing the road can be more successful, culverts that pass under roads can allow for safe passage. • Barriers along the road are also constructed to guide animals to the culverts. • For larger animals, wildlife overpasses will be used to allow crossing. Appropriate design of crossings depends on the specific target species and will likely vary across different geographical regions. Research can provide the insight needed to construct wildlife crossings that facilitate passage over roads and eliminate some of the negative consequences of roads on wildlife.	Department of Transport, Guidelines for Traffic Impact Studies, Report No. PR 93/645, Pretoria, 1995. National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	Implementation throughout the Life of Mine

			Soil and Water Identify the most serious problems by assessing road systems at watershed scale, followed by field reconnaissance. Give extensive thought to road routes, road design, drainage, and road-stream crossings such as culverts and bridges. Relocate or realign roads to improve degraded riparian areas. Use appropriate construction, upgrading, and maintenance methods to manage drainage and minimize erosion and sedimentation. Construct lead-out ditches and rock aprons to disperse water-flow energy and reduce erosion. Restrict traffic (perhaps during the wet season) or close roads to manage sediment runoff. After road construction, seed, mulch, terrace, or combine treatments to control erosion. Plant native plants to help control invasive alien plants. Adequate storm water management must be planned for. The respective institutions should include green technologies in their designs. Ensure effective storm water management will be exercised to limit negative impacts on the environment and enhance the positive impacts, and ensure catering for the hydraulic needs of the development while		

			minimizing the associated negative environmental impacts. Ensure storm water management planning allows for the opportunity to conserve water and make it available to the public for beneficial use. Ensure the planning undertaken by engineers appointed takes cognizance of the responsibility to preserve the natural environment. Air quality Dust suppression measures need to be implemented on site to reduce the liberation of dust. It is recommended that water and dust-a-side, or similar coagulating chemical, be sprayed on the road when and where applicable. There should be strict speed limits on dusty roads to prevent the liberation of dust into the atmosphere. Adequate communication and education of personnel of the need to mitigate against dust. Spillages Provide proper warning signage to make people aware of the activities within designated areas. Employees should be provided with absorbent spill kits and disposal containers to handle spillages. Train employees and contractors on the correct handling of spillages and precautionary measures that need to be		

			implemented to minimize potential spillages. All earth moving vehicles and equipment must be regularly maintained to ensure their integrity and reliability. No repairs may be undertaken beyond the contractor laydown area. Employees should record and report any spillages to the responsible person. An Emergency Preparedness and Response Plan will be developed and implemented should an incident occur. Access to storage areas on site must be restricted to authorized employees only. Contractors will be held liable for any environmental damages caused by spillages. Radiation control In accordance with COR conditions.		
Mining Site Crushing & Screening	Operational Phase	~12.5ha	High pressure and low volume dust suppression on transfer points within the crushing and screening plant. Radiation control In accordance with COR conditions.	National Environmental Management Air Quality Act (Act 39 of 2004) and the regulations. National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	Throughout operational phase
Waste Rock dumps	Operational, Decommissioning and Post closure Phase	Abante ~ 28ha Main ~ 29ha Extension ~ 35ha Haanekuil ~ 27ha	Civil construction of Class D barrier for footprint of waste rock dump. Pollution control dam (PCD) construction for the control of waste rock dump seepage. The PCD will include a silt trap and both will be lined with a HDPE (or similar) liner. The footprint of the waste rock dump will be minimised.	National Environmental Management Waste Act (Act 59 of 2008) and the National Water Act (Act 36 of 1998) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999).	Throughout life of mine and post closure.

			Radiation control In accordance with COR conditions.	Certificate of Registration (COR) issued by the NNR	
Pollution Control Dams	Operational, Decommissioning and Post closure Phase	Collective 2.205ha	The PCD itself serves as an important mitigation measure however if not properly managed it too can contribute to environmental impacts. The freeboard of the PCD must be maintained below 0.8m and a mechanism (automatic/digital or manual inspection) should be established to monitor the freeboard. The silt traps must be inspected weekly and maintained in such a way that they remain effective. Radiation control In accordance with COR conditions.	National Water Act (Act 36 of 1998) GN704 National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	Throughout life of mine and post closure.
Open pit Mining	Operational, Decommissioning	Abante ~49.42ha Extension ~33.27ha Main ~21.65ha Haanekuil ~27.23ha	The perimeter of all the pits will be surrounded by berms of at least 1.5m in height with a cut off trench for clean storm water on the upslope side. Pits will be back filled concurrently and only Pit 3 will be partially back-filled and shaped in order to aid in the post closure ground water management program. De-watering of the pits will be conducted in accordance with the WUL in order to keep the pits dry during operations. Radiation control In accordance with COR conditions.	National Environmental Management Waste Act (Act 59 of 2008) and the National Water Act (Act 36 of 1998) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	Operational and Decommissioning phase.
Central Processing Plant (CPP)	Construction, operational and decommissioning	~40ha	Perimeter high security fence in order to control access. Dust control within the CPP will be minimised through close systems and suppression of dust where emission point closure/sealing is not possible (e.g. ore transfer points into the plant). Radiation control addressing both environmental,	National Environmental Management Waste Act (Act 59 of 2008) and the National Water Act (Act 36 of 1998) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999).	Throughout life of mine and post closure.

			public and employee exposure will be implemented in accordance with the COR for the CPP. Clean storm water will be diverted along concrete lined v-trenches to a collection point/sump/mini PCD from where it will be pumped back into the process water dam for recycling. Diversion berms for clean storm water outside the CPP operational area will divert clean rain water away from the facility. All HCS storage on site will be within bunded areas with sumps for cleaning and maintenance purposes. Implementation of mine/site specific Waste Management Plan for all waste streams.	Certificate of Registration (COR) issued by the NNR	
Tailings Storage Facility (TSF)	Construction, operational and decommissioning	78 ha	The TSF must be constructed and operated in accordance with the SRK TSF Report of August 2017. The perimeter fence must be constructed in accordance with the recommendation/s provided in the Biodiversity specialist report in order to minimise the ingress of fauna. If recommended then a sound cannon may be required to minimise the number of birds landing on and utilising the TSF. The rock impoundment wall toe area should be constructed in such a way that surface water runoff outside the TSF is directed away from the TSF. Slightly elevated topsoil from the TSF construction phase can be utilised to create the appropriate slope.	National Environmental Management Waste Act (Act 59 of 2008) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	Throughout life of mine and post closure.
Office Complex (applicable to Extension,	Operational, Decommissioning	Abante NA Extension ~0,4ha Main ~0,4ha Haanekuil ~0,4ha	Perimeter security fence in order to control access. Clean storm water diversion berms will be constructed on the upslope side and concrete V-trenches will channel dirty water	National Environmental Management Waste Act (Act 59 of 2008)	Operational Phase

Haanekuil, and Main)			to the silt trap and PCD. An oil trap will capture runoff from the maintenance slab and bunding will be provided for the diesel storage and waste oil collection. Implementation of mine/site specific Waste Management Plan for all waste streams.	National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR	

6.4 Impact Management Outcomes

ACTIVITY	POTENTIAL IMPACT	ASPECTS AFFECTED	PHASE	MITIGATION TYPE	STANDARD TO BE ACHIEVED
Drilling, Blasting, Load & Haul, dozing, crushing, screening, product stockpile, loading & transport from mining sites, off-loading at CPP, process plant operation and tailing storage management.	Fugitive dust emission, noise, possible surface and ground water contamination and consumption of raw materials.	Air, soil, surface water, ground water.	Operational Phase and Decommissioning Phase	Noise: all reasonable mechanical controls through the proper use and maintenance of exhausts/mufflers. Dust: daily use of water for dust suppression. Use of chemical bonding agent if required. Monthly monitoring of dust fall out levels and actions taken where necessary. Surface Water: All interaction between surface water and contaminated surface/equipment minimised. Separation of clean and dirty areas through use of berms and trenches. Monitoring through monthly sampling of surface waters. Groundwater: All interaction between groundwater and contaminated surface/ equipment minimised. Separation of clean and dirty areas through use of berms and trenches. Monitoring through monthly sampling of groundwater. Radiation: All measures recommended in the LRP Radiological Safety Assessment	Noise: Levels maintained below those that result in increased complaints from IAP's Dust: Maintained within Residential Limits Surface Water: Quality levels not impacts adversely from baseline conditions and within catchment DWS parameters. Groundwater: Quality levels not impacts adversely from baseline conditions and within catchment DWS parameters Various SANS codes: SANS 10103:2008 (Env noise) & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS 1929: 2011; (Air Pollutants) SANS 5667-

				Report of July 2017 as well as those included as condition of compliance incorporated into the Certificate of Registration (COR) issued by the NNR.	11:2015 (sampling Ground Water) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR

6.5 Impact Management Actions

(A description of impact management actions, identifying the manner in which the impact management objectives and outcomes contemplated in paragraphs (c) and (d) will be achieved).

ACTIVITY	POTENTIAL IMPACT	MITIGATION TYPE	TIME PERIOD FOR IMPLEMENTATION	COMPLIANCE WITH STANDARDS
Drilling, Blasting, Dozing, Load & Haul	Dust, noise, diesel/chemical spillage	Evaluation of control through monitoring and measurement. Dust fall out monitoring and noise assessment. Reduction of fugitive dust emissions through suppression with water and biodegradable dust palliative product. Noise control through proper use and maintenance of exhausts/ mufflers. Blasting impacts can be minimised through ensuring no over-charge, number of holes detonated per delay etc. These criteria must be managed and evaluated by a competent individual to ensure that the impacts associated with blasting are minimised.	Throughout operational phase	Various SANS codes: SANS 10103:2008 & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS 1929: 2011; (Air Pollutants) SANS 5667-11:2015 (sampling Ground Water) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR
Stockpile, crushing and screening	Dust, noise diesel/chemical spillage	Control through monitoring and measurement. Dust fall out monitoring and noise assessment. Reduction of fugitive dust emissions through suppression with water. Noise control through proper use and maintenance of exhausts/mufflers.	Throughout operational phase	Various SANS codes: SANS 10103:2008 (Environmental noise) & SANS 10328:2003 (Noise EIA); SANS 5667-6:2006 (sampling rivers and streams); SANS 1929: 2011; (Air Pollutants) SANS 5667-11:2015 (sampling Ground Water) National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR
Product stockpile and loading	Dust, noise diesel/chemical spillage,	Control through monitoring and measurement. Daily inspections and record keeping. Dust fall out	Throughout operational phase	Various SANS codes.

	surface water contamination	monitoring and noise assessment. Reduction of fugitive dust emissions through suppression with water. Noise control through proper use and maintenance of exhausts/mufflers.		National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR
Tailings management	Dust, noise and potential ground and surface water contamination	Dust fall out monitoring and associated radiation monitoring must be reported in accordance with legislated requirements and data interpretation must result in recommendations being actioned. Daily inspections of the TSF leak detection manholes and reporting must be maintained.	Throughout life of TSF and closure phase. Termination of monitoring in accordance with NNR requirements for closure.	National Nuclear Regulator Act, 1999 (Act No. 47 of 1999). Certificate of Registration (COR) issued by the NNR

6.5.1 Biodiversity Action Plan

Priority Areas for Conservation

These areas correspond to the rivers and riparian areas within the AOI. Correlation is evident between these highest biodiversity importance areas and those demarcated as CBA 1 according to the WCBSP (2017). However, discrepancies exist between these two datatsets related to the large CBA 1 area along the northern boundary of Ryst Kuil Main and Haanekuil and are likely due to the implementation of updated landcover data in the WCBSP (2017) study.

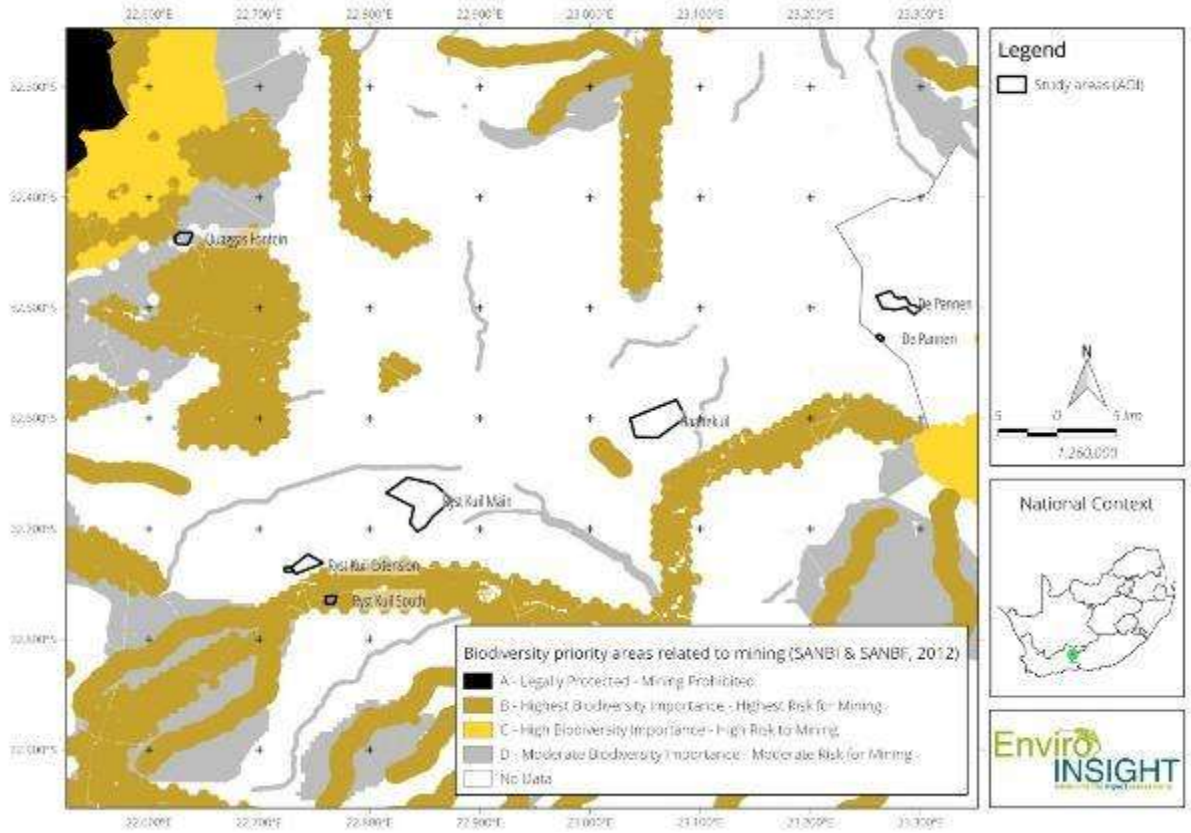


Figure 6-10. Biodiversity priority areas (SANBI & SAMBF, 2012) sensitive to the impacts of mining applicable to the AOI

Priority Species for Conservation

Based on the floristic analysis and the observations made during the field surveys it is evident that the area currently does show sound ecological functionality and although only one Red-Listed plant species was observed, possibly due to phenological limitations of the survey, it does not eliminate the possibility of their occurrence. One Red-Listed and five Orange-Listed plant species were identified during the field survey. Table 6-2 shows the likelihood of occurrence for these species and those species previously recorded within the QDS's as queried from the PRECIS database. All habitat descriptions were taken directly from the Red List of South African Plants website (Redlist.sanbi.org, 2017)

Table 6-2. The probability of occurrence[9] for selected red and orange listed flora by study area

Species	Habitat	Ryst Kuil Main	Ryst Kuil Extension	Haanekuil
Pleiospilos bolusii **(VU)**	Quartz flats in karroid shrubland	Confirmed	High	High
Nananthus sp.[10]	Specific micro-habitats within silty clayey habitats	Confirmed	High	High
Hoodia gordonii **(DDD)**	Wide variety of arid habitats	Medium	Medium	Medium
Hoodia pilifera cf. subsp pilifera **(NT)**	On steep shale slopes or near the foot of sandstone mountains, usually on hotter, northern aspects, occasional it is found on flat areas and cooler, southern slopes.	Confirmed	Confirmed	Medium
Aloe broomii cf. var tarkaensis **(Rare)**	Low, stony ridges.	Medium	Low	Medium
Aloe longistyla **(DD)**	Occurs on gentle slopes and on flat or stony ground in karroid shrubland. Plants are usually scattered and grow under 'nurse' shrubs, particularly Pteronia and Pentzia species.	High	High	High
Crassula socialis **(Rare)**	In rock crevices on cliffs, which are usually south or south-east facing.	High	Low	Low
Indigofera hantamensis **(Rare)**	Scree slopes.	Medium	Medium	Medium
Lotononis azureoides **(Rare)**	Steep, rocky sandstone slopes at 1600 m.	Low	Low	Low
Pelargonium denticulatum **(Rare)**	Sandy soils near freshwater streams.	Low	Low	Low
Phymaspermum schroeteri **(Rare)**	Arid rocky slopes and summits.	Medium	Medium	Medium
Pteronia hutchinsoniana **(Rare)**	Dry sandstone slopes.	Low	Low	Low
Tritonia florentiae **(Rare)**	In a variety of vegetation types on dry stony clay flats.	High	High	High

Avifauna

According to the literature, 14 Red-Listed species are known to occur in the region with 9 species confirmed during the respective surveys, representing a very high success rate. Two of the species are globally Endangered, four of the species are globally Vulnerable species and three are globally Near-Threatened, while five are protected by NEMBA. These species are discussed in the detail in the Biodiversity Report. The probability of occurrence for selected threatened and near threatened avifauna on the respective study areas is shown in Table 6-3. Seven species can be expected regularly in the study areas. *A. paradisaea* and *N. ludwigii* are particularly widespread in the area.

According to Table 6-3(which describes the likelihood of occurrence of Red-Listed species per study area) it is evident most of the study areas exhibit similar likelihoods of occurrence. These study areas are the only study areas characterised by some moderately unique habitat attributes and thus likely to provide foraging habitat for large terrestrial bird species (e.g. cranes, secretary bird and storks) and/ or wetland associates/ foraging migratory raptors.

[9] Confirmed: Confirmed presence High: highly likely due to suitable habitat and known range distribution, Medium: suitable habitat limited and outside known range distribution Low: no suitable habitat

[10] Due to the precautionary principle, the potentially undescribed Nananthus sp. is regarded as a potential SCC

In regards to the current study, it was deemed unnecessary that all species should be discussed in detail. Species such as lanner falcon and lesser kestrel as migrants incur pressures outside of the borders of South Africa and do not warrant intensive discussion here. Therefore, the selected relevant species that are possibly susceptible to the proposed development have been discussed in detail in the Biodiversity Specialist Study Report.

Table 6-3. The probability of occurrence of selected Threatened and Near Threatened avifaunal species by study area

Species	Ryst Kuil Main&Abante	Ryst Kuil Extension	Ryst Kuil Extension	Haannekuil
Aquila verreauxii(Verreaux's Eagle*)*	Low	Low	Low	Low
Polemaetus bellicosus (Martial Eagle)	Low	Low	Low	Low
Anthropoides paradiseus (Blue Crane)	High	High	High	High
Ciconia nigra (Black Stork)	Low	Low	Low	Low
Ardeotis kori (Kori Bustard)	Medium	Medium	Medium	Medium
Eupodotis vigorsii (Karoo Korhaan)	High	High	High	High
Neotis ludwigii (Ludwig's Bustard)	Medium	Medium	Medium	Medium
Falco biarmicus (Lanner Falcon)	Medium	Medium	Medium	Medium
Oxyura maccoa (Maccoa Duck)	Low	Low	Low	Low
Sagittarius serpentarius (Secretary bird)	Medium	Medium	Medium	Medium
Afrotis afra (Southern Black Korhaan)	High	High	High	High
Total (High-Medium)	7	7	7	7

Mammals

Three of the observed mammal species within the study areas are Red-Listed in South Africa and two species are protected by NEMBA. These species are discussed below and the probability of occurrence for selected threatened and near threatened mammal species on the respective study areas is shown in Table 6-4.

Table 6-4. The probability of occurrence for selected threatened and near threatened mammal taxa by study area

Species	Ryst Kuil Main&Abante	Ryst Kuil Extension	Haanekuil
Felis nigripes (Small-spotted or black footed cat)	Low	Low	Medium
Vulpes chama (Cape fox)	High	High	High
Mellivora capensis (Honey Badger)	Low	Low	Low

Herpetofauna (Reptiles & Amphibians)

A total of 29 reptile species (over 200 individuals) and three amphibian species were observed during the biodiversity survey. The observed species respectively represents 64% and 27% of the expected number of reptile and amphibian species for this region.

A very high tortoise density was recorded during the 2015 herpetofauna surveys. Tortoises are one of the primary seed dispersers in the Nama-Karoo biome (Dean and Milton 1999) and therefore essential for the

continued ecological functioning of the system. Unfortunately, these animals are particularly vulnerable to collisions with vehicles on roads, an aspect which will require strict mitigation by the proposed development. Tortoises are also particularly vulnerable to isolation through fencing.

Three herpetofauna species of conservation concern are expected to occur within the study areas, two of which were directly observed during the current and previous field surveys (Table 6-5). These are the Data Deficient Karoo caco (*Cacosternum karooicum*), the Near-Threatened giant bull frog (*Pyxicephalus adspersus*) and the Near-Threatened Karoo padloper (*Homopus boulengeri*). Ryst Kuil Main is the only area considered highly likely to support two of these species (Table 6-5). Although previously listed as Data Deficient (IUCN, 2009), Fisk's House Snake was more recently evaluated in the national conservation assessment to be of Least Concern (Bates et al., 2014).

In addition to individual species of conservation concern it should also be noted that herpetofauna in the Nama-Karoo biome likely form a major component of the vertebrate biomass on which many other predators rely (e.g. birds of conservation concern).

Table 6-5. The probability of occurrence for selected threatened and near threatened herpetofauna by study area

Species	Ryst Kuil Main&Abante	Ryst Kuil Extension	Haanekuil
Cacosternum karooicum (Karoo caco)	Low	Low	Low
Pyxicephalus adspersus (Giant bullfrog)	Confirmed	Confirmed	Low
Homopus boulengeri (Karoo padloper)	Confirmed	Medium	Medium

Identification of Conservation Actions

Priority Areas for Conservation

Ryst Kuil Main and Abante:

The combined habitat sensitivity for the Ryst Kuil Main study area (Main, Abante, CPP and TSF) consists almost entirely of Medium sensitivity areas. Only a few isolated Medium-High sensitivity areas are present due mostly to surface water, windmills and rocky ridges, with scattered High sensitivity areas associated with potential habitat for the potentially undescribed Nananthus sp. The prevailing wind direction on Ryst Kuil (Slabbert, 2017) is south-east-east. No CBA's are located south-east-east from the study area, however CBA's are located on the Northern boundary of the study area as well as 4 km south of the study area boundary. The proposed location for the tailings storage facility (TSF) on Ryst Kuil Main does not overlap with the CBA on the Northern boundary, although its calculated Zone of Influence (ZOI) does. As mentioned above, the bulk of the ecological infrastructure associated with Ryst Kuil Main is associated and linked with sensitive aquatic ecosystems downstream from the study area. Without mitigation, the proposed location of the TSF therefore poses a potential risk of pollution of the surface and ground water on a local and potentially regional scale.

Haanekuil:

The combined habitat sensitivity for the Haanekuil study area consists entirely of Medium sensitivity areas except for the two windmills which have a Medium-High sensitivity as they are the only water sources available to fauna in this study area.

Ryst Kuil Extension:

The combined habitat sensitivity for the Ryst Kuil Extension study area consists entirely of Medium sensitivity areas, with a Medium-High peripheral sensitivity area due to the presence of a windmill.

ACTIONS ASSOCIATED WITH PRIORITY SPECIES

The following embedded controls have been included in the project design:

- Planning in the placement of construction camps and laydown areas to exclude sensitive habitats;
- Preservation of high value plant species *in-situ* through a pre-construction walkover and botanical survey;
- Relocation of Red and Orange Listed species;
- Soil management to limit effects of erosion arising from vegetation clearing; and
- Rehabilitation of cleared/impacted areas by the planting of indigenous species after construction phase.

Additional conservation actions include the following:

- Minimise the footprint of construction and operation (maintenance) activities through appropriate planning. Each activity must be well planned to determine the minimum footprint required, which must be demarcated on the ground in advance (to reduce the potential of accidental spill-over and accidental damage into surrounding areas and to allow botanical experts to carry out a final sweep of the footprint areas to initiate possible relocation of Red and Orange Listed species). These areas must include vehicle parking areas, turning facilities, worker's toilet facilities, worker's camps, material and equipment lay down areas etc.;
- Embedded erosion control measures should further aim to reduce the slope of cleared areas. Although very difficult in such an arid environment re-vegetation should be conducted with suitable indigenous vegetation to form a vegetation cover that will protect exposed surfaces and attempt to limit the loss of topsoil during high rainfall events while simultaneously reducing sedimentation of streams/rivers. The process of rehabilitation in the Karoo requires detailed input from a subject specialist as well as intensive oversight and monitoring. It is anticipated that long term maintenance will be required to establish successful rehabilitation.
- Maximum use of existing cleared areas, areas of disturbance and road networks should be utilised.

The following conservation actions are primarily designed to limit mortalities of especially tortoises (inclusive of the Karoo Dwarf tortoise) along roads:

- The ECO should monitor live animal observations to monitor trends in animal populations and thus implement adaptable mitigation of vehicle movements;
- Road mortalities should be monitored by both vehicle operators (for personal incidents only) and the ECO (all road kill on periodic monitoring basis as well as specific incidents) with trends being monitored and subject to review as part of the monthly reporting. Monitoring should occur via a logbook system where staff takes note of the date, time and location of the sighting/ incident. This will allow determination of the locations where the greatest likelihood exists of causing a road mortality and mitigate against it through both the embedded measures mentioned above (reducing vehicle speeds in

sensitive areas) and below (e.g. fauna underpasses, fence removals and seasonal speed reductions). Finally, mitigation should be adaptable to the onsite situation which may vary over time;

- Reduce direct mortalities either by removing fences in identified sensitive areas or indeed, increasing the buffer area either side of the road by 50 metres either side, to allow fauna to have an escape area away from impenetrable fences;
- Reduce direct mortalities by allowing for fauna to cross the roads, particularly where the roads cross a sensitive natural habitat (e.g. wetlands or artificial water points). This can be achieved by constructing fauna underpasses under the roads (large culverts or large open-ended concrete pipes laid into the raised roads). These underpasses should be used in conjunction with "fauna barriers" which prevent the most susceptible small fauna from crossing the roads on the surface by directing them towards the underpasses where they can cross under the roads safely. It is important to note that utilization of underpasses is strongly dependent on animal body size (larger culverts are more successful) and the surrounding habitat (Mata et. al 2005); and
- All staff operating motor vehicles must undergo an environmental induction training courses that includes instruction on the need to comply with speed limits, to respect all forms of wildlife (especially reptiles and amphibians) and, wherever possible, prevent accidental road kills of fauna. Dead mammals should never be handled due to the risk of rabies and snakes should only be handled after inductions have taken place due to the risks of post-mortem envenomation. Drivers not complying with speed limits should be subject to penalties.

The success of a BAP rests largely on commitment to implement the plan and effectiveness in implementing the plan. The ability to demonstrate success in implementing the plan rests on the effectiveness of data capture and recording.

6.5.1.1 Maintaining the BAP

6.5.1.1.1 Keeping the BAP Relevant

The BAP is a living document that will be maintained on the mine and will be subject to review. The BAP will need to be updated as new information becomes available (Table 6-6).

Table 6-6. Actions required to ensure that BAP remains relevant

Objective: To keep BAP up to date		
Target: Regular updating and review of the BAP		
Actions	**Responsibility**	**Performance**
• Ensure new information is captured quarterly; • Review the BAP every second year against the data gathered to ensure it remains relevant and current. This is to include species observations/records, photos of species not yet photographed; and • The review should also reflect consideration of any changes to legislation or status of species of conservation concern	SHEQ Manager	

6.5.1.1.2 Data Management

Data will need to be managed in electronic form as well as hardcopy datasheets. A structured system of managing biodiversity data must be set up and maintained (Table 6-7).

Table 6-7. Biodiversity Data Management

Objective: Establish and maintain a system for management and retention of biodiversity data on the mine		
Target: An established functional data management system that handles georeferenced information		
Actions	**Responsibility**	**Performance**
i) Set up GIS or CAD system to capture georeferenced biodiversity data. This will include: a. Biodiversity units; b. Location of restricted/sensitive areas; c. Location of sp. population records. Structure must allow for data layering per species; d. Recording of sampling localities when structured monitoring or sampling takes place. To include point co-ordinates and tagging of species of special concern that were identified; and e. Observation records for fauna must be kept / updated for all species of special concern. Capture coordinates and observations per species;	SHEQ Manager & Team	
ii) Other information to be captured in GIS or CAD a) Areas disturbed by mining and associated infrastructure;	SHEQ Manager & Team	
iii) Set up hard copy biodiversity data management system to manage, store and retain field forms, specialist studies, species lists etc.; iv) Retain the system in a functional state through quarterly (minimum) updates of hardcopy information into electronic GIS system; v) Develop simple forms for capture of field data. Field forms should include capture of at least the following data: a. Date & time of observation / sampling; b. Location (GPS co-ordinates) or annotated map. For new population records co-ordinates must be captured; c. Species observed, and number in the case of fauna; d. Comments / notes; and e. Checkbox and signoff window to confirm that data has been captured into the biodiversity database.	SHEQ Manager & Team	
vi) Set up a data bank (spreadsheet / database) to capture species specific information. Recommended that a single data sheet be retained per species in the hard copy data management system.	SHEQ Manager & Team	

6.5.1.2 Custodianship of Threatened Taxa

6.5.1.2.1 Species of Conservation Concern

Several faunal and floral species of conservation concern were recorded at various locations in the project area. To ensure no net loss of biodiversity a detailed inventory and management strategy is required for species of conservation concern (Table 6-8).

Table 6-8. Threatened Species Inventory and Management Strategy

Objective: To develop and maintain a detailed management plant for red data species (fauna and flora)		
Target: No net loss of red data species (fauna and flora)		
Actions	**Responsibility**	**Performance**
i) Compile a detailed inventory of red data fauna and flora species within the entire project area. Aspects that should be included in the inventory should include: a) Location; b) Abundance; ii) Any incidental records of red data species should also be captured on the inventory; iii) Inventory needs to be updated on an annual basis so that trends in the abundance of red data species can be established; iv) Develop a biodiversity GIS / CAD database map showing the location and abundance of red data species.	SHEQ Manager & Team	

6.5.1.2.2 Alien Invasive Species Management

Degraded habitats provide a suitable habitat for the encroachment of alien invasive plant species. This necessitates the rehabilitation of degraded areas as well as the management of alien invasive plant species. The establishment and encroachment of alien invasive plant species poses a threat to ecosystems and therefore needs to be management to ensure no net loss of biodiversity.

Based on the outcome of the threatened ecosystem inventory an alien invasive plant management strategy needs to be compiled (Table 6-9).

Table 6-9. Alien Invasive Plant Management

Objective: To prevent the establishment and encroachment of alien invasive plant species in sensitive habitats within the mining areas		
Target: No net loss of sensitive ecosystems due to encroachment by alien invasive plant species		
Actions	**Responsibility**	**Performance**
i) Conduct a Risk Assessment of Alien Invasive Plants. The risk assessment should focus on the following: a) Identifying areas most at risk from encroachment; b) Identifying key areas for focusing of management efforts; c) Identifying key invasive species that require management; d) Identify suitable management measures based of the specific invasive plant species; ii) Document management efforts in terms of: a) Location (coordinates and map); b) Invasive species being managed; c) Intervention measures taken; d) Follow-up measures and visits required; e) Record of follow up inspections and observations.	SHEQ Manager & Team	

6.5.1.3 ACTION PLAN FOR AREAS DIRECTLY IMPACTED BY MINING

This section contains action plans for biodiversity within the proposed mining footprint.

6.5.1.3.1 Biodiversity Actions to be Implemented Prior to Mining

There is a high likelihood that there will be rare and / or endangered species in areas within the future mining footprint.

LUKISA should commit to revisiting areas within the mining footprint area that lie in advance of the mine in order to continually build the mine's knowledge base concerning the location of populations of sensitive species (plant and animal) so that, where possible, the mine can intervene directly to relocate the affected populations to suitable areas outside the mining areas, or in the case of plant populations, possibly also into rehabilitated areas.

6.5.1.3.1.1 Ongoing Identification of Threatened Species Populations

LUKISA should commit in their EMP to carry out fauna and flora surveys in areas that lie within the following 5-year mining block to identify populations of species of conservation concern (Table 5-10).

Table 6-10. Action plan for identification of species of conservation concern in mining areas

Objective: To identify populations of species of conservation concern through upfront and ongoing assessment of land that is yet to be mined, to locate and define the extent of such species populations which may previously have been overlooked in baseline work conducted to date.		
Target: No net loss of species of conservation concern through completion of field surveys for the following 5-year mining block, and collection of up to date knowledge of species of conservation concern associated with the mines.		
Actions	**Responsibility**	**Performance**
i) Implement collection of data on species of conservation concern within the mining area; ii) Generate a map showing the next 5-year mining block and the known distribution of species populations which remain in situ; iii) Do this at least 2 years before mining is due to take place to allow time for relocation of populations; iv) Conduct an assessment of flora and fauna within this block to coincide with suitable field conditions. This is typically conducted during the flowering season (spring/ summer); v) Record: 1. Species of conservation concern; 2. Location of populations; 3. Describe the population including count or estimate of number of plants or animals, comment on condition of the population, and any special habitat features evident; and 4. Date & time. vi) Capture this information into the GIS database; vii) Evaluate whether it is possible to relocate the population/s. Document the outcome and, if negative, describe in detail why relocation is not possible. If possible, describe method and time period for relocation; viii) Confirm and document whether any permit / approval is required; and ix) If the area covered in the mine 5-year plan changes, repeat this process.	SHEQ Manager	

6.5.1.3.2 Relocation of Threatened Species prior to Mining

In some cases there will be populations of species of conservation concern that have been identified within the footprint of future mining areas. These populations should not be sacrificed but, where possible, should be relocated (Table 6-11). Relocation should be into habitats similar to those from which the species came in order to improve relocation success. Alternatively, relocation should be into rehabilitated areas that have established well and which are stable.

Table 6-11. Action plan for relocation of threatened species prior to mining

Objective: To ensure no net loss of species of conservation concern and establish additional populations in rehabilitated areas		
Target: To translocate as many populations of sensitive species as practical from areas that lie within the future mining footprint		
Actions	**Responsibility**	**Performance**
• Develop a map (based on the GIS/ CAD database) showing all populations of species of conservation concern within the footprint of future mining advance. • Indicate these in 5-year mining advance blocks; • Schedule the relocation of these populations, and relocate plant / animal species to identified receiving sites; • Record: 1. The methods that were used during the relocation, including capture / harvesting techniques 2. Location of receiving site [corner coordinates]; 3. The species relocated and number of individuals successfully released / replanted; and 4. Date & time. • Follow up after 6 and 12 months to document survival within the transplanted population. • Flora: Document as above but also recording survival against number of plants planted. • Fauna: Document observational records of species at new location. Note this will only apply for ground dwelling populations. Mobile species can be expected to disperse and measurement of success will need to rely on review of long term observation records for the species • Six (6) and 12 month post relocation monitoring, review procedure employed during translocation and, if survival has been poor, critically amend practice in discussion with specialists in the taxa if necessary.	SHEQ Manager	

6.5.1.3.3 Relocation of Other Plant Species

In addition to red data plant species, there are numerous species which occur inside the future mining footprints which are relatively easy to translocate. Although some of the bulbous species do transfer to rehabilitated areas together with topsoil many bulbs and other plants get lost when topsoil is stripped. These species are often fairly easy to identify and hardy to transplant and should be actively removed from areas that will be mined, and replanted into aged rehabilitated areas to improve the diversity of the rehabilitated areas and reduce the impact of the mine on floral biodiversity (Table 5-12).

Table 6-12. Action plan for relocation of additional plant species

Objective: To improve biodiversity value of rehabilitated land.		
Target: To translocate specific hardy species into previously rehabilitated areas.		
Actions	**Responsibility**	**Performance**

i) Demarcate areas that will be stripped within the next year (simple flags/ poles placed using hand held GPS); ii) Walk this area and identify reasonably sized populations of bulbous plants and aloes and flag these for a labour team to harvest; iii) Harvest and replant into aged rehabilitated areas in the same general area of the mine; vi) Record: 1. The methods that were used during the relocation, including capture / harvesting techniques; 2. Location of receiving site [corner coordinates]; 3. The species relocated and number of individuals successfully released / replanted; and 4. Date & time. vii) Follow up after 6 and 12 months to document survival within the transplanted population. Flora: Document as above but also record survival against number of plants planted. Fauna: Document observational records of species at new location. Note this will only apply for ground dwelling populations. Mobile species can be expected to disperse and measurement of success will need to rely on review of long term observation records for the species iv) After 6 and 12 month post relocation monitoring, review procedure employed during translocation and, if survival has been poor, critically amend practice in discussion with specialists in the taxa if necessary.	SHEQ Manager	

6.5.1.3.3.1 Actions to be carried out during rehabilitation

Lukisa will rehabilitate disturbed/ mined-out area as soon as they become available for rehabilitation, therefore minimising the rehabilitation backlog as far as possible. In broad summary land rehabilitation entails the following:

- Earth works;
- Backfilling of mined-out area;
- Profiling of the backfilled material in order to achieve a surface that is natural in appearance and free draining, avoiding flat surfaces and geometric lines, wherever possible;
- Replacement of stripped topsoil. Where possible, soil must be placed live and not stockpiled; and
- Spreading and levelling of topsoil.
- Stabilisation of topsoil and backfilled material;
- Netting of topsoil areas to protect soil resources from wind erosion.

Revegetation of stabilised area:

- Seeding of the area; and
- Planting of transplants and / or cuttings when conditions are favourable.

6.5.1.3.3.2 Rehabilitation of Mined Areas

This section summarises aspects of rehabilitation which have a bearing on biodiversity (Table 5-13).

Table 6-13. Action plan for rehabilitation of mined areas

Objective: To minimise the impact of mining through effective rehabilitation of mined areas		
Target: Self-sustaining rehabilitated areas and a limited rehabilitation backlog.		
Actions	**Responsibility**	**Performance**

i. Rehabilitate available areas by using the established backfilling and levelling techniques; ii. The backfilling of mined-out areas and any levelling of tailings must be properly planned to minimise the rehabilitation backlog; iii. The backfilling and levelling must be conducted as per the planned schedule; and iv. A quality check must be done to ensure that the backfilling depth, topsoil distribution and final profiling of the surface meets the requirements as set out in the rehabilitation plan.	Mine Planner, Mine Engineer and SHEQ Manager	

6.5.1.3.3.3 Seed Harvesting, Cuttings and Transplants

LUKISA should develop a revegetation program that can be refined over time. This program should involve the harvesting of ripe seed, taking of cuttings and collection of rooted plants from the natural environment for use in revegetation of mined areas (Table 6-14).

While this practice is of immense value in improving the quality and diversity of the rehabilitated areas, it could pose some risk to natural areas if not managed well. Risks include:

- Spread of exotic species due to collection by untrained personnel;
- Spread of encroaching species; and
- Creation of a monoculture of unwanted/pioneer species due to the incorrect use of highly competitive species.

Equally, the introduction of foreign seed to the site could pose risk to local biodiversity if such seed was sourced from an inappropriate location.

Table 6-14. Action plan for seed harvesting, cuttings and transplants

Objective: To improve floral diversity of rehabilitated areas through the use of transplants (cuttings or whole plant transplants) and seed to supplement the soil seed bank.		
Target: A diverse plant community on rehabilitated land which is self-sustaining without exacting a negative cost in donor areas		
Actions	**Responsibility**	**Performance**
i. Only use seed, cuttings and transplants harvested within the mining area or on identified neighbouring farms in rehabilitation; ii. Preferably harvest such material in areas which fall within the mine footprint as these areas will be lost to mining anyway; iii. When harvesting seed, do not harvest more than one third of the seed that has fallen around any plant in order to leave sufficient seed for recruitment in the donor environment; iv. Record all material brought into the site and the site of origin. If not from an agreed harvesting site, do not allow entry to the site; v. Improve floral biodiversity in rehabilitated areas through the active translocation of hardy plants from ahead of the pit back into aged rehabilitated areas; vi. Document all revegetation efforts (seeding, cuttings, transplants and active translocation of plants); and vii. Monitor rehabilitated areas in order to be able to demonstrate success in rehabilitation but also to be able to clearly identify practices which are not working effectively.	SHEQ Manager	

6.5.1.3.3.4 Actions to be carried out after rehabilitation

The success of land rehabilitation is influenced by many factors, many of which are outside the control of the land manager. Consequently, it is very important to inspect areas that have previously been rehabilitated and

to intervene when rehabilitated land or areas within a rehabilitated block are performing poorly (Table 5-15). It is equally important to document these interventions.

Table 6-15. Action plan post rehabilitation

Objective: To ensure rehabilitation success through follow up intervention		
Target: Self-sustaining rehabilitated areas		
Actions	**Responsibility**	**Performance**
i. Inspect rehabilitated areas and identify areas that are not performing well; ii. Poor performance areas must be documented; and iii. Corrective actions/interventions must be recorded.	SHEQ Manager	

6.5.1.3.4 Biodiversity Monitoring Plan

Biodiversity monitoring entails monitoring of natural habitat areas and monitoring of the performance of rehabilitated areas within the mining area. Monitoring includes both fauna and flora.

6.5.1.3.4.1 Existing Monitoring Sites

Monitoring sites will need to be established across the mining areas and will need to encompass areas that are likely to be developed during future mining operations, areas beyond the future mining footprints as well as rehabilitated areas.

6.5.1.3.4.2 Recommended Monitoring Sites

Monitoring sites will need to be selected as part of the first phase of the monitoring programme. Biomonitoring should be conducted annually.

Biomonitoring should include a combination of:

- Total species list development;
- Identification of species of special concern; and
- Primary species abundance data;
- Species counts; and
- Crown cover data, in addition to the species counts.

Rehabilitation monitoring should follow standard vegetation survey protocols, date and capture primary species abundance data, crown cover data and species counts. Monitoring of these sites should be conducted biannually.

6.5.2 Waste Management Plan

Domestic waste

The LRP will use a licensed Contractor for collection and disposal of domestic waste at the registered Beaufort West waste disposal sites. The waste will be sorted before disposal, and paper and cardboard will be separated

out and sent for recycling. Vaalkoppies Landfill Site is a licensed landfill site for general waste (GB) in Beaufort West.

Hazardous waste

All waste arising from the mine (classified as hazardous waste – old paint tins, degreaser containers, oily rags, etc.) will be collected in a different waste collection system and disposed of by a licensed contractor in a licensed hazardous waste site. Safe disposal certificates would be required from contractors to ensure legal disposal of waste. Such records would be archived.

Scrap metal and equipment

Batteries, tyres, used oil drums and scrap metal will be collected around the mine, transported to a lay-down yard and sorted. The waste will then be sold to scrap and recycling companies.

6.5.2.1 Waste Classification and Management Regulations

Based on the results of the waste classification analyses for selected the waste rock samples, all materials are classified as Type 3 wastes. Based on the total concentrations reported for the aqua regia extracts of the composite waste rock samples, Ba and Cu exceed the TCT0 value in all samples. Arsenic exceeds in most samples while Pb exceeds the TCT0 value in nine samples. Based on the GAI neither of these elements is significantly enriched in the waste rocks. The LCT0 values are derived from the drinking water guideline values (refer Table 6.1), and indicate that the leachable concentrations of F, Mo and Se exceed the LCT0 values in five samples.

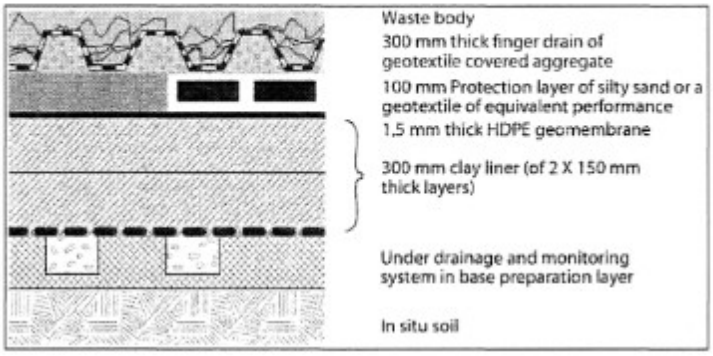
Although based on the total concentrations, the waste rock would classify as a Type 3 waste material, the concentrations are not considered to be significantly enriched relative to crustal abundances.

The tailings material, however, classifies as a Type 3 waste based on elevated total concentrations of As, Ba, and Mo. Furthermore, the leachate concentrations of SO_4, total dissolved solids, As, Cd and Mn exceed the LCT0 values and the un-mineralised waste rock samples.

Based on the results of the TCT and LCT of the waste rock and tailings material, the materials are classified as Type 4 and Type 3 wastes respectively. Because of the small margins by which the values exceed the LCT0 limits, and the compacted nature of the foundations of the waste rock material it is our recommendation that a Class C landfill would suffice (see Figure below). This recommendation is also based on the nature of the underlying rock considering the geology, i.e. compacted weathered sandstone of the Stormberg Group with it's abundance of secondary clay minerals, as well as the associated mineralogy and whole rock geochemistry.

Type 4 waste may be disposed of at a Class D landfill (Figure 6-11) designed in accordance with section 3(1) and (2) of the Norms and Standards. However, the mineralogy of the waste rock indicates a high modal proportion of clay minerals in the waste material. This has the distinct effect of inhibiting the flow of the polluting elements through the waste material.

(c) Class C Landfill:



(d) Class D Landfill:

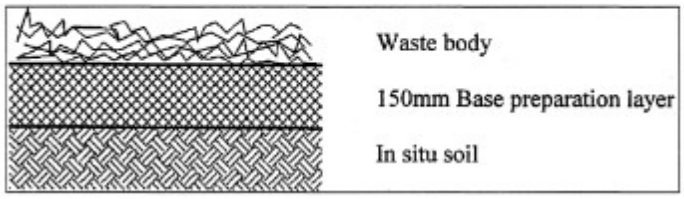


Figure 6-11. Typical characteristics of a Class C & D Landfills.

The results of geochemical characterisation can be summarised as follows:

- The results of the waste rock geochemical assessment indicate that the major lithologies present in any of the proposed mining areas are classified as non-acid generating;
- The waste rock lithologies are not significantly enriched with respect to other trace elements, with GAI generally ≤ 3;
- The potentially leachable concentrations of trace elements from the waste rocks are generally low and below their respective drinking water guideline values;
- Although based on the total concentrations, the waste rock would classify as a Type 3 waste material, but the concentrations are not considered to be significantly enriched.

According to the norms and standards a Class C liner is required for stockpiling of waste rock, as well as tailings

Waste rock

Waste rock will be generated at the operational areas. Waste rock will be placed on designated waste rock dumps until required for backfill and/or TSF impoundment wall construction.

Radioactive Waste

Typical mining wastes are classified according to the following definitions of the South African Radioactive Waste Management Policy:

- NORM-L (low activity):
    - Potential radioactive waste containing low concentrations of NORM.
    - Long-lived radio nuclide concentration: < 100 Bq/g.
    - Unpackaged waste in a miscible waste form.
    - Disposal options:
        - Re-use as underground back-fill material in an underground mine area.
        - Extraction of any economically recoverable minerals, followed by disposal in any mine tailings dam or other sufficiently confined surface.
- NORM-E (enhanced activity)
    - Radioactive waste containing enhanced concentrations of NORM.
    - Long-lived radionuclide concentration: > 100 Bq/g.
    - Packaged or unpackaged waste in a miscible or solid form with additional characteristics for a specific repository.
    - Disposal options:
        - Dilute and re-use as underground back-fill material in an identified underground (mining) area.
        - Extraction of any economically recoverable minerals, followed by dilution and disposal in an identified mine tailings dam or other sufficiently confined surface impoundment.
        - Regulated deep or medium depth disposal.

The formal radiological category of some of the waste rock at Ryst Kuil will be NORM-L.

6.5.3 Conceptual stormwater Management Plan

The proposed mining operation will alter the natural environmental state, thereby affecting the generation of

stormwater. Volumes of stormwater generated over areas disturbed by mining operations are generally expected to increase because of the reduction in natural vegetation and removal/compaction of soils, while the quality of the stormwater generated is expected to decrease due to the nature of mining operations. Therefore, the purpose of this section is to produce a conceptual level SWMP by which clean and dirty water-generating areas are first identified and then managed appropriately. This stormwater management plan is based upon the principles presented in the DWS Best Practice Guideline G1 for Stormwater Management (BPG1).

6.5.3.1 Areas Requiring Management

In Figure 6-12 until Figure 6-16, areas requiring pollution control (i.e. dirty areas) have been delineated. The SWMP has been based upon the mine in its fully developed state, inclusive of both TSF Phases 1 and 2.

A constraint in the development of the SWMP was the position of infrastructure within defined watercourses, which means that the stormwater management necessary to achieve GN 704 compliance is unavoidably placed within areas which will require a GN 704 exemption with regard to flood risk. It should also be noted that the stormwater infrastructure has been designed (conceptualised) around stormwater management and not flood protection. Additional flood protection may be necessary, particularly in the case of pollution control dams (PCDs), where the consequence of failure is considerable.

Clean areas are identifiable as both defined clean areas and areas without a clean or dirty classification (i.e. where there is only aerial imagery in Figure 6-12 until Figure 6-16). These additional clean areas have not been formally recognised since they either do not flow into the operation (therefore do not require diversion around the operation) or are located on the operation but do not require diversions to route them away from dirty areas. Clean areas may, however, have occasional spills of dirty material requiring periodic cleaning of this material.

Dirty areas are also delineated; however, there is a differentiation depending on the type of dirty area, with typical dirty areas and "self-contained" dirty areas (specific to the pits and TSF) illustrated. The self-containment of the pits has been reinforced using proposed berms (where no diversion and berm is present). The TSF has been delineated as a dirty (self-contained) area; however, no management beyond the diversion of clean areas has been proposed since the design of the TSF will require specific engineering beyond this report's detail.

The remaining dirty areas and defined clean water areas are consequently the focus of this section since they require management (diversion) and containment (within suitability-sized PCDs). Dirty diversions are used to divert water towards PCDs, while berms act as partitions to define dirty areas more clearly, as well as creating a partition between clean areas. In most instances, clean and diversions include a berm element (to create a partition between clean and dirty areas); however, there are locations at Haanekuil where the clean diversion excludes a berm (to allow inflow from both sides).

It should also be noted that due to the very low slopes of the surrounding areas, clean diversions have utilised the natural landscape to enhance conveyance. This has been done by keeping one side slope at 1:2 (for the berm) and the other side slope at 1:50 or 1:100 (depending on terrain and model needs).

Site roads have not been specifically assessed with regard to this SWMP, given their linear nature and the uncertainty as to which sections of internal roads will experience possible spillage of excavated material (thereby being deemed dirty areas). This SWMP should be revised based on the final expected section of haul roads that are likely to experience regular spillage of excavated material. Haul roads not within a dirty area routing to a PCD, should have regular clean-up of spilt material undertaken as part of their management.

6.5.3.2 Fuels, Lubricants and Chemicals

The storage/handling of fuel, lubricants and chemicals will require special attention due to their hazardous nature as is the case with the diesel and oil bay. These areas are required to be managed on impermeable floors with appropriate bunding, sumps and roofing. This is regarded as localised management and does not from part of this conceptual SWMP.

6.5.3.3 Stormwater Management Infrastructure

Stormwater management infrastructure has been conceptually designed in this report as per the requirements of GN 704 and BPG1 using the 1:50 year RI event. No account has been taken of climate change and any potential future increases in rainfall depth or intensity. These will need to be considered depending on the expected life of the structure.

Figure 6-12 illustrates the conceptual SWMP for the site. Sizing of diversions has been based upon a review of the layout, land-cover, soils and terrain of the relevant area.

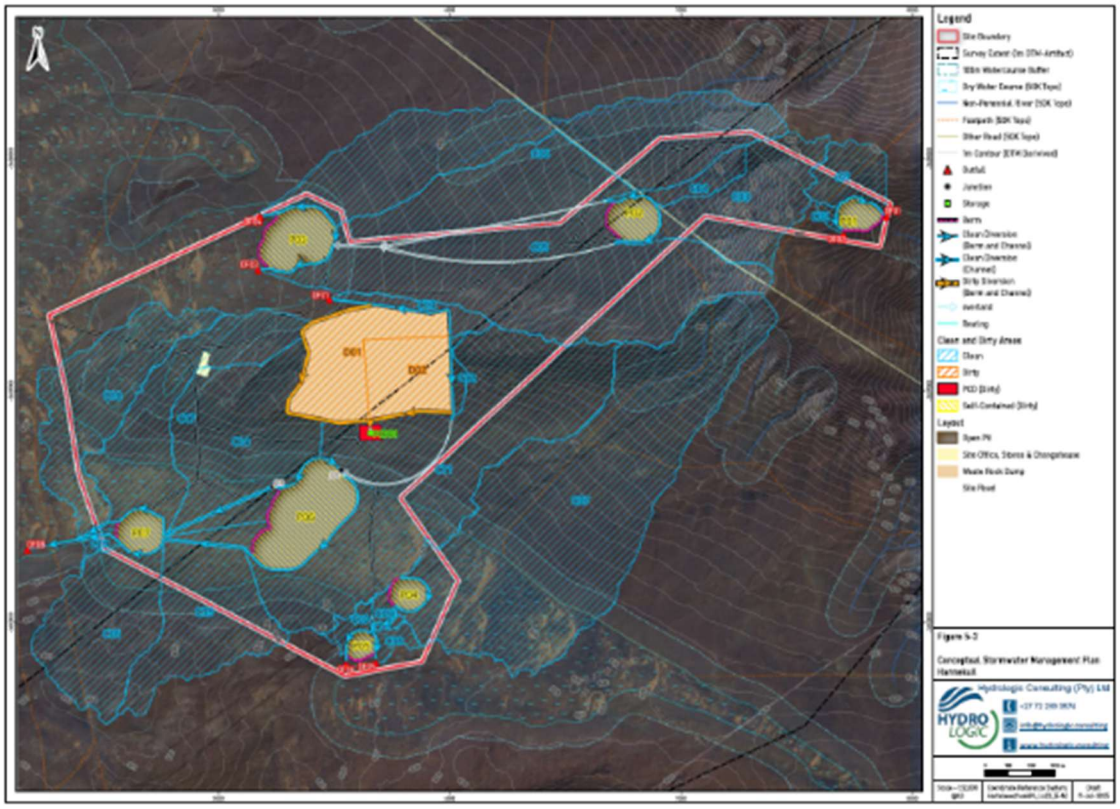


Figure 6-12. Conceptual Stormwater Management Plan - Haanekuil.

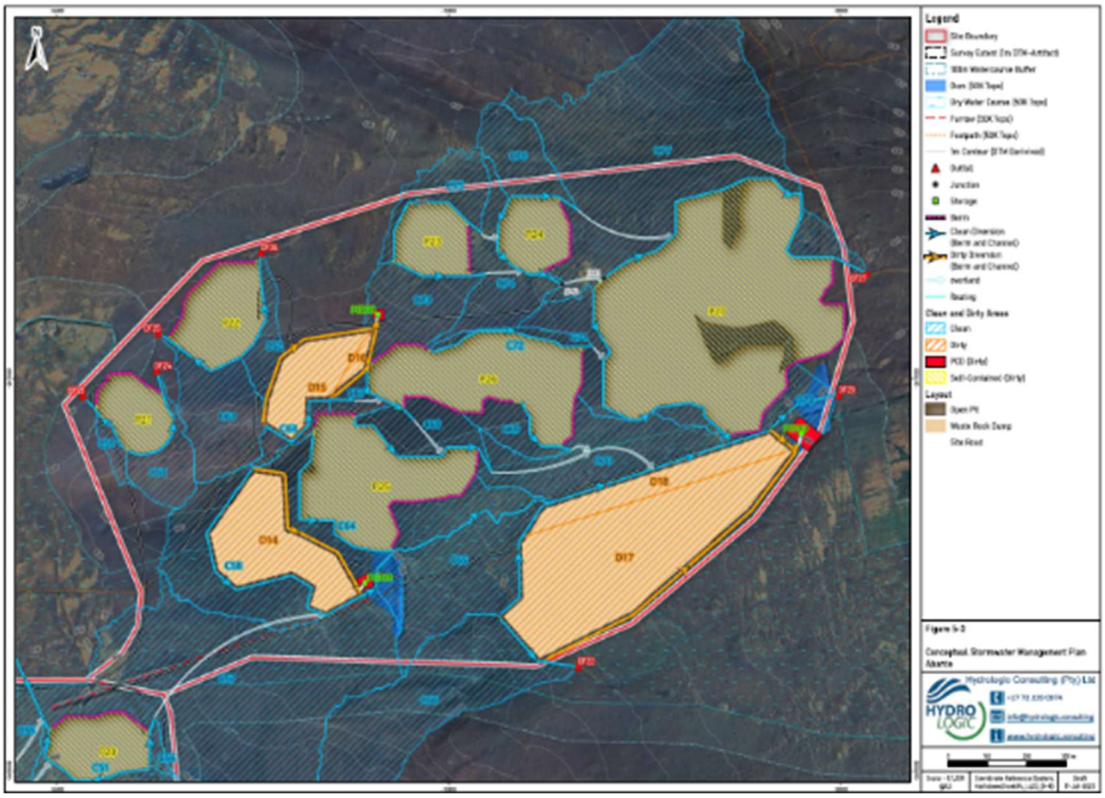


Figure 6-13. Conceptual Stormwater Management Plan – Abante.

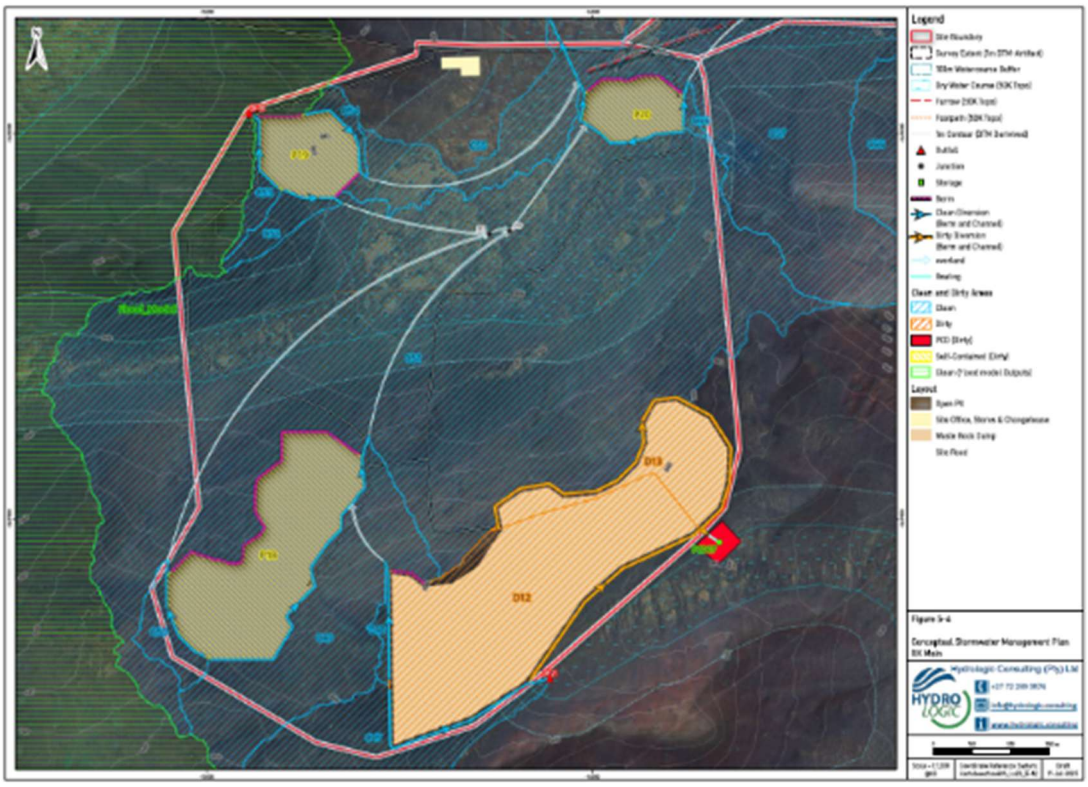


Figure 6-14. Conceptual Stormwater Management Plan – RK Main.

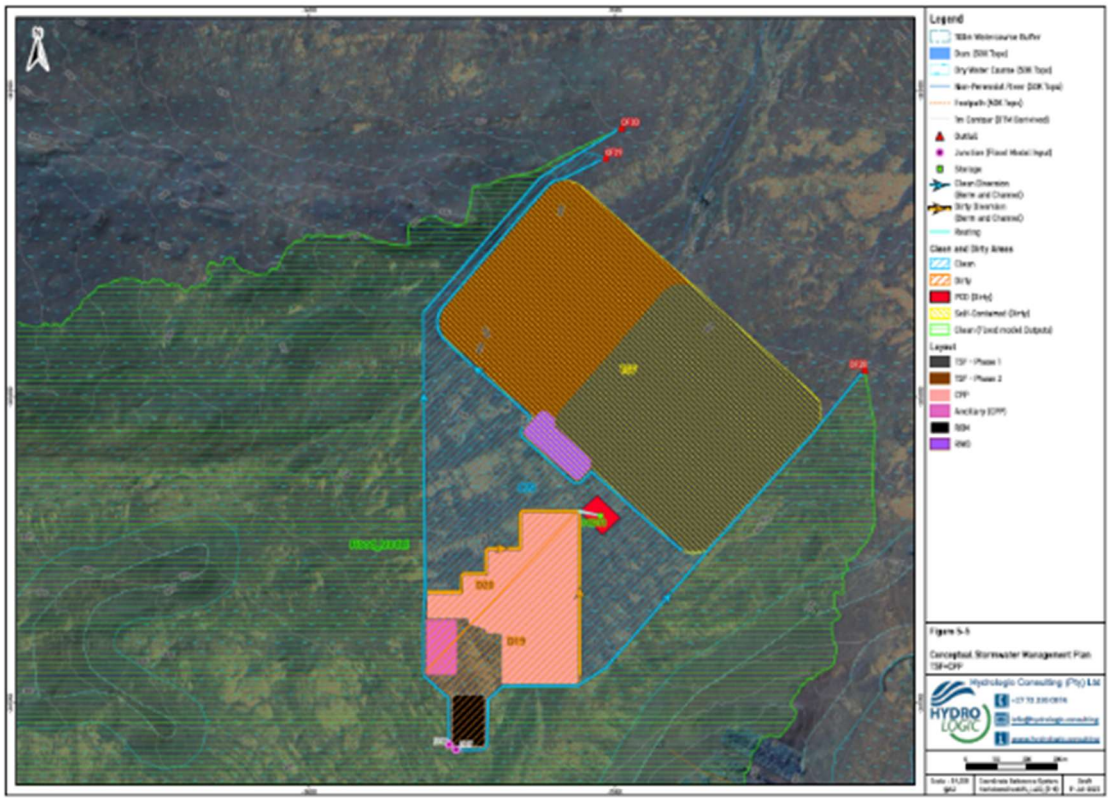


Figure 6-15. Conceptual Stormwater Management Plan – TSF & CPP.

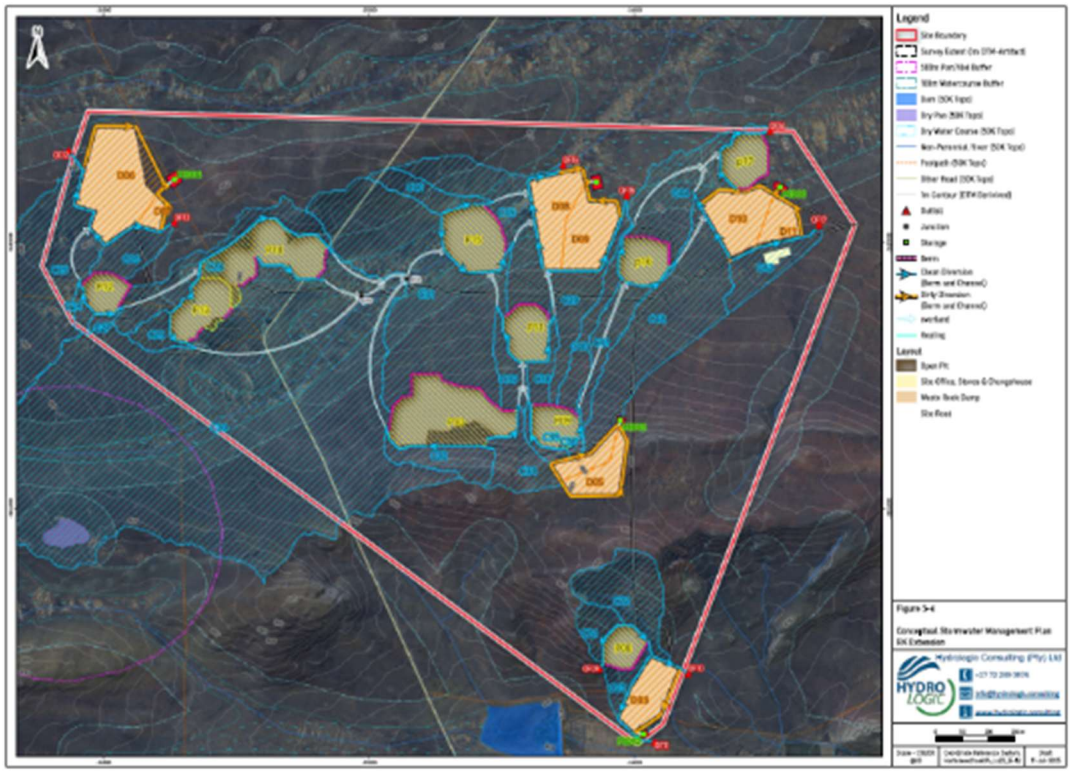


Figure 6-16. Conceptual Stormwater Management Plan – RK Extension.

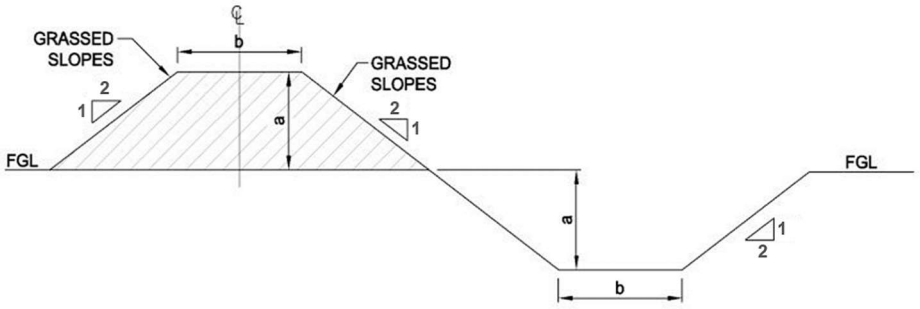


Figure 6-17. Typical Berm and Channel for Stormwater Diversion System.

6.5.3.4 Dirty Water System - Diversions

Dirty area diversions have been designed to ensure dirty water generated on the operation is contained. These systems will typically consist of a berm and channel component routing to a PCD. The berm and channel component have been designed to accommodate the 1:50 year RI storm event and serve two main purposes:

- Diverting upstream clean water which would otherwise flow into the identified dirty areas.
- Contain dirty water in the identified dirty areas and direct it towards the appropriate dirty water containment facility.

Figure 6-17 represents a typical dirty water containment berm and channel. The side slopes for all berms and channels have been kept constant at 1 vertical: 2 horizontal. A minimum channel dimension of 0.5m channel depth and 1.0m channel base breadth has been used to simplify the design. The indicated construction dimensions and flows may differ from the final, depending on the construction method, the location of diversions and the additional detail included in the detailed design. The diversion dimensions should consequently be reviewed during the detailed design phase.

6.5.4 Mitigating external radiation from tailings material

External radiation from TSFs and mineralised rock dumps is a radiological hazard in addition to dust and radon. A RESRAD dose assessment, using a conservative U-238 decay chain concentration of ≤16 Bq/g, evaluated the shielding effect of soil covers of varying thickness (0.01 m, 0.1 m, and 1 m). The analysis showed that a 1-meter soil cover offers sufficient protection against external radiation (Table 6-16). However, the cover's effectiveness against radon depends on specific soil characteristics.

Table 6-16. Shielding against external radiation on a TSF surface

External radiation sensitivity analysis of soil cover thickness		
0.01 m cover layer	0.1 m cover layer	1 m cover layer
24.27(mSv/yr)	8.24 (mSv/yr)	< 1(mSv/yr)

6.5.5 Stock Theft

Within 6 months of the issuing of the mining right a procedure on stock theft management should be developed for implementation. It should be noted however that most employees would be brought to the various mining sites by small bus/kombi. Access protocols would be implemented to ensure that management know which employees are on site or not at any given moment.

Recruitment, medical evaluation and training certification will not be undertaken at the mining sites but rather in Beaufort West at the LRP mine offices, thereby reducing the number of persons wanting to gain access to the site with the purpose of obtaining employment, thereby improving access control and preventing unauthorised persons from accessing the area.

6.5.6 The Health of Workers and Affected parties

Uranium itself is only slightly radioactive hoowever, radon, a radioactive gas, is released to the atmosphere in very small quantities when uranium ore is mined and crushed. Radon occurs naturally in most rocks - minute traces of it are present in the air which we all breathe and it is a significant contributor to the natural radiation dose that we all receive. Because it is airborne, special care must be taken to ensure that mine worker exposure, especially in poorly ventilated mines, is limited.

The proposed LRP open pits will naturally be well ventilated while the proposed underground mining areas will be ventilated with powerful fans. Radon levels must be maintained at a safe level and must be monitored on an ongoing basis.

Gamma radiation may also be a hazard to those employees working close to high-grade ores. It comes principally from uranium decay products in the ore, so exposure will be regulated as required by the National Nuclear Regulator. Adequate dust suppression is also vital as it represents the main potential exposure to alpha radiation.

Radiological protection of employees during the mining and milling of uranium ores that will be required at part of the COR's include:

- Good forced ventilation systems.
- Efficient dust control.
- Limiting the radiation exposure of workers within the LRP, so as low as reasonably possible, and that does not exceed the allowable dose limits set by the NNR.
- The use of radiation detection equipment including personal dose badges.
- Imposition of strict personal hygiene standards for workers.

6.6 Rehabilitation

6.6.1 General Mine Closure Objectives

It is acknowledged that the Ryst Kuil mining right application area is arid in nature and poses great difficulties in terms of rehabilitation objectives.

Objective: To minimise all impacts of mining on the receiving environment during and after the mine closure.

Specific goals:

- To manage the effects of the mining activities on the environment using the Best Available Technology.
- To minimise the effects of mining activities by keeping all mining related development and infrastructure within the footprint boundaries of the operational site as depicted in this EIA/EMP.
- To return the area to as close as possible to its pre-mining environment upon closure.
- To return as much of the impacted areas to as close as possible to grazing potential.

Action plan

6.6.1.1.1 Office Complex

The Office Complex includes but may not be limited to: temporary office containers, car ports, temporary change house, maintenance area and wash bay, emulsion silo's, septic tanks and French drains. All mobile office, store rooms and equipment must be removed from site unless it forms a specific part of the rehabilitation program. The concrete V-trench and wash bay surface will be demolished and removed from site.

Rehabilitation:

- Visual inspection of footprint after infrastructure removal to determine any visual indication of remedial action in terms of spillage or contamination.
- If required a soil contamination assessment should be conducted with the utilisation of BTex/TPH analysis where hydrocarbon related contamination may be suspected.
  Note: Soil contamination assessment can be implemented periodically during the operational phase to ensure any contamination is addressed promptly and adequately prior to the rehabilitation phase.
- Should contaminated soils be found, these should be removed and disposed of at hazardous waste.
- The soil surface should be ripped perpendicular to the slope and the topsoil replaced.
- Seeding should be conducted using a seed mix recommended for the area and must include pioneer species.
- Access to the rehabilitated area after top soiling and seeding must be restricted.

6.6.1.1.2 Haul Roads

Access to the operational areas will be required post closure for monitoring purposes as well as for medium term rehabilitation follow-up. For this reason the haul roads will initially be rehabilitated by ripping, top soiling, contouring and seeding a portion of the width of the road while leaving a 2,5m wide access track. This access track will be finally rehabilitated once a closure certificate has been issued by the DMR for the site and in consultation with the land owner.

Rehabilitation:

- Haul road rehabilitation must only be initiated once all large mining vehicles (yellow plant) has been removed from site.

- The project ECO must evaluate the surface prior to ripping and topsoil placement to ensure no material removal is required.
- Seeding should be conducted using a seed mix recommended for the area and must include pioneer species.
- Access to the rehabilitated area after top soiling and seeding must be restricted.

6.6.1.1.3 Waste Rock Dumps/Stockpiles

The waste rock dump is considered a post closure permanent landscape feature. It will be used for the placement of only barren (according to RP program monitoring) waste rock during the mining period. A lined pollution control dam collects any run-off from the rock dump and topsoil and overburden berms protect the perimeter of the waste rock dump.

Rehabilitation:

- The proposed overburden / waste rock dump sizes have been calculated by the project engineers in accordance with the pit and underground mining areas in each production area. It should however be noted that due to the 30-40% expansion/swell factor of overburden/waste rock versus pit volume, these rock dump footprints are considered a final post closure landscape feature. However, every effort should be made to minimise the number, footprint size and height of all waste rock dumps through maximising backfilling operations and ensuring efficiency in utilising waste rock dump footprint areas.
- The PCD must remain in place until such time that monitoring results demonstrate that it is no longer required. It can then be rehabilitated through the testing and appropriate removal of any remaining sediment in the PCD. This sediment should be disposed of in accordance with the outcomes of a contamination assessment. The liner should then be removed and disposed of correctly off site. The footprint of the PCD should then undergo a soil contamination assessment to determine if any material should be removed. The footprint can then undergo ripping, contouring, top soiling and seeding.
- During post closure monitoring it should be determined whether it is feasible to push the berms onto the toe of the waste rock dump to encourage vegetation growth on the rock dump toe. This opportunity should be evaluated by an appropriately experienced ECO and addressed in the final Rehabilitation Strategy Implementation Plan (RSIP) which must be submitted to the DMR and DWS.
- Post closure monitoring of waste rock dump impacts must be addressed in the revised monitoring plan appropriate to the closure phase and driven by the operational phase monitoring data.

6.6.1.1.4 Open Pits

The first waste rock that is mined will be placed on the waste rock dump. Open pits will be back-filled concurrently as part of operational mining processes. Once the first pit has been mined out, the material from the following pit will be placed back into the first pit and compacted pneumatically as part of the tipping operations.

Rehabilitation:

- Concurrent back-filling will be conducted.
- Compaction of pit backfill will be done via multi-pass ADT pneumatic compaction of single dump layers after dozing. No edge tipping or dozing must be conducted by the applicant.

- As presented in the SRK ground water report:
  If a pit lake is allowed to form at one down-gradient pit in all areas, then the modelling shows a slight decrease in plume area linked to the pit lakes showing a continuous drawdown of c.5 m below natural groundwater levels / recovery levels in the area (due to the effects of evaporation) and thus local groundwater advective flow is inward, which would therefore serve as a potential contaminant 'trap' or 'sink' and pits would never 'overtop';
- The final down-gradient pits will therefore be partially back-filled and shaped to remove high wall dangers but to leave a topographical depression which will provide a post closure ground water sink. These pit depressions do not require top soiling but this should be evaluated by the project ECO or another competent person during the closure RSIP revision.
- It is the express intention of this EMP to return as much of the operational footprint to a reasonably achievable degree of agricultural value. To this end a commitment is made to conduct rehabilitation testing on the back-filled pit footprints. This testing may include both natural vegetation seeding as well as agricultural cover crops such as Lucerne. An arid landscape rehabilitation specialist should be consulted during this testing phase. Outcomes of these tests must be presented to the DMR as part of the annual revision of the rehabilitation plan.
- Seeding should be conducted using a seed mix recommended for the area and must include pioneer species.
- Access to the rehabilitated area after top soiling and seeding must be restricted.

The perimeter fence around the operational area is anticipated to remain in place into post closure as stock and anthropogenic access should be controlled.

6.6.1.1.5 Underground Mining Areas

All underground mining areas are planned to extend from adits within the high walls of open cast pits. Once an underground section has been completed and no further mining is anticipated underground, then the adit must be sealed. Adit closure must incorporate a reinforced concrete cap/wall of adequate strength over the adit entrance to ensure that backfilled material does not enter the underground stoping during backfilling of the open cast pits.

Ventilation shafts that are no longer required should also be sealed. Above ground level infrastructure must be removed from the ventilation shaft and a concrete cap placed over the ventilation shaft adequate to ensure no access to the shaft.

6.6.1.1.6 Bore hole Rehabilitation

A "Clean as You Go" approach will be implemented. This policy enables the rehabilitation team to initiate cleaning and removal of drill chips within 72 hours of the completion of drilling. The positive benefit of this approach has already been evident in the flora surrounding the bore hole. Re-growth of existing shrubs has been visible within 7 days of Phase 1 Rehabilitation.

Responsibilities of this team will include:

- Re-establishment of topsoil contours at bore hole sites;
- Removal of any remaining solid waste;
- Removal and remediation of all hydrocarbon spills;
- Maintaining a "before and after" photographic record of remediated sites;
- Reporting of any non-conformances at bore holes (e.g. collapsed holes);
- Removal of any remaining samples or sampling material; and
- Weekly reporting of progress.

A final rehabilitation Phase will be entered into once all prospecting operations (including down-hole surveying) have been concluded on these properties. Re-seeding of disturbed topsoils at a completed bore hole site in Haane Kuil have been tested. Results of this test have indicated that more significant hand scarifying of bore hole sites may be required.

Full time final rehabilitation teams will be established which will consist of Beaufort West residents. Monitoring of the success of this final rehabilitation Phase will continue for a period of 24 months after rehabilitation has been completed to ensure re-establishment of natural vegetation. In addition to natural succession, ripping/scarifying and re-seeding of areas will also be conducted once no further prospecting related disturbance is anticipated. This final Phase of rehabilitation will include the following:

Bore Hole Sites

- A final inspection of each bore hole site;
- Removal of any solid waste or hydrocarbon spills that remain after the initial rehabilitation Phase;
- Final re-establishment of topsoil contours where non-conformities are noted;
- The removal of all PVC collar pipes below the finished top soil level;
- Plugging and capping of all drilled bore holes;
- Plugging and capping of bore holes will involved cutting off the PVC collar that remains just below finished ground level. The hole will then be plugged using two PVC bags filled with a liquid-to-solid expansion foam ("*A-B Foam*") mix to a depth of 1m. The top of the bore hole will then be covered with topsoil.
- Areas around bore holes that remain bare during the 12-month monitoring period will be ripped/scarified and seeded as described below ("Roads and Tracks").

6.6.1.1.6.1.1 Roads and Tracks

- Pre-existing roads will be inspected by a third party in cooperation with the land owner and those areas that require further rehabilitation will be identified;
- Where appropriate, prospecting access tracks will be ripped using a single blade plough. The area between the tracks will not be ripped. The process of ripping will involve raising the plough blade every 4-5m to reduce the effects of erosion within ripped lines;
- These ripped areas will be seeded with natural vegetation;
- Monitoring of the re-establishment of vegetation on rehabilitated tracks and roads will be conducted for a period of 24 months;
- A contractor agreed upon between the land owner and LUKISA will be used for all road and track rehabilitation.

6.6.1.1.6.2 Infrastructure

- Any damage to existing farm infrastructure such as gates, gate and fence posts, fence wire etc will be repaired or replaced at the expense of LUKISA.
- Removal of prospecting related infrastructure will be conducted in conjunction with the planned rehabilitation procedures and in cooperation with the land owner.
- All infrastructure will be removed from site before final rehabilitation and in accordance with all related procedure documents.

6.6.1.1.6.3 Special Considerations

Special consideration will be given to the rehabilitation of bore hole positions located near any of the identified sensitive areas on these farm portions; and

No plant or animal species shall be removed or transplanted on any of the farm portions, however if identified red data species are found to occur at proposed bore hole positions, the necessary permit/s from DEADP will be applied for to remove and transplant these species.

6.6.1.2 Confirm specifically that the environmental objectives in relation to closure have been consulted with landowner and interested and affected parties.

Liaison with the land owners of the Ryst Kuil application areas has been ongoing. Various one-on-one meetings as well as focus group meetings have been conducted. During the DEIR public comment period, these specific environmental objectives will be presented to and discussed with all the applicable land owners.

These closure objectives will be communicated to IAP's over a 30-day comment period during August 2025. All comments, concerns or questions will be recorded in the Consultation Report update.

Implementation of the rehabilitation plans as described and depicted in the plan below is expected to result in the following post closure land form/outcomes:

- The waste rock dumps will remain as a permanent post closure land form. The rock dump will not be covered as insufficient topsoil is available for such covering. Backfilling of pits must be maximised in order to minimise the final elevation and footprint of the waste rock dump. The final elevation and footprint should not exceed the authorised scale. It is recommended that any additional legal utilisation of waste rock (e.g. aggregate sales for offsite civil construction) be considered in order to minimise this post closure land form.
- With the exception of the most southerly pit potentially being partially backfilled (i.e. a shaped depression) in order to establish a localised ground water sink, all other pits are planned to be backfilled to pre-mining contours. Top soil bund walls will be spread and contoured and immediate land cover seeding and potentially irrigation must be implemented to facilitate establishment of vegetation. The EAP and specialist team acknowledge the difficulty of the rehabilitation process in an arid environment and it is recommended that locally available specialist input/advice/oversight be engaged by the applicant.
- Adits are to be sealed using a 3m thick concrete plug,

- Haul roads will be rehabilitated leaving only enough narrow (2,5m) track for LDV access to the rehabilitation sites for long term monitoring and follow up rehabilitation work. Any internal fences along haulage routes must be removed during decommissioning.
- Final land cover of some or all disturbed areas will be based on the results of the test work conducted on backfilled and top soiled pits. It is anticipated that either natural endemic plant species will be seeded or lucern lands planted (see request from land owner above).
- Perimeter fencing is anticipated to remain in place effectively mitigating grazing pressure of the rehabilitated areas until monitoring result outcomes demonstrate that either all impacted areas can be grazed of selected areas can be made available for grazing.
- The TSF should be capped. Closure of the TSF will require that dust generation is controlled and that an adequate barrier to the emission of radon222 be constructed as a final capping layer. Various characterisation data are required to confirm the assumed current capping thickness of 1m, consisting of 0.7m of reconstituted mudrock and 0.3m of protection sandstone dumprock. This capping thickness is deemed conservative, but should additional characterisation indicate that a thicker cap is necessary, sufficient mudrock sandstone dumprock is available on site to accommodate this.

Post closure monitoring forms an integral part of the above actions and outcomes and must inform the decision-making process in the annually reviewed Rehabilitation Strategy Implementation Plan (RSIP).

6.6.1.3 Provide a rehabilitation plan that describes and shows the scale and aerial extent of the main mining activities, including the anticipated mining area at the time of closure.

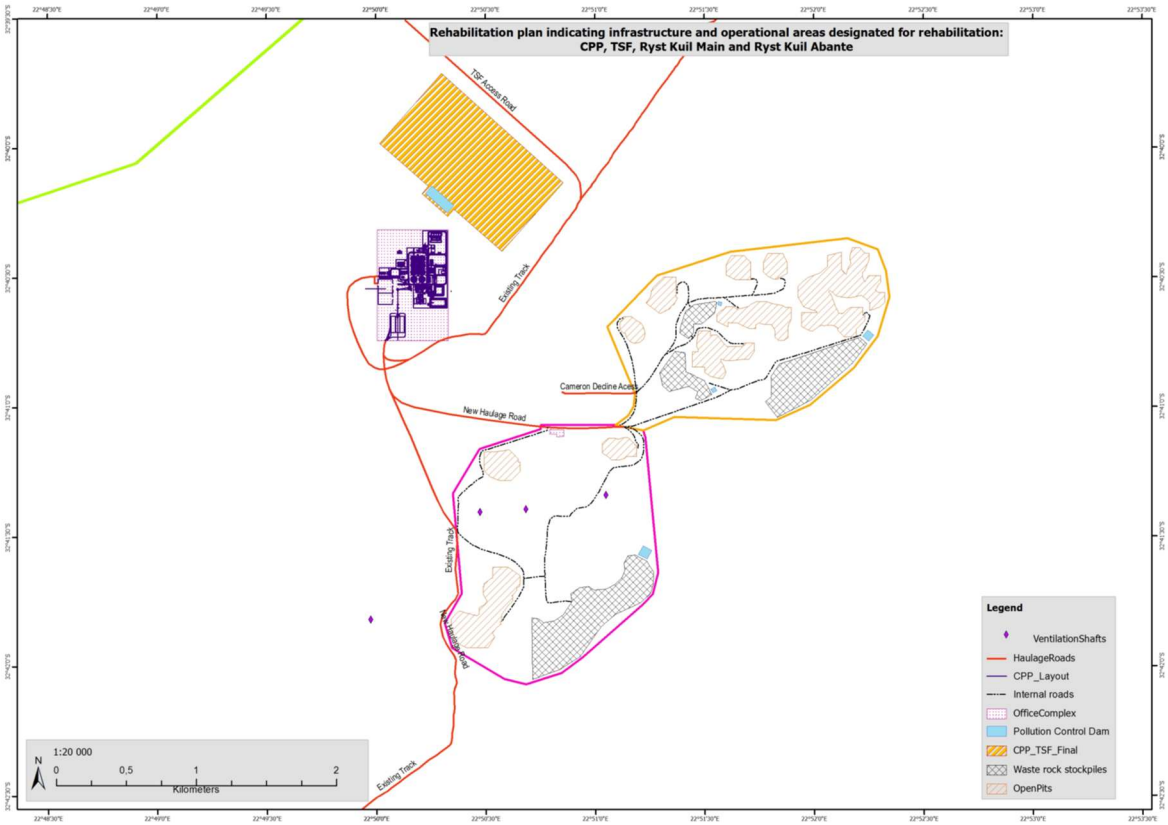


Figure 6-18. Rehabilitation plan indicating infrastructure and operational areas designated for rehabilitation within the Ryst Kuil Main, Plant and Ryst Kuil Abante area.

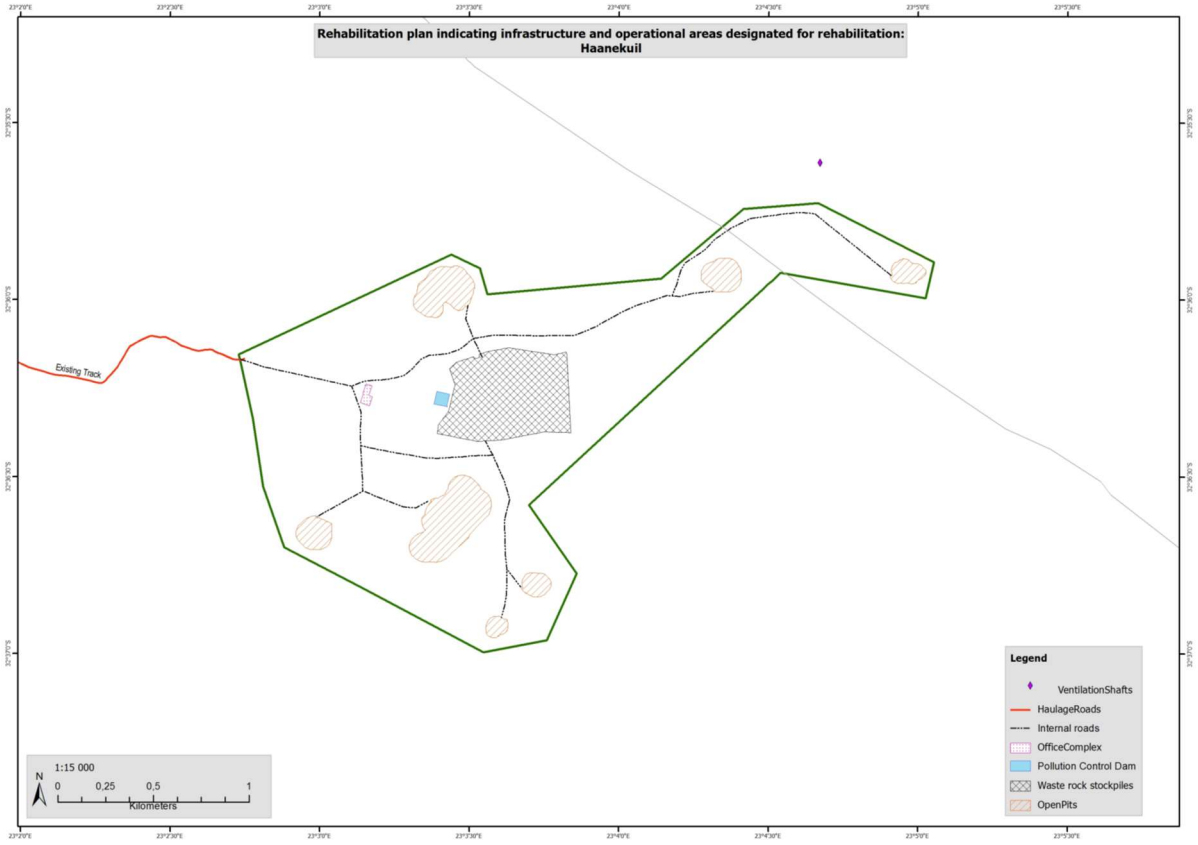


Figure 6-19. Rehabilitation plan indicating infrastructure and operational areas designated for rehabilitation Within the Haanekuil operational area.

6.6.1.3.1 Explain why it can be confirmed that the rehabilitation plan is compatible with the closure objectives.

As described above, the rehabilitation plan requires the back-filling of all open cast pits with a final shaped void for ground water management. Re-vegetation will be tested even though the growth phases in the Karoo biome are extremely slow. As described above the other impacted areas will also be ripped and rehabilitated. These rehabilitation actions are driven not only to provide a safe post closure land form but to minimise post closure environmental impacts and maximise post closure land capability.

6.6.1.3.2 Calculate and state the quantum of the financial provision required to manage and rehabilitate the environment in accordance with the applicable guideline.

The Financial Provision calculated and committed to for this mining right application amounts to **R 80 781 807.00 excl VAT** for Year 1 of operations which will be provided as a financial guarantee. The Life of Mine Financial Provisioning quantum has been calculated as **R 258 459 832.00 excl VAT.** The supporting data and explanation for these quantum calculations is provided in the EIA above.

6.6.1.3.3 Confirm that the financial provision will be provided as determined.

The required quantum for the project will be provided for, in a form of either a bank guarantee from a South African registered bank, in terms of Regulation 53 (1)(b) of the MPRDA, 2002 or a DMR approved insurance policy guarantee.

Lukisa Invest 100 Pty Ltd will annually review the quantum for the financial provision of the mine in terms of Regulation 54(3) of the MPRDA, 2002. Depending on the outcomes of the review, annual contributions will be adjusted to ensure that sufficient funds are available for rehabilitation during the decommissioning, closure and post closure phases. An adjusted guarantee will be submitted annually to the Department of Mineral Resources.

7 Mechanisms for monitoring compliance with and performance assessment against the environmental management programme and reporting thereon, including

SOURCE ACTIVITY	PARAMETERS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS	METHOD	REPORTING AND RECORDS
Surface Water (when available)	EC, PH, TDS, total hardness, total alkalinity, Uranium, Ca, Mg, Na, K, Cl, SO_4, F, Fe, Mn, U, Al, turbidity and Carbonates.	As per DWS water quality guideline: Livestock watering	Water Sampler: SANAS accredited lab / contractor	Quarterly according to SANAS accredited lab's schedule	1l plastic bottles for taking of samples	- E-Database - Mine Specific folder - Hard copies on Mine Specific folders
Surface water	Contamination of the watercourses and adjacent dams by spills from chemicals used to clean or maintain the facility's assets	Inspection	Contractor / ECO / Water Scientist	Monthly / After major spill event	Do spot checks on cleaning equipment checklists / storage facilities. Collect & analyse water quality parameters at specified monitoring points	- Water monitoring points should be located both upstream and downstream of the proposed development site to ensure any impacts can be identified with appropriate responsive mitigation measures implemented.
An increase in impervious areas, in the form of internal access roads and service infrastructure	All footprint areas must remain as small as possible and vegetation clearing to be limited to what is essential to ensure as much indigenous vegetation is retained. Vegetated berms to be placed along the downslope	To reduce the rates of increased surface flow velocity, thus decreasing the risk of erosion and sediment reaching the natural water resources	Contractor / ECO	Weekly	Assess and document vegetation growth around site infrastructure.Record areas of erosion, subsidence, or soil loss.	- E-database - Hard copies on Mine Specific folders

SOURCE ACTIVITY	PARAMETERS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS	METHOD	REPORTING AND RECORDS
	of infrastructure, so slow the accelerated runoff from hardened surfaces.				Ensure surface runoff is adequately channelled.	
Pollution control dams	0.8m free board.	Visual / mechanical	ECO – daily monitoring	Daily monitoring. Should free-board decrease, water to be used for dust suppression.	Automatic or digital reading devise or manual.	- E-Database
Tailings Storage Facility (TSF)	Leak detection man holes Freeboard Beach surface area Penstock height	Visual inspection and digital recording of water levels in accordance with TSF Manual	TSF Manager/Trained individual delegated by the TSF Manager/ECO	Daily/weekly/monthly monitoring as per TSF Manual. Deviations reported immediately to supervisor/management	Visual & digital measuring/ surveying	- E-database - Hard copies on Mine Specific folders
Groundwater: Boreholes selected based on the Ground Water specialist report and in consultation with the DWS which will form part of the WUL.	Field - Ph - EC Laboratory - Ca, Mg, Na, K, NO_3, Cl, SO_4, F, Fe, Mn, U, Al, Alkalinity & Carbonates - pH, EC, TDS - Petroleum hydrocarbon cont. - *E.Coli*, faecal coliforms for potable water	As per DWS water quality guidelines	Water Sampler: SANAS accredited lab / contractor. If locally trained ECO then oversight by qualified contractor.	Quarterly according to SANAS accredited lab's schedule	3lt PVC down hole sampler, 1l PET bottles for sample containment. Electronic dip meter.	- E-Database - Mine Specific folder - Hard copies on Mine Specific folders
Soil	- pH - N, P, K and OM content	As per soil management plan	Environmental Manager / Superintendent, Consultant	During rehabilitation operations, aftercare and vegetation audits	Soil Auger, plastic bags	- Mine Closure Aftercare folder
Potable Water	- E-Coli	Water management	Water Sampler	As and when necessary	Glass bottles for taking of samples	- Mine Specific folder - Hard copies on Mine Specific folders

SOURCE ACTIVITY	PARAMETERS REQUIRING MONITORING PROGRAMMES	FUNCTIONAL REQUIREMENTS FOR MONITORING	ROLES AND RESPONSIBILITIES (FOR THE EXECUTION OF THE MONITORING PROGRAMMES)	MONITORING AND REPORTING FREQUENCY and TIME PERIODS FOR IMPLEMENTING IMPACT MANAGEMENT ACTIONS	METHOD	REPORTING AND RECORDS
Vegetation	Species composition, pasture structure and vigour. Invasive species	As per soil management plan; Alien Vegetation management plan.	Consultant	Two yearly		- Mine Closure Aftercare folder
Erosion	- Tonnes / ha / year	As per soil management plan	Environmental Officer/Consultant	During all and any site visits of all operational areas.		- Mine Closure Aftercare folder
Noise	dB: environmental baseline impact dB: occupational exposure limit (occupational)	In accordance with the recommendations of the AIA	Department of Labour Approved Inspection Authority (AIA Consultant)	Two yearly assessment or as and when noise character is changed.	Type II sound level meter	Environmental and Occupational Noise Impact Assessment reports maintained by mine doc control
Fall Out Dust (fugitive dust)	- mg/m^2/day	In accordance with SANAS and DEDEA guidelines – see Air Quality Assessment Report	SANAS accredited lab / contractor	Monthly	Dust fall-out (buckets)	- Database - Mine Specific folder - Hard copies on Mine Specific folders
Radiation	Radon, Ground water (uranium concentration); Biological samples; Airborne dust	Conditions as approved as part of the COR issued by the NNR	NECSA	Parameter varies from daily to quarterly.	Each parameter methodology as per IAEA requirements	- NNR reporting - Database - Hard copies on Mine Specific folders
Heritage	Legislated parameters as described in the National Heritage Resources Act (Act 25 of 1999)	No deviation outside HWC recommendations. In the absence of guidance from HWC the guidance of the specialist Report	ASAPA Registered Professional Archaeologist	As required during the construction and operational phase	Visual inspection by ASAPA Registered Professional Archaeologist	All reports provided by ASAPA Registered Professional Archaeologist maintained by mine.
Environmental performance	EMPr	EMPr	External assessment practitioner	Annual	Site inspection and review of monitoring records	Report submitted to DMR, copy held by the mine
Water management	WUL	WUL	External auditor	As per WUL	Site inspection and review of water monitoring records	Report submitted to DWS, copy retained by the mine
Biodiversity	Alien vegetation	BAP	Botanist or qualified assessor	BAP, Alien vegetation management plan	Site inspection	Report submitted to DAFF & DMR

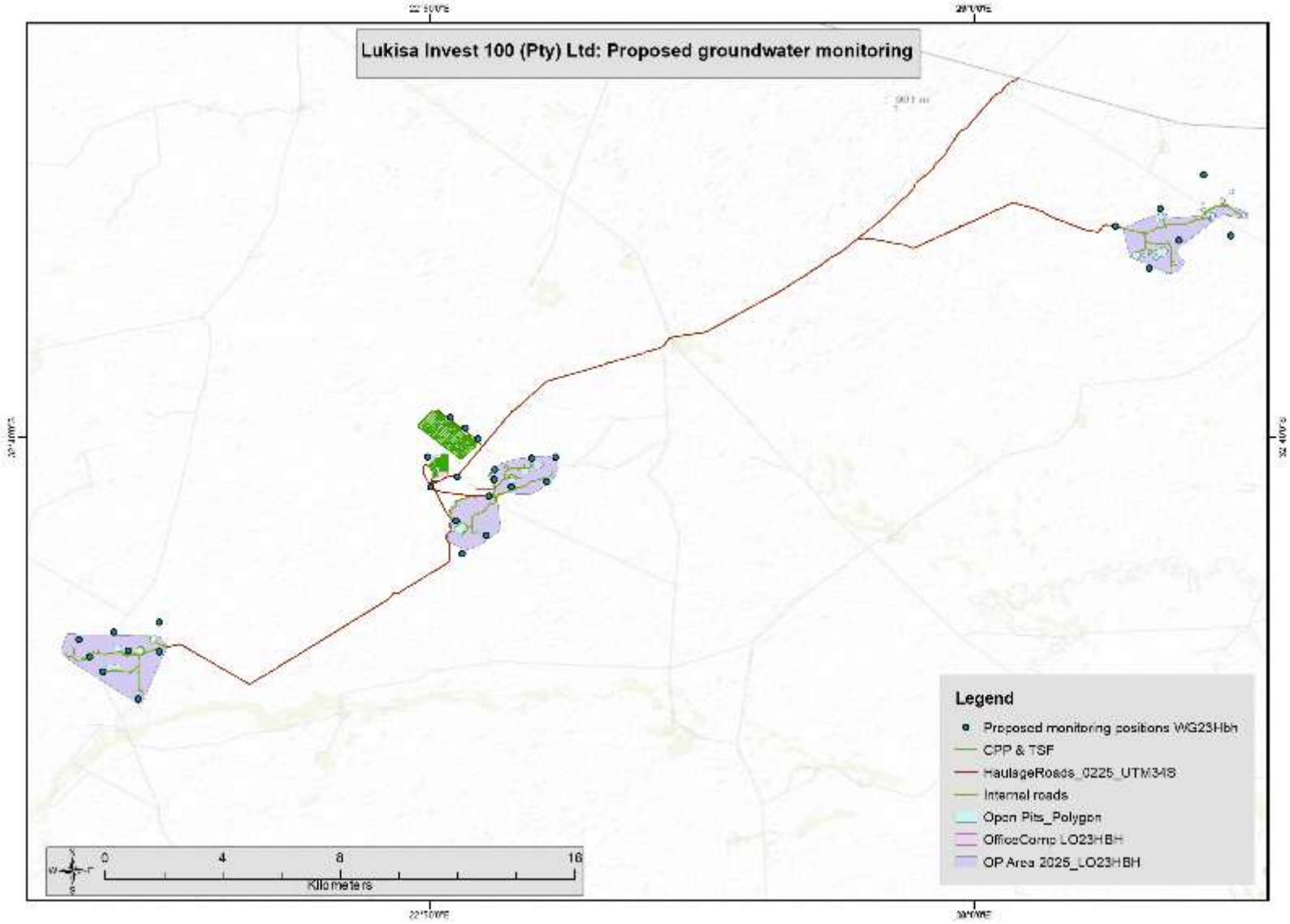


Figure 7-1. Proposed groundwater monitoring positions.

7.1 Indicate the frequency of the submission of the performance assessment report.

An EMP Performance Assessment Audit Report should be submitted to the governing authority every year (annually).

7.2 Environmental Awareness Plan

7.2.1 Manner in which the applicant intends to inform his or her employees of any environmental risk which may result from their work.

In terms of section 39 (3) (c) of the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002), LUKISA must compile and implement an environmental awareness plan. The above-mentioned environmental awareness plan must describe the way the mine will inform their employees of any environmental risk which may result from their work and the way the environmental risk will be addressed to avoid pollution or/and degradation of the environment. This document therefore concerns the details of the environmental awareness plan TVLJVC as required by the Mineral and Petroleum Resources Development Act, 2002 (Act 28 of 2002).

In view of the above, an environmental awareness plan is developed and explained in more detail below.

Note that the responsible person will revise these environmental awareness procedures from time to time. The date of commencement of the revised procedure will always be indicated to prevent confusion, in this case after the issuing of mining right to Lukisa. This Environmental Awareness (Standard Training Procedure) sets out the mine's training objectives regarding environmental awareness. It is a stand-alone procedure, which serves to improve awareness, training and competency in the environmental field. It contains no detail on the actual training initiatives but rather serves to ensure that a responsible person is appointed to deal with and increase environmental awareness on the mine.

Scope

This Environmental Training Standard Procedure sets out the mine's training objectives regarding environmental awareness. It is a stand-alone procedure, which serves to improve awareness, training and competency in the environmental field. It contains no detail on the actual training initiatives but rather serves to ensure that a responsible person is appointed to deal with and increase environmental awareness on the mine.

Objectives

The following are the objectives set for this standard procedure:

- To explain and aid the personnel involved in training with regards to the Environmental Management System (EMS);
- To clarify the EMS training and ensure that all employees are correctly instructed with regards to the environment.

Safety risks associated with activity

There were no hazards identified in applying this standard procedure.

Responsibilities

In the case where there is no training department on site, a responsible person should be identified (Mine Manager, Environmental Officer or Consultant) to ensure that the objective of this procedure is met.

Legal requirements

The following legislation and standards apply to this Standard Procedure:

- Employment Equity Act 55 of 1998 – AREAS WHERE EMPLOYMENT EQUITY ARE DEFINED, INCLUDING TRAINING & DEVELOPMENT
- National Environment Management Act 77 of 1998 – RECOMMENDATIONS FOR INSTITUTIONAL CO-OPERATION
- Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) – DEVELOPMENT OF AN ENVIRONMENTAL AWARENESS PLAN

Activity procedures

Induction Programme

An Induction Programme, which will include environmental awareness programme, will be established for the mine. During the training sessions, various topics will be discussed such as, but not limited to: Water Pollution Prevention, Good Environmental Housekeeping etc. Through the Induction Programme, the mine manager, safety officer, or any other responsible appointed person shall ensure that all staff receives training in:

- Administrative requirements and procedures, which will include the Environmental Emergency Procedures.
- Resource conservation and environmental reporting and general environmental awareness for mine related environmental issues.

All employees (including contractor employees) will undergo Induction. This induction includes training and awareness on environmental issues on the mine and is compulsory for all new employees. The induction programme will, as mentioned above, have an environmental management component. On an annual basis, the environmental section of the induction gets updated to ensure that it is up to date.

Consideration should be given to:

- Significant environmental impacts as identified in the EMP
- Procedures: environmental awareness and emergency procedures
- Trends in incidents
- Trends in audit findings

Trainee needs

The identification of environmental training and environmental awareness needs are derived from an analysis of the role different categories of employees play at the mine. The following categories are considered, viz:

- Senior Management
- Middle management (Environmental Officers)
- Supervisors
- Operators
- Visitors and contractors

Each of these categories has different responsibilities and therefore has different knowledge requirements and environmental awareness training needs to obtain that knowledge.

Training Planning

Identified and agreed training needs shall be included in budgets. Course attendance (other than at the internal induction courses) shall be scheduled on the basis of the importance of task contribution to the maintenance, effectiveness and improvement of the objective.

- General environmental awareness training

General awareness training will be offered to operators, processors and the other various sections of the mine during the safety toolbox talks. This will be conducted on rotational basis.

New environmental awareness topics are determined and new topics are introduced after all the shifts have received training/awareness on the current topic. The following will be undertaken to ensure that the above awareness training is conducted:

- A monthly environmental awareness topic for discussion will be distributed to all mine sections. These topics will be discussed at the safety toolbox talks, by SHE (Safety, Health and Environmental) representatives /environmental officers if available.
- The topics will also be displayed on the notice boards of all mine sections
- Ad hoc environmental awareness sessions to various departments/sections will be conducted on request. The presentations will focus on the environmental issues relevant to individual tasks.

- Job specific environmental awareness training

Job specific training will be developed to address urgent training needs as identified/required. The training material will focus on the following:

- Waste prevention and control (implementation of the waste management procedure).
- Water management (Leaking pipes and taps)
- Hydrocarbon and chemical spill reporting and clean up
- Storing and handling of chemicals
- Rehabilitation
- Dust management on the mine
- Speed limits on unsurfaced roads

Supervisory staff within specific mine sections will be equipped with the necessary knowledge and information to guide their employees on environmental aspects applicable in performing a specific task.

- Competency training

Management (training official/environmental officer if available) is responsible for the environmental competency and awareness training of middle management and supervisors. This training will be conducted on both a one to one basis and through workshops. If required, external organizations may be requested to provide training to selected employees (e.g. EMP auditing).

Competence and the effectiveness of training and development initiatives will be determined through the following:

- Trend analysis and reporting
- Analysis of work areas during visits and audits

- Trend analysis of monthly incidents (or zero tolerance if available) as recorded per mine sections.

Specific competency requirements:

Mine Geologist: Fossil identification and monitoring of excavations for fossil discovery (presented by paleotologist)

Certification

Photocopies of certificates issued after completion of a training course shall be maintained in the staff member's file and Management records

Records

Environmental awareness and training records will be kept at a safe and accessible place on site.

7.2.2 Manner in which risks will be dealt with to avoid pollution or the degradation of the environment.

The effective implementation of controls and mitigation measures as described by the various specialist inputs are paramount to the adequate control of risks. It is the endeavour of Tasman Lukisa JV Company and its contractors to adequately implement all planned controls and mitigation measure that are reasonable and practicable in order to minimise risk.

Evaluation of the effectiveness of these mitigation measures is determined through the process of monitoring and checking. It should also be noted that the reporting of the effectiveness of controls (i.e. the monthly/quarterly and annual environmental reports) is only worth recording if the recommendations of such reports are actioned.

7.3 Emergency Preparedness and Response Procedures

An environmental emergency is an unplanned event, which has the potential to result in a significant adverse environmental impact and/or could result in legal liability to the mining right holder in terms of environmental legislation requirements. Based on experience in environmental compliance in the mining industry in South Africa, the following are considered the most likely potential environmental emergencies:

- Hydrocarbon/HCS spills or leaks
- Surface fires, including possible veld fires
- Explosions
- Spillage or leak from wash bay silt trap and/or PCD
- Overflow of the wash bay and or waste rock dump PCD
- Flooding of operational area
- Transportation accident involving ore or diesel

The conditions in a COR cover aspects of radiation protection such as the following:

- radiation hazard assessments for workers;
- operational radiation protection of the workforce;
- prospective and operational safety assessments to determine the impact on public health and the environment;
- radioactive waste management;
- transportations of radioactive material;
- physical security;
- occurrences and emergency planning;
- operational limitations; and
- a radiation protection quality management system.

Procedures for managing environmental related emergencies, is explained in more detail below. Note that the responsible person will revise these procedures during the construction and operational phases of the mining process. The date of commencement of the revised procedures will always be indicated to maintain document control.

Introduction

The procedure describes the process to be followed to report and deal with emergencies, which may occur on the property. An effective, comprehensive, well-considered and tested environmental emergency preparedness and response plan has the potential to save lives, prevent unnecessary damage to company and other property and to manage environmental risk.
This standard procedure aim is to identify potential for and respond to accidents and emergency situations, and for preventing and mitigating the environmental impacts that may be associated with them. Below are the objectives of the above-mentioned procedure:

- To ensure quick and controlled response to environmental emergencies using correct personnel and equipment.
- To prevent incidents from becoming more extensive through the timeouts contact and arrival of trained personnel on site.
- To establish a management mechanism from which a range of safety, environmental and health issues can be dealt with should they arise

Purpose of the procedure

To provide guidance to all employees and contractors in the event of an environmental emergency at Ryst Kuil application area or related to its activities.

This procedure is developed to provide guidance to ensure that:

- Danger to the environment, personnel, contractors and non-employees are minimised.
- Legal liability is managed and minimised.
- Public relations are effectively managed during and following emergency

- Reporting is effective and corrective/follow-up actions are implemented

This procedure contains information relevant to all employees and contractors. It is the responsibility of all employees to familiarise themselves with the contents of this procedure. Furthermore, mine management should ensure that all contractors have access to this procedure and the requirements contained herein.

Legal requirements

The following legislations below listed were identified for emergency response activities in the mining industry. These legislations require that government department be kept informed of incidents and accidents:

- Regulation 51 of the Regulations under the Minerals and Petroleum Resources Development Act, 2002 (Act 28 of 2002) – PROCEDURE FOR ENVIRONMENTAL RELATED EMERGENCY AND REMEDIATION.
- Mine Health & Safety Act 29 of 1996 – MANNER OF REPORTING AND KEEPING OF INFORMATION REGARDING INCIDENTS & EMERGENCIES.
- Occupational Health & Safety Act 85 of 1993 – EMPLOYEE REQUIREMENTS TO REPORT INCIDENTS WHERE ACTIVITY HAS OCCURRED
- Section 30 NEMA (Act 107 of 1998)
- Section 20 NWA (Act 59 of 1998)
- Regulations in Terms of Section 36, Read with Section 47 of The National Nuclear Regulatory Act, 1999 (Act No. 47 Of 1999), On Safety Standards and Regulatory Practices (SSRP).

Responsibilities

Mine Management

Management is responsible for the safety and wellbeing of employees working at the Ryst Kuil application area as well as the protection of the environment from unnecessary negative impact. The management of the mine has a responsibility to initiate a warning process should an emergency occur or should something at the mine site deteriorate in an uncontrolled manner presenting a risk to employees, the public or the environment.

General Mine Manager

It is the responsibility of the General Manager to appoint a person or persons to review and audit the activities as covered by the scope of this Procedure. The Mine Manager or his appointed representative shall ensure that the audits are being conducted systematically and at regular defined intervals. The General Manager shall further ensure that the person nominated to perform audits of the emergency system, are given all the necessary assistance and facilities to conduct the task effectively.

Local Government

Local government have the responsibility to warn residents of a hazardous situation, these warnings must be based on information provided by the mine.

All employees, contractors and other relevant parties

All employees, contractors and other relevant parties should ensure that they are familiar with this procedure.

Notification process

There are six main steps in managing an emergency, from the identification of the situation to final close off. They are as follows:

- Find and identify
- Ensure human safety
- Reporting
- Containment and clean-up
- Corrective action
- Monitoring

Emergency equipment and supplies

There will be a directory of emergency equipment and other supplies on site as well as person/s responsible for the equipment.

Communication systems

Communication is critical during an emergency on site so that efforts to manage the situation are coordinated to produce the desired results. The communication channels that will be available on site will include:

- Hand-held radios
- Cellular phone

Emergency preparedness and response training

The management will ensure that employees are trained on emergencies that might occur at the Ryst Kuil operation.

Monitoring and activity procedure

Method of emergency activity identification

The above listed typical environmental emergencies were identified through the compilation of the Environmental Impact Assessment and Environmental Management Programme (This document) and from previous mine environmental management experiences. During the operation, the mine management will ensure that measures are put in place to ensure that other possible environmental emergency activities and radiation procedures according to COR requirements are identified.

Review and revision

During the mining operation several emergency response drills will be carried out and recorded (minimum of one per section every year). Emergency response drills will normally be carried out during operational hours to

best evaluate the response and involve the highest number of employees. These are at the discretion of the General Manager and Site/section Manager and may involve one or more of the emergency activities listed in this standard procedure. Emergency response drills should not be of the same type unless significant problems were experienced with the previous drill.

Regular auditing and questioning of the key personnel involved in emergency response will also be conducted. This will take the form of planned task observations (PTO). It is the responsibility Site/Section Manager to undertake these PTO's on a regular basis and record the response.

Information from PTO's and drills will be collated and assessed. Alterations and modifications to the Emergency Response Procedure will also be conducted after the response drill evaluation. This task will be performed in co-ordination with the Section/Site Manager to which the drill applies. A report will be generated, which will be distributed to the parties concerned for review and remedial action. Any significant problems will be addressed by altering the response plan in this procedure.

Response during an emergency situation while transporting uranium oxide concentrate.

It will be necessary to transport the uranium oxide concentrate (yellow cake) on public roads. For emergency response purposes, the uranium oxide concentrate is no different from the other classes of dangerous goods transported on public roads. Hazards are communicated by marking, labelling, placarding and documentation. Transport must comply with the International Atomic Energy Agency transport regulations and the NNR has to authorise the mine's transport and emergency response procedure.

In the case of a spillage during shipment of the uranium concentrate product, the release or leakage of any material is treated as per any other dangerous goods or heavy metal concentrate in accordance with the mine's emergency response procedures. Actions during such occurrence:

- The first priority is to rescue any injured personnel;
- Non–critical personnel should be excluded from the area;
- The spilt material should be contained (covered to prevent dusting, bunding of area to reduce washdown);
- Plant, equipment and personnel being excluded from accessing the incident area;
- Basic PPE, e.g. respirator, goggles, gloves, disposable overalls) provide all the necessary protection required for responder safety;
- Clean up will vary according to the scale of the spill but could be as easy as requiring manual collection of spilt material; and
- The NNR, the local emergency response authority and the consignor must be informed of any incident involving a spillage of material.
    - Reporting must include a description of the accident
    - The magnitude, quantification of on- and off-site radiation hazard conditions and
    - Mitigation measures implemented.

The mine's radiation protection personnel will carry out radiation monitoring to delineate the area of contamination in the unlikely event that material escapes from containers during the accident, as well as monitoring after removal of spilled material to confirm removal of all surface contamination.

Emergency Response flowchart

The emergency response at the Ryst Kuil operation will be undertaken as shown in Figure 7-2 below.

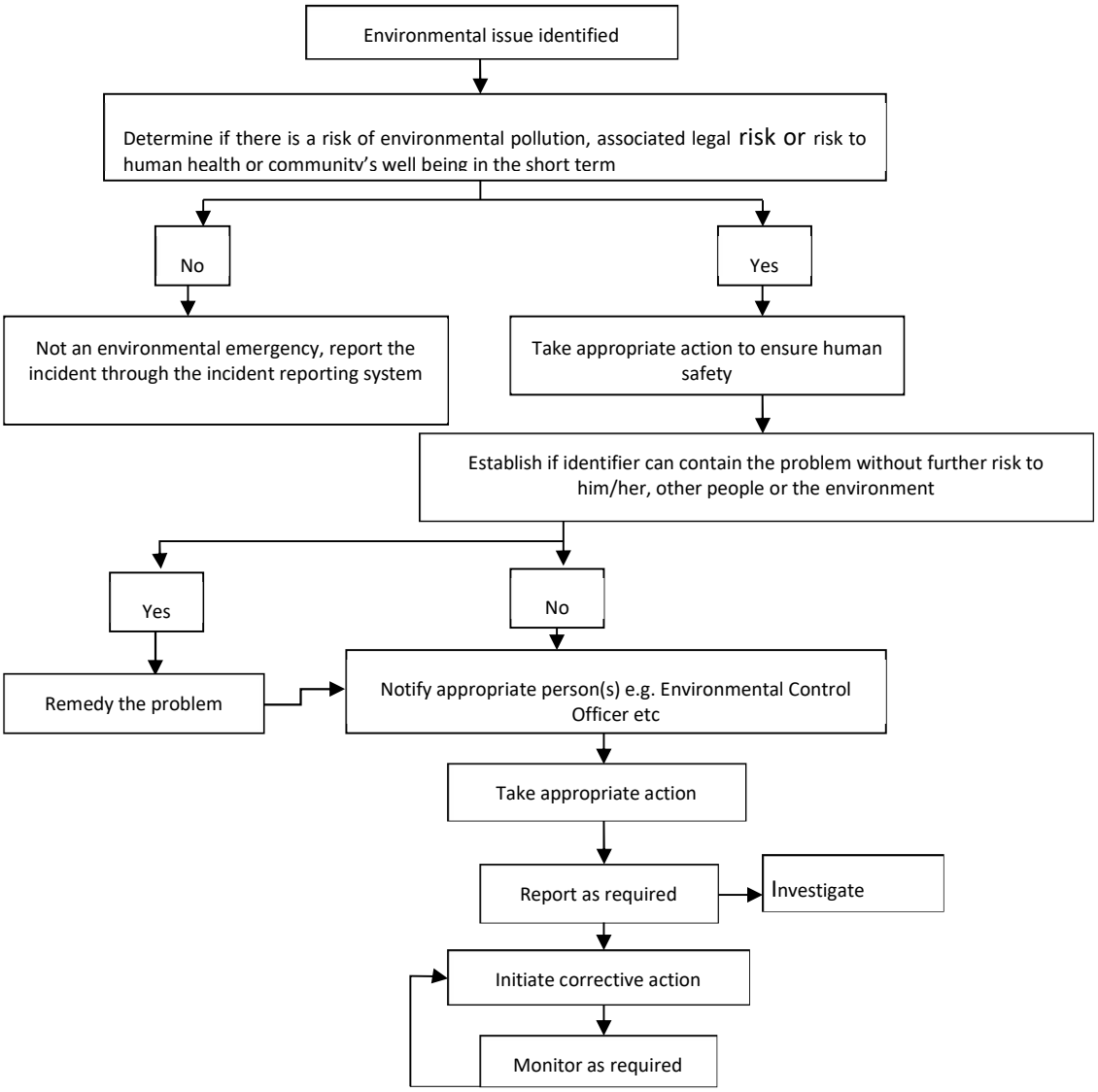


Figure 7-2. Emergency Response flowchart.

7.4 Specific information required by the Competent Authority

The EMPr Compliance Audit Report will be compiled on an annual basis and submitted to the DMR. The Financial Provisioning will be reviewed annually by the applicant and submitted to the DMR.

An emissions monitoring plan is recommended to monitor the actual impact of particulate emissions on the environment throughout the duration of the project. The remote location of the project allows for dust fallout monitoring as per SANS 1137:2012 to be implemented to monitor the impact of this project on dust fallout in the region. Ideally, such a monitoring programme starts prior to the construction phase of the project to establish a baseline of emissions

8 UNDERTAKING

8.1 Undertaking

Confirm that the undertaking required to meet the requirements of this section is provided at the end of the EMPr and is applicable to both the Environmental Impact Assessment report and the Environmental Management Programme report.

I, ... the undersigned and duly authorised thereto by Lukisa Invest 100 (Pty.) Ltd. have studied and understand the contents of this Environmental Impact Assessment and Environmental Management Programme and duly undertake to adhere to the conditions as set out therein.

Signed at .....on this .....day of .....20…..

.....

Signature of applicant

Designation

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