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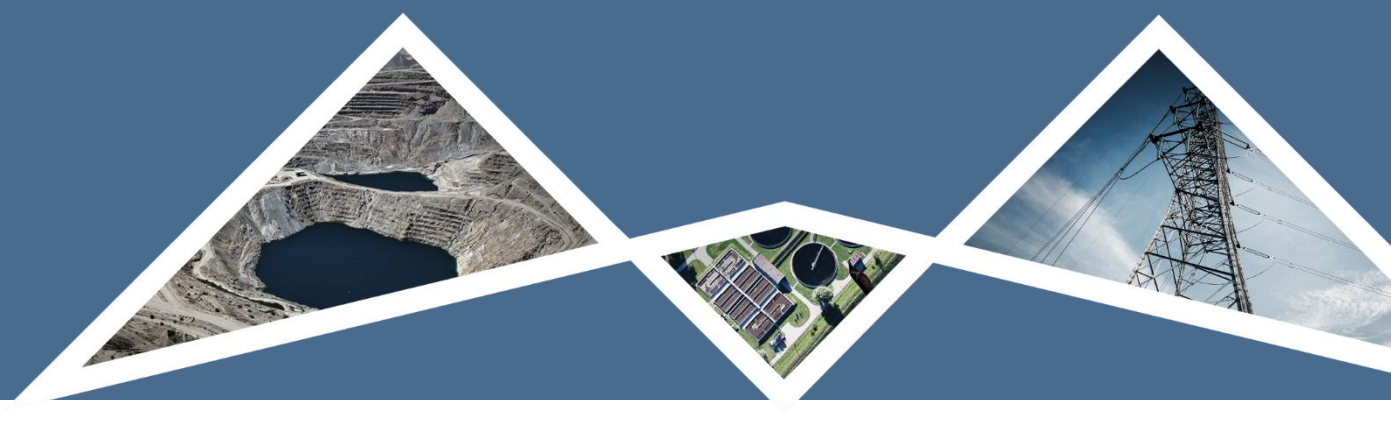
T 011 789 7170 E info@eims.co.za W www.eims.co.za

ENVIRONMENTAL SCOPING REPORT

MOTUOANE PRODUCTION RIGHT APPLICATION

PASA Ref: PR 12/4/016



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CHECKED:	Liam Whitlow		2025/12/12
AUTHORIZED:	Liam Whitlow		2025/12/12

REVISION AND AMENDMENTS

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ACRONYMS AND ABBREVIATIONS

2D	Two-dimensional
AA	Administrative Authority
AWD	Accelerated Weight Drop
BID	Background Information Document
CA	Competent Authority
CBA	Critical Biodiversity Area
CBL	Cement Bond Log
CMA	Catchment Management Agency
CO	Carbon Monoxide
CR	Critically Endangered
CSIR	Council for Scientific and Industrial Research
DEA	Department of Environmental Affairs
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
DMPR	Department of Mineral and Petroleum Resources
DWA	Department of Water Affairs
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Electrical Conductivity
ECA	Environmental Conservation Act
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd.
ELWU	Existing Lawful Water Use
EMPR	Environmental Management Program
EMS	Environmental Management System
EN	Endangered
EPF	Exploration and Production Forum
ER	Environmental Risk
ESA	Ecological Support Area
ESO	Environmental Site Officer
FEPA	Freshwater Ecosystem Priority Area
FIT	Formation Integrity Test
GA	General authorisation

GIS	Geographic Information Systems
GNR	Government Notice Regulation
GPS	Global Positioning System
Ha	Hectare
HIA	Heritage Impact Assessment
Hz	Hertz
I&AP's	Interested and Affected Parties
IDP	Integrated Development Plan
IEP	Integrated Energy Plan
IUCN	International Union for Conservation of Nature
LC	Least Concern
MAE	Mean Annual Evaporation
mamsl	meters above mean sea level
MAP	Mean Annual Precipitation
MP	Marginally Protected
MPRDA:	Mineral and Petroleum Resources Development Act
MT	Magnetotellurics Survey
NAAQS	National Ambient Air Quality Standards
NEMA	National Environmental Management Act
NEMAQA:	National Environmental Management: Air Quality Act
NEMBA	National Environmental Management: Biodiversity Act
NEMWA:	National Environmental Management: Waste Act
NFEPA	National Freshwater Ecosystem Priority Areas
NGDB	National Groundwater Database
NHRA	National Heritage Resources Act
NO_2	Nitrogen Dioxide
NPAES	National Protected Area Expansion Strategy
NT	Near threatened
PASA	Petroleum Agency South Africa
PM	Particulate Matter
PM_{10}	Particles with a diameter of 10 micrometers or less
PM_{20}	Particles with a diameter of 2.5 micrometers or less.
PPP	Public Participation Process
Ptn	Portion
RE	Remaining Extent
SAHRA	South African Heritage Resources Agency

SAHRIS:	South African Heritage Resources Information System
SANBI	South African National Biodiversity Institute
SANS	South African National Standards
SAPAD	South African Protected Areas Database
SCC	Species of conservation concern
SEI	Site Ecological Importance
SO_2	Sulphur Dioxide
TC	Total concentration
TDS	Total Dissolved Solids
TOPS	Threatened and Protected Species
TVD	True Vertical Depth
VOC	Volatile Organic Compounds
VU	Vulnerable
WMA	Water Management Area
WUL	Water Use Licence

GLOSSARY OF TERMS

This section provides a catalogue of terms and definitions, which may be used in this report and, or other documents drafted for the project.

Table 1: Glossary of terms.

Term	Definition	Reference
Clearing/Clearance	Clearing/Clearance refers to the removal of vegetation through permanent eradication and in turn no likelihood of regrowth. 'Burning of vegetation (e.g., fire- breaks), mowing grass or pruning does not constitute vegetation clearance, unless such burning, mowing or pruning would result in the vegetation being permanently eliminated, removed or eradicated'.	**Department of Environmental Affairs, 2017. Clearance of Indigenous Vegetation Explanatory Document**
Competent Authority	In respect of a listed activity or specified activity, means the organ of state charged by this Act with evaluating the environmental impact of that activity and, where appropriate, with granting or refusing an environmental authorisation in respect of that activity.	**National Environmental Management Act (NEMA), 1998 (Act 107 of 1998) as amended, NEMA 1998 hereafter**
Construction	According to the regulations this term is defined as – the building, erection or establishment of a facility, structure or infrastructure that is necessary for the undertaking of a listed or specified activity but excludes any modification, alteration or expansion of such a facility, structure or infrastructure and excluding the reconstruction of the same facility in the same location, with the same capacity and footprint'. In this application, construction refers to the site establishment, seismic surveys and drilling activities.	**NEMA, EIA Regulations, 2014, as amended**
Critical Biodiversity Area	Areas that are deemed important to conserve ecosystems and species. For this reason, these areas require protection.	**SANBI**

Term	Definition	Reference
Decommissioning	means to take out of active service permanently or dismantle partly or wholly, or closure of a facility to the extent that it cannot be readily recommissioned;	**NEMA, EIA Regulations, 2014, as amended**
Environment	the surroundings within which humans exist and that are made up of— the land, water and atmosphere of the earth; (ii) micro-organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.	**National Environmental Management Act 1998 (Act No. 107 of 1998), as amended, NEMA hereafter**
Environmental Authorisation	This is a decision by a Competent Authority to authorise a listed activity in terms of the National Environmental Management Act (NEMA). The authorisation means that a project, either in totality or partially, can commence subject to certain conditions. The Competent Authority has a right to refuse to grant authorisation for a project in totality or partially.	**NEMA, EIA Regulations, 2014, as amended**
Environmental Assessment Practitioners	The individual responsible for the planning, management, coordination or review of environmental impact assessments, strategic environmental assessments, environmental management programmers or any other appropriate environmental instruments introduced through regulations.	**NEMA, 1998**
Fatal Flaw	An environmental or social negative impact that is not possible to mitigate and significant enough to prevent the scheme from being able to be implemented.	**NEMA, 1998**
Fauna	Animal life that occurs in a specific geographical region and/habitat.	**SANBI**
Flora	plant life that occurs in a specific geographical region and/habitat.	**SANBI**
Indigenous vegetation	Refers to vegetation consisting of indigenous plant species occurring naturally in an area, regardless of the level of alien infestation and where the topsoil has not been lawfully disturbed during the preceding ten years.	**NEMA, EIA Regulations, 2014, as amended**
Interested and Affected Parties (IAPs)	a) any person, group of persons or organisation interested in or affected by such operation or activity; and (b) any organ of state that may have jurisdiction over any aspect of the operation or activity.	**NEMA, 1998**
Protected Area	A protected area is a clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.	**International Union for Conservation of Nature (IUCN)**
	These are areas aimed at the protection and conservation of areas which are ecologically viable and have high biodiversity. Example of Protected Areas include but are not limited to National Parks, Nature Reserves, world heritage sites and marine protected areas	**National Environmental Management: Protected Areas Act, 2003 (Act No. 57 of 2003)**
Public Participation Process	In relation to the assessment of the environmental impact of any application for an environmental authorisation, means a process by which potential Interested and Affected Parties are given opportunity to comment on, or raise issues relevant to, the application.	**NEMA, 1998, as amended**
Regulated Area of a watercourse	An area for which a General Authorisation or a Water Use Licence would need to be obtained prior to undertaking any activities.	**National Water Act 36 of 1998**

Term	Definition	Reference
Screening	Screening determines whether or not a development proposal requires environmental assessment, and if so, what level of assessment is appropriate Screening is therefore a decision-making process that is initiated during the early stages of the development of a proposal.	**NEMA, EIA Regulations, 2014, as amended**
Species of Conservation Concern	IUCN Red List definition: Threatened species, and other species of significant conservation importance: Extinct, Extinct in the Wild, Near Threatened, Data Deficient. In South Africa, the following additional categories are added: Rare, Critically Rare.	**SANBI**
Watercourse	Watercourse refers to: (a) a river or spring; (b) a natural channel in which water flows regularly or intermittently; (c) a wetland, lake or dam into which, or from which, water flows; and (d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.	**National Water Act 36 of 1998**
Wetland	Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil	**National Water Act 36 of 1998**

EXECUTIVE SUMMARY

1.1 INTRODUCTION AND OVERVIEW

Motuoane Energy (Pty) Ltd (Motuoane) (hereafter referred to as the applicant) holds an Exploration Right (ER315) for hydrocarbons, granted in terms of Section 80 of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 – MPRDA, as amended) on the 19th of October 2018. The then Department of Mineral Resources and Energy (DMRE) issued an Environmental Authorisation (EA – reference number: 12/3/315) to Motuoane in terms of the National Environmental Management Act (Act 107 of 1998 – NEMA).

The originally approved exploration area is located over an area of approximately 149 377 hectares (ha), covering various farms near the city of Welkom, within the Free State Province, extending north from approximately Theunissen, northeast towards Kroonstad, and east of Virginia and Hennenman. Motuoane were subsequently required to relinquish part of their ER land position during their second renewal which reduced the ER footprint to approximately 95 483 ha, a decrease of over 50 000 ha less than the originally approved area. In accordance with the National Environmental Management Act (Act 107 of 1998 – NEMA) an application for amendment of the EA through a Scoping and EIA process was submitted to Competent Authority in 2024 to undertake an additional ten new exploration boreholes, approximately 30 km of new onshore seismic transects, and amend the approved Environmental Management Programme (EMPr). The amended EA was granted in terms of Regulation 33 of the NEMA EIA Regulations on the 31st of October 2024.

The applicant wishes to convert a portion of their existing Exploration Right area (ER315) into a Production Right (PR). The proposed extraction and production will target helium and methane gas, and will consist of up to 43 production wells, gas gathering pipelines, a helium recovery and gas processing plant (CNG and/or LNG) and associated infrastructure. In addition, ongoing exploration activities will include drilling of exploration wells, seismic and/or audio magnetotelluric surveys. The proposed production right application area covers a total of ~14 440 hectares. The proposed project will involve the following activities:

- Pre-drilling seismic and/or audio magnetotelluric surveys to optimize well locations for maximum deliverability;
- Drilling and completion of wells;
- Maintenance workovers of wells;
- Construction of gas gathering pipeline systems;
- Installation of gas compression and processing facilities;
- Construction of a helium recovery facility (gas or liquid helium) and gas (methane) processing plant (CNG and/or LNG); and
- Construction of associated infrastructure including roads, communications facilities and temporary accommodation facilities, if necessary.

The proposed project infrastructure triggers various listed activities in terms of the NEMA Listing Notices 1, 2 and 3 and a full Scoping and Environmental Impact Assessment process is being undertaken. The relevant Water Use Licence (WUL) and Air Emissions Licence (AEL) applications will be submitted where relevant for the triggers under the National Water Act (Act 36 of 1998 – NWA) and National Environmental Management Air Quality Act (Act 39 of 2004 – NEMAQA), respectively. Motuoane has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Independent Environmental Assessment Practitioner (EAP) to assist with undertaking the required assessment and authorisation processes (including the statutory public participation), and to compile and submit the required documentation.

1.2 PURPOSE OF THE SCOPING REPORT

The purpose of the scoping process is to:

- Identify the policies and legislation that are relevant to the activity;
- To motivate the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the preferred location;
- To identify and confirm the preferred activity and technology alternative through an impact and risk assessment and ranking;
- Where appropriate, to identify and confirm the preferred site, through a detailed site selection process, which includes an impact and risk assessment process including cumulative impacts and a ranking process of all the identified alternatives focusing on the geographical, physical, biological, social, economic, and cultural aspects of the environment;
- To identify the key issues to be addressed in the assessment phase;
- To agree on the level of assessment to be undertaken, including the methodology to be applied, the expertise required, as well as the extent of further consultation to be undertaken to determine the impacts and risks the activity will impose on the preferred site through the life of the activity, including the nature, significance, consequence, extent, duration and probability of the impacts to inform the location of the development footprint within the preferred site; and
- To identify suitable measures to avoid, manage, or mitigate identified impacts and to determine the extent of the residual risks that need to be managed and monitored.

1.3 NEEDS AND DESIRABILITY OF THE PROJECT

Helium has several unique properties with numerous applications that make it an essential and irreplaceable element for many industries. This is because it cannot be synthesised, manufactured or substituted in many cases. Helium is listed on the critical materials lists for several major economies. Helium is a vital resource, essential in modern technologies with major critical uses throughout the science, medicine and manufacturing industries. It is an inert gas for cryogenic, heat transfer, shielding, leak detection, analytical and lifting applications. It is the most important element in studying super-cold conditions in low-temperature physics studies. It is a critical component in the manufacturing process, specifically ones which serve unique high-tech applications in MRIs, fibre optics and semiconductor chip manufacturing. More recent uses include hybrid air vehicles, helium filled hard drives and nuclear fusion technology.

Helium is a non-renewable natural resource that is predominantly recovered as a by-product of natural gas production. Globally, helium occurs in economically recoverable concentrations at a limited number of locations, many of which are experiencing progressive depletion. Recent studies of the Virginia gas fields in the Free State Province indicate an unusually high helium concentration, suggesting a geologically distinctive resource when compared to most conventional gas fields. This characteristic presents a notable departure from prevailing global practice, as the proposed Motuoane development has the potential to prioritise helium as the primary product, with methane recovered as a secondary by-product. This approach contrasts with the conventional model, where helium recovery is contingent on sustained natural gas production. As international pressures to reduce fossil gas production increase, global helium supply is expected to decline accordingly. In contrast, the Virginia gas fields represent a scenario in which helium recovery is not dependent on large-scale gas production, positioning the resource as a potentially strategic source of helium. The economic need and desirability of the proposed development are underpinned by the current and projected demand for helium, which is widely recognised as strong and enduring due to its critical applications and limited substitutes. Available market indicators suggest that demand for helium is expected to remain robust over the medium to long term, thereby supporting the economic justification and desirability of the proposed production project.

In summary, production success would result in long-term benefits for South Africa consisting of access to new energy sources, improved security of supply, in-country investments in a development project and reduced

dependence on the importation of hydrocarbons. It should be noted that SA is pursuing a diverse energy mix which include significant renewable power generation.

1.4 PUBLIC PARTICIPATION

The public participation process for this application has been undertaken in accordance with the requirements of the NEMA EIA Regulations, and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

The PPP commenced on the 17th of November 2025 with an initial notification and call to register for a minimum period of 30 days. The initial notification was undertaken in English, Afrikaans and Sesotho and was given in the following manner:

- Registered letters, faxes, emails and sms's: Notification were distributed to all pre-identified I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that may be interested or affected.
- Advertisements describing the proposed project and EIA process were published in the Vista Newspaper with circulation in the vicinity of the study area. The initial advertisements were placed in the Vista newspaper in English, Afrikaans and Sesotho on the 20th of November 2025 with a government gazette published (also in 3 languages) on the 14th of November 2025.
- A1 Correx site notices in English, Afrikaans and Sesotho were placed at 50 locations within and around the application area from 17th to 19th of November 2025.
- A3 posters in English, Afrikaans and Sesotho were placed at local public gathering places in Virginia, Welkom, Ventersburg and Theunissen.

Notification regarding the availability of this Scoping Report for public review was given in the following manner to all registered I&APs:

- Registered letters with details on where the scoping report can be obtained and/or reviewed, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above; and/or
- Email notifications with a letter attachment containing the information described above.

The scoping report will be available for public review from the 23rd of January 2026 to 23rd of February 2026 for a period of at least 30 days.

1.5 IMPACT ASSESSMENT AND MITIGATION

The scoping-level assessment identified a range of potential environmental and socio-economic impacts associated with the construction, operation and decommissioning phases of the proposed Motuoane Production Right Project. The assessment was undertaken using a structured impact identification and screening methodology, taking into account the nature, extent, duration, intensity and probability of identified impacts, as well as the sensitivity of the receiving environment. Each of the identified risks and impacts at the various project phases were assessed.

Construction activities, including well pad establishment, access road construction and pipeline installation, may result in the disturbance or loss of natural vegetation, habitat fragmentation, and disturbance to fauna. Indirect impacts may include the introduction of alien invasive species and increased human activity within previously undisturbed areas. Mitigation will focus on impact avoidance and minimisation through micro-siting of infrastructure to avoid sensitive habitats, restriction of disturbance footprints, and implementation of rehabilitation measures. Alien invasive species management, controlled vehicle access, and post-construction

rehabilitation will be implemented. Biodiversity mitigation measures will be developed during the EIA phase, informed by specialist ecological assessments.

Potential impacts include alteration of surface drainage patterns, sedimentation of watercourses, and contamination risks associated with drilling activities, accidental spills or poor waste management. Wetlands and drainage lines may be particularly sensitive during construction. Buffer zones around watercourses and wetlands will be applied in accordance with best practice and specialist recommendations. Stormwater management controls, spill prevention measures, and emergency response procedures will be implemented. Where required, Water Use Authorisations will be obtained in terms of the National Water Act.

Groundwater impacts may arise from drilling activities, well integrity failure, or accidental contamination during handling and storage of drilling fluids and hydrocarbons. Groundwater is an important resource in the project area, particularly for agricultural and domestic use. Well design and construction will comply with recognised industry standards to ensure casing integrity and isolation of aquifers. Groundwater monitoring programmes will be implemented, and handling of hazardous substances will follow strict containment and spill prevention protocols. A groundwater management plan will be developed as part of the EIA phase.

Soil disturbance, compaction and erosion may occur during construction and operational activities. Loss of topsoil could affect agricultural productivity and rehabilitation success if not properly managed. Topsoil will be stripped, stockpiled and reused for rehabilitation. Erosion control measures will be implemented, including stabilisation of disturbed areas and rehabilitation following construction. Activities will be confined to approved footprints to minimise land degradation.

Potential air quality impacts include dust generation during construction and emissions associated with gas processing, flaring during commissioning or maintenance, and vehicle movements. Dust suppression measures will be implemented during construction, including water spraying where necessary. Gas handling and processing infrastructure will be designed to minimise emissions, and flaring will be limited to commissioning, maintenance and/or emergency scenarios where necessary. Where applicable, an Air Emissions Licence will be obtained in terms of the National Environmental Management: Air Quality Act.

Noise impacts may occur during drilling, construction and maintenance activities, potentially affecting nearby receptors such as farmsteads and rural communities. Noise-generating activities will be limited to daytime hours where feasible. Equipment will be maintained to minimise noise emissions, and noise monitoring may be implemented where sensitive receptors are present. A noise management plan will be developed if required.

Ground-disturbing activities may impact heritage or palaeontological resources that have not yet been identified. A Chance Finds Procedure will be implemented, and specialist heritage and palaeontological assessments will be undertaken during the EIA phase. Any identified resources will be managed in consultation with the South African Heritage Resources Agency (SAHRA) and relevant provincial authorities.

Positive socio-economic impacts include employment creation, skills development and local economic stimulation during construction and operation. Potential negative impacts may include land use conflicts, disruption to agricultural activities, and increased traffic on local roads. Engagement with landowners and affected communities will continue throughout the project life cycle. Local employment and procurement will be prioritised where feasible. Traffic management measures will be implemented to minimise disruption, and compensation arrangements will be agreed with affected landowners where applicable.

Health and safety risks may arise from construction activities, handling of hazardous substances, and operational processes. Compliance with occupational health and safety legislation will be enforced. Site-specific Health and Safety Plans, emergency response procedures and staff training programmes will be implemented throughout the project life cycle.

Cumulative impacts may arise from the proposed project in combination with existing and planned production/mining, energy and agricultural activities in the region, particularly in relation to land use, water resources and socio-economic change. Cumulative impacts will be assessed in detail during the EIA phase, informed by specialist studies and regional context. Mitigation measures will be aligned with broader land use planning and regulatory requirements.

The most significant risks and impacts identified were those that remain high in terms of significance even post mitigation measures being considered. The following preliminary identified impacts were determined to have a potentially moderate final significance at this stage:

- Negative impact on groundwater quality during operation and closure phases;
- Negative impact on identified wetlands and aquatic species;
- Negative impact on soils and agricultural activities;
- Negative impact on vegetation and habitats;
- Mortality / disturbance of terrestrial species; and
- Positive socio-economic impact through employment opportunities.

The negative impacts, in particular, will be further interrogated and assessed during the EIA phase of the project. Potential preliminary mitigation measures have been identified and will be refined based on input from the Environmental Assessment Practitioner (EAP), public consultation, and specialist assessments during the EIA phase of the project. The associated EMPr will identify appropriate mitigation mechanisms for avoidance, minimisation and / or management of the negative impacts and enhancement of the positive aspects.

1.6 ENVIRONMENTAL IMPACT STATEMENT

Based on the outcomes of the scoping process, no fatal flaws have been identified that would preclude the proposed Production Right development from proceeding. The Plan of Study for the EIA, including the proposed specialist studies, assessment methodology and public participation requirements for the next phase, is provided in **Section 12**. It is recommended that the application proceed to the EIA phase to enable a detailed assessment of identified impacts and to inform decision-making by the Competent Authority.

The following detailed specialist studies will form part of the EIA report:

- Agricultural Potential, Soils & Land Capability;
- Air Quality Assessement;
- Climate Change Assessment;
- Noise Impact Assessment;
- Archaeological and Cultural Heritage Assessment;
- Palaeontological Impact Assessment;
- Terrestrial Biodiversity Assessment;
- Aquatics and Wetland Assessment;
- Geohydrological Assessment;
- Hydrological Assessment;
- Social Assessment;
- Financial Provisions; and
- Quantitative Risk Assessment (QRA).

2 INTRODUCTION

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The proposed project infrastructure triggers various listed activities in terms of the NEMA Listing Notices 1, 2 and 3 and a full Scoping and Environmental Impact Assessment process is being undertaken. The relevant Water Use Licence (WUL) and Air Emissions Licence (AEL) applications will be submitted where relevant for the triggers under the National Water Act (Act 36 of 1998 – NWA) and National Environmental Management Air Quality Act (Act 39 of 2004 – NEMAQA), respectively. Motuoane has appointed Environmental Impact Management Services (Pty) Ltd (EIMS) as the Independent Environmental Assessment Practitioner (EAP) to assist with undertaking the required assessment and authorisation processes (including the statutory public participation), and to compile and submit the required documentation.

2.1 REPORT STRUCTURE

This report has been compiled in accordance with the NEMA EIA Regulations, 2014, as amended. A summary of the report structure, and the specific sections that correspond to the applicable regulations, is provided in **Table 2** below.

Table 2: Report structure.

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 2(1)(a):	Details of – i. The Environmental Assessment Practitioner (EAP) who prepared the report; and ii. The expertise of the EAP, including a curriculum vitae;	**Section 2.2** **Appendix B**
Appendix 2(1)(b):	The location of the activity. Including – i. The 21-digit Surveyor General code of each cadastral land parcel; ii. Where available, the physical address and farm name; iii. Where the required information in items (i) and (ii) is not available, the coordinates of the boundary of the property or properties;	**Section 3**
Appendix 2(1)(c):	A plan which locates the proposed activity or activities applied for at an appropriate scale, or, if it is – i. A linear activity, a description and coordinates of the corridor in which the proposed activity or activities is to be undertaken; or ii. On a land where the property has not been defined, the coordinates within which the activity is to be undertaken;	**Section 3**
Appendix 2(1)(d):	A description of the scope of the proposed activity, including – i. All listed and specified activities triggered; ii. A description of the activities to be undertaken, including associated structures and infrastructure;	**Section 4**
Appendix 2(1)(e):	A description of the policy and legislative context within which the development is proposed including an identification of all legislation, policies, plans, guidelines, spatial tools, municipal development planning frameworks and instruments that are applicable to this activity and are to be considered in the assessment process;	**Section 5**

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
Appendix 2(1)(f):	A motivation for the need and desirability for the proposed development including the need and desirability of the activity in the context of the preferred location;	**Section 6**
Appendix 2(1)(g):	A full description of the process followed to reach the proposed preferred activity, site and location within the site, including – i. Details of all alternatives considered; ii. Details of the public participation process undertaken in terms of regulation 41 of the Regulations, including copies of the supporting documents and inputs; iii. A summary of the issues raised by interested and affected parties, and an indication of the manner in which the issues were incorporated, or the reasons for not including them; iv. The environmental attributes associated with the alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; v. The impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts – a. Can be reversed; b. May cause irreplaceable loss or resources; and c. Can be avoided, managed or mitigated; vi. The methodology used in determining and ranking the nature, significance, consequences, extent, duration and probability of potential environmental impacts and risks associated with the alternatives; vii. Positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects; viii. The possible mitigation measures that could be applied and level of residual risk; ix. The outcome of the site selection matrix; x. If no alternatives, including alternative locations for the activity were investigated, the motivation for not considering such; and xi. A concluding statement indicating the preferred alternatives, including preferred location of the activity;	**Sections 7, 8, 9 and 10**
Appendix 2(1)(h):	A plan of study for undertaking the environmental impact assessment process to be undertaken, including – i. A description of the alternatives to be considered and assessed within the preferred site, including the option of not proceeding with the activity; ii. A description of the aspects to be assessed as part of the environmental impact assessment process;	**Section 12**

Environmental Regulation	Description – NEMA Regulation 982 (2014) as amended	Section in Report
	iii. Aspects to be assessed by specialists; iv. A description of the proposed method of assessing the environmental aspects, including a description of the proposed method assessing the environmental aspects to be assessed by specialists; v. A description of the proposed method of assessing duration and significance; vi. An indication of the stages at which the competent authority will be consulted; vii. Particulars of the public participation process that will be conducted during the environmental impact assessment process; and viii. A description of the tasks that will be undertaken as part of the environmental impact assessment process; ix. Identify suitable measures to avoid, reverse, mitigate or manage identified impacts and to determine the extent of the residual risks that need to be managed and monitored;	
Appendix 2(1)(i)	An undertaking under oath or affirmation by the EAP in relation to – i. The correctness of the information provided in the report; ii. The inclusion of comments and inputs from stakeholders and interested and affected parties; and iii. Any information provided by the EAP to interested and affected parties and any responses by the EAP to comments or inputs made by interested or affected parties;	**Section 14**
Appendix 2(1)(j):	An undertaking under oath or affirmation by the EAP in relation to the level of agreement between the EAP and interested and affected parties on the plan of study for undertaking the environmental impact assessment;	**Section 15**
Appendix 2(1)(k):	Where applicable, any specific information required by the competent authority; and	None
Appendix 2(1)(l):	Any other matter required in terms of section 24(4)(a) and (b) of the Act.	None

2.2 DETAILS OF THE EAP

EIMS has been appointed by Motuoane as the independent Environmental Assessment Practitioner (EAP) to prepare and submit the EA application, Scoping and EIA Reports, and undertaking a Public Participation Process (PPP) in support of the proposed production right within the existing Motuoane ER315 footprint. The contact details of the EIMS consultant and EAP who compiled this Report are indicated in **Table 3**.

Table 3: Details of the Environmental Assessment Practitioner.

EAP:	Mr. Sikhumbuzo Mahlangu
Tel No:	+27 11 789 7170
Fax No:	+27 86 571 9047
E-mail:	sk@eims.co.za
Professional Registrations:	• Registered Environmental Assessment Practitioner with Environmental Assessment Practitioner Association of South Africa – EAPASA (Reg. No: 2022/4554). • Professional Natural Scientist with the South African Council for Natural Scientific Professions – SACNASP (Reg. No: 400429/13).

In terms of Regulation 13 of the EIA Regulations, 2014, as amended, an independent EAP, must be appointed by the applicant to manage the application. EIMS is compliant with the definition of an EAP as defined in Regulations 1 and 13 of the EIA Regulations, as well as Section 1 of the NEMA. This includes, inter alia, the requirement that EIMS is:

- Objective and independent;
- Has expertise in conducting EIA's;
- Comply with the NEMA, the environmental regulations and all other applicable legislation;
- Considers all relevant factors relating to the application; and
- Provides full disclosure to the applicant and the relevant environmental authority.

EIMS is a private and independent environmental management-consulting firm that was founded in 1993. EIMS has in excess of 30 years' experience in conducting EIA's. Please refer to the EIMS website (www.eims.co.za) for further details of expertise and experience.

Sikhumbuzo holds a BSc. Master's degree in Zoology (Aquatic Health) from the University of Johannesburg. He is an aquatic and research scientist with over 2 years' experience, and over 15 years' working experience as an environmental scientist. He is a registered Environmental Assessment Practitioner (EAP) with the Environmental Assessment Practitioners Association of South Africa (EAPASA Reg. #2022/4554), a registered Professional Natural Scientist with the South African Council for Natural Scientific Professions (SACNASP Reg. #400429/13) and a registered Provisional Auditor with the Southern African Auditor and Training Certification Authority (SAATCA Reg #E5533). He has completed certificate courses in Environmental Management Systems (ISO 14001: 2015) and Environmental Law with the North-West University. He has also completed an advanced course on Tools for Wetland Assessments as well as Aquifer Hydraulics and Groundwater Monitoring. His expertise lies mainly in environmental impact assessments, environmental management, auditing, monitoring, surface and ground water quality assessments, biomonitoring, wetland assessments, reporting and project management. The Curriculum Vitae of the EAP responsible for the compilation of this Report is included in **Appendix B**.

2.3 PURPOSE OF THE REPORT

The purpose of the scoping phase is to understand the scope of the proposed project activities, gather information on the proposed site and establish an understanding of the study area and the receiving environment. This phase will also determine how the proposed activities will potentially impact on the environment. The assessment of feasible alternatives will be considered in this report. The report will further identify any Interested and Affected Parties in the study area, engage with such parties and relevant authorities and identify environmental issues and potential impacts. This Scoping report is intended to guide the EIA process and the required specialist studies by:

- Providing an overview of the legal requirements with regards to the proposed Motuoane PR project;
- Provide a project description of the proposed Motuoane PR project as well as the anticipated environmental and social impacts that will be further investigated in the EIA phase;
- Setting the scope for the EIA process as well as the Terms of Reference (ToR) for the proposed specialist studies; and
- Outlining the approach and methodologies to be used in the Scoping and EIA phase including the impact assessment methodology.

2.4 THE SCOPING AND EIA REQUIREMENTS

The list of activities applied for in terms of the NEMA EIA Regulations 2014 as amended is discussed in **Section 5.1.3.1**. These listed activities triggered by the proposed project must follow the required Environmental Impact Assessment process as required by the National Environmental Management (Act 107 of 1998) (NEMA) Environmental Impact Assessment (EIA) Regulations 2014, as amended. Based on these Regulations, a Scoping and EIA process must be followed. The Application Form was submitted to the Competent Authority (CA), the Department of Mineral and Petroleum Resources (DMPR), previously the Department of Mineral Resources and Energy (DMRE) through the Administrative Authority (AA), the Petroleum Agency of South Africa (PASA). The DMPR is the relevant CA stipulated in the 2014 NEMA EIA Regulations application procedures as the applicant is a private company and the proposed Motuoane PR is a mining application, thus, is in line with the identified activities which the Member of the Executive Council of the National Department of Forestry, Fisheries and the Environment (DFFE) has delegated to the DMPR as the CA.

2.5 SPECIALIST CONSULTANTS

One of the objectives of a Scoping Report is to identify the required specialist assessments to be undertaken during the EIA Phase. Based on a review of the National Web-Based Environmental Screening Tool Report (DFFE Screening Tool), EAP's Site Sensitivity Verification and review of available information, the following specialist assessments have been pre-identified as necessary assessments required for the Scoping (baseline) and EIA.

Table 4: Details of the specialist team.

Discipline	Consultant / Company
Agricultural Potential, Soils & Land Capability	The Biodiversity Company
Air Quality Assessment	Airshed Planning Professionals
Climate Change Assessment	Airshed Planning Professionals
Noise Impact Assessment	Enviro Acoustic Research
Archaeological and Cultural Heritage Assessment	EIMS (Pty) Ltd

Discipline	Consultant / Company
Palaeontological Impact Assessment	Banzai Environmental
Terrestrial Biodiversity Assessment	The Biodiversity Company
Aquatics and Wetland Assessment	The Biodiversity Company
Geohydrological Assessment	Gradient Groundwater Consulting
Hydrological Assessment	SMEC South Africa
Social Assessment	Equispectives Research and Consulting Services
Financial Provisions	EIMS (Pty) Ltd
Quantitative Risk Assessment (QRA)	Riscom (Pty) Ltd

The specialist studies listed above in **Table 4** will involve the gathering of data relevant to identifying and assessing preliminary environmental impacts that may occur as a result of the proposed project. These preliminary impacts were assessed according to pre-defined impact rating methodology (**Section 10.1**). Preliminary mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this Scoping Report and will be adjusted where relevant during the EIA phase once detailed assessments are concluded and input from the public has been considered. The specialist reports that informed this scoping level report will be made available in the EIA phase.

3 DESCRIPTION OF THE PROJECT AREA

Table 5 provides a description of the property details of the proposed Motuoane PR site as well as the distance to the nearest towns. The proposed project will be located within the Matjhabeng Local Municipality and Masilonyana Local Municipalities. See **Figure 1** and **Figure 2** for the locality of the proposed production right area.

Table 5: Locality details.

Property Area	The proposed project area is located southeast of the town of Welkom in the Free State Province of South Africa.	
Property Name, 21-digit Surveyor General Code	**Farm Name, Number and Portion**	**21-Digit Surveyor General Code**
	Detente Farm 744 Remaining Extent	F03500000000074400000
	Detente Farm 744 Portion 2	F03500000000074400002
	Detente Farm 744 Portion 3	F03500000000074400003
	Eureka 2101 Portion 0	F04200000000210100000
	Siberiasfontein 605 Portion 0	F04200000000060500000
	Doornnek,Farm 905 Portion 0	F04200000000090500000
	Gooi Die Hoed, Farm 5 Portion 1	F04200000000000500001
	Zoutfontein 841 Portion 0	F04200000000084100000
	Junctiondrift 217 Portion 1	F03500000000021700001
	Leeuwkuil 428 Portion 0	F03500000000042800000
	Azeka Farm 1019 Portion 0	F04200000000101900000
	Vruchtenfontein, Farm 94 Portion 0	F04200000000094200000
	Mazelspruit Farm 1 Portion 0	F04200000000000100000
	Mazelspruit Farm 1 Portion 2	F04200000000000100002
	Pieter's Gift Farm 1890 Portion 1	F04200000000038100001

	Pieter's Gift Farm 1890 Portion 1	F04200000000189000001
	Doornnek Farm 905 Portion 2	F04200000000090500002
	Mazelspruit, Farm 1 Portion 1	F04200000000000100001
	Pieter's Gift Farm 1890 Portion 0	F04200000000189000000
	Kriegers Kraal 708 Portion 0	F03500000000070800000
	Kriegers Kraal 708 Portion 1	F03500000000070800001
	Blomskraal 216 Portion 0	F03500000000021600000
	Detente Farm 744 Portion 1	F03500000000074400001
	Quaggafontein, Farm 3 Portion 0	F04200000000000300000
	Palmiet Fontein 229 Portion 1	F04200000000022900001
	Delaporte, Farm 887 Portion 0	F04200000000088700000
	Palmiet Fontein 229 Portion 0	F04200000000022900000
	Zanddraai Farm 58, Portion 1	F03500000000005800001
	Duikerbos 246 Portion 0	F03500000000024600000
	Beginsel 75 Portion 0	F03500000000007500000
	Randjesfontein Farm 297 Portion 0	F03500000000029700000
	Venters Paalmyn Farm 298 Portion 0	F03500000000029800000
	Azeka Farm 1019 Portion 1	F04200000000101900001
	Hazor Farm 381 Portion 0	F04200000000038100000
	Schoemanskop, Farm 654 Portion 0	F04200000000065400000
	Junctiondrift Farm 217 Portion 2	F03500000000021700002
	Le Roux 766 Portion 0	F03500000000076600000
	Le Roux 717 Portion 1	F03500000000071700001
	Siberiasfontein 605 Portion 1	F04200000000060500001
	Paardekuil Farm 228 Portion 0	F04200000000022800000
	Boschkop, Farm 227 Portion 0	F04200000000022700000
	Uithoek, Farm 847 Portion 5	F04200000000084700005
	Rietvallei Farm 4 Portion 4	F04200000000000400009
	Doornnek Farm 905 Portion 3	F04200000000090500003
	Mazelspruit Farm 1 Portion 4	F04200000000000100004
	Palmiet Fontein 229 Portion 2	F04200000000022900002
	Palmiet Fontein 229 Portion 3	F04200000000022900003
	Palmiet Fontein 229 Portion 5	F04200000000022900005
	Palmiet Fontein 229 Portion 4	F04200000000022900004
	Palmiet Fontein 229 Portion 9	F04200000000022900009
	Palmiet Fontein 229 Portion 6	F04200000000022900006
	Zoutfontein Farm 841 Portion 2	F04200000000084100002
	Zoutfontein Farm 841 Portion 1	F04200000000084100001
	Pieter's Gift Farm 1890 Portion 2	F04200000000189000002
	Palmiet Fontein Farm 229 Portion 8	F04200000000022900008
	Palmiet Fontein Farm 229 Portion 7	F04200000000022900007
	Rooiheuvel Farm 57 Portion 0	F03500000000005700000
	Junctiondrift, Farm 217 Portion 0	F03500000000021700000
	Lelievlei 407 Portion 0	F03500000000040700000
	Bosrand Farm 228 Portion 0	F03300000000022800000
	Junctiondrift Farm 217 Portion 3	F03500000000021700003
	Zanddraai Farm 58 Portion 0	F03500000000005800000
	Doornnek Farm 905 Portion 1	F04200000000090500001
	Pieter's Gift Farm 1890 Portion 3	F04200000000189000003

Application Area (Ha)	The Motuoane PR is approximately 14 440 ha.
Magisterial District	The project area falls within the Matjhabeng and Masilonyana Local Municipalities, Lejweleputswa District Municipalities.
Distance and direction from nearest towns	The site boundary is ~15km south east of the town of Virginia, ~28km south east of the town of Welkom, ~13km south west of the town of Ventersburg and ~21km north east of the town of Theunissen. The geographic coordinates at the approximate centre of the application area are 28°14'38.37"S and 26°57'54.97"E
Surrounding land uses	Neighbouring land-use in the surrounding of the proposed project comprises predominantly of agriculture activities with mining activities to the southwest.

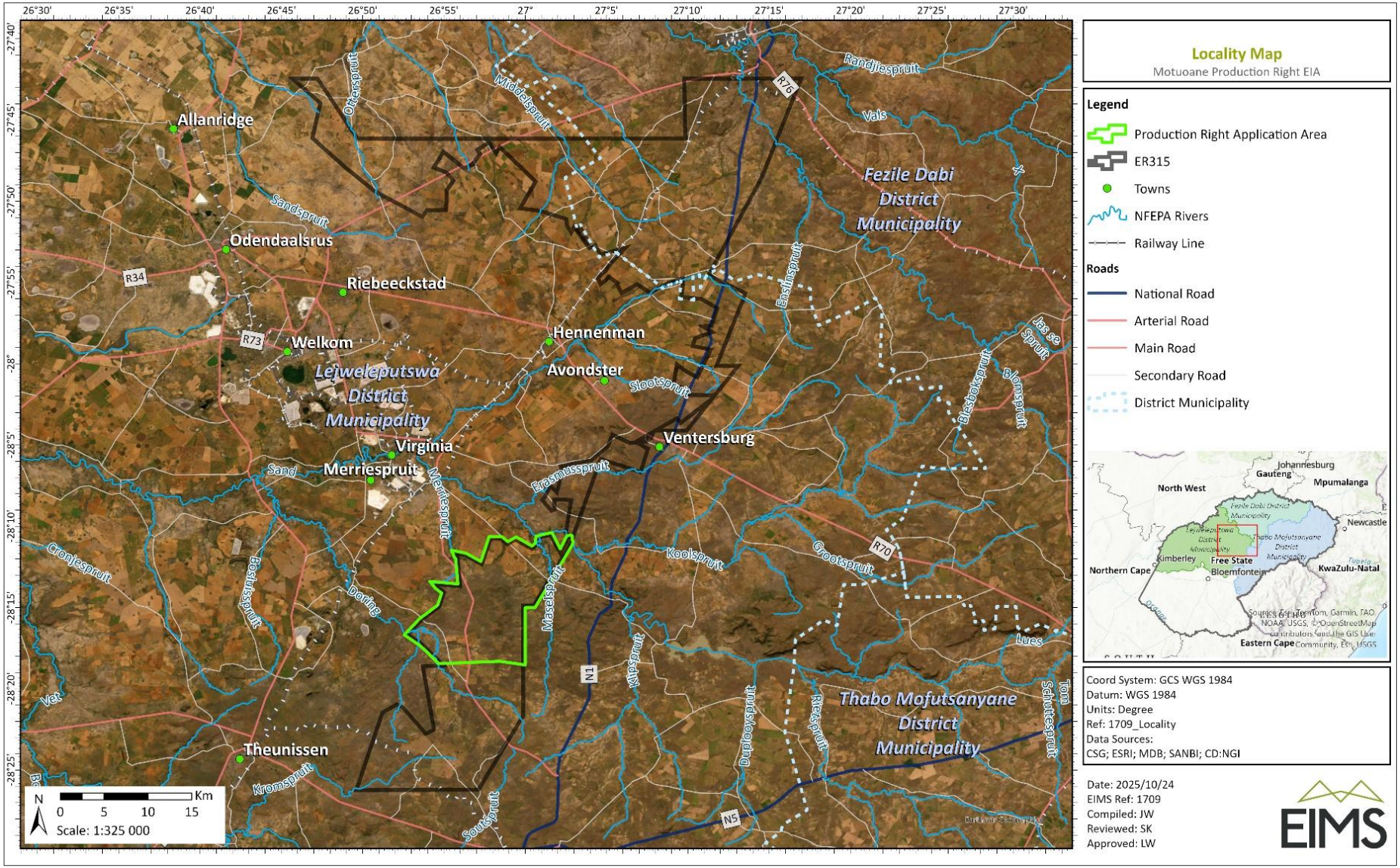


Figure 1: Aerial imagery locality map indicating the location of the proposed Motuoane Production Right in relation to ER315.

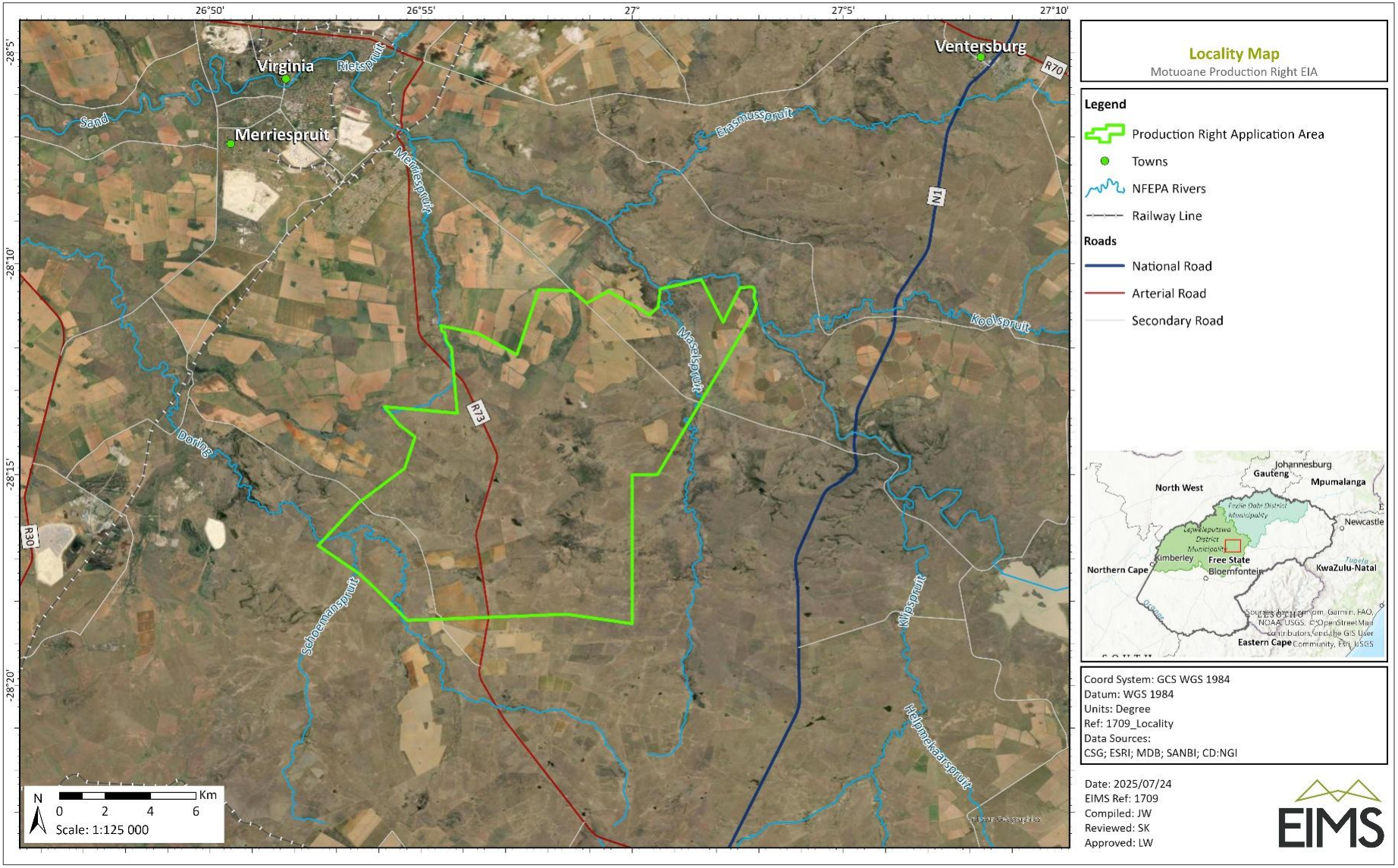


Figure 2: Locality map indicating the boundary of the proposed PR footprint.

4 DESCRIPTION AND SCOPE OF THE PROPOSED PROJECT

This section provides a detailed description for the proposed Motuoane Production project with its associated infrastructure. Most of the key information presented in this chapter was obtained from the applicant. The aim of the project description is to describe the proposed activities. Furthermore, the project description is designed to facilitate the readers understanding of the proposed project related activities which are anticipated to lead to the preliminary impacts identified and assessed in this Scoping Report, and for which management measures have been, or will be designed.

4.1 PROJECT DESCRIPTION

Motuoane wishes to convert a portion of their existing ER315 into a Production Right (PR) (**Figure 1**). Motuoane applied for a Production Right (PR 12/4/016) in terms of the Mineral and Petroleum Resources Development Act (Act 28 of 2002 – MPRDA, as amended) to the Administrative Authority (AA), the Petroleum Agency South Africa (PASA) in August 2025. The proposed extraction and production will target helium and methane gas, and will consist of up to 43 production wells, gas gathering pipelines, a helium recovery and gas processing plant (CNG and/or LNG) and associated infrastructure. In addition, ongoing exploration activities will include drilling of exploration wells, seismic and/or audio magnetotelluric surveys. The production right application area covers a total of ~14 440 hectares. The proposed project of the Production Right area will involve the following activities:

- Pre-drilling seismic and/or audio magnetotelluric surveys to optimize well locations for maximum deliverability;
- Maintenance workovers of wells;
- Drilling and completion of wells;
- Construction of gas gathering pipeline systems;
- Installation of gas compression and processing facilities;
- Construction of a helium recovery facility (gas or liquid helium) and gas (methane) processing plant (CNG and/or LNG); and
- Construction of associated infrastructure including roads, communications facilities and temporary accommodation facilities if necessary.

The production right study area and the preliminary infrastructure footprint are presented in **Figure 3**.

The locations of all proposed production wells and infrastructure have been chosen using desktop studies and available information from publicly available mapping services. All production well locations, gas gathering pipelines and processing plant infrastructure will be located in consultation with the landowners and any other stakeholders and be located to minimize damage to existing services, vegetation and land. Proposed infrastructure and production wells will be located close to existing fence lines and farm roads / tracks where practically possible and not be located within close proximity to housing and major structures. **Figure 3** depicts the proposed project locations for production wells, gas gathering pipelines and processing plant. In must be noted that although up to 43 production wells are proposed, additional wells have been plotted in the locality map below to make allowance for areas where wells may intersect solar development projects in the PR. This will allow for the exclusion of those wells that intersect or may interfere with the solar developments in the area should it be required (Refer to **Section 7.2**). The applicant is still in discussions with the solar companies in an attempt to find a coexistence arrangement.

The proposed production wells are located along known faults (i.e. Virginia and Ventersburg faultlines) and close to either existing blowers or exploration wells drilled by Motuoane. The initial development will focus on the wells located on the Virginia fault where there are 13 new well locations and 3 existing wells that will be utilised in the development. There are an additional 27 well locations located on the Ventersburg fault that will be drilled as required to maintain the required sales production. The production right area has an expected life of at least 30 years.

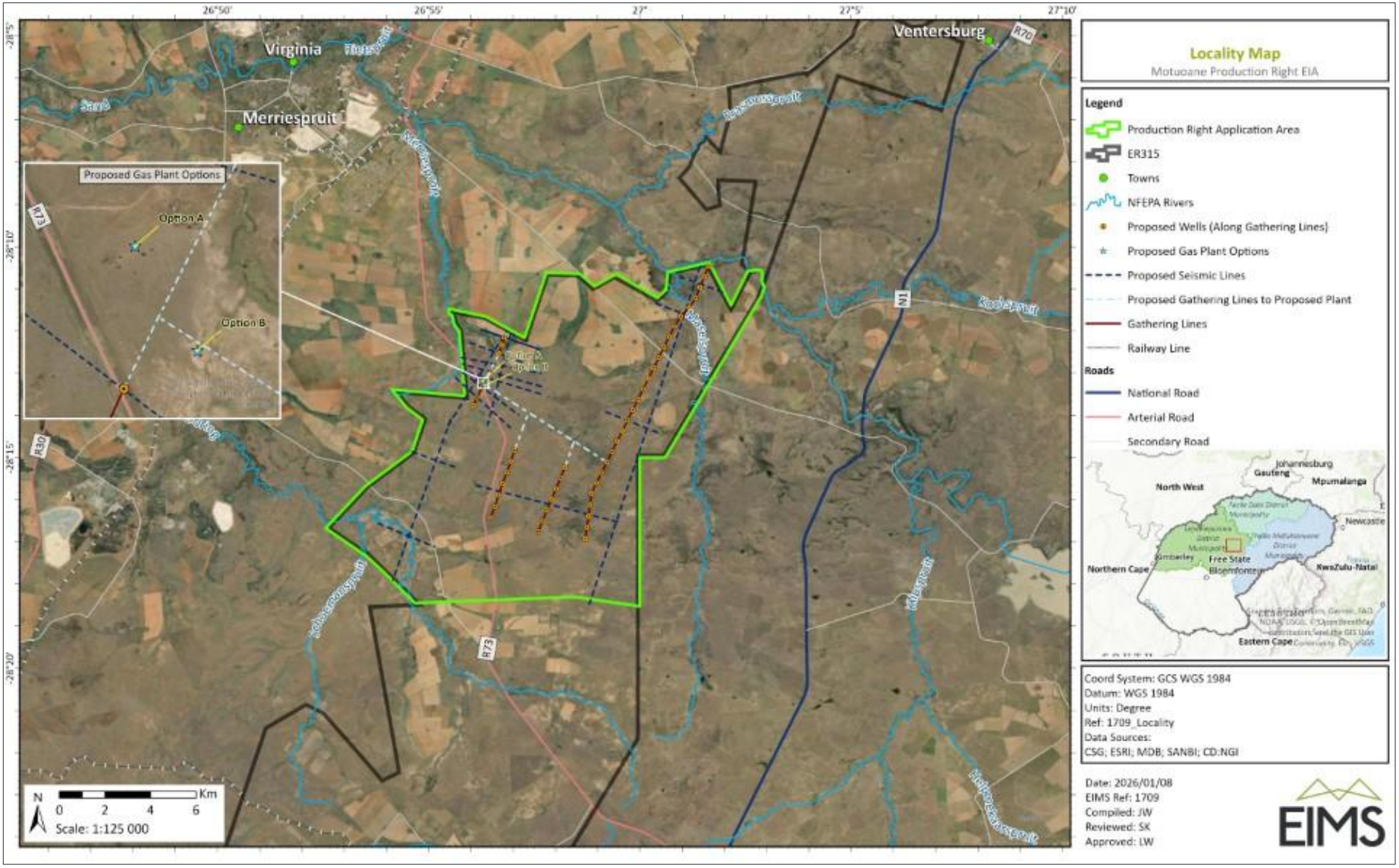


Figure 3: Motuoane PR study area and preliminary proposed infrastructure footprint.

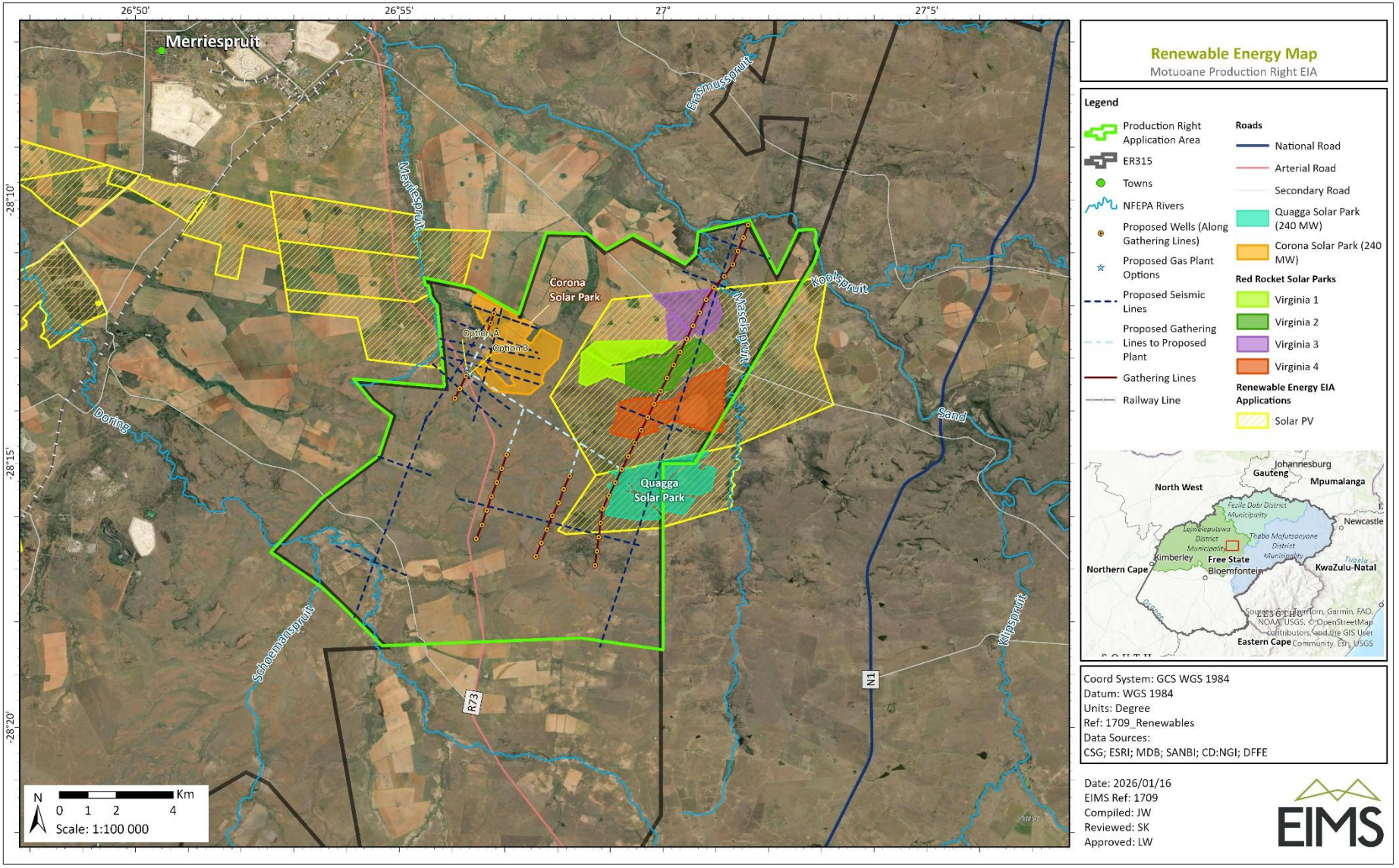


Figure 4: Motuoane PR study area in relation to renewable energy developments.

4.1.1 SEISMIC AND AUDIO MAGNETOTELLURIC SURVEYS

Seismic and audio magnetotelluric (MT) surveys are complementary geophysical methods that use different physical principles to image the earth's subsurface. Seismic methods use acoustic waves to detect variations in acoustic impedance (related to density and wave velocity), while MT survey methods use natural electromagnetic fields to map variations in electrical resistivity. Various survey techniques may be employed along pre-determined seismic transects as depicted in **Figure 5** below.

Seismic surveying along the transects through a Vibroseis technique are undertaken by a small team (approximately 5-10 personnel) by deploying an array of energy sources from a small-sized Seismic Vibrator and an array of sensors or receivers (geophones) on the identified area of interest (**Figure 5**). A single Seismic Vibrator consisting of a vibrating baseplate that is connected to the ground is used. The vibrating plate emits a low frequency signal (4-80 Hz) into the ground, called a sweep. The vibrator vehicle moves slowly along the pre-determined lines (transects) using GPS for navigation. It stops, emits a signal 8-20 seconds long, moves approximately 10 meters ahead, stops, emits a signal and so on until all the transects have been traversed. Several small geophones are used to convert the ground movements or seismic waves from the Seismic Vibrator into voltage, which is recorded at a nearby recording station. The survey team then generates and analyses the 2-D sub-surface geological network and identify areas of interest for well optimisation. The outcome of the seismic survey will be used to inform preferable drilling locations.

Although the Vibroseis technique is the likely method to be undertaken for the seismic activities. There are also potential alternatives to the Vibroseis known as the Propelled Energy Generators (PEGs), more commonly referred to as the Accelerated Weight Drop Seismic (AWD) as well as Magnetotellurics Survey (MT) which Motuoane may consider over the Vibroseis. AWD are light weight, highly portable seismic energy sources designed for a multitude of applications within the fields of geology, geophysics, civil engineering, and more. AWD systems utilize simple and effective elastomer band technology to propel the hammer to a high velocity. The AWD is comprised of two easily manageable components for fast and efficient installation and de-installation in the field. The AWD's lightweight, streamlined design also affords its users economy in shipping. The AWD-40Kg is designed to easily mount on trucks, bakkie, trailers, and all-terrain vehicles (**Figure 5**). AWD is a variant of seismic source of the “weight drop” type. The hammer is equipped with an inclined platform, allowing it to be installed at an angle of 45 degrees, and a special stop, adding stability in an upright position, what allows to perform survey on shear waves. The source AWD-40PS is mounted on a compact lightweight frame equipped with reliable wheel blocks. The source can be used on a rugged terrain. The total weight of the source without battery pack is less than 120 kg. The energy of a single impact reaches 1000J.

Magnetotellurics (MT) is a passive geophysical technique that uses naturally occurring electromagnetic fields to image the subsurface electrical resistivity structure by measuring the Earth's natural time-varying electric and magnetic fields. The MT method utilizes naturally occurring, broadband electromagnetic waves over the Earth's surface to image subsurface resistivity structure. The electromagnetic waves originate from regional and worldwide thunderstorm activity and from the interaction of solar wind with the Earth's magnetosphere. Due to the remote nature of the sources and the high refractive index of the Earth relative to air, the electromagnetic waves are assumed to be planar and to propagate vertically into the Earth. However, the scattering of electromagnetic waves by subsurface structure can be arbitrary in polarization, necessitating a tensor description (Wannamaker *et al*., 2005). Accordingly, two components of electric field (Ex and Ey) and three components of magnetic field (Hx, Hy and Hz) are measured. The frequencies of the waves (signals) range from about 1 Hz to a fraction of milli Hertz, which allows to image a wide depth range. A detailed account of the MT method is given in Vozoff (1991). The audio magnetotelluric surveys will be utilised to optimize well locations for maximum deliverability.

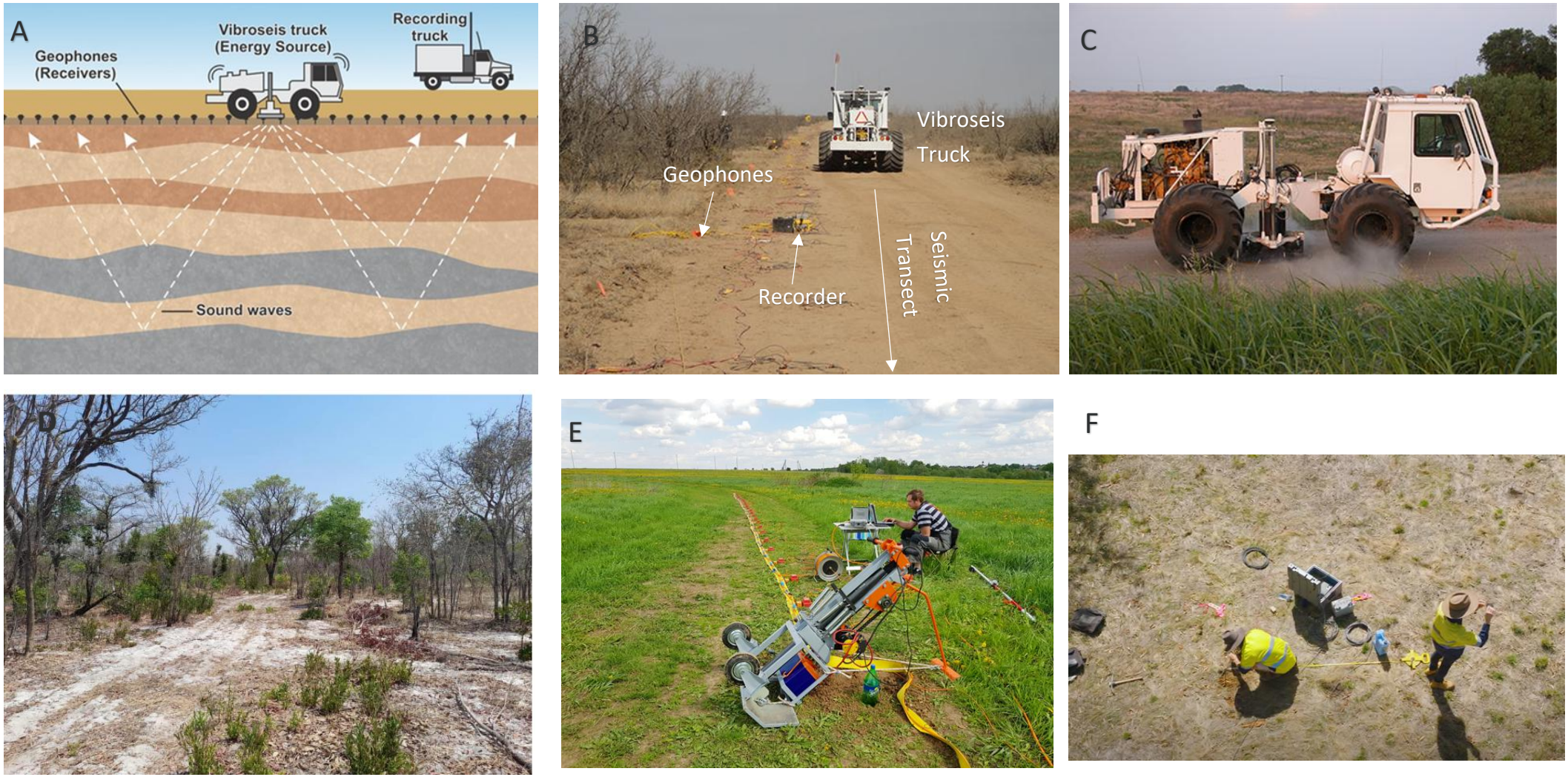


Figure 5: Seismic surveying process and potential impacts. (A) Showing an animated Vibroseis process, (B) Showing a real life Vibroseis process, (C) Showing minimal dust generated from the process, (D) Showing minimal vegetation impact associated with a new access path (transect route), (E) Showing the weight drop alternative method and (F) showing magnetotelluric survey.

4.1.2 WELL WORKOVER AND INTERVENTION

The proposed activities to be undertaken as part of the production activities include identifying existing blowers[1] within the ER, undertaking well workover and intervention if necessary. Well intervention and workover are both remedial operations performed on wells to maintain or enhance production, but they differ in scope and the level of intervention required. Well intervention is a broader term encompassing any operation to access the wellbore for maintenance, repair, or production enhancement, often using tools and equipment lowered into a live well. Workover, on the other hand, typically involves more extensive operations, including removing the well valves and potentially replacing the production tubing string after killing the well.

4.1.2.1 WELL WORKOVER

Well workover stands as a comprehensive operation within the gas industry, strategically undertaken on existing wells to rejuvenate or amplify their production capabilities. This process encompasses substantial interventions and the deployment of significant equipment to address a spectrum of issues, ultimately aiming to improve the overall performance of the well. Well workovers become imperative when a well experiences a decline in production or encounters mechanical challenges that necessitate remedial action. The process of well workover will be one or a combination of the following:

a. Restoring Production:

Well workovers are often initiated with the goal of restoring or enhancing production rates. This may involve the removal of obstructions, thorough cleaning of the wellbore, or the repair of damaged equipment. By addressing these impediments, operators can optimize the well's functionality and boost production.

b. Changing Completion Design:

Modification of the well's completion design is a common facet of well workovers. This may entail actions such as replacing tubing or installing new downhole equipment. These adjustments are geared towards improving the efficiency and effectiveness of the well's completion design.

c. Sidetracking Operations:

Some well workovers encompass sidetracking, a process that involves drilling a new borehole from an existing wellbore. This technique is employed to access additional reservoir zones, effectively bypass damaged sections, or maximize recovery from the reservoir. Sidetracking adds a layer of flexibility to well workovers, allowing operators to strategically tap into untapped resources.

4.1.2.2 WELL INTERVENTION

Well intervention in the context of gas wells refers to a set of activities aimed at diagnosing, maintaining, or enhancing the performance of a well without resorting to major interventions or workovers. These interventions are crucial for optimizing production, addressing specific issues, and ensuring the continued functionality of the well. Unlike major workovers, which involve substantial interventions, interventions are generally minor in nature and focus on improving well productivity and efficiency. The process of Well Intervention will be one or a combination of the following (but **will exclude any well stimulation techniques such as hydraulic fracturing activities associated with well intervention**):

a. Well Logging and Diagnostics:

Well logging and diagnostics involve the deployment of specialized tools and instruments downhole. These tools gather data on reservoir properties, wellbore conditions, and fluid characteristics. The collected data aids in reservoir evaluation and helps optimize production strategies by providing insights into the well's current status.

[1] Well that intersects a gas-bearing fracture zone.

b. Maintenance and Servicing:

Maintenance and servicing interventions encompass routine activities aimed at preserving the well's functionality. This includes cleaning the wellbore to remove debris and scale, replacing damaged or worn-out equipment, and addressing minor mechanical issues. Regular maintenance is essential to prevent larger problems and maintain the well's efficiency over time.

4.1.2.3 PROCESS FOR IMPLEMENTATION

Onshore well interventions and workovers can lead to various environmental, health, and safety impacts. These may include water and air pollution, risks to worker health and safety, and potential impacts on surrounding communities. Mitigation strategies involve implementing best management practices, employing advanced technologies, and ensuring robust emergency response plans. The process to be followed will include:

- Assessment of existing conditions and process required: Motuoane will first assess the conditions and issues of each existing blower (gas emitting well) within the ER. If the well is found to be suffering from significant production decline, blocked completions, or severe casing damage, a workover is likely to be undertaken. However, if less critical issues like instrumentation malfunction, scale buildup, or needing to perform diagnostics, a well intervention is the more efficient, cost-effective and likely the option to be undertaken.
- Development of an emergency response plan: an emergency response plan will be developed including spill response, fire prevention protocols and blowout response.
- Training and personal protective equipment: providing comprehensive training on safety procedures, emergency response, and the use of personal protective equipment (PPE) will be undertaken.
- Preventing blowouts: maintaining well control through hydrostatic pressure management, utilizing fit for purpose blowout preventer (BOP) systems, and implementing thorough planning and risk assessment. The well pressures for this project are expected to be very low and as such the risk of a blowout is minimal.
- Equipment maintenance: regularly inspecting and maintaining equipment to prevent malfunctions.
- Chemical management: proper handling, storage, and disposal of chemicals.
- Casing and plugging of the wells: additional steel casing and cement barriers to prevent leaks as well as plugging at the end of exploration to prevent groundwater seepage.
- Rehabilitation: each well site will be rehabilitated to support the existing land-use.

4.1.3 WELL DRILLING

Exploration wells will be drilled and, if successful (gas producing), converted into production wells. All exploration boreholes must be drilled and cased in accordance with applicable international standards and best practice guidelines and will be sealed with a combination of steel casing and grouting (cement) to ensure there is no mixing of gas or deep saline water with the shallower freshwater aquifers. The drilling of exploration boreholes is a temporary and short-lived activity and the equipment to be used during drilling activities includes a truck/trailer or skid mounted drill rig, TLB, light motor vehicles for transport of personnel and chemical toilets. Drilled exploration wells will be evaluated based on gas flow, pressure and gas composition, prior to making a decision to either complete the well as a production well or to safely decommission and rehabilitate it. Well testing may include venting and/or flaring of the gas where it is safe to do so (Refer to **Section 7.3**)

Using the data gathered during the preceding background review, surveying and exploration, up to 43 production wells will be sited. A development spacing of 500 m has been chosen for the production wells to be drilled. This spacing has been chosen following a review of geological and reservoir properties including well interference testing. The wells will be drilled to a total depth of approximately 500-600 m and open hole completed (i.e. without casing) in the reservoir zone (**Figure 7**). Production casing from the surface to the base of the Karoo will be cemented to the surface to ensure wellbore integrity. Then, the well will be drilled into the Witwatersrand formation in order to encounter gas-producing fractures. Initially, Motuoane will log the open

hole Karoo, run and set casing, then run a Casing Bond Log (CBL). Upon reaching Total Depth (TD), Motuoane will log the open hole beneath the casing. This logging program may evolve as drilling continues. The wells will be completed as simple open hole completions, with no tubing or pumping equipment necessary.

The actual casing sizes and configurations will vary depending on the specific geological characteristics and functional requirements. Each well will be steel cased and have cement barriers to prevent leaks as well as plugged at the end of production to prevent groundwater seepage (**Figure 8**). Drilling activities are estimated to be one to two weeks per hole during which time there will be a drill rig, a service truck and an LDV on site. Intermittent use of a TLB will be used during site establishment and demobilisation.

The construction of each drill pad will disturb an area of up to 50 x 50 m (**Figure 8**). Within the disturbed area, the drill rig and drilling rods will be located. Hazardous and general waste storage, chemical toilets, and any site offices required will also be placed inside the drill pad (**Figure 8**). Each drill site will be suitably rehabilitated before drilling continues at the next drill site. The production wells will be capped with a steel cap that is engraved with the borehole number according to industry specifications.

The wellhead surface facilities will be simplistic in design to have a minimum footprint on the environment. As it is anticipated that there will be no liquids produced from the wells contemplated herein, there will be no need for surface equipment such as water storage and holding tanks to be located at the wellheads. The fencing surrounding the wellsite will be able to be modified easily to maximize the land use available for the landowner. Consideration will also be given to having the wellsite facilities located below ground level in closed chambers to further reduce the visual and environmental impact. Instrumentation at each well location will consists of gas metering and pressure monitoring only. These instruments are planned to be powered by replaceable lithium batteries, so eliminating the need for any instrumentation that requires gas to be emitted and therefore reducing fugitive emissions.

Figure 6: Typical wellhead surface infrastructure (to be connected to underground pipeline if converted to production well).

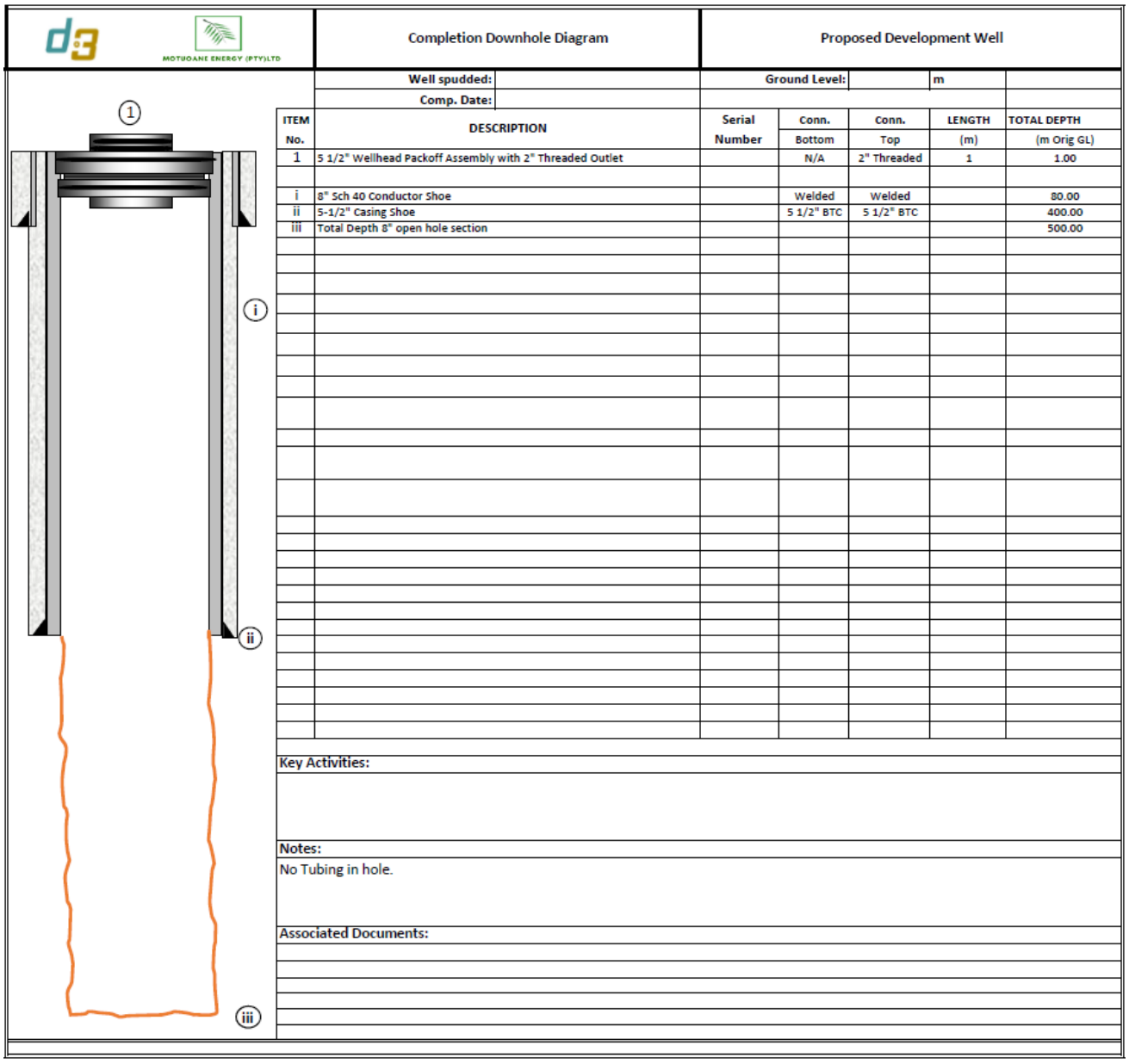


Figure 7: Production Well Typical Design

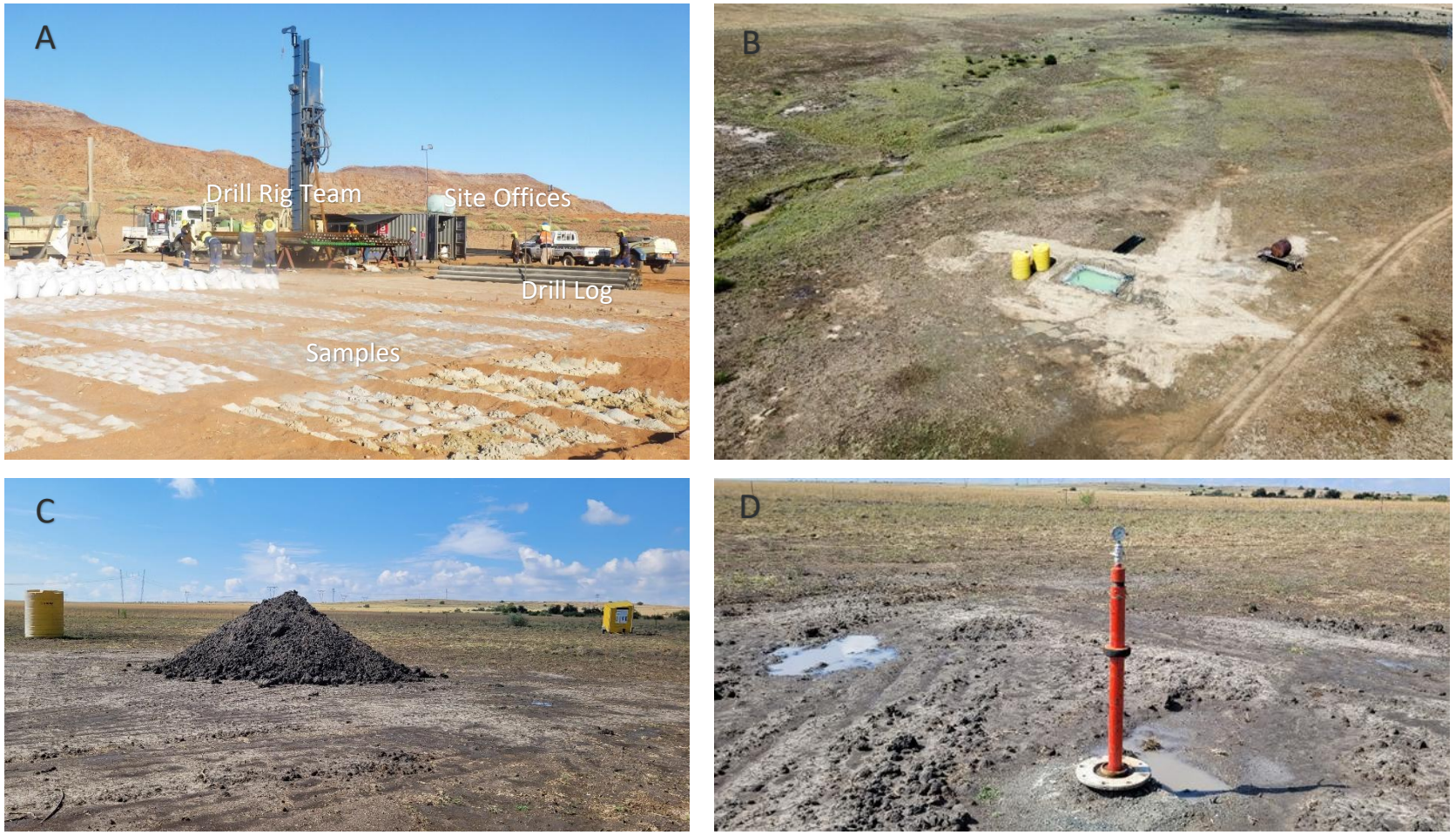


Figure 8: Exploration drilling and potential impacts. (A) Showing the drilling process and associated infrastructure, (B) Showing the drill pad footprint at one of the active Motuoane drilling sites, (C) Showing some of impacts associated with drilling activities including contained vegetation clearance and topsoil heaps and (D) Showing the final exploration well, steel cased and cemented to prevent leaks.

4.1.4 GAS GATHERING PIPELINES

The gas gathering network covers all low-pressure underground pipework from the wellhead to the gas processing plant. It is critical in this project to keep wellhead pressures low, as this maximizes gas and helium recovery from the field. The pipelines have been designed to have only one gas and helium processing plant within the project area to reduce the requirement for nodal compression. This will reduce the environmental footprint and keep noise emitting equipment to fewer locations. A provision will be made to have field nodal compression powered by the gas in the pipelines should the actual flow rates and pressures differ from the modelling, and it is found that nodal compression is required.

The preliminary conceptual gas gathering systems have been designed to minimize pipeline lengths and pressure loss, while maintaining the required distances from landowner and environmental constraints. As discussed previously all locations will be subject to review once stakeholder and landowner discussions are undertaken. Flow modelling has been conducted to ensure that the wellhead pressures at the wells are kept to a minimum. The sizing of the high-density polyethylene pipe (HDPE) pipelines will range from 110 mm diameter for up to 315 mm for main gas trunkline installed at a minimum depth of approximately 750mm for grazing land and up to 1000mm for cultivated crop land. The pipelines will be constructed from HDPE pipe and be designed to use the natural flow of the land contouring to reduce the need for low point drains. Low point drains in gas pipelines function to remove condensed water (resulting from the gas temperature dropping) that collects at low points, preventing flow obstruction and ensuring efficient gas transport. Where drains are required, consideration will be given to installing them in underground pits to reduce visual, environmental and landowner impact. Regular pipeline leak detection surveys will be undertaken, detail of which will be included in the detailed EIA report. The total amount of underground gathering pipeline system to be installed is detailed in **Table 6** below. The pipeline routes will be marked with aboveground concrete markers similar to those used in the neighbouring Tetra4 production right area. Servitude corridors (10 m wide) will be maintained free of woody plants to prevent disturbance of the pipeline by root growth and ensure access for regular inspection and maintenance when necessary.

Table 6: Expected HDPE Pipe Size and Quantity

HDPE Pipe Size	~Installed Length
110 mm OD	9,500 m
200 mm OD	6,250 m
250 mm OD	7,650 m
315 mm OD	5,400 m

4.1.5 HELIUM RECOVERY FACILITY AND GAS PROCESSING PLANT

The helium recovery and gas processing facilities **(Figure 9)** will have the optionality of producing either gaseous or liquified helium and methane. It is planned that the plant will be fully gas-powered. One helium recovery and gas processing plant with the optionality of producing either gaseous or liquified helium and methane will be required. The plant is proposed in proximity of the Virginia fault line. The location of the 3 existing wells along the Virginia fault line as well as other production wells proposed on this fault make it the best location for the plant to reduce the length of pipeline require in the initial phase of the project (**Figure 3**). A description of the helium and methane streams for gas and liquefaction processes is given below.

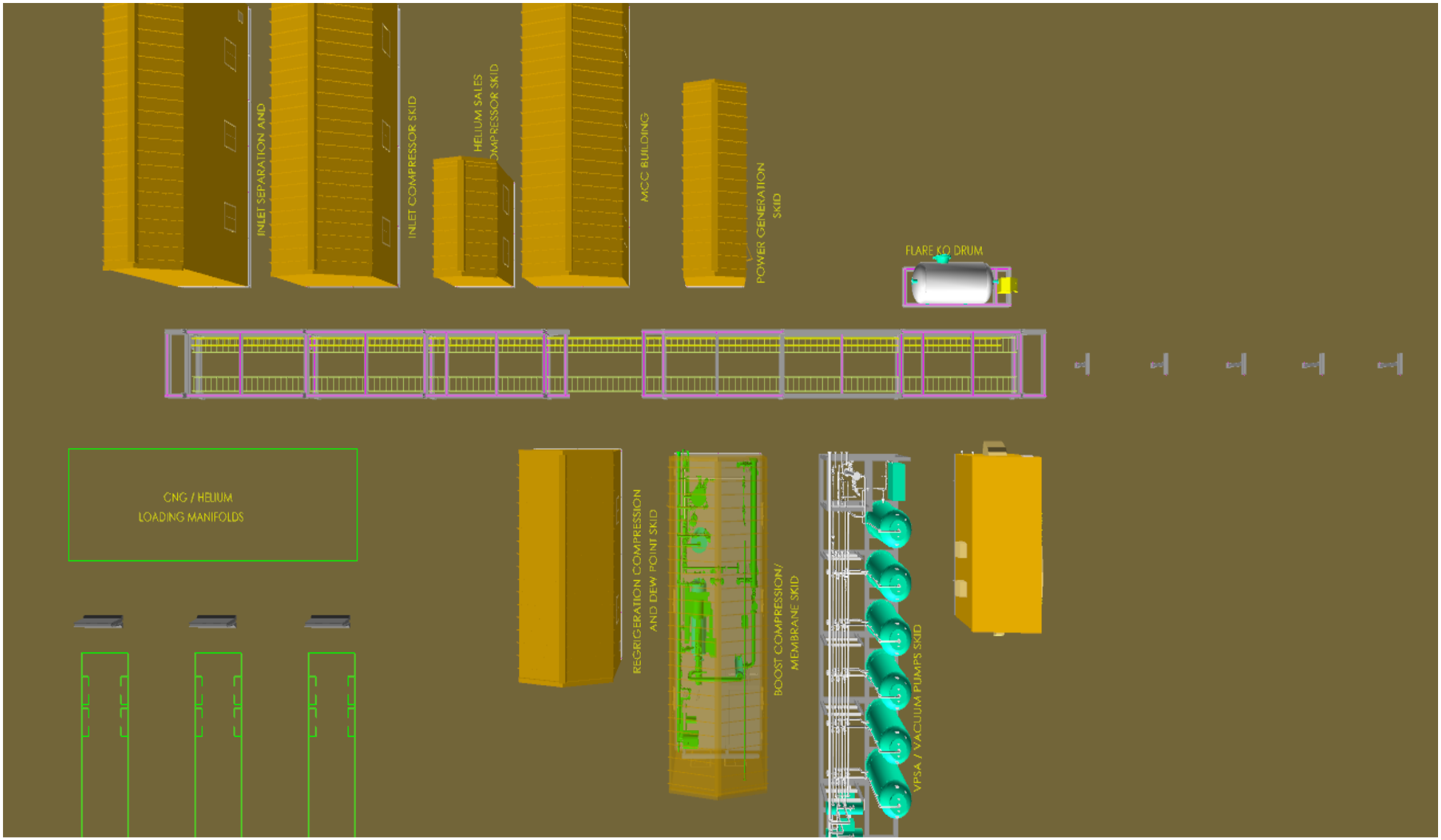


Figure 9:Helium Recovery and Gas Processing Plant 3D Render

4.1.5.1 HELIUM RECOVERY

The 3.0 Million Standard Cubic Feet per Day (MMscfd) capacity helium recovery facility design features include a modular-based facility. The process modules include inlet compression, pretreatment, single stage membrane separation, Pressure Swing Adsorption (PSA) boost compression, vacuum PSA purification, helium sales compression and/or liquefaction. The process starts with the inlet reception equipment to manage the incoming process stream to the facility. After regulating the pressure and flow to approximately 25 kPag, the inlet gas is compressed to achieve the necessary pressure required to operate the membrane system.

The pretreatment module provides dew point control and removal of water that would otherwise condense in the membrane systems. The condensate water will go into an HDPE lined evaporation pond. The treated gas then flows to the inlet of the membrane separation system. The membrane separation system has been designed for single stage separation. The first stage separates the bulk contaminants from the crude helium permeate stream which flows to the PSA purification unit. The retentate stream (methane) is back-pressure controlled flowing to the package limits where it will flow into the inlet of the gas CNG or LNG facility.

The crude helium from the first stage permeate is compressed on route to the PSA purification package. Within the vacuum PSA module, the crude helium stream is purified to >98% within the PSA vessels before flowing to the helium sales compressor or liquefaction unit. For gaseous helium sales, the gas compressor is designed to deliver pressure up to 26,200 kPag to the 3-truck loading system. The manual loading system is located off the end of the helium sales gas compressor package.

If Motuoane decides to liquify the helium gas on the project site, the helium liquefaction unit will receive purified helium from the PSA module and will deliver grade 5 helium to the liquid helium dewar at the outlet. From the liquid helium dewar, the liquid helium can be loaded into helium ISO containers for shipment.

4.1.5.2 METHANE GAS PROCESSING

The retentate stream (methane) from the helium recovery facility will flow into the inlet of either the CNG or LNG process modules. The CNG module will compress the gas from the inlet pressure of 2,500 kPag up to the 25,000 kPag required pressure for CNG tube trailers. As with the helium system, the compressed methane will flow from the module exit to the 3-truck loading system. The manual loading system is located off the end of the methane sales gas compressor package.

The LNG module, if installed, will take the feed gas and compress it up to the 5,000 kPag pressure required by the plant. Before liquefaction, impurities contained in the raw natural gas may need to be removed as they may freeze under the low temperature state used in the liquefaction process and block the equipment or reduce the performance of the heat exchanger. The liquefaction element adopts a propane precooling mixed refrigerant refrigeration process. The pre-coolant is propane, and the mixed refrigerant is nitrogen, methane, ethylene and propane components.

The purified, predominately methane gas, will be precooled to -20°C by a pre-coolant before entering the cold box. Any heavy hydrocarbons in the gas stream will also freeze at low temperatures, so a heavy hydrocarbon separator is set up in the cold box to separate any condensed heavy hydrocarbons. The gas entering the cold box uses the large amount of cold released by the mixed refrigerant in the cold box to liquefy the natural gas, and the liquefied LNG is sent to the manual loading system used to fill the LNG trucks.

4.1.6 ASSOCIATED ACTIVITIES AND INFRASTRUCTURE

The development of the area will require the construction of associated infrastructure. Local business / contractors and local communities will be instrumental in providing the workforce and equipment for this infrastructure.

4.1.6.1 OFFICE AND MAINTENANCE WORKSHOP

Motuoane has a field office located in the nearby town of Virginia. Motuoane plans to construct a maintenance workshop beside the helium and gas processing facilities. The multipurpose facility will be used as an office for field staff, company plant and equipment storage, maintenance activities, and storage warehouse. The office

and workshop facility will have provision for storage of consumables and spares needed during the main operating phase of the development. During the initial construction phase, there will be a need to store larger construction equipment, well casing/tubulars and HDPE pipes, these will be stored in the same workshop area.

4.1.6.2 ROADS AND SITE ACCESS

Wherever possible existing roads and tracks will be used for well and plant access. Where upgrades are required due to increased traffic or wet weather access there may be a requirement for utilizing road base materials or surfacing materials. Where access is not available, access tracks to accommodate a vehicle, approximately 3.5m wide will be created. These will be rehabilitated accordingly at the end of production. Below is a summary of anticipated number of vehicles and traffic trips during the construction and operational phases.

Table 7: Summary of anticipated number of vehicles/trips.

Phase	Vehicle Type	Number of Vehicles on site/day	Vehicle Trip Numbers
Construction	Light Vehicles	18	45
	Heavy Vehicles	14	30
Total		**32**	**75**
Operational	Light Vehicles	4	12
	Heavy Vehicles	1	2
Total		**5**	**14**
Gas and Helium Sales (Operational)	CNG Truck	15	30
	Helium Truck	1	2
Total		**16**	**32**

4.1.6.3 ACCOMMODATION AND CONSTRUCTION RESOURCES

The greater majority of construction workers will be based in the local towns of Welkom, Virginia and surrounds. Prior to the commencement of the initial project construction period, Motuoane will engage with accommodation providers to determine the anticipated availability of rooms throughout the period planned for the construction activities. It is paramount that the existing accommodation that is currently available for regular visitors remains available during the construction activities. Where demand is found to exceed supply, Motuoane will work with the accommodation suppliers to bring in additional temporary accommodation to make up the shortfall.

Many of the construction activities during the development of the area are very specialized and require specifically skilled contract workers to complete the construction activities. Motuoane will strive to employ these contract skilled workers locally in the first instance and only when not available locally will specialized non-local contractors be engaged. Equipment for seismic surveys and drilling will be provided by specialist contractors. Motuoane will concurrently utilize local contractors and workforce in the more non-specialized construction activities with a view to training these employees and contractors to the more skilled job tasks over time.

Electricity, if required during construction, will be provided by on-site generators which must be placed on impermeable surfaces. Water required for the operation of the drilling rig, as well as potable water will be obtained locally, by agreement with landowners or the local municipality, and in accordance with relevant legal

requirements. The water requirements for drilling operations will be a maximum of 70 000 litres per production well up to the depth of ~600m.

Chemical toilets will be provided for the personnel. The toilets will be supplied and managed by a specialist contractor and the sewage disposed of at the nearest wastewater management facility, or as required by the local authority. All general and hazardous waste generated at the survey and/or drilling site will be separated and stored in containers, before being removed from site and disposed at an appropriate licenced waste disposal facility.

4.1.7 WASTE MANAGEMENT

The design philosophies for waste management are based on applicable legislation, in particular NEMWA, DWAF (DWS) best practice guidelines, and currently accepted good industry practice for waste management. Principles of waste minimisation at source, segregation for reuse, recycling and treatment or disposal will be applied to the handling of waste, wherever possible. The waste (general and hazardous) generated during construction and operations will be addressed as detailed below.

4.1.7.1 GENERAL WASTE

The following types of general waste (produced mainly during construction, with minimal amounts post construction/ operation) will be generated by the proposed production project:

- Domestic solid waste;
- Scrap metal; and
- Construction waste.

The project will temporarily store general waste on site in a designated area, and all waste will be collected by an approved, licenced waste contractor for removal and final disposal at a registered general waste disposal facility. No new landfills will be directly established by the project within the project boundaries.

4.1.7.2 HAZARDOUS WASTE

Hazardous waste, including but not limited to hydrocarbon containing waste (used oil and filters, diesel, lubricants, and grease) will be stored in clearly marked skip bins (solids) and containers (liquids). These skip bins/ containers will be placed in an isolated area on a hard, impervious surface. When full, the bins/ containers will be collected by a contractor for safe disposal or recycling companies which will be appointed to collect waste. A waste disposal certificate will be required from the contractor to ensure safe disposal.

Drilling waste will consist of wastewater and drilling mud which will not be stored more than 90 days on site. This waste will be stored in lined aboveground tanks adjacent to the drill rig and once drilling is completed, the waste will be removed from site and adequately disposed of at an appropriately licenced waste disposal facility.

4.1.8 PROJECT TIMELINE

The major construction activities will occur during the initial 5 years of the development. The Motuoane gas production project will comprise of three components namely the production well drilling, gas gathering network and the processing plant construction. The commencement of activities will be dependent on the issuance of relevant permits, authorisations and licences (including the EA). Motuoane will initially conduct a multi-well drilling campaign of approximately 15 wells during 2027 and a further 15 wells during 2028. The CNG plant, and helium separation plant is planned to be ready to accept gas by early 2028. The remainder of the wells are located on the Ventersburg fault and will be drilled as required to maintain the required sales production. The production right area has an expected life of at least 30 years which will then be followed by decommissioning, rehabilitation and closure.

4.1.9 ABNORMAL OR UNWANTED EVENTS OR CONDITIONS

When undertaking an EIA it is important to consider the potential abnormal operating conditions or unwanted events. These are especially significant in instances where these conditions or events may result in an unacceptable environmental impact. A predictive risk identification and assessment process should be followed

by the proponent and updated on a regular basis. Many of these risks can be adequately mitigated through pre-emptive contingency planning and if necessary, embedded into relevant project design. **Table 8** provides a high-level identification and description of potential abnormal operating conditions and the embedded designs / controls that have been considered and incorporated for this project.

Table 8: Abnormal events and conceptual controls.

Abnormal condition/ event	Description	Embedded design or preventative control
Downhole loss of fluids or cement.	Depending on the permeability of the geology through which the drill is moving there may be a potential to lose drilling fluids into the geological formation. Further there is a potential that the cement or grouting being used in the annulus may enter the surrounding geology or resource. This may compromise the functionality of the cementation job or even impact on the gas permeability of the geology (e.g. invasion of the cement into the natural fractures).	Readily available fluid loss control additive for the drilling process. Cement design provides for lightweight slurry. This reduces the hydrostatic weight of the cement slurry. Readily available fluid loss additives would be available to add to the bentonite mix to seal off any voids encountered in susceptible formations.
Wellbore casing bursts due to excessive pressures (e.g. during hydraulic stimulation).	The wellbore may be exposed to additional pressures during the testing or cementing operations. This has the potential to damage or rupture the casing string and result in a loss of gas or fluids, as well as risk of pollution.	Ensure correct specification casing used based on well engineer's requirements. Casing pressure rating would exceed maximum specified pressure rating for the stimulation rig. Undertake casing and cementation job testing prior to stimulation (e.g. bond log tests, compression strength test on cement samples, etc).
Rupture of gas gathering network pipes.	The gas gathering system will include HDPE piping which is susceptible to damage in abnormal instances. This could be due to excavations, burrowing animals, tree roots, etc.	Ensure adequate bedding and padding in the respective trenches where required. Real time monitoring of pressures at well head and gas plant to detect leaks.
Excess water content in gas.	Excessive water content in the raw gas may result in damage to equipment and blockage for gathering lines.	Installation and operation of low point drains where required. Real time monitoring of pressures to detect leaks.
Medium to long term climate change vulnerability	The prevailing climatic conditions are predicted to change over time as per the climate change predictions (refer to **Section 9.11** for a description of the likely changes predicted). Changes in temperature and rainfall may affect the	Equipment design would provide for equipment to be operational under elevated temperatures and rainfall. Excess rainfall events would be catered for in the stormwater designs.

	optimal functioning of certain infrastructure and equipment.	
Uncontrolled releases of LNG from storage vessels.	Storage vessels could be damaged through pressures exceeding design, accidental physical damage (e.g. vehicle accident). This could result in a gradual or sudden release of LNG.	Isocontainer design is of such a nature that any boil-off gas gets returned to the gas plant for reprocessing, resulting in no excessive pressure build up. The Isocontainer consists of a double wall to prevent accidental damage and to keep the gas cold for longer. The storage facility would also be barricaded against moving machinery to eliminate interaction.
Sabotage, Community unrest, and terrorist attacks.	Production operations or equipment could be damaged resulting in uncontrolled release of gas.	Gas in the pipe network on its way to the gas plant would either vent to atmosphere or be burned at the gas plant until depleted should any of the above-mentioned happens.

This EIA process will identify and assess potential environmental impacts and make recommendations for relevant alternatives, management and mitigation measures.

4.2 DECOMMISSIONING AND CLOSURE

According to the NEMA and the associated Financial Provision Regulations (2015) (NEMA GNR 1147), every mine must make financial provision for annual rehabilitation, final rehabilitation, decommissioning and closure activities at the end of mining; and remediation and management of latent or residual environmental impacts which may become known in the future. As such, Motuoane will be required to prepare and submit, as part of this EIA process, a final rehabilitation decommissioning and closure plan.

A rehabilitation plan will be included in the EMPr to be submitted as part of the EIAR. The EMPr shall outline the closure objectives that are aimed at re-instating the landform, land use and vegetation units to the same state as before production operations take place, unless a specific, reasonable alternate land use is requested by the landowner. As such, the intended end use for the disturbed areas and the closure objectives will be defined in consultation with the relevant landowner. Proof of such consultation will be submitted together with the application for Closure Certificate. The overall aim of the rehabilitation plan is to rehabilitate the environment to a condition as close as possible to that which existed prior to the gas production activities. This shall be achieved with a number of specific objectives.

- Set the course for eventual ecosystem restoration, including the restoration of the natural vegetation community, hydrology, and wildlife habitats.
- Prevent future environmental issues related to fluid or gas leakage or lateral movement through the well.
- Protection of water resources.
- Ensure that land is usable, in alignment with surrounding land uses.
- Making the area safe. i.e.: Decommission exploration and production activities so as to ensure that the environment is safe for people and animals. This entails refilling excavations, sealing and grouting wells where applicable, etc.
- Recreating a free draining landform. This entails earthworks infilling, reshaping, levelling, etc. to recreate as close as possible the original topography and to ensure a free draining landscape.

- Re-vegetation. This involves either reseeding or allowing natural succession depending on the area, climate etc.
- Storm water management and erosion control. Management of storm water and prevention of erosion during rehabilitation. E.g. cut off drains, berms, etc. and erosion control where required.
- Verification of rehabilitation success. Entails monitoring of rehabilitation.

Rehabilitation will be undertaken in accordance with the rehabilitation and closure plan as required by the Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations, GNR 1147, gazetted in November 2015. This includes the determination of the financial provision as well. A closure certification application will be applied for in accordance with section 43 of the Mineral and Petroleum Resources Development Act, 2002.

5 POLICY AND LEGISLATIVE CONTEXT

This section provides an overview of the governing legislation identified which may relate to the proposed project. The primary legal requirement for this project stems from the need for an EA to be granted by the competent authority, which is the DMPR (PASA being the delegated authority), in accordance with the requirements of the NEMA EIA Regulations 2014, as amended and the MPRDA. In addition, there are numerous other pieces of legislation governed by many acts, regulations, standards, guidelines and treaties on an international, national, provincial and local level, which should be considered in order to assess the potential applicability of these for the proposed project. The key legislation applicable to this project is discussed in the subsections below. The contents of this report are based on a review of the information that was available at the time of the compilation of the report. The discussion in this chapter is by no means an exhaustive list of the legal obligations of the applicant in respect of environmental management for the proposed Motuoane PR016 project.

5.1 NATIONAL LEGISLATION

5.1.1 CONSTITUTION OF THE REPUBLIC OF SOUTH AFRICA

The constitution of any country is the supreme law of that country. The Bill of Rights in chapter 2 section 24 of the Constitution of South Africa Act (Act No. 108 of 1996) makes provisions for environmental issues and declares that: *"Everyone has the right -*

a) to an environment that is not harmful to their health or well-being; and

b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that:

i. prevent pollution and ecological degradation;

ii. promote conservation; and

iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development".

The EIA and associated impact mitigation actions are conducted to fulfil the requirement of the Bill of Rights.

5.1.2 MINERAL AND PETROLEUM RESOURCES DEVELOPMENT ACT (MPRDA)

The aim of the Mineral and Petroleum Resources Development Act, 2002 (MPRDA) is to *"make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources"*. The MPRDA outlines the procedural requirements that need to be met to acquire mining rights in South Africa. The MPRDA also requires adherence with related legislation, chief amongst them is the National Environmental Management Act (Act No. 107 of 1998, NEMA) and the National Water Act (Act No. 36 of 1998, NWA).

In terms of Section 83 of the MPRDA, a Production Right must be issued prior to the commencement of any gas production activities. Several amendments have been made to the MPRDA. These include, but are not limited to, the amendment of Section 102, concerning amendment of rights, permits, programmes and plans, to requiring the written permission of the Minister for any amendment or alteration; and the section 5A(c) requirement that landowners or land occupiers receive twenty-one (21) days' written notice prior to any activities taking place on their properties. One of the most important amendments requires all mining and production related activities to follow the full NEMA process as per the EIA Regulations which came into effect on 4 December 2014 for any new applications. A Production Right is subject to prescribed terms and conditions and is valid for the period specified in the right, which periods, each of which may not exceed 30 years, and becomes effective on the effective date.

In support of the EA application, the applicant is required to conduct an EIA process comprising of the preparation of environmental Scoping and EIA Reports, an EMPr, as well as Interested and Affected Party (I&AP) consultations, all of which must be submitted to the PASA for adjudication. This report has been compiled in

accordance with Section 21 and Appendix 2 of the EIA Regulations (2014, as amended) in order to satisfy the criteria for a Scoping Report.

5.1.3 THE NATIONAL ENVIRONMENTAL MANAGEMENT ACT (NEMA)

The main aim of the National Environmental Management Act, 1998 (Act 107 of 1998 – NEMA) is to provide for co-operative governance by establishing decision-making principles on matters affecting the environment. In terms of the NEMA EIA Regulations, the applicant is required to appoint an EAP to undertake the EIA process, as well as conduct the public participation process towards an application for EA. In South Africa, EIAs became a legal requirement in 1997 with the promulgation of regulations under the Environment Conservation Act (ECA). Subsequently, NEMA was passed in 1998. Section 24(2) of NEMA empowers the Minister and any MEC, with the concurrence of the Minister, to identify activities which must be considered, investigated, assessed and reported on to the competent authority responsible for granting the relevant EA. On 21 April 2006, the Minister of Environmental Affairs and Tourism (now Department of Forestry, Fisheries and the Environment – DFFE) promulgated regulations in terms of Chapter 5 of the NEMA. These regulations, in terms of the NEMA, were amended several times between 2010 and 2022. The NEMA EIA Regulations, 2014, as amended, are the current regulations applicable to this project. Exploration and Production activities officially became governable under the NEMA EIA Regulations in December 2014 with the competent authority identified as the DMRE (now DMPR).

The objective of the EIA Regulations is to establish the procedures that must be followed in the consideration, investigation, assessment and reporting of the listed activities that are triggered by the proposed project. The purpose of these procedures is to provide the competent authority with adequate information to make informed decisions which ensure that activities which may impact negatively on the environment to an unacceptable degree are not authorised, and that activities which are authorised are undertaken in such a manner that the environmental impacts are managed to acceptable levels.

An environmental Scoping and Impact Assessment process is reserved for activities which have the potential to result in significant impacts which are complex to assess. Scoping and Impact Assessment studies accordingly provide a mechanism for the comprehensive assessment of activities that are likely to have more significant environmental impacts. **Figure 10** below provides a graphic representation of all the components of a full EIA process. The listed activities the proposed project triggers and consequently requires authorisation prior to commencement are detailed in **Section 325.1.3.1**.

NEMA sets out the general objectives of IEM in South Africa, including to (section 23(2)), of which the following two are of relevance for this report:

- Identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage, the risks and consequences and alternatives and options for mitigation of activities. This is to be done with a view to minimising negative impacts, maximising benefits and promoting compliance with the principles of environmental management set out in section 2 (of NEMA).
- Ensure that the effects of activities on the environment receive adequate consideration before actions are taken in connection with them.

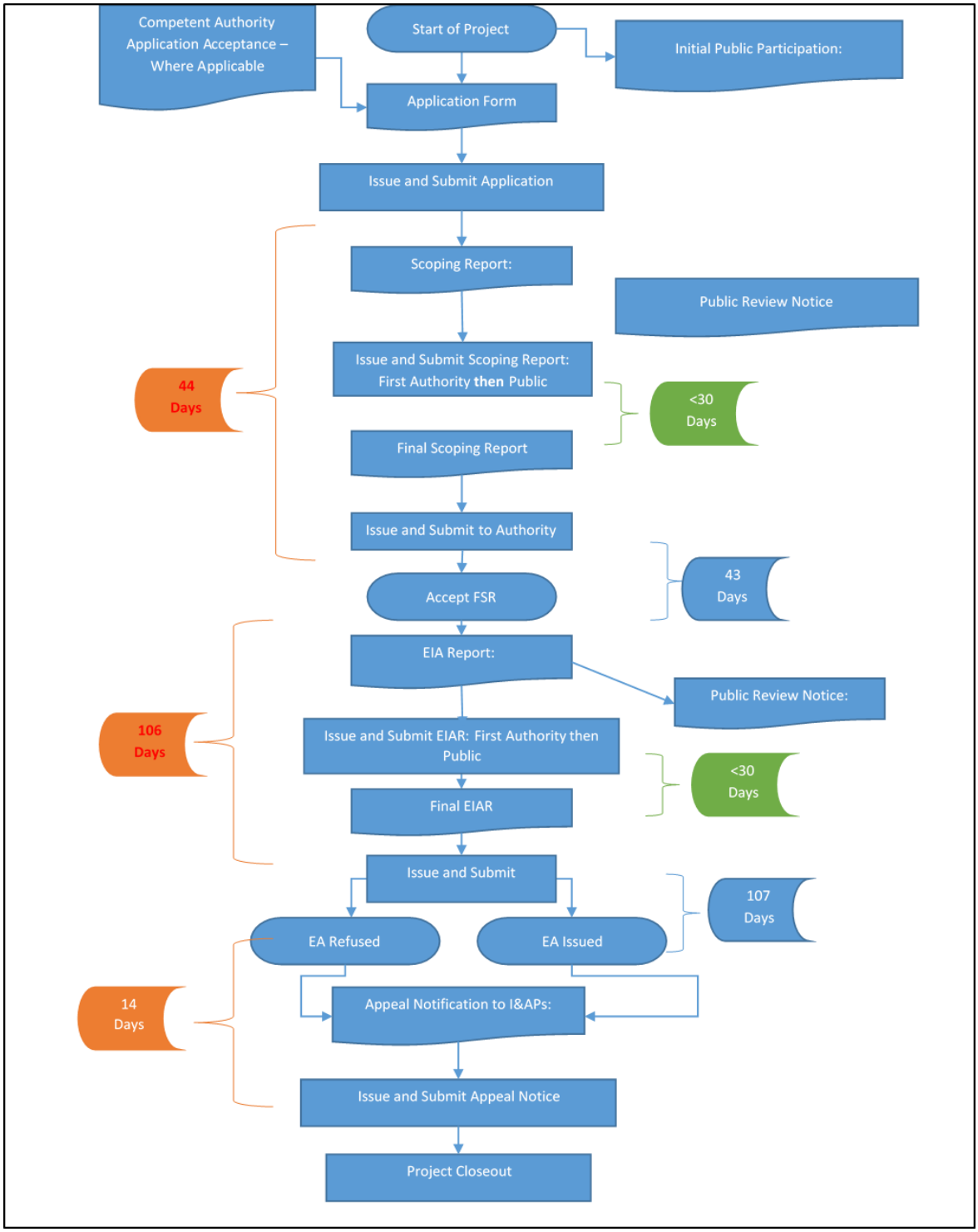


Figure 10: EIA process diagram.

5.1.3.1 LISTED ACTIVITIES

In accordance with the provisions of Sections 24(5) and Section 44 of the NEMA the Minister has published Regulations (GN R. 982) pertaining to the required process for conducting EIAs in order to apply for, and be considered for, the issuing of an EA. These EIA Regulations provide a detailed description of the EIA process to be followed when applying for EA for any listed activity.

In terms of these regulations a Scoping and Impact Assessment process is required for the proposed project. The **Table 9** below identifies the listed activities the proposed project triggers and consequently requires authorisation prior to commencement.

Table 9: NEMA listed activities to be authorised

Activity No(s):	Activity	Applicability
NEMA GNR 983 Activity 21C	Any activity including the operation of that activity associated with an onshore seismic survey which requires an exploration right in terms of section 79 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the exploration right, excluding (a) any desktop study, (b) any arial survey, and (c) a hydraulic fracturing activity which is included in activity 20A in Listing Notice 2 of 2014, in which case that activity applies	The proposed activities include the undertaking of onshore seismics / telluric survey over 28km long around known structures and possible drill locations.
NEMA GN984, Activity 20	Any activity including the operation of that activity which requires a production right in terms of section 83 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice, in Listing Notice 1 of 2014 or Listing Notice 3 of 2014, required to exercise the production right.	The proposed activities include the establishment of up to 43 production wells, which requires a production right in terms of section 83 of the MPRDA.
Other NEMA EIA Regulations, 2014 as amended applicable listed activities to be assessed in the EIA		
NEMA GNR 983 Activity 12	The development of- (i) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or (ii) infrastructure or structures with a physical footprint of 100 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of a watercourse;- excluding- (aa) the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour; (bb) where such development activities are related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies; (cc) activities listed in activity 14 in Listing Notice 2 of 2014 or activity 14 in Listing Notice 3 of 2014, in which case that activity applies; (dd) where such development occurs within an urban area; (ee) where such development occurs within existing roads, road reserves or railway line reserves; or (ff) the development of temporary infrastructure or structures where such infrastructure or structures will be removed within 6 weeks of the commencement of development and where indigenous vegetation will not be cleared.	This project comprises linear activities such as pipelines and possible access roads which will impact on watercourses or within 32 m of a watercourse when in proximity to these areas.

	This project comprises linear activities such as pipelines (with associated low point drains, pigging, booster and compressor stations) and access roads which will impact on watercourses or within 32 m of a watercourse when in proximity to these areas. NEMA GNR 983 Activity 16 The development and related operation of facilities for the desalination	
NEMA GNR 983 Activity 19	The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse; but excluding where such infilling, depositing, dredging, excavation, removal or moving- (a) will occur behind a development setback; (b) is for maintenance purposes undertaken in accordance with a maintenance management plan; (c) falls within the ambit of activity 21 in this Notice, in which case that activity applies; (d) occurs within existing ports or harbours that will not increase the development footprint of the port or harbour; or (e) where such development is related to the development of a port or harbour, in which case activity 26 in Listing Notice 2 of 2014 applies.	This project comprises linear activities such as pipelines and possible access roads which will require infilling or depositing of more than 10 m^3 of material to or from a watercourse when in proximity to these areas.
NEMA GNR 983 Activity 24	The development of a road- (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in Government Notice 387 of 2006 or activity 18 in Government Notice 545 of 2010; or (ii) with a reserve wider than 13,5 meters, or where no reserve exists where the road is wider than 8 metres; but excluding a road- (a) which is identified and included in activity 27 in Listing Notice 2 of 2014; (b) where the entire road falls within an urban area; or (c) which is 1 kilometre or shorter.	Access roads may be required to service the various project infrastructure (~43 production wells, pipelines and processing plant) although the vast majority of these roads will not be wider than 2m and many will only be 2-spoor tracks. This activity will be investigated further during the EIA process and if no access roads wider than 8m are identified, this activity will be removed during the EIA phase.
NEMA GNR 983 Activity 27	Clearance of an area of 1 hectares or more, but less than 20 hectares of indigenous vegetation, except where such clearance of indigenous vegetation is required for- (i) the undertaking of a linear activity; or (ii) maintenance purposes undertaken in accordance with a maintenance management plan	The proposed activities will require the clearance of an area of 1 hectare or more, but less than 20 hectares of indigenous vegetation for the processing plant (~1.5ha). Pipelines and access roads are linear activities and therefore excluded from this listed activity and the calculation of vegetation clearance.

NEMA GNR 983 Activity 28	Residential, mixed, retail, commercial, industrial or institutional developments where such land was used for agriculture, game farming, equestrian purposes or afforestation on or after 01 April 1998 and where such development: (i) will occur inside an urban area, where the total land to be developed is bigger than 5 hectares; or (ii) will occur outside an urban area, where the total land to be developed is bigger than 1 hectare; excluding where such land has already been developed for residential, mixed, retail, commercial, industrial or institutional purposes.	The proposed development is on land previously used for agricultural activities (grazing and crop farming) and covers an area greater than 1 hectare (outside urban area).
NEMA GNR 983 Activity 56	The widening of a road by more than 6 metres, or the lengthening of a road by more than 1 kilometre- (i) where the existing reserve is wider than 13,5 meters; or (ii) where no reserve exists, where the existing road is wider than 8 metres; excluding where widening or lengthening occur inside urban areas.	Existing roads may require lengthening by more than 1km however this is dependent on the landowner negotiations for use of existing roads. This activity will be investigated further during the EIA process and if no lengthening of existing roads is required, this activity will be removed during the EIA phase.
NEMA GNR 983 Activity 67	Phased activities for all activities- (i) listed in this Notice, which commenced on or after the effective date of this Notice or similarly listed in any of the previous NEMA notices, which commenced on or after the effective date of such previous NEMA Notices; excluding the following activities listed in this Notice- 17(i)(a-d); 17(ii)(a-d); 17(iii)(a-d); 17(iv)(a-d); 17(v)(a-d); 20; 21; ...; 24(i); 29; 30; 31; 32; 34; 54(i)(a-d); 54(ii)(a-d); 54(iii)(a-d);	The proposed production project will be constructed in a phased manner which may on their own not trigger a listed activity but when combined, exceed the threshold for clearance of vegetation.

	54(iv)(a-d); 54(v)(a-d); 55; 61; 64; and 65; or (ii) listed as activities 5, 7, 8(ii), 11, 13, 16, 27(i) or 27(ii) in Listing Notice 2 of 2014 or similarly listed in any of the previous NEMA notices, which commenced on or after the effective date of such previous NEMA Notices; where any phase of the activity was below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.	
NEMA GNR 984 Activity 5	The development and related operation of facilities or infrastructure for the processing of a petroleum resource, including the beneficiation or refining of gas, oil or petroleum products with an installed capacity of 50 cubic metres or more per day, excluding activities which are included in the list of waste management activities published in terms of section 19 of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) in which case the National Environmental Management: Waste Act, 2008 applies.	The helium recovery and gas processing plant will be constructed which serves the purpose of processing of gas of more than 50 m^3/day.
NEMA GNR 984 Activity 7	The development and related operation of facilities or infrastructure for the bulk transportation of dangerous goods- (i) in gas form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day; (ii) in liquid form, outside an industrial complex, using pipelines, exceeding 1 000 metres in length, with a throughput capacity of more than 50 cubic metres per day; or (iii) in solid form, outside an industrial complex, using funiculars or conveyors with a throughput capacity of more than 50 tons per day.	The proposed project will include the development and operation of gas pipelines exceeding 1 000 metres in length, with a throughput capacity of more than 700 tons per day.
NEMA GNR 985 Activity 4	The development of a road wider than 4 metres with a reserve less than 13,5 metres. b. Free State i. Outside urban areas: (aa) A protected area identified in terms of NEMPAA, excluding disturbed areas; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an international convention;	Access roads may be required to service the various project infrastructure (~43 production wells, pipelines and processing plant) which may occur within the identified CBA areas within the application area. In certain areas the width of the access roads may exceed 4m however the majority of these roads will not be wider than 2m and many may only be 2-spoor tracks. This activity will be investigated further during the EIA process and if no access roads wider than 8m are identified, this activity will be removed during the EIA phase.

NEMA GNR 985 Activity 12	The clearance of an area of 300 square meters or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan (b). Free State: i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004; ii. Within critical biodiversity areas identified in bioregional plans; iii. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning; or iv. Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland.	Sections of the proposed project footprint fall within CBA areas and watercourses where more than 300 m^2 will be cleared of vegetation.
NEMA GNR 985 Activity 14	The development of- (i) dams or weirs, where the dam or weir, including infrastructure and water surface area exceeds 10 square metres; or (ii) infrastructure or structures with a physical footprint of 10 square metres or more; where such development occurs- (a) within a watercourse; (b) in front of a development setback; or (c) if no development setback has been adopted, within 32 metres of a watercourse, measured from the edge of a watercourse; excluding the development of infrastructure or structures within existing ports or harbours that will not increase the development footprint of the port or harbour. Free State i. Outside urban areas: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) World Heritage Sites; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (ee) Sites or areas identified in terms of an international convention; (ff) Critical biodiversity areas or ecosystem service areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (gg) Core areas in biosphere reserves; or	Sections of the project footprint fall within CBA areas and watercourses and infrastructure in these areas will exceed the 10 m^2 threshold.

	(hh) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; or ii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority, zoned for a conservation purpose.	
NEMA GNR 985 Activity 18	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre. b. Free State i. Outside urban areas: (aa) A protected area identified in terms of NEMPAA, excluding conservancies; (bb) National Protected Area Expansion Strategy Focus areas; (cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority; (dd) Sites or areas identified in terms of an international convention; (ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans; (ff) Core areas in biosphere reserves; (gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve; or (hh) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland; or ii. Inside urban areas: (aa) Areas zoned for use as public open space; or (bb) Areas designated for conservation use in Spatial Development Frameworks adopted by the competent authority or zoned for a conservation purpose.	There are CBA areas overlapping with certain well and pipeline transects, and existing roads may require lengthening by more than 1 km however this is dependent on the outcome of landowner negotiations for use of existing roads. This activity will be investigated further during the EIA process and if no lengthening of existing roads is required, this activity will be removed during the EIA phase.

The DFFE have published a number of guidelines and protocols which have been considered in the compilation of this report and include but not limited to:

- Public Participation Guideline in terms of NEMA EIA Regulations (2017).
- Need and desirability Guideline in terms of NEMA (2012).
- National guideline on minimum information requirements for preparing Environmental Impact Assessments for mining act activities that require environmental authorisation (2018).
- 2004 Information Series covering various aspects of the EIA process.
- Procedures for assessment and minimum criteria for specialist studies.

5.1.3.2 SCREENING TOOL

A Screening Tool Report was generated from the DFFE Screening tool as per the requirements of Regulation 16 (1)(b)(v) of the EIA Regulations 2014, as amended, and was included in the Application for EA. The screening Tool provided a list of specialist studies for consideration and inclusion in the process. The Screening Tool identified environmental sensitivities are presented in Table 10.

Table 10: Screening Tool environmental sensitivities.

Theme	Sensitivity			
	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	X			
Animal Species Theme			X	
Aquatic Biodiversity Theme	X			
Archaeological and Cultural Heritage Theme				X
Civil Aviation Theme		X		
Defence Theme				X
Palaeontology Theme	X			
Plant Species Theme				X
Terrestrial Biodiversity Theme	X			

In this regard, as Site Sensitivity Verification Report (SSVR) has been compiled to consider the recommendations of the DFFE Screening Tool Report and to provide a rationale for the selection of specialist studies included in the assessment report. Please refer to **Table 11** for a summary of the verification process. Please refer to Appendix E for the SSVR.Table 11Table 11: SSVR findings and motivation.

Screening Tool identified specialist	Level of sensitivity	Suggested Sensitivity	Motivation
Agriculture Theme	Very High	**Medium**	Relative Agricultural Sensitivity was confirmed to be *Medium* by the Site Sensitivity Verification Report (SSVR) attached as **Appendix E**. The SSVR found that there are limited agricultural activities within the application area with some agricultural activities being undertaken especially in the southern and northern sections of the PR. However, the bulk of the proposed PR activities are will not directly impact on these areas. Furthermore, the activities will be limited to a maximum footprint of 50m x 50m for drill pads and 10m wide seismic transects which will have an acceptable overall impact on the soils and agricultural potential. In addition, post construction, the disturbed areas will be rehabilitated and only limited above ground infrastructure will remain (i.e. blower (gas emitting well) footprint of 2m x 2m).
Animal Species Theme	Medium	**Medium**	Aquatic habitats were noted and certain areas within the PR have intact vegetation, providing potential habitats of fauna species. The desktop biodiversity assessment also indicates that several species of conservation concern are expected to occur within the proposed project area.
Plant Species Theme	Low	**High**	According to the SSVR, certain habitats are generally intact, and various floral species were noted. The composition, species diversity and number of plant species recorded were noted during the site assessment.
Terrestrial Biodiversity Theme	Very High	**High**	According to the SSVR, certain habitat sensitivities are regarded as high sensitivity due to the role of this intact habitat to biodiversity within the proposed project area.
Aquatic Biodiversity Theme	Very High	**High**	Some production wells and seismic transects are proposed within and/or proximity of watercourses and wetlands. Construction could result in the encroachment into water resources and result in the loss or degradation of these systems, some of which may be functional and provide ecological services.
Archaeological and Cultural Heritage Theme	Low	**Medium**	The desktop Heritage assessment identified a total of 12 distinct heritage features which may potentially be impacted by the proposed development. These included burial grounds or graves, historical period remains, structures associated with farmsteads, and a potential Iron Age or historical settlement.
Civil Aviation Theme	High	**Low**	The proposed project which entails the establishment of up to 43 production gas boreholes and ~28.8km gas gathering pipelines and a gas processing plant which will not reflect light which may have an impact on civil aviation. The proposed activities do not interfere with surface and air transmission and therefore, no anticipated impacts on civil aviation emanating from the project. The proposed project does not entail the establishment of high-rise structures, use of aboveground high frequency electromagnetic radiation nor reflecting infrastructure. In addition, the area has low air traffic.
Defence Theme	Low	**Low**	There are no known military bases / facilities present within the vicinity of the project site. The nearest defence facility is the military base in Kroonstad, approximately 50 km northeast of the site and there are no anticipated impacts on defence theme emanating from the proposed activities

Palaeontology Theme	Very High	**High**	Based on the site investigation as well as desktop research it is concluded that fossil heritage of scientific and conservational interest in the project footprint may be present. Although no fossiliferous outcrops were noted within the proposed project areas, the SSVR concluded the Relative Palaeontological Theme Sensitivity to be High-Sensitive due to the possibility of subsurface fossils being present.

5.1.4 THE NATIONAL ENVIRONMENTAL MANAGEMENT LAWS AMENDMENT ACT (NEMLA)

The National Environmental Laws Amendment Act, known as 'the NEMLA Bill' or 'NEMLA4' (Act No. 2 of 2022), finally became an Act on 24 June 2022 and will introduce a major shift in South Africa's environmental legislation on a date to be fixed and proclaimed by the President. Act No. 2 of 2022 – undoubtedly the most significant piece of environmental legislation that has been published since the implementation of the One Environmental System (OES) in 2014 – has finally been signed into law (the Act). Many of the changes under NEMLA are intended to clean up a range of issues associated with the roll-out of the OES – which overhauled the manner in which environmental issues are regulated on mine sites, among other things. Overall, the changes imposed by the Act aim to deter non-compliance with environmental laws by, among other things, introducing new offences, increasing the quantum of fines and administrative penalties where laws or licenses have been contravened, and extending enforcement powers to enable more widespread enforcement of environmental laws. The applicant must ensure that the activities take into consideration the changes stipulated under NEMLA. A review of NEMLA and its impact on the development may be applicable should the developer fail to comply with the legislation discussed in this report, the EA and/or any other authorizations / licenses applicable to the development. The applicant may face harsh penalty fines should they fail to comply with NEMA EIA Regulations, 2014 as amended and/or specific conditions which will be stipulated in the Environmental Authorization by the competent authority.

5.1.5 THE NATIONAL ENVIRONMENTAL MANAGEMENT PROTECTED AREAS ACT (NEMPAA)

The National Environmental Management Protected Areas Act (Act No. 57 of 2003 – NEMPAA) is intended to *"provide for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes"* and creating a *"national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity".*

The NEMPAA defines various kinds of protected areas, namely: *"special nature reserves, national parks, nature reserves (including wilderness areas) and protected environments; world heritage sites; marine protected areas; specially protected forest areas, forest nature reserves and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act 84 of 1998); and mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act 63 of 1970)".*

According to the Baseline Terrestrial Biodiversity Assessment undertaken by the Biodiversity Company (**Appendix F**), the project area falls within >5 km of H. J. Joel Private Nature Reserve, Tara Wildlife Safaris, and LM Safaris Nature Reserve.

5.1.6 THE NATIONAL ENVIRONMENTAL MANAGEMENT AIR QUALITY ACT (NEMAQA)

The National Environmental Management: Air Quality Act (Act No. 39 of 2004 as amended – NEMAQA) is the main legislative tool for the management of air pollution and related activities. The Object of the Act is:

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

The NEMAQA mandates the Minister of Environment to publish a list of activities which result in atmospheric emissions and consequently cause significant detrimental effects on the environment, human health and social welfare. All scheduled processes as previously stipulated under the Air Pollution Prevention Act (APPA) are included as listed activities with additional activities being added to the list. The updated Listed Activities and

Minimum National Emission Standards were published on the 22nd of November 2013 (Government Gazette No. 37054).

National Ambient Air Quality Standards (NAAQS) were determined based on international best practice for particulate matter less than 10 and 2.5 µm in aerodynamic diameter (PM_{10} and $PM_{2.5}$), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), carbon monoxide (CO), lead (Pb) and benzene. The NAAQS were published in the Government Gazette (no. 32816) on 24 December 2009 for PM_{10} and other pollutants (South Africa, 2009). The $PM_{2.5}$ NAAQS were published in 2012 (South Africa, 2012).

The NEMAQA also provides for the monitoring and reporting of GHG emissions. The National Greenhouse Gas Emission Reporting Regulations (South Africa, 2017) were published in terms of Section 53 (aA), (o) and (p) of NEM: AQA on 3 April 2017 and amended on 11 September 2020 (South Africa, 2020). The purpose of these Regulations is to implement a single national reporting system for the transparent reporting of GHG emissions.

The National Pollution Prevention Plans Regulations were published in March 2014 (Government Gazette 37421) and tie in with the National Greenhouse Gas (GHG) Emission Reporting Regulations which took effect on 3 April 2017. In summary, the Regulations aim to prescribe the requirements that pollution prevention plans of greenhouse gases declared as priority air pollutants, need to comply with in terms of the NEMAQA. The Regulations specify who needs to comply, and by when, as well as prescribing the content requirements.

The National Dust Control Regulations are promulgated under the NEMAQA and the purpose of these Regulations is to prescribe general measures for the control of dust in all areas. Dustfall is assessed for nuisance impact and not for inhalation health impact. The National Dust Control Regulations (Department of Environmental Affairs, 2013) prescribes measures for the control of dust in residential and non-residential areas. Acceptable dustfall rates are measured (using American Standard Testing Methodology (ASTM) D1739:1970 or equivalent) at and beyond the boundary of the premises where dust originates. In addition to the dustfall limits, the National Dust Control Regulations prescribe monitoring procedures and reporting requirements. Dust that may be created from the project (including but not limited to the construction phase) will be managed in accordance with these Regulations.

According to the NEMAQA, air quality management control and enforcement is in the hands of local government with District and Metropolitan Municipalities as the licensing authorities. Provincial government is primarily responsible for ambient monitoring and ensuring municipalities fulfil their legal obligations, with national government primarily as policy maker and co-ordinator. Each sphere of government must appoint an Air Quality Officer responsible for co-ordinating matters pertaining to air quality management. Given that air quality management under the old Act was the sole responsibility of national government, local authorities have in the past only been responsible for smoke and vehicle tailpipe emission control.

Based on the proposed activities (production), the applicant will be obligated to report on the GHG emissions under these Regulations. As part of this EIA application, Air Quality and Climate Change studies are being undertaken.

5.1.7 THE NATIONAL ENVIRONMENTAL MANAGEMENT BIODIVERSITY ACT (NEMBA)

The National Environmental Management Biodiversity Act (Act No. 10 of 2004 – NEMBA) provides for the management and conservation of South Africa's biodiversity within the framework of the NEMA as well as the protection of species and ecosystems that warrant national protection. Within the framework of this act, various regulations are promulgated which provide specific requirements and management measures relating to protecting threatened ecosystems, threatened or protected species as well as the control of alien and invasive species. A summary of these regulations is presented below.

The National List of Ecosystems that are Threatened and Need of Protection (GN 1002 of 2011) are promulgated under the NEMBA and these Regulations provide for listing of threatened or protected ecosystems in one of the following categories:

- Critically Endangered (CR) ecosystems, being ecosystems that have undergone severe degradation of ecological structure, function or composition as a result of human intervention and are subject to an extremely high risk of irreversible transformation;

- Endangered (EN) ecosystems, being ecosystems that have undergone degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems;
- Vulnerable (VU) ecosystems, being ecosystems that have a high risk of undergoing significant degradation of ecological structure, function or composition as a result of human intervention, although they are not critically endangered ecosystems or endangered ecosystems; and
- Protected ecosystems, being ecosystems that are of high conservation value or of high national or provincial importance, although they are not listed as critically endangered, endangered or vulnerable.

Further regulations published under the NEMBA are the threatened or protected Species Regulations (GN R 152 of 2007) which aims to:

(a) further regulate the permit system set out in Chapter 7 of the Biodiversity Act insofar as that system applies to restricted activities involving specimens of listed threatened or protected species;

(b) provide for the registration of captive breeding operations, commercial exhibition facilities, game farms, nurseries, scientific institutions, sanctuaries and rehabilitation facilities and wildlife traders;

(c) provide for the regulation of the carrying out of a specific restricted activity, namely hunting;

(d) provide for the prohibition of specific restricted activities involving specific listed threatened or protected species;

(e) provide for the protection of wild populations of listed threatened species; and

(f) provide for the composition and operating procedure of the Scientific Authority.

The Alien and Invasive Species Lists are promulgated under the NEMBA with the aim of protecting the quality and quantity of arable land in South Africa. Loss of arable land should be avoided and declared Weeds and Invaders in South Africa are categorised according to one of the following categories, and require control or removal:

- Category 1a Listed Invasive Species: Category 1a Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be combated or eradicated;
- Category 1b Listed Invasive Species: Category 1b Listed Invasive Species are those species listed as such by notice in terms of section 70(1)(a) of the Act as species which must be controlled;
- Category 2 Listed Invasive Species: Category 2 Listed Invasive Species are those species listed by notice in terms of section 70(1)(a) of the Act as species which require a permit to carry out a restricted activity within an area specified in the Notice or an area specified in the permit, as the case may be; and
- Category 3 Listed Invasive Species: Category 3 Listed Invasive Species are species that are listed by notice in terms of section 70(1)(a) of the Act, as species which are subject to exemptions in terms of section 71(3) and prohibitions in terms of section 71A of Act, as specified in the Notice.

In giving effect to the above, the Alien and Invasive Species Regulations (GNR 1020 of 2020) provide for amongst others, the prevention of the spread or allowing the spread of, any specimen of a listed invasive species.

5.1.8 THE NATIONAL ENVIRONMENTAL MANAGEMENT WASTE ACT (NEMWA)

On 2 June 2014, the NEMWA came into force. The objectives of this Act are:

a) to protect health, well-being and the environment by providing reasonable measures for-

   i. minimising the consumption of natural resources;

   ii. avoiding and minimising the generation of waste;

   iii. reducing, re-using, recycling and recovering waste;

   iv. treating and safely disposing of waste as a last resort;

v. preventing pollution and ecological degradation;

vi. securing ecologically sustainable development while promoting justifiable economic and social development;

vii. promoting and ensuring the effective delivery of waste services;

viii. remediating land where contamination presents, or may present, a significant risk of harm to health or the environment; and

ix. achieving integrated waste management reporting and planning;

b) to ensure that people are aware of the impact of waste on their health, well-being and the environment;

c) to provide for compliance with the measures set out in paragraph (a); and

d) generally, to give effect to section 24 of the Constitution in order to secure an environment that is not harmful to health and well-being.

Section 16 of the NEMWA states:

1. A holder of waste must, within the holder's power, take all reasonable measures to-

a) "*Avoid the generation of waste and where such generation cannot be avoided, to minimise the toxicity and amounts of waste that are generated;*

b) Reduce, re-use, recycle and recover waste;

c) Where waste must be disposed of, ensure that the waste is treated and disposed of in an environmentally sound manner;

d) Manage the waste in such a manner that it does not endanger health or the environment or cause a nuisance through noise, odour, or visual impacts;

e) Prevent any employee or any person under his or her supervision from contravening the Act; and

f) *Prevent the waste from being used for unauthorised purposes.*"

The NEMWA provides for specific waste management measures to be implemented, as well as providing for the licensing and control of waste management activities.

The anticipated waste to be generated based on similar adjacent work (Motuoane ER315) includes both general and hazardous waste streams. The waste must be managed accordingly and be disposed by a certified waste service provider at a registered hazardous landfill site.

5.1.9 THE NATIONAL WATER ACT (NWA)

The purpose of the NWA is to ensure that the nation's water resources are protected, used, developed, conserved, managed and controlled in ways which take into account amongst other factors:

a) meeting the basic human needs of present and future generations;

b) promoting equitable access to water;

c) redressing the results of past racial and gender discrimination;

d) promoting the efficient, sustainable and beneficial use of water in the public interest;

e) facilitating social and economic development;

f) providing for growing demand for water use;

g) protecting aquatic and associated ecosystems and their biological diversity;

h) reducing and preventing pollution and degradation of water resources;

i) meeting international obligations;

j) promoting dam safety;

k) managing floods and droughts,

and for achieving this purpose, to establish suitable institutions and to ensure that they have appropriate community, racial and gender representation.

The NWA makes provision for two types of applications for water use licences, namely individual applications and compulsory applications. The NWA also provides that the responsible authority may require an assessment by the applicant of the likely effect of the proposed licence on the resource quality, and that such assessment be subject to the NEMA EIA Regulations. A person may use water if the use is –

- Permissible as a continuation of an existing lawful water use (ELWU);
- Permissible in terms of a general authorisation (GA);
- Permissible under Schedule 1; or
- Authorised by a licence.

The water use processes are described in **Figure 11.**

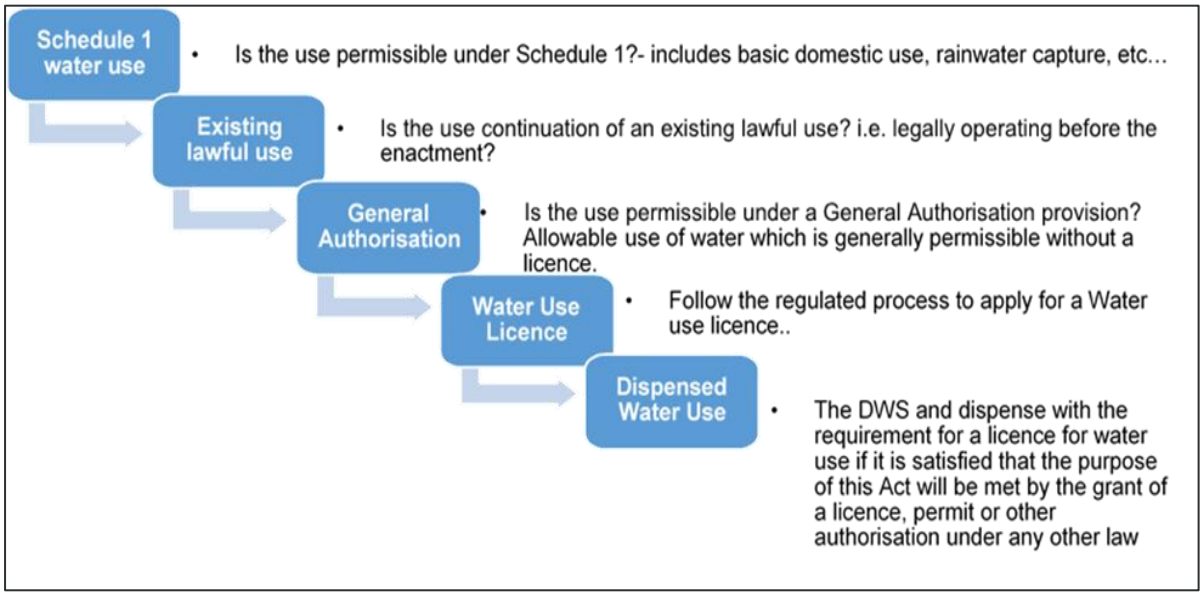


Figure 11: Authorisation processes for new water uses.

The NWA defines 11 water uses in Section 21 of the Act. A water use may only be undertaken if authorised by the Department of Water and Sanitation (DWS). The water uses for which an authorisation or licence can be issued include:

a) Taking water from a water resource;

b) Storing water;

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

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

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

f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduits;

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

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

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

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

k) Using water for recreational purposes.

The proposed production project includes extensive linear infrastructure which will impact on water resources in certain areas. The main water use that will be applicable is the Section 21 (c&i) uses for activities within proximity (or within) the regulated area of a watercourse. A watercourse is defined in terms of the Act as follows:

a) a river or spring;
b) a natural channel in which water flows regularly or intermittently;
c) a wetland, lake or dam into which, or from which, water flows; and
d) any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks;

The regulated area of a watercourse for section 21 activities of the Act water uses is similarly defined in terms of the Act as follows:

a) The outer edge of the 1 in 100-year flood line and/or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;

b) In the absence of a determined 1 in 100-year flood line or riparian area the area within 100m from the edge of a watercourse where the edge of the watercourse is the first identifiable annual bank fill flood bench (subject to compliance to section 144 of the Act); or

c) A 500 m radius from the delineated boundary (extent) of any wetland or pan.

As part of this EIA process, specialist input will be obtained to delineate the watercourses as well as the 1 in 100-year floodlines and based on that input, the relevant water uses will be identified and applied for. South Africa is divided into nine Water Management Areas (WMAs). The delegation of water resource management from central government to catchment level is achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA progressively develops a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA. This is to ensure that on a regional scale, water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons. The main instrument that guides and governs the activities of a WMA is the Catchment Management Strategy (CMS) which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. According to the DWS water management areas delineations, the Motuoane Production Project is situated in primary catchment (C) of the Vaal River drainage system which covers a total area of approximately 196,438 km^2. The resource management falls under the Vaal Water Management Area (WMA5) which spans portions of the North West Province, northern Free State as well northern sections of the Northern Cape. The application area is situated within quaternary catchments C42G, C42H and C42K.

5.1.10 THE NATIONAL HERITAGE RESOURCES ACT (NHRA)

The National Heritage Resources Act (Act 25 of 1999 – NHRA) stipulates that cultural heritage resources may not be disturbed without authorisation from the relevant heritage authority. Section 34(1) of the NHRA states that, "*no person may alter or demolish any structure or part of a structure which is older than 60 years without a permit issued by the relevant provincial heritage resources authority…*" The NHRA is utilised as the basis for the identification, evaluation and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA, and those developments administered through the NEMA, the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and the Development Facilitation Act (FDA) legislation. In the latter cases the feedback from the relevant heritage resources authority is required by the State and Provincial Departments

managing these Acts before any authorisations are granted for a development. The last few years have seen a significant change towards the inclusion of heritage assessments as a major component of Environmental Impact Processes required by the NEMA and MPRDA.

The NEMA 23(2)(b) states that an integrated environmental management plan should, *"…identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage".* A study of subsections (23)(2)(d), (29)(1)(d), (32)(2)(d) and (34)(b) and their requirements reveals the compulsory inclusion of the identification of cultural resources, the evaluation of the impacts of the proposed project on these resources, the identification of alternatives and the management procedures for such cultural resources for each of the documents noted in the Environmental Regulations. A further important aspect to be taken into account of in the EIA Regulations under the NEMA relates to the Specialist Report requirements (Appendix 6 of EIA Regulations 2014, as amended) which apply to Heritage Impact Assessments.

The MPRDA defines 'environment' as it is in the NEMA and, therefore, acknowledges cultural resources as part of the environment. Section 39(3)(b) of this Act specifically refers to the evaluation, assessment and identification of impacts on all heritage resources as identified in Section 3(2) of the NHRA that are to be impacted on by activities governed by the MPRDA. Section 40 of the same Act requires the consultation with any State Department administering any law that has relevance on such an application through Section 39 of the MPRDA. This implies the evaluation of Heritage Assessment Reports in Environmental Management Plans or Programmes by the relevant heritage authorities.

In accordance with the legislative requirements and EIA rating criteria, the regulations of the South African Heritage Resources Agency (SAHRA) and Association of Southern African Professional Archaeologists (ASAPA) have also been incorporated to ensure that a comprehensive and legally compatible Heritage Report is compiled. According to the Baseline Heritage Impact Assessment undertaken by the Dr Lucien James (Appendix F), heritage resources were identified within the proposed project footprint. These observations will be further elaborated on through the full Heritage Impact Assessment including a field survey in the EIA Phase.

5.1.11 ENVIRONMENT CONSERVATION ACT (ECA)

The ECA (Act 73 of 1989) was, prior to the promulgation of the NEMA, the backbone of environmental legislation in South Africa. To date the majority of the ECA has been repealed by various other Acts, however Section 25 of the Act and the Noise Regulations (GN R. 154 of 1992) promulgated under this section are still in effect. These Regulations serve to control noise and general prohibitions relating to noise impact and nuisance.

In terms of section 25 of the ECA, the National Noise Control Regulations (GN R. 154 – NCRs) published in Government Gazette No. 13717 dated 10 January 1992, were promulgated. The NCRs were revised under GN R. 55 of 14 January 1994 to make it obligatory for all authorities to apply the regulations. Provincial noise control regulations have been promulgated in Gauteng, Free State and Western Cape Provinces.

The NCRs will need to be considered in relation to the potential noise that may be generated mainly during the construction phase of the proposed project. The two key aspects of the NCRs relate to disturbing noise and noise nuisance.

Section 4 of the Regulations prohibits a person from making, producing or causing a disturbing noise, or allowing it to be made produced or caused by any person, machine, device or apparatus or any combination thereof. A disturbing noise is defined in the Regulations as "*a noise level which exceeds the zone sound level or if no zone sound level has been designated, a noise level which exceeds the ambient sound level at the same measuring point by 7 dBA or more*."

Section 5 of the NCRs in essence prohibits the creation of a noise nuisance. A noise nuisance is defined as "*any sound which disturbs or impairs or may disturb or impair the convenience or peace of any person".* The South African National Standard 10103 also applies to the measurement and consideration of environmental noise and should be considered in conjunction with these Regulations.

There are a few South African National Standards (SANS) relevant to noise from mines, industry and roads. They are:

- South African National Standard (SANS) 10103:2008 – 'The measurement and rating of environmental noise with respect to annoyance and to speech communication';
- SANS 10210:2004 – 'Calculating and predicting road traffic noise';
- SANS 10328:2008 – 'Methods for environmental noise impact assessments';
- SANS 10357:2004 – 'The calculation of sound propagation by the Concave method';
- SANS 10181:2003 – 'The Measurement of Noise Emitted by Road Vehicles when Stationary'; and
- SANS 10205:2003 – 'The Measurement of Noise Emitted by Motor Vehicles in Motion'.

The relevant standards use the equivalent continuous rating level as a basis for determining what is acceptable. The levels may take single event noise into account, but single event noise by itself does not determine whether noise levels are acceptable for land use purposes. With regards to SANS 10103:2008, the recommendations are likely to inform decisions by authorities, but non-compliance with the standard will not necessarily render an activity unlawful per se. A noise impact assessment will be undertaken for this project and the findings utilised in the impact assessment and associated management measures in the EMPr.

5.1.12 THE CONSERVATION OF AGRICULTURAL RESOURCES ACT (CARA)

The law on Conservation of Agricultural Resources (Act 43 of 1983) aims to provide for the conservation of the natural agricultural resources of the Republic by the maintenance of the production potential of land, by the combating and prevention of erosion and weakening or destruction of the water sources, and by the protection of the vegetation and the combating of weeds and invader plants. In order to achieve the objectives of this Act, control measures related to the following may be prescribed to land users to whom they apply:

- The cultivation of virgin soil;
- The utilisation and protection of land which is cultivated;
- The irrigation of land;
- The prevention or control of waterlogging or salination of land;
- The utilisation and protection of vleis, marshes, water sponges, water courses and water sources;
- The regulating of the flow pattern of run-off water;
- The utilisation and protection of the vegetation;
- The grazing capacity of veld, expressed as an area of veld per large stock unit;
- The maximum number and the kind of animals which may be kept on veld;
- The prevention and control of veld fires;
- The utilisation and protection of veld which has burned;
- The control of weeds and invader plants;
- The restoration or reclamation of eroded land or land which is otherwise disturbed or denuded;
- The protection of water sources against pollution on account of farming practices;
- The construction, maintenance, alteration or removal of soil conservation works or other structures on land; and
- Any other matter which the Minister may deem necessary or expedient in order that the objects of this Act may be achieved.

Further, different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine. Preliminary impacts on the agriculture and soil,

biodiversity and water resources have been identified with regards to this project, and mitigation and management measures recommended. These will be updated during the EIA phase of this project as and where necessary.

5.1.13 THE SPATIAL PLANNING AND LAND USE MANAGEMENT ACT (SPLUMA)

The Spatial Planning and Land Use Management Act (Act 16 of 2013 – SPLUMA) is set to aid effective and efficient planning and land use management, as well as to promote optimal exploitation of minerals and mineral resources. The SPLUMA was developed to legislate for a single, integrated planning system for the entire country. Therefore, the Act provides a framework for a planning system for the country and introduces provisions to cater for development principles; norms and standards; inter-governmental support; Spatial Development Frameworks (SDFs) across national, provincial, regional and municipal areas; Land Use Schemes (LUS); and municipal planning tribunals.

5.1.14 NATIONAL VELD AND FOREST FIRE ACT

The National Veld and Forest Fire Act 101 of 1998 is a key piece of legislation in South Africa aimed at reforming the legal framework surrounding veld and forest fires. Its primary purpose is to prevent and manage wildfires through coordinated efforts, particularly in rural and fire-prone areas. The Act encourages the formation of Fire Protection Associations (FPAs), which are legally recognized bodies that facilitate local collaboration among landowners, municipalities, and other stakeholders to predict, prevent, and suppress veldfires. These associations play a vital role in fire management by offering training, support, and technical expertise to their members.

For private developers and landowners, the Act imposes several important obligations. They are legally required to take reasonable precautions to prevent fires from starting or spreading from their property. This includes maintaining firebreaks, ensuring that controlled burns are conducted safely and in accordance with regulations, and joining or cooperating with local FPAs. Failure to meet these responsibilities can result in legal liability, especially if negligence leads to damage or loss caused by a fire. In such cases, landowners may face civil claims for damages, making it essential for them to understand and comply with the Act's provisions.

In essence, the Act not only promotes proactive fire management but also establishes a framework for accountability. Private developers and landowners must be vigilant and informed, as their actions—or lack thereof—can have significant legal and financial consequences. By participating in FPAs and adhering to fire safety regulations, they contribute to a safer and more resilient environment for their communities and the broader ecosystem

5.1.15 OCCUPATIONAL HEALTH AND SAFETY ACT

The Occupational Health and Safety Act (Act 85 of 1993 - OHSA) provides for the health and safety of persons at work and for the health and safety of persons in connection with the use of plant and machinery; the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work; to establish an advisory council for occupational health and safety; and to provide for matters connected therewith. Worker safety will form part of the contractor's safety requirements and be guided by the OHSA. This would entail a full health and safety file including but not limited to pre-mobilization medical assessments, work environment and task specific risk assessments and method statements etc. The project will be required to comply with the OHSA and or Mine Health and Safety Act (dependent on the specific aspect of the production operations). Therefore, safety of all personnel will be guided by overarching South African legislation.

The Major Hazard Installation Regulations (GNR 692 of 30 July 2001) are promulgated under the OHSA and apply to employers, self-employed persons and users, who have on their premises, either permanently or temporarily, a major hazard installation or a quantity of a substance which may pose a risk that could affect the health and safety of employees and the public.

A "major hazard installation" means an installation-

a) where more than the prescribed quantity of any substance is or may be kept, whether permanently or temporarily; or

b) where any substance is produced, processed, used, handled or stored in such a form and quantity that it has the potential to cause a major incident.

The proposed project entails the installation of gas production infrastructure, including a gas processing plant and as such is likely to trigger a need for an MHI. A qualitative risk assessment will be undertaken during the EIA Phase.

5.1.16 THE MINE HEALTH AND SAFETY ACT

The Mine Health and Safety Act, 1996 (Act No. 29 of 1996) provides for protection of the health and safety of employees and other persons at mines and, for that purpose-

- to promote a culture of health and safety;
- to provide for the enforcement of health and safety measures;
- to provide for appropriate systems of employee, employer and State participation in health and safety matters;
- to establish representative tripartite institutions to review legislation, promote health and enhance properly targeted research;
- to provide for effective monitoring systems and inspections, investigations and inquiries to improve health and safety;
- to promote training and human resources development;
- to regulate employers' and employees' duties to identify hazards and eliminate, control and minimise the risk to health and safety;
- to entrench the right to refuse to work in dangerous conditions; and
- to give effect to the public international law obligations of the Republic relating to mining health and safety;
- and to provide for matters connected therewith.

With specific reference to the Regulations (GN R93 of 1997) published under this Act, the following has reference to this proposed project:

17(6) The employer must take reasonable measures to ensure that the competent person referred to in regulation 17(2)(a) in writing notifies the employer, which notification must be dated, of any workings being advanced to come within: -

> *(a) a horizontal distance of 100 (one hundred) metres from reserve land, buildings, roads, railways, dams, waste dumps or any other structure whatsoever including structures beyond the mining boundaries, or from any surface, which it may be necessary to protect in order to prevent any significant risk;*
>
> *(b) 50 (fifty) metres from any excavation, workings, restricted area or any other place where there is, or is likely to be a dangerous accumulation of fluid material, noxious or flammable gas. Such notification must include a sketch plan giving the distance to such place from the nearest survey station.*

17(7) The employer must take reasonable measures to ensure that: -

> *(a) no mining operations are carried out within a horizontal distance of 100 (one hundred) metres from reserve land, buildings, roads, railways, dams, waste dumps, or any other structure whatsoever including such structures beyond the mining boundaries, or any surface, which it may be necessary to protect in order to prevent any significant risk, unless a lesser distance has been determined safe by risk*

assessment and all restrictions and conditions determined in terms of the risk assessment are complied with;

(b) workings coming within 50 (fifty) metres, from any other excavation, workings, restricted area or any other place where there is, or is likely to be a dangerous accumulation of fluid material, noxious or flammable gas are mined subject to such restrictions and stopped at such positions as determined by risk assessment.

(c) where ground movement, as a result of mining operations, poses significant risk, an effective ground movement monitoring system is in place.

(d) survey records and plans relating to conditions described in paragraphs (a) and (b) above, are made available to the persons doing the risk assessment.

17(8) No person may erect, establish or construct any buildings, roads, railways, dams, waste dumps, reserve land, excavations or any other structures whatsoever within a horizontal distance of 100 (one hundred) metres from workings, unless a lesser distance has been determined safe:-

(a) in the case of the employer, by risk assessment and all restrictions and conditions determined in terms of the risk assessment are complied with; or

(b) in the case of any other person, by a professional geotechnical specialist and all restrictions and conditions determined by him or her or by the Chief Inspector of Mines are complied with.

The Mine Health and Safety Act and associated Regulations will be applicable to the Motuoane Production Right project.

5.1.17 THE NATIONAL ENERGY ACT

The National Energy Act (Act 34 of 2008) provides to ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors; to provide for energy planning, increased generation and consumption of renewable energies, contingency energy supply, holding of strategic energy feedstock's and carriers, adequate investment in, appropriate upkeep and access to energy infrastructure; to provide measures for the furnishing of certain data and information regarding energy demand, supply and generation; to establish an institution to be responsible for promotion of efficient generation and consumption of energy and energy research; and to provide for all matters connected therewith. Importantly, the Department of Energy (DoE) is mandated to provide for energy planning and measures for the furnishing of certain data and information regarding energy demand, supply and generation. The objectives of this Act are to-

a) ensure uninterrupted supply of energy to the Republic;

b) promote diversity of supply of energy and its sources;

c) facilitate effective management of energy demand and its conservation;

d) promote energy research;

e) promote appropriate standards and specifications for the equipment, systems and processes used for producing, supplying and consuming energy;

f) ensure collection of data and information relating to energy supply, transportation and demand;

g) provide for optimal supply, transformation, transportation, storage and demand of energy that are planned, organised and implemented in accordance with a balanced consideration of security of supply, economics, consumer protection and a sustainable development;

h) provide for certain safety, health and environment matters that pertain to energy;

i) facilitate energy access for improvement of the quality of life of the people of Republic;

j) commercialise energy-related technologies;

k) ensure effective planning for energy supply, transportation and consumption; and

l) contribute to sustainable development of South Africa's economy.

The Act provides for the establishment of the South African National Energy Development Institution (SANEDI), whose functions include:

Energy efficiency-

i. undertake energy efficiency measures as directed by the Minister;

ii. increase energy efficiency throughout the economy;

iii. increase the gross domestic product per unit of energy consumed; and

iv. optimise the utilisation of finite energy resources;

Energy research and development-

i. direct, monitor, conduct and implement energy research and technology development in all fields of energy, other than nuclear energy; and

ii. promote energy research and technology innovation;

iii. provide for-

a. training and development in the field of energy research and technology development;

b. establishment and expansion of industries in the field of energy; and

c. commercialisation of energy technologies resulting from energy research and development programmes;

iv. register patents and intellectual property in its name resulting from its activities;

v. issue licences to other persons for the use of its patents and intellectual property;

vi. publish information concerning its objects and functions;

vii. establish facilities for the collection and dissemination of information in connection with research, development and innovation;

viii. undertake any other energy technology development related activity as directed by the Minister, with the concurrence of the Minister of Science and Technology;

ix. promote relevant energy research through cooperation with any entity, institution or person equipped with the relevant skills and expertise within and outside the Republic;

x. make grants to educational and scientific institutions in aid of research by their staff or for the establishment of facilities for such research;

xi. promote the training of research workers by granting bursaries or grants-in-aid for research;

xii. undertake the investigations or research that the Minister, after consultation with the Minister of Science and Technology, may assign to it; and

xiii. advise the Minister and the Minister of Science and Technology on research in the field of energy technology.

Motuoane has been in discussions with Linde who are the world's leading supplier of helium to customers globally. Linde have expressed a strong interest in purchasing the helium produced from the development plan area. In addition, Linde have also provided detail and costings on a fit for purpose helium recovery and liquefaction plant for the project. Discussions have also been held between the Motouane and Renergen discussing a sales arrangement that would see the gaseous helium component sold to Renergen for processing through their liquefaction plant.

In addition to the Helium production, Methane is one of the other products the Motuoane Gas Production Project will produce. Motuoane has a gas sales term sheet in place with NOVO Energy, an integrated energy and technology company and licensed gas trader that owns gas infrastructure and provides turnkey customer solutions (industrial, NGV, power generation and feedstock) for companies across South Africa. The processing and supply of this LNG will be subject to the conditions and requirements of this Act, and the gas production on the whole will contribute to the South African economy and promote development in technologies pertaining to helium and LNG extraction and processing.

5.1.18 GAS ACT

The Gas Act (Act 48 of 2001) aims to promote the orderly development of the piped gas industry; to establish a national regulatory framework; to establish a National Gas Regulator as the custodian and enforcer of the national regulatory framework; and to provide for matters connected therewith. The Motuoane Production Right will contribute towards the development of the gas industry in South Africa.

5.2 NATIONAL POLICY AND PLANNING CONTEXT

5.2.1 GAS MASTER PLAN AND INTEGRATED RESOURCE PLAN

The SA Government published a Gas Master Plan in December 2021 for comments from the public. The background to the Master Plan is the following (quoted directly from the plan): "*The National Development Plan (NDP) envisions that by 2030 South Africa will have an energy sector that promotes economic growth and development through adequate investment in energy infrastructure. At just 2.6% of the country's total energy mix, South Africa's natural gas market is small, but with all its inherent benefits, it has the potential to completely change the economy by stimulating economic growth and development, stability, and job creation. The meaningful addition of natural gas to the country's energy mix will rejuvenate an overburdened, out-dated energy infrastructure and reduce cyclical energy shortfalls. Perhaps even more importantly, it will stimulate the economy by allowing business and industry to lower their energy and operational spend while also creating significant numbers of new jobs and skills development opportunities. Considering that nearly 90% of South Africa's existing natural gas demand is supplied by a single entity, namely Sasol Gas, the associated economic and employment risks of limited supply options, development and sourcing of alternative natural gas resources are high. It is imperative to ensure economic and employment stability within the natural gas sector by introducing more suppliers. Southern Africa's gas potential has been revealed by major discoveries that, when developed, widen options for greater regional energy trade. South Africa's gas resource potential remains to be quantified but raises the prospect of possible domestic production in the longer term. Globally the natural gas industry has moved into a supply surplus, favouring a larger role for gas as a clean fossil fuel in many countries' energy policies. A challenge in developing the gas sector is to bring gas demand and supply on stream at the same time and spread geographically to stimulate broader localized demand through South Africa. Without such localized gas demand, it is difficult to develop distributed gas supply and without such distributed gas supply it is difficult to develop localized gas demand. One way of breaking this impasse is to create significant "anchor" gas demand through the development of a gas-to-power programme. In pursuit of adding generating capacity, lowering carbon emissions, enhancing energy security and supporting industrial development, South Africa has taken the first steps in a gas-to-power programme to be executed under the Integrated Resource Plan 2025*."

5.2.2 THE MINING AND BIODIVERSITY GUIDELINES

The Mining and Biodiversity Guidelines (2013) was developed by the Department of Mineral Resources, the Chamber of Mines, the SANBI and the South African Mining and Biodiversity Forum, with the intention to find a balance between economic growth and environmental sustainability. The Guideline is envisioned as a tool to "foster a strong relationship between biodiversity and mining, which will eventually translate into best practice within the mining sector. It provides a tool to facilitate the sustainable development of South Africa's mineral resources, in a way that enables regulators, industry and practitioners to minimise the impact of mining on the country's biodiversity and ecosystem services. It provides the mining sector with a practical, user- friendly

manual for integrating biodiversity considerations into the planning processes and managing biodiversity during the operational phases of a mine, from exploration through to closure. The Guideline provides explicit direction in terms of where: mining-related impacts are legally prohibited; biodiversity priority areas may present high risks for mining projects; and biodiversity may limit the potential for mining."

In identifying biodiversity priority areas, which have different levels of risk against mining, the Guideline categorises biodiversity priority areas into four categories of biodiversity priority areas in relation to their importance from a biodiversity and ecosystem service point of view as well as the implications for mining in these areas:

A) Legally protected areas, where mining is prohibited;

B) Areas of highest biodiversity importance, which are at the highest risk for mining;

C) Areas of high biodiversity importance, which are at a high risk for mining; and

D) Areas of moderate biodiversity importance, which are at a moderate risk for mining.

The proposed activities are located with Categories B and D (highest and moderate risk for mining, respectively) but importantly does not fall within Category A and therefore, not prohibited from mining activities (**Figure 12**). The implications for the proposed activity in terms of the risk categories implies that environmental screening, environmental impact assessment (EIA) and their associated specialist studies should focus on confirming the presence and significance of these biodiversity features, and to provide site-specific basis on which to apply the mitigation hierarchy to inform regulatory decision-making for mining, water use licenses, and EAs. This assessment should fully consider the environmental sensitivity of the area, the overall environmental and socio-economic costs, and benefits of mining, as well as the potential strategic importance of the minerals to the country. Authorisations may well not be granted. If granted, the authorisation may set limits on allowed activities and impacts and may specify biodiversity offsets that would be written into license agreements and/or authorisations.

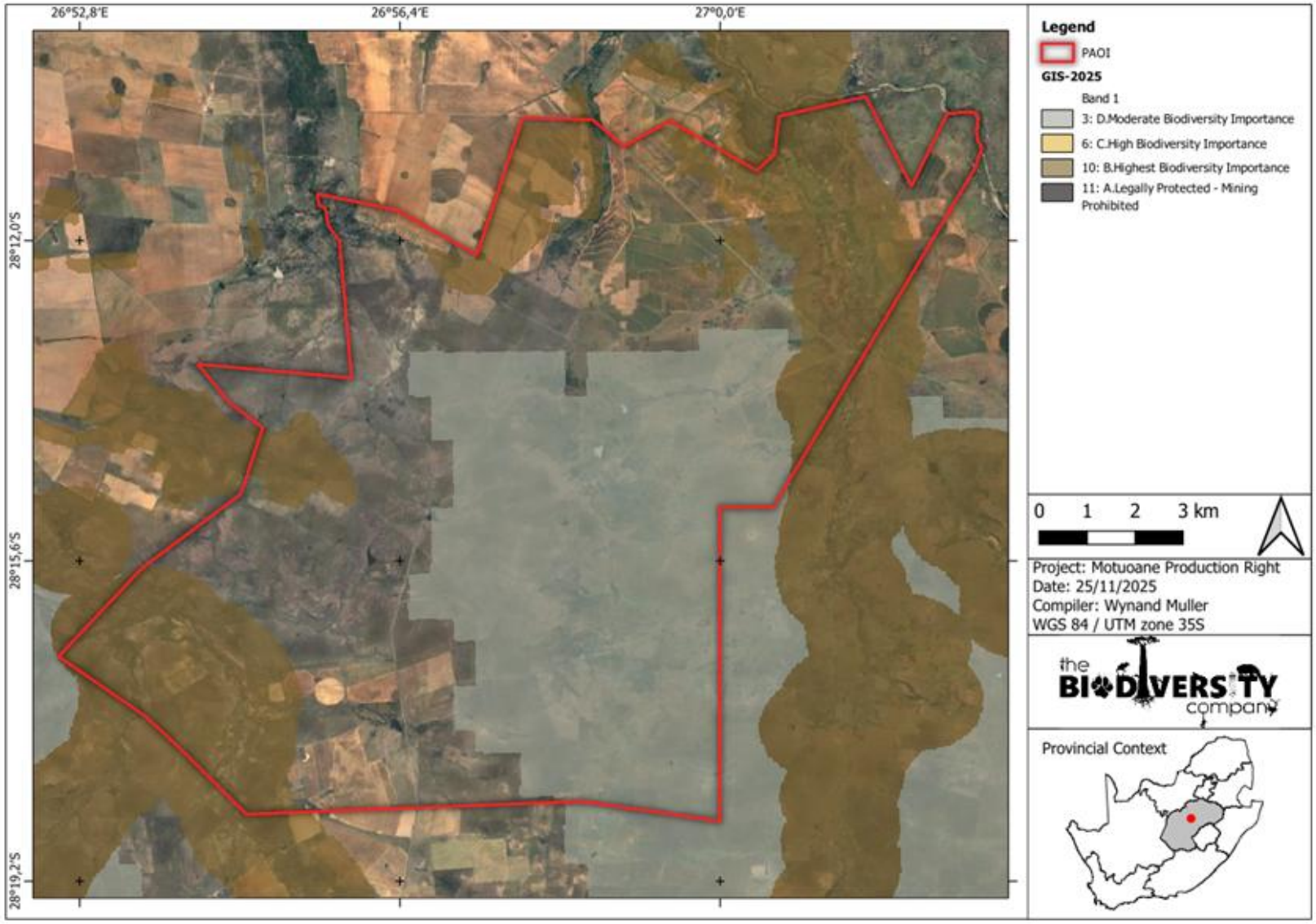


Figure 12: The project area in relation to the Mining and Biodiversity Guidelines (The Biodiversity Company, 2025).

5.3 PROVINCIAL POLICY AND PLANNING CONTEXT

5.3.1 FREE STATE NATURE CONSERVATION ORDINANCE 8 OF 1969

This Ordinance makes provision with respect to the protection and conservation of wildlife in the Free State Province. It makes provision for, among other things, hunting and the protection of wild animals, fishing and the protection of aquatic resources, the protection of indigenous plants and the establishment and management of nature reserves. The Ordinance defines, in Schedule1, protected game and, in Schedule 2, ordinary game and sets out specific rules relating to hunting of each class of game. It also defines prohibited acts in respect of wild or exotic game and rules regarding the importation and exportation of endangered or exotic animals. According to the list of protected species under the Schedule, if any individuals of these plant species are to be disturbed, permits must be obtained from the Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs (FSDESTEA). A detailed assessment of floral species within the study area will be undertaken as part of the Terrestrial Biodiversity Assessment during the EIA phase.

5.3.2 FREE STATE PROVINCIAL SPATIAL DEVELOPMENT PLAN

The Free State Provincial Spatial Development Framework (PSDF) is a policy document that promotes a 'developmental state' in accordance with national and provincial legislation and directives. It aligns with the Free State Provincial Growth and Development Strategy which has committed the Free State to 'building a prosperous, sustainable and growing provincial economy which reduces poverty and improves social development'. The PSDF includes comprehensive plans and strategies that collectively indicate which type of land-use should be promoted in the Free State Province, where such land-use should take place, and how it should be implemented and managed. The proposed production activities are within an approved exploration right.

5.3.3 FREE STATE BIODIVERSITY PLAN, 2015

The development of provincial biodiversity plans is a key component of the systematic biodiversity planning in South Africa and therefore a strong focus of the Biodiversity Planning Forum. Many of the innovative approaches and methodologies have been initiated and established through the development of these provincial biodiversity plans. A key objective of the Provincial Spatial Development Framework (PSDF) is to integrate and standardize planning at all spheres of government in the province with specific reference to amongst others facilitating land-use classification of the entire land surface of the province. To this extent a set of dedicated Spatial Planning Categories (SPCs) were developed which provide a spatial framework to guide decision-making regarding land-use at all levels of planning. The SPCs represent a classification system that indicates the most suitable, or a range of, land use options for a certain piece of land. Associated with each SPC category is land use guidelines which when implemented ensures a balance between development and conservation. Mainstreaming of the biodiversity plan into spatial planning process will be achieved by aligning the biodiversity plan categories with those of the SPCs so that planning according to SPC will then automatically also adopt the biodiversity plan categories and their associated land use guidelines. Various biodiversity layers were overlaid to the study area and used to determine the sensitivity and/or certain requirements thereof. The results are provided in various sections in this report such as **Sections 5.1.7**.

5.4 INTERNATIONAL LEGISLATION

Other applicable acts and guidelines include the Green House Gases and International Finance Corporation Requirements, and International Agreements.

5.4.1 GHG AND CLIMATE CHANGE

Greenhouse gases (GHG) are "those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of thermal infrared radiation emitted by the earth's surface, the atmosphere itself, and by clouds. This property causes the GHG effect. Water vapour (H_2O), CO_2, nitrous oxide (N_2O), methane (CH_4) and O_3 are the primary greenhouse gases in the earth's atmosphere. Moreover, there are a number of entirely human-made GHG gases in the atmosphere, such as the

halocarbons and other chlorine and bromine containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the greenhouse gases sulphur hexafluoride (SF6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) (IPCC, 2007). Human activities since the beginning of the Industrial Revolution (taken as the year 1750) have produced a 40% increase in the atmospheric concentration of carbon dioxide, from 280 ppm in 1750 to 406 ppm in early 2017 (NOAA, 2017). This increase has occurred despite the uptake of a large portion of the emissions by various natural "sinks" involved in the carbon cycle (NOAA, 2017). Anthropogenic CO_2 emissions (i.e., emissions produced by human activities) come from combustion of fossil fuels, principally coal, oil, and natural gas, along with deforestation, soil erosion and animal agriculture (IPCC, 2007).

The International Finance Corporation (IFC) lists methods that countries and projects can reduce GHG impacts. These include carbon financing; improvement of energy efficiency; GHG sinks and reservoir protection and improvements; that environmentally friendly agriculture and forestry be encouraged; the increased use of renewable energy methods; implementation of carbon capture and sequestration methods; and improved waste management (recovery and use of methane emissions) as well as reducing GHG emissions from vehicle use and industrial, construction and energy production processes (IFC, 2007). Carbon financing may have much potential in developing countries as well as sustainable agriculture and forestry practices (IFC, 2012), and when supported by governments may be a way of reducing the country's GHG impacts, where projects receive carbon credits and financing for reducing GHG emissions and installing more environmentally friendly alternatives. Because different industries contribute various amounts of GHG emissions, the IFC performance standards suggests that for industrial processes the CO_2-equivalent (CO_2-e) emissions per year do not exceed 100 000 tonnes, this including direct (Scope 1) and indirect (Scope 2) sources (IFC, 2012).

5.4.1.1 INTERNATIONAL AGREEMENTS

In 1992, countries joined an international treaty, the United Nations Framework Convention on Climate Change (UNFCCC) as a framework for international cooperation to combat climate change by limiting average global temperature increases and the resulting climate change, and coping with impacts that were, by then, inevitable.

By 1995, countries launched negotiations to strengthen the global response to climate change, and, two years later, adopted the Kyoto Protocol. The Kyoto Protocol legally binds developed country parties to emission reduction targets. The Protocol's first commitment period started in 2008 and ended in 2012. As agreed in Doha in 2012, the second commitment period began on 1 January 2013 and would end in 2020 (UNFCCC, 2017) but due to lack of ratification has not come into force.

The Paris Agreement was adopted by 196 Parties at Conference of the Parties (COP) 21 in Paris, on 12 December 2015 and commenced 4 November 2016. The Paris Agreement (2016) builds upon the Convention and – for the first time – brings all nations into a common cause to undertake ambitious efforts to combat climate change and adapt to its effects, with enhanced support to assist developing countries to do so. As such, it charts a new course in the global climate effort.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by keeping a global temperature rise this century well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase even further to 1.5°C. Additionally, the agreement aims to strengthen the ability of countries to deal with the impacts of climate change. To reach these ambitious goals, appropriate financial flows, a new technology framework and an enhanced capacity building framework will be put in place, thus supporting action by developing countries and the most vulnerable countries, in line with their own national objectives.

The Paris Agreement is founded on the idea of countries improving on their climate change strategies in 5-year cycles. The Paris Agreement requires all Parties to put forward their best efforts through "nationally determined contributions" (NDCs) and to strengthen these efforts in the years ahead. This includes requirements that all Parties report regularly on their emissions and on their implementation efforts. The Paris Agreement proposes that Parties submit long-term low greenhouse gas emission development strategies (LT-LEDS) by 2020 but this was not mandatory.

Parties will take stock of the collective efforts in relation to progress towards the goal set in the Paris Agreement and to inform the preparation of NDCs. There will also be a global stocktake every 5 years to assess the collective progress towards achieving the purpose of the Agreement and to inform further individual actions by Parties. Ethiopia submitted their first NDC to the UNFCCC secretariat and ratified the Paris agreement on 9 March 2017. Existing Parties were expected to submit their updated NDC in 2020; and new Parties their original NDCs. Parties are to submit updated NDCs every 5 years. As of May 2021, there are 192 parties that have submitted their NDCs and 8 parties that have submitted their second NDC. There are only 191 Parties to the Paris Agreement; Eritrea has not become a Party to the Paris Agreement but has submitted its first NDC.

Countries as part of the Paris agreement established an enhanced transparency framework (ETF). ETF commenced in 2024, and all countries need to openly report on all activities untaken and progress in climate change mitigation, adaptation measures as well as any support provided or received. ETF also sets out a procedure for reviewing submitted reports. The information provided as part of the ETF will be used as an input for the global stocktake which will assess the collective progress towards the long-term climate goals. South Africa has made strides in implementing the ETF under the Paris Agreement, submitting its first Biennial Transparency Report (BTR1) on December 23, 2024, and is committed to transparently reporting its climate actions.

5.4.1.2 GLOBAL GHG EMISSION INVENTORY

The proposed Motuoane production would most likely fall under the category of "energy" for the global GHG inventory. According to the "mitigation of climate change" document as part of the Intergovernmental Panel on Climate Change (IPCC) fifth Assessment Report (AR5) (IPCC, 2014) the 2010 global GHG emissions were 49 (±4.5) Gt CO_2-e, of which 35% (17 Gt CO_2-e) was a result of the energy sector. The World Resources Institute Climate Watch global GHG emissions from the "industrial processes" sector were 2.7711 Gt CO_2-e in 2016 (6% of total anthropogenic GHG emissions).

5.4.1.3 SOUTH AFRICA'S STATUS IN TERMS OF CLIMATE CHANGE AND QUANTIFICATION OF GREENHOUSE GASES

5.4.1.3.1 PARIS AGREEMENT - NATIONALLY DETERMINED CONTRIBUTION

South Africa ratified the UNFCCC in August 1997 and acceded to the Kyoto protocol in 2002, with effect from 2005. However, since South Africa is an Annex 1 country it implies no binding commitment to cap or reduce GHG emissions. The South African Intended Nationally Determined Contribution (INDC) was completed in 2015 and submitted to the UNFCCC on 1 November 2016. This was undertaken to comply with decision 1/CP.19 and 1/CP.20 of the Conference of the Parties to the UNFCC. This document describes South Africa's INDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions.

As part of the adaption portion the following goals have been assembled:

- Goal 1: Development and implementation of a National Adaption Plan. The implementation of this will also result in the implementation of the National Climate Change Response Plan (NCCRP) per the 2011 policy.
- Goal 2: In the development of national, sub-national and sector strategy framework, climate concerns must be taken into consideration.
- Goal 3: An official institutional function for climate change response planning and implementation needs to be assembled.
- Goal 4: The creation of an early warning, vulnerability, and adaptation monitoring system
- Goal 5: Develop policy regarding vulnerability assessment and adaptation needs.
- Goal 6: Disclosure of undertakings and costs with regards to past adaptation strategies.

As part of the mitigation portion the following have been, or can be, implemented at National level:

- The approval of 79 (5 243 MW) renewable energy Independent Power Producer (IPP) projects as part of a Renewable Energy Independent Power Producer Procurement Programme (REI4P). An additional 6 300 MW is being deliberated.
- A "Green Climate Fund" has been created to back green economy initiatives. This fund will be increased in the future to sustain and improve successful initiatives.
- It is intended that by 2050 electricity will be decarbonised.
- Carbon Capture and Sequestration (or Carbon Capture and Storage) (CCS).
- To support the use of electric and hybrid electric vehicles.
- Reduction of emissions can be achieved through the use of energy efficient lighting; variable speed drives and efficient motors; energy efficient appliances; solar water heaters; electric and hybrid electric vehicles; solar photovoltaic; wind power; CCS; and advanced bioenergy.

A draft update of the first NDC was published for public comment on the 30th of March 2021 and the final updated of the first NDC was published and submitted to the UNFCCC on the 27th of September 2021 in preparation for the 26th Conference of the Parties (to held in Glasgow, Scotland in November 2021). The final update of the first NDC South Africa has not submitted its second NDC to UNFCCC. The draft document describes South Africa's NDC on adaptation, mitigation and finance and investment necessities to undertake the resolutions with updated revisions to the adaptation goals and mitigation targets.

As part of the updated adaption portion the following goals have been assembled:

- Goal 1: Enhance climate change adaptation governance and legal framework.
- Goal 2: Develop an understanding of the impacts on South Africa of 1.5 and 2°C global warming and the underlying global emission pathways through geo-spatial mapping of the physical climate hazards, and adaptation needs in the context of strengthening the key sectors of the economy. This will provide the scientific basis for strengthening the national and provincial governments' readiness to respond to climate risk.
- Goal 3: Implementation of National Climate Change Adaptation Strategy (NCCAS) adaptation interventions for the period 2021 to 2030, where priority sectors have been identified as biodiversity and ecosystems; water; health; energy; settlements (coastal, urban, rural); disaster risk reduction, transport infrastructure, mining, fisheries, forestry and agriculture.
- Goal 4: Mobilise funding for adaptation implementation through multilateral funding mechanisms.
- Goal 5: Quantification and acknowledgement of the national adaptation and resilience efforts.

Updated targets based on revised 100-year global warming potential (GWP) factors (published in the Annex to decision 18/CMA.1 of the IPCC 5th assessment report) and based on exclusion of land sector emissions arising from natural disturbance. The updated NDC mitigation targets, consistent with South Africa's fair share, are presented in **Table 12**.

Table 12: South Africa's NCD mitigation targets.

Year	Target	Corresponding period
2025	South Africa's annual GHG emissions will be in a range between 398 - 510 Mt CO_2-e.	2021-2025
2030	South Africa's annual GHG emissions will be in a range between 398 - 440 Mt CO_2-e.	2026-2030

5.4.1.3.2 NATIONAL CLIMATE CHANGE RESPONSE POLICY

The National Climate Change Response White Paper stated that in responding to climate change, South Africa has two objectives: to manage the inevitable climate change impacts and to contribute to the global effort in stabilising GHG emissions at a level that avoids dangerous anthropogenic interference with the climate system. The White Paper proposes mitigation actions, especially a departure from coal-intensive electricity generation, be implemented in the short- and medium-term to match the GHG trajectory range. Peak GHG emissions are expected between 2020 and 2025 before a decade long plateau period and subsequent reductions in GHG emissions.

The White Paper also highlighted the co-benefit of reducing GHG emissions by improving air quality and reducing respiratory diseases by reducing ambient particulate matter, ozone and SO_2 concentrations to levels in compliance with NAAQS by 2020.

In order to achieve these objectives, the Department of Forestry, Fisheries and the Environment (DFFE) has appointed a service provider to establish a national GHG emissions inventory, which will report through SAAQIS.

South Africa's Climate Change Act 22 of 2024, signed into law in July 2024 and proclaimed into effect on March 17, 2025, establishes a framework for a coordinated national response to climate change, including mitigation and adaptation strategies, and a just transition to a low-carbon economy. The Act is aligned with international policies guidelines and South Africa's Nationally Determined Contribution and aim to reduce GHG emissions as primary driver to anthropogenic climate change. The aim of the Act is to achieve an effective climate change response through a long-term just transition to a low carbon economy that is climate resilient and allows for sustainable development of South Africa. The Act provides for the following:

- Establish provincial and municipal forums on climate change which will be responsible for coordinating climate change response actions in each province.
- Strengthen the establishment of the Presidential Climate Change Coordinating Commission (4PC). Although, the 4PC has already been established and has been working for the Government since December 2020, however, its establishment only carries legal force after the Bill becomes an Act.
- Within one year of the coming into force of the Act, establish a National Adaptation Strategy. This strategy will guide South Africa's adaptation to the impacts of climate change and develop adaptation scenarios which anticipate the likely impacts over the short, medium, and long term.
- Determine a national GHG emissions trajectory, which must be reviewed every five years, and which indicates an emissions reduction objective.
- Put in place a 5-yearly sectoral emission targets for identified sectors and sub-sectors. The sectoral targets must be aligned with the national GHG emissions trajectory and include quantitative and qualitative GHG emission reduction goals.
- Bring into force the carbon budget allocation mechanism, which will replace the current National Pollution Prevention Plan mechanism which is enforced under the National Environmental Management: Air Quality Act (NEM:AQA). The carbon budget will be linked to the Carbon Tax Act, in relation to carbon tax rates which will be charged on emissions above the carbon budget.

While the Act is now in effect, not all of its provisions have come into operation. A large part of the Act's commencement has been deferred to a later date to allow for the promulgation of necessary regulations. The Act states that the minister will need to develop the following:

- Within one year, sectors and sub-sectors emitting greenhouse gases have published emissions targets;
- Develop sector-specific emissions frameworks and targets in consultation with relevant Ministers;
- Publish a list of greenhouse gases contributing to climate change;
- Assign a carbon budget for a minimum of 15 years to entities involved in emitting listed greenhouse gases.

5.4.1.3.3 GREENHOUSE GAS EMISSIONS REPORTING

Regulations pertaining to GHG reporting using the National Atmospheric Emissions Inventory System (NAEIS) were published in 2017 (Republic of South Africa, 2017) (as amended by GN R994, 11 September 2020). The South African mandatory reporting guidelines focus on the reporting of Scope 1 emissions only.

The South African Greenhouse Gas Emission Reporting System (SAGERS) web-based monitoring and reporting system will be used to collect GHG information in a standard format for comparison and analyses. The system forms part of the national atmospheric emission inventory component of South African Atmospheric Emission Licensing and Inventory Portal (SAAELIP). Motuoane will have to report their GHG emissions to SAGERS since there is no threshold for annual GHG emissions reporting for the Natural Gas producers as per the amended GHG reporting guidelines (GG43712, 7 September 2020).

The DFFE is working together with local sectors to develop country specific emissions factors in certain areas; however, in the interim the IPCC default emission figures may be used to populate the SAAQIS GHG emission factor database. These country specific emission factors will replace some of the default IPCC emission factors. Technical guidelines for GHG emission estimation have been issued.

Also, the Carbon Tax Act (No 15 of 2019) (Republic of South Africa, 2019) includes details on the imposition of a tax on the CO_2-e of GHG emissions. Certain production processes indicated in Annexure A of the Declaration of Greenhouse Gases as Priority Pollutants (Republic of South Africa, 2017) with GHG more than 0.1 mega tonnes (Mt) or million metric tonnes, measured as CO_2-e, are required to submit a pollution prevention plan to the Minister for approval.

5.4.1.3.4 NATIONAL GHG EMISSIONS INVENTORY

South Africa is perceived as a global climate change contributor and is undertaking steps to mitigate and adapt to the changing climate. DFFE is categorised as the lead climate change institution and is required to coordinate and manage climate related information such as development of mitigation, monitoring, adaption, and evaluation strategies (DEA, 2019). This includes the establishment and updating of the National GHG Inventory. The National Greenhouse Gas Improvement Programme (GHGIP) has been initiated; it includes sector specific targets to improve methodology and emission factors used for the different sectors as well as the availability of data.

The 2000 to 2017 National GHG Inventory was prepared using the 2006 IPCC Guidelines (IPCC, 2006) based on updated sector information and emission estimation techniques. According to the 4th Biennial Update Report to the UNFCCC (DFFE, 2021), the total GHG emissions in 2017 were estimated at approximately 512.14 million metric tonnes CO_2-e (excluding Forestry and Other Land Use [FOLU]). This was a 14.2% increase from the 2000 total GHG emissions (excluding FOLU) and 2.8% decrease from the 2015 total GHG emissions (excluding FOLU). FOLU is estimated to be a net carbon sink which reduces the 2017 GHG emissions to 482.02 million metric tonnes CO_2-e. The estimated GHG emissions (excluding FOLU) for 2017 showed the Industrial Processes and Product Use (IPPU) sector contributed 6.3% to the total GHG emissions (excluding FOLU). The estimated CO_2-e emissions (excluding FOLU) for 2017 for the IPPU sector is 32.08 million metric tonnes.

6 NEED AND DESIRABILITY OF THE PROPOSED ACTIVITY

The needs and desirability analysis component of the "Guideline on need and desirability in terms of the EIA Regulations (Notice 819 of 2014)" includes, but is not limited to, describing the linkages and dependencies between human well-being, livelihoods and ecosystem services applicable to the area in question, and how the proposed development's ecological impacts will result in socio-economic impacts (e.g., on livelihoods, loss of heritage site, opportunity costs, etc.). This section of the report provides the need and desirability for the proposed Motuoane PR016.

Helium has several unique properties with numerous applications that make it an essential and irreplaceable element for many industries. This is because it cannot be synthesised, manufactured or substituted in many cases. Helium is listed on the critical materials lists for Canada, the EU, China and other major economies. Helium is a vital resource, essential in modern technologies with major critical uses throughout the science, medicine and manufacturing industries. It is an inert gas for cryogenic, heat transfer, shielding, leak detection, analytical and lifting applications. It is the most important element in studying super-cold conditions in low-temperature physics studies. It is a critical component in the manufacturing process, specifically ones which serve unique high-tech applications in MRIs, fibre optics and semiconductor chip manufacturing. More recent uses include hybrid air vehicles, helium filled hard drives and nuclear fusion technology.

Helium is a non-renewable natural resource that is predominantly recovered as a by-product of natural gas production. Globally, helium occurs in economically recoverable concentrations at a limited number of locations, many of which are experiencing progressive depletion. Recent studies of the Virginia gas fields in the Free State Province indicate an unusually high helium concentration, suggesting a geologically distinctive resource when compared to most conventional gas fields. This characteristic presents a notable departure from prevailing global practice, as the proposed Motuoane development has the potential to prioritise helium as the primary product, with methane recovered as a secondary by-product. This approach contrasts with the conventional model, where helium recovery is contingent on sustained natural gas production. As international pressures to reduce fossil gas production increase, global helium supply is expected to decline accordingly. In contrast, the Virginia gas fields represent a scenario in which helium recovery is not dependent on large-scale gas production, positioning the resource as a potentially strategic source of helium. The economic need and desirability of the proposed development are underpinned by the current and projected demand for helium, which is widely recognised as strong and enduring due to its critical applications and limited substitutes. Available market indicators suggest that demand for helium is expected to remain robust over the medium to long term, thereby supporting the economic justification and desirability of the proposed production project.

The White Paper on the Energy Policy (1998) is the overarching policy document that guides future policy and planning in the energy sector. It states that the government will, inter alia, "promote the development of South Africa's gas resources…" and "ensure private sector investment and expertise in the exploitation and development of the country's gas resources". The successful exploitation of these natural resources would contribute to the growth of the economy.

The National Development Plan (NDP) (2012) provides the context for all development in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa. The NDP identifies the need to diversify the current energy mix and to reduce carbon emissions. Gas will play a more significant role in the energy mix and the exploration of gas as an alternative to coal for energy production has been recognised as a planning priority. The position of the NDP is reiterated in the Integrated Energy Plan (IEP) (2016), which seeks to determine how current and future energy needs can be addressed efficiently. Main objectives outlined in the plan include security of supply, increased access to energy, diversity in supply sources and primary sources of energy and minimising negative environmental impacts from the energy sector. The plan indicates that projected demand for natural gas between 2010 and 2050 would be second only to petroleum products, primarily due to increased growth in the industrial sector. It also identifies significant potential for natural gas in terms of power generation and direct thermal uses.

As such, exploration for additional domestic gas reserves is considered important and any discoveries would be well received by the local market. The Department of Energy's Integrated Resource Plan (2005) supports this

view, stating that the requirement for gas combine cycle gas turbines in the South African power system by 2030 is critical in lieu of the impending decommissioning of 8 GW of baseload coal-fired plants. The government's official position is that exploration and development of gas fields should be encouraged.

The identification of potential geological structures or "prospects" within the proposed production area for future exploration and possible well-drilling provides an opportunity to develop a South African gas industry resulting in long-term benefits consisting of access to new energy sources, improved security of supply, major in-country investments in a development project and reduced dependence on the importation of hydrocarbons. There is also potential in the long-term for local economic stimulation through direct employment, future business opportunities, royalties and tax revenues.

In summary, production success would result in long-term benefits for South Africa consisting of access to new energy sources, improved security of supply, in-country investments in a development project and reduced dependence on the importation of hydrocarbons. It should be noted that SA is pursuing a diverse energy mix which include significant renewable power generation.

Table 13: Needs and desirability analysis for the proposed exploration activities.

Ref No.	Question	Answer
1	Securing ecological sustainable development and use of natural resources	
1.1	How were the ecological integrity considerations taken into account in terms of: Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Systems, Conservation Targets, Ecological drivers of the ecosystem, Environmental Management Framework, Spatial Development Framework (SDF) and global and international responsibilities.	Several specialist studies will inform this application and environmental impact assessment including: • Agricultural Potential, Soils & Land Capability • Air Quality & Climate Change Assessment; • Aquatics and Wetland Assessment; • Archaeological and Cultural Heritage Assessment; • Palaeontological Impact Assessment; • Terrestrial Biodiversity Assessment; • Geohydrological Assessment; • Hydrological Assessment; • Social Assessment; and • Noise Assessment. These studies will assist in identifying any Threatened Ecosystems, Sensitive and vulnerable ecosystems, Critical Biodiversity Areas, Ecological Support Areas, Conservation Targets and Ecological drivers of the ecosystem. Where sensitive species or ecosystem drivers are identified, relevant mitigation measures will be put forward to prevent or minimise the impacts. The findings and impact assessment will be discussed during the EIA Phase.
1.2	How will this project disturb or enhance ecosystems and / or result in the loss or protection of biological diversity? What measures were explored to avoid these negative impacts, and where these negative impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	The overall PR footprint is approximately 14 440ha, however, the permanent surface infrastructure is significantly reduced due to the proposed pipelines being underground. Where infrastructure is to be constructed or installed in natural areas, various measures are put forward to mitigate the impacts on biological diversity. The mitigation measures have been developed in consultation with the relevant specialists as mentioned above. Existing and future alien and invasive species will be controlled which will enhance the opportunities for indigenous and beneficial species in the environment.
1.3	How will this development pollute and / or degrade the biophysical environment? What measures were explored to either avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	
1.4	What waste will be generated by this development? What measures were explored to avoid waste, and where waste could not be avoided altogether, what measures were explored to minimise, reuse and / or recycle the waste? What measures have been explored to safely treat and/or dispose of unavoidable waste?	This project will possibly generate various general and minor hazardous waste, the majority of which will be generated during the construction phase. The general waste will be stored in designated areas and through the process of recovery and recycling, the volume of general waste being disposed to landfill will be minimised. The hazardous portion of the waste stream will also be

Ref No.	Question	Answer
		adequately stored prior to disposal at a suitably licenced hazardous waste disposal facility. Safe disposal certificates will be obtained from the disposal facility used.
1.5	How will this project disturb or enhance landscapes and / or sites that constitute the nation's cultural heritage? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	A heritage and palaeontological impact assessment is being conducted as part of the EIA to determine areas of archaeological and/or cultural heritage and associated mitigation measures The identified sites including suitable buffers will be identified as highly sensitive / no-go areas to prevent adverse impacts in these areas. In addition to the above, a chance find procedure has been put forward by the specialist should any unidentified sites of cultural heritage or palaeontological significance be identified during the construction process.
1.6	How will this project use and / or impact on non-renewable natural resources? What measures were explored to ensure responsible and equitable use of the resources? How have the consequences of the depletion of the non-renewable natural resources been considered? What measures were explored to firstly avoid these impacts, and where impacts could not be avoided altogether, what measures were explored to minimise and remedy the impacts? What measures were explored to enhance positive impacts?	It is acknowledged that due to the nature of gas resources, an onshore (potentially non-renewable) gas resource will be depleted should the project be authorised. It has not yet been conclusively determined if the gas field is biogenic or thermogenic. Although gas production will however contribute significantly to the country's economy as well as the transition from dirtier energy production (coal) to renewable energy production in the future. Locally produced gas will also result in a reduced need for these resources to be imported. Therefore, at present, this gas resource is still needed within South Africa. It must be noted that there are a number of renewable energy projects under application and approved from various applicants located within PR area. Motuoane and the renewable energy applicants will need to discuss the way forward and/or make necessary arrangements to coexist especially within the PR area where there may be infrastructure overlap. Coexisting arrangements can be successfully arranged for the Motuoane PR footprint, particularly since a majority of the planned infrastructure will be underground. It is therefore, anticipated that this will result in little to no impact on the planned aboveground solar projects.
1.7	How will this project use and / or impact on renewable natural resources and the ecosystem of which they are part? Will the use of the resources and / or impacts on the ecosystem jeopardise the integrity of the resource and / or system taking into account carrying capacity restrictions, limits of acceptable change, and thresholds? What measures were explored to firstly avoid the use of resources, or if avoidance is not possible, to minimise the use of resources? What measures were taken to ensure responsible and equitable use of the resources? What measures were explored to enhance positive impacts?	
1.7.1	Does the proposed project exacerbate the increased dependency on increased use of resources to maintain economic growth or does it reduce resource dependency (i.e., de-materialised growth)?	The proposed project will provide an opportunity for South Africa to move away from dirtier energy (coal) while transitioning to a more renewable energy source. This can be translated into a "reduced dirty resource dependency".
1.7.2	Does the proposed use of natural resources constitute the best use thereof? Is the use justifiable when considering intra- and intergenerational equity, and are there more important priorities for which the resources should be used?	The harvesting of this gas resource (during production) would constitute a better use thereof as it is currently not being harvested in this area (other than by Tetra4) for any commercial beneficial use. In fact, several historically drilled gold prospecting boreholes in the area are undergoing uncontrolled release of Methane into the atmosphere without being flared or burned (to only release CO_2 which is a lower order GHG pollutant). Due to growing global geopolitical uncertainty and increasingly constrained transit of international goods, South Africa would be well positioned to increase local production of gas as opposed to

Ref No.	Question	Answer
		relying on importation thereof. Furthermore, the small spatial extent of the activities allows for the concurrent use of the land for other purposes such as farming etc.
1.7.3	Do the proposed location, type and scale of development promote a reduced dependency on resources?	The location, type and scale of the proposed project promotes a reduced dependency on the importation of gas resources from other countries as at this stage, a large volume of gas used in the country is imported. It will further provide an opportunity to reduce dependency on more harmful resources such as coal for energy production. As such, this project should not be viewed in isolation in terms of resources but in a holistic manner both nationally and globally.
1.8	How were a risk-averse and cautious approach applied in terms of ecological impacts:	
1.8.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	In order to prevent repetition, the reader is directed to the assumptions and limitations presented in **Section 13.**
1.8.2	What is the level of risk associated with the limits of current knowledge?	The level of risk is considered low at this stage and will be further interrogated during the EIA phase (where applicable).
1.8.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	As final drilling locations, and associated infrastructure such as pipelines has not been identified at this stage, it is fortunate that a strategic assessment of corridors (500m width) and seismic transects (50m corridors) will be assessed in order to identify areas of high sensitivity and even no-go areas. In this manner, a risk-averse and cautious approach is able to be more fully realised in future project planning. An effort will also be made to place infrastructure in the lease sensitive areas using the combined sensitivity map to be developed in the EIA phase.
1.9	How will the ecological impacts resulting from this development impact on people's environmental right in terms following?	
1.9.1	Negative impacts: e.g. access to resources, opportunity costs, loss of amenity (e.g. open space), air and water quality impacts, nuisance (noise, odour, etc.), health impacts, visual impacts, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	The application and proposed project footprint occur predominantly on properties that are of commercial agricultural concerns. The final infrastructure placement and seismic transects will be discussed and agreed with each affected landowner prior to commencement of drilling and surveying and where necessary, appropriate compensation negotiated. Furthermore, as mentioned above, this EIA process is undertaken at a more strategic level assessment of the receiving environment within proposed project corridors which allows input from numerous specialist disciplines to identify highly sensitive or no-go areas which can then be excluded from project where necessary. The positive impact of job creation has been identified by the social specialist and the requirement for local upliftment in the form of employment creation or social programmes put forward.
1.9.2	Positive impacts: e.g. improved access to resources, improved amenity, improved air or water quality, etc. What measures were taken to enhance positive impacts?	

Ref No.	Question	Answer
1.10	Describe the linkages and dependencies between human wellbeing, livelihoods and ecosystem services applicable to the area in question and how the development's ecological impacts will result in socio-economic impacts (e.g. on livelihoods, loss of heritage site, opportunity costs, etc.)?	A low impact on third party wellbeing, livelihoods and ecosystem services is currently foreseen at this stage of this application as the predominant land use of the affected properties is commercial agriculture as mentioned above, and the site sensitivities from a socio-economic and biophysical point of view will be identified and avoided where possible prior to the final placement of infrastructure.
1.11	Based on all of the above, how will this development positively or negatively impact on ecological integrity objectives / targets / considerations of the area?	As discussed above, this project is anticipated to have a low overall impact on the ecological integrity objectives or targets as consideration of these aspects will be undertaken prior to final placement of infrastructure.
1.12	Considering the need to secure ecological integrity and a healthy biophysical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the "best practicable environmental option" in terms of ecological considerations?	As part of the scoping phase, suitable alternatives are being considered and will be finalised in the EIA phase once due consideration of alternatives has been completed. Therefore at this stage of the application process, this aspect is yet to be concluded.
1.13	Describe the positive and negative cumulative ecological / biophysical impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and existing and other planned developments in the area?	Refer to **Section 10** of this report for the identified impacts, their assessment and recommended mitigation measures. This aspect will be further explored in the EIA phase and findings thereof presented in the EIA Report and EMPr.
2	Promoting justifiable economic and social development	
2.1	What is the socio-economic context of the area, based on, amongst other considerations, the following:	
2.1.1	The IDP (and its sector plans' vision, objectives, strategies, indicators and targets) and any other strategic plans, frameworks or policies applicable to the area	Details of the IDP's for the Lejweleputswa District Municipality (LDM), as well as the Matjhabeng and Masilonyana Local Municipalities are included in **Section 9.4.** The proposed project will promote and support the sustainability of existing business in the local and regional economy and assist in increasing local beneficiation and shared economic growth, through the output production of gas. More detail will be provided in the Social Assessment report that will form part of the EIA.
2.1.2	Spatial priorities and desired spatial patterns (e.g., need for integrated of segregated communities, need to upgrade informal settlements, need for densification, etc.),	
2.1.3	Spatial characteristics (e.g., existing land uses, planned land uses, cultural landscapes, etc.), and	
2.1.4	Municipal Economic Development Strategy ("LED Strategy").	
2.2	Considering the socio-economic context, what will the socio-economic impacts be of the development (and its separate elements/aspects), and specifically also on the socio-economic objectives of the area?	This project will result in positive socio-economic impacts in the local, regional and national economy. Refer to the impact assessment in **Section 10** in this report

Ref No.	Question	Answer
2.2.1	Will the development complement the local socio-economic initiatives (such as local economic development (LED) initiatives), or skills development programs?	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom, Virginia, Hennenman, Ventersburg and Theunissen. The project will indirectly assist with increasing the gas production in the area which will ensure that the community projects proposed by Motuoane under their Social and Labour Plan will be realised. This will complement the local socio-economic initiatives identified for the area.
2.3	How will this development address the specific physical, psychological, developmental, cultural and social needs and interests of the relevant communities?	At this stage of the application process, there has not been specific feedback from the relevant communities on how this project will impact on their physical, psychological, developmental, cultural and/or social needs. While the baseline receiving environment is presented in **Section 9**, this aspect will be updated during the EIA phase once more consultation has been undertaken.
2.4	Will the development result in equitable (intra- and inter-generational) impact distribution, in the short- and long-term? Will the impact be socially and economically sustainable in the short- and long-term?	None of the identified impacts are anticipated to have a high negative impact significance post mitigation. It is therefore not anticipated that this project will result in negative equitable impact distribution in the short- and long-term.
2.5	**In terms of location, describe how the placement of the proposed development will:**	
2.5.1	Result in the creation of residential and employment opportunities in close proximity to or integrated with each other.	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Virginia, Venterburg and Theunissen (to a limited extent) both locally and regionally. This project is not anticipated to have a material impact on the need for transport of people and goods or impact on access to public transport.
2.5.2	Reduce the need for transport of people and goods.	
2.5.3	Result in access to public transport or enable non-motorised and pedestrian transport (e.g. will the development result in densification and the achievement of thresholds in terms of public transport),	
2.5.4	Compliment other uses in the area,	The proposed project is adjacent to the existing Tetra4 production right and will thus compliment the current land us. The nature of the project will also make it possible to coexist with other uses (agriculture) in the area.
2.5.5	Be in line with the planning for the area.	Refer to item 2.1.1 of this table (above).
2.5.6	For urban related development, make use of underutilised land available with the urban edge.	Not applicable. The proposed project is not located in an urban area.
2.5.7	Optimise the use of existing resources and infrastructure,	

Ref No.	Question	Answer
2.5.8	Opportunity costs in terms of bulk infrastructure expansions in non-priority areas (e.g., not aligned with the bulk infrastructure planning for the settlement that reflects the spatial reconstruction priorities of the settlement),	The proposed project is located within an existing exploration right area where a number of gas exploration wells have been drilled. The approach is to first determine and map the geographic extent of all boreholes currently emitting gas on and near the ER area. Then measure rates and monitor pressures where possible and perform gas composition analysis. Motuoane will also search records at the Council for Geoscience and the Petroleum Agency for seismic data that was acquired on the Exploration Right in the past. Existing access roads will be used as far as possible.
2.5.9	Discourage "urban sprawl" and contribute to compaction / densification.	This project is located in a rural setting and is not anticipated to have an impact on or any control over urban sprawl in the nearby towns.
2.5.10	Contribute to the correction of the historically distorted spatial patterns of settlements and to the optimum use of existing infrastructure in excess of current needs,	Refer to items 2.5.7 – 2.5.9 of this table (above).
2.5.11	Encourage environmentally sustainable land development practices and processes	This project will have a minimal impact on the current land uses in the application area as pipeline network is subterranean while the production wells are insignificantly small in area (less than $2m^2$ each). This will allow for existing land uses to concurrently with the production activities.
2.5.12	Take into account special locational factors that might favour the specific location (e.g., the location of a strategic mineral resource, access to the port, access to rail, etc.),	The proposed Motuoane production project falls within the approved ER315 area.
2.5.13	The investment in the settlement or area in question will generate the highest socio-economic returns (i.e. an area with high economic potential).	As mentioned in 2.5.11 above, this project will not sterilise existing land uses and therefore it will in fact result in higher economic returns per land area as agriculture, solar development and gas production can occur simultaneously.
2.5.14	Impact on the sense of history, sense of place and heritage of the area and the socio-cultural and cultural-historic characteristics and sensitivities of the area, and	The proposed activities will have a minimal impact on the existing sense of place. Furthermore, a detailed Heritage Impact Assessment is included in this assessment which has identified numerous existing cultural and heritage sites which allows for their protection from negative impacts.
2.5.15	In terms of the nature, scale and location of the development promote or act as a catalyst to create a more integrated settlement?	Given the scale of the development, it is not anticipated that the activities will contribute significantly to settlements or areas in terms of direct socio-economic returns however the project will have limited temporary and permanent employment opportunities for the locals.
2.6	**How was a risk-averse and cautious approach applied in terms of socio-economic impacts:**	

Ref No.	Question	Answer
2.6.1	What are the limits of current knowledge (note: the gaps, uncertainties and assumptions must be clearly stated)?	Refer to **Section 13** of this report.
2.6.2	What is the level of risk (note: related to inequality, social fabric, livelihoods, vulnerable communities, critical resources, economic vulnerability and sustainability) associated with the limits of current knowledge?	The level of risk is considered low as the project is not expected to have far reaching negative impacts on socio-economic conditions.
2.6.3	Based on the limits of knowledge and the level of risk, how and to what extent was a risk-averse and cautious approach applied to the development?	The limited information relating to the final site-specific location of drill sites and pipeline placement will likely be raised by the solar developments and other mineral right holders in the proposed PR. Motuoane will continue to engage mineral right holders and the solar developers to provide as much additional information as possible and consultations with landowners and other key I&APs will be held in the EIA phase to discuss this matter further.
2.7	How will the socio-economic impacts resulting from this development impact on people's environmental right in terms following:	
2.7.1	Negative impacts: e.g., health (e.g. HIV-Aids), safety, social ills, etc. What measures were taken to firstly avoid negative impacts, but if avoidance is not possible, to minimise, manage and remedy negative impacts?	Refer to the impact assessment in **Section 10** of this report. Both positive and negative socio-economic impacts have been identified and relevant mitigation measures put forward to reduce negative impacts and enhance positive impacts as far as practicable. As detail social impact assessment will also be undertaken during the EIA phase to inform this section.
2.7.2	Positive impacts. What measures were taken to enhance positive impacts?	
2.8	Considering the linkages and dependencies between human wellbeing, livelihoods and ecosystem services, describe the linkages and dependencies applicable to the area in question and how the development's socioeconomic impacts will result in ecological impacts (e.g. over utilisation of natural resources, etc.)?	
2.9	What measures were taken to pursue the selection of the "best practicable environmental option" in terms of socio-economic considerations?	
2.10	What measures were taken to pursue environmental justice so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons (who are the beneficiaries and is the development located appropriately)? Considering the need for social equity and justice, do the alternatives identified, allow the "best practicable environmental option" to be selected, or is there a need for other alternatives to be considered?	

Ref No.	Question	Answer
2.11	What measures were taken to pursue equitable access to environmental resources, benefits and services to meet basic human needs and ensure human wellbeing, and what special measures were taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination?	By conducting an EIA Process, the applicant ensures that equitable access has been considered. The potential impact on existing land uses has been identified from the start of this application process and an assessment of this impact as well as mitigation measures put forward to prevent undue negative impacts in this regard. Refer to the impact assessment in **Section 10** of this report.
2.12	What measures were taken to ensure that the responsibility for the environmental health and safety consequences of the development has been addressed throughout the development's life cycle?	Refer to the impact assessment in **Section 10** of this report. The EIA and EMPr will specify timeframes within which mitigation measures must be implemented.
2.13	What measures were taken to:	
2.13.1	Ensure the participation of all interested and affected parties.	Refer to **Section 8** of this report, describing the public participation process undertaken for the proposed project.
2.13.2	Provide all people with an opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation,	Refer to **Section 8** of this report, describing the public participation process undertaken for the proposed project. Advertisement, notification letters and site notices have been made available in English, Afrikaans and Sesotho to assist in understanding of the project. Further public consultation will be held during the review period of the Scoping / EIA report for the project. Furthermore, public meetings will be undertaken during the current Scoping phase and in the EIA phase consultation during which any additional consultation requirements of the I&APs will be identified and addressed where necessary.
2.13.3	Ensure participation by vulnerable and disadvantaged persons,	
2.13.4	Promote community wellbeing and empowerment through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means,	
2.13.5	Ensure openness and transparency, and access to information in terms of the process,	
2.13.6	Ensure that the interests, needs and values of all interested and affected parties were taken into account, and that adequate recognition were given to all forms of knowledge, including traditional and ordinary knowledge,	
2.13.7	Ensure that the vital role of women and youth in environmental management and development were recognised and their full participation therein will be promoted?	
2.14	Considering the interests, needs and values of all the interested and affected parties, describe how the development will allow for opportunities for all the segments of the community (e.g. a mixture of low-, middle-, and high-income housing opportunities) that is consistent with the priority needs of the local area (or that is proportional to the needs of an area)?	

Ref No.	Question	Answer
2.15	What measures have been taken to ensure that current and / or future workers will be informed of work that potentially might be harmful to human health or the environment or of dangers associated with the work, and what measures have been taken to ensure that the right of workers to refuse such work will be respected and protected?	Potential future workers will have to be educated on a regular basis as to the environmental and safety risks that may occur within their work environment. Furthermore, adequate measures will have to be taken to ensure that the appropriate personal protective equipment is issued to workers based on the conditions that they work in and the requirements of their job. Their right to refuse work (if considered dangerous) must and will be included in the education programme.
2.16	Describe how the development will impact on job creation in terms of, amongst other aspects:	
2.16.1	The number of temporary versus permanent jobs that will be created.	It is anticipated that the use of local labour will be utilised as far as possible. Labourers will mostly be sourced from surrounding towns and areas such as Welkom, Virginia, Venterburg and Theunissen. Details in terms of job figures and employment opportunities will be made available for the EIA-phase report. It is anticipated that workers travelling from the local areas will have to commute approximately 10-30 km to the PR area project.
2.16.2	Whether the labour available in the area will be able to take up the job opportunities (i.e. do the required skills match the skills available in the area).	
2.16.3	The distance from where labourers will have to travel.	
2.16.4	The location of jobs opportunities versus the location of impacts.	
2.16.5	The opportunity costs in terms of job creation.	
2.17	What measures were taken to ensure:	
2.17.1	That there were intergovernmental coordination and harmonisation of policies, legislation and actions relating to the environment.	The Scoping and EIA Process requires governmental departments to communicate regarding any application. In addition, all relevant departments are notified at various phases of the project by the EAP and any feedback received from government departments is considered where relevant.
2.17.2	That actual or potential conflicts of interest between organs of state were resolved through conflict resolution procedures.	
2.18	What measures were taken to ensure that the environment will be held in public trust for the people, that the beneficial use of environmental resources will serve the public interest, and that the environment will be protected as the people's common heritage?	Environmental attributes that may be impacted by this project have been identified and where relevant, specialist input has been solicited to ensure that a rigorous impact assessment process is undertaken. Where positive impacts on the interests of the public have been identified (e.g. job creation, impact on existing land use, etc.), mitigation measures are put forward to enhance positive impacts and/or reduce negative impacts.
2.19	Are the mitigation measures proposed realistic and what long-term environmental legacy and managed burden will be left?	The majority of the proposed mitigation measures for this application are in alignment with the approved exploration right (Motuoane ER315) EMPr mitigation measures and therefore these measures have been tested in the real world. Refer to the impact assessment and mitigation

Ref No.	Question	Answer
		measures in **Section 10** of this report. During the EIA phase, addition and detailed mitigation measures will be put forward by the relevant specialists for inclusion in the EMPr.
2.20	What measures were taken to ensure that the costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimising further pollution, environmental damage or adverse health effects will be paid for by those responsible for harming the environment?	The proposed survey activities are not anticipated to produce significant pollution, environmental damage or adverse health effects in the long term. Financial provisioning for closure and rehabilitation as well as the rehabilitation plan will be undertaken in the EIA Phase.
2.21	Considering the need to secure ecological integrity and a healthy bio-physical environment, describe how the alternatives identified (in terms of all the different elements of the development and all the different impacts being proposed), resulted in the selection of the best practicable environmental option in terms of socio-economic considerations?	Refer to **Section 7**, description of the process followed to reach the proposed preferred site.
2.22	Describe the positive and negative cumulative socio-economic impacts bearing in mind the size, scale, scope and nature of the project in relation to its location and other planned developments in the area?	Refer to the impact assessment and mitigation measures in **Section 10**. The impacts will be further explored in the EIA phase and findings thereof presented in the EIA Report and EMPr.

7 PROJECT ALTERNATIVES

The identification of alternatives is a key aspect of the success of the impact assessment process. All reasonable and feasible alternatives must be identified and screened to determine the most suitable alternatives to consider and assess in the EIA phase. There are, however, some significant constraints that have to be taken into account when identifying alternatives for a project of this scope. Such constraints include social, financial and environmental issues, which will be discussed as part of the evaluation of the alternatives for this project. Alternatives can typically be identified according to:

- Activity alternatives;
- Location alternatives (including design and layout);
- Technology/Process alternatives;
- Design and Layout alternatives; and
- The No Action alternative (No-go Alternative).

For any alternative to be considered feasible, such an alternative must meet the need and purpose of the project proposal without presenting significantly high associated impacts. **Section 6** provides an overview of the project need and desirability.

In this section the various alternatives considered are described and their advantages and disadvantages are presented where applicable. Furthermore, the feasibility of the considered alternatives, from both a technical as well as environmental perspective, is determined and the result thereof are the alternatives that will be investigated further in the EIA phase, towards the selection of preferred alternatives. Essentially, alternatives represent different means of meeting the general purpose and need of the proposed project through the identification of the most appropriate and feasible method of development, all of which are discussed below.

Alternatives can further be distinguished into discrete or incremental alternatives. Discrete alternatives are overall project options, which are typically identified during the pre-feasibility, feasibility and or scoping phases of the EIA process. Incremental alternatives typically arise during the EIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation and management measures and are not specifically identified as distinct alternatives. This section provides information on the Project's location, process, technology and activity alternatives considered and assessed.

7.1 ACTIVITY ALTERNATIVES

The current land uses within the study area and surroundings comprise predominantly of mining and agriculture. The Tetra4 production development is also located adjacent to the proposed Motuoane production right study area. The development of renewable energy facilities for power generation is often seen as a better option than gas production. However, there are numerous renewable energy facilities already in the region and nationally that aim to meet the demand for renewable power. Furthermore, Motuoane is a natural gas and helium company and doesn't engage in other project activities. Gas utilisation is also specifically included in the IRP2025 as a flexible, dispatchable resource to stabilise the system during a rapid transition away from coal.

Gas production operations, as a land use, is often viewed as directly competing and eventually replacing existing land uses. However, a mixed land use approach consisting of gas production and agriculture as has been demonstrated within the Tetra 4 Cluster 1 project is feasible and achievable. Similarly, current agricultural activities and proposed solar development activities within the proposed study area should be able to coexist within the vicinity of the gas production activities, particularly because the proposed pipeline network is below ground at a depth (750 – 1000mm) that allows for continued agricultural practises. The surface infrastructure of the gas production network is extremely small compared to the overall application area (even on an individual property).

On the other hand, mixed land use consisting of conservation and gas production is unlikely to coexist due to certain land use restrictions within national parks/ nature reserves and buffer areas as per the National Environmental Management: Protected Areas Act (2003) (NEMPPA). However, there are currently no

conservation areas (e.g. IBAs, nature reserves, etc.) within the proposed Motuoane study area, as well as no known plans for the proclamation and/or expansion of any IBAs or nature reserves within or adjacent to the study area. Therefore, the coexistence of the proposed gas production activity in conjunction with current agricultural and mining land uses as well as the proposed solar development land use will be taken forward to the EIA phase for further assessment. No additional activity alternatives are identified.

7.2 LOCATION / PROPERTY ALTERNATIVES

Location alternatives can apply to the entire Motuoane production project (e.g. the strategic decision to locate the proposed project in the Free State within the Lejweleputswa District where there is an existing Exploration Right 315 held by Motuoane), as well as the specific individual components of the proposed developments (e.g. the location of production wells, pipelines, the helium recovery and gas processing plant including any associated infrastructure within the study area).

While location alternatives can be considered from a macro- or microscale, from a macro location perspective the production is driven by the presence of the target resource and therefore this activity cannot be undertaken in other areas due to the absence of the target resource. No macro or regional location alternatives are therefore deemed feasible.

7.2.1 PRODUCTION ACTIVITIES WITHIN PRELIMINARY IDENTIFIED PRODUCTION CORRIDORS

Undertaking the activities within preliminary identified production corridors would entail a process where the proposed production activities are restricted to within 500m of development corridors and within 25m of the preliminary seismic transects. This would entail undertaking the activities within areas assessed in detail, with known sensitivities to be avoided and processes in place to be followed to ensure activities are undertaken in an environmentally friendly and sustainable manner.

7.2.1.1 PRODUCTION WELLS

The proposed production project involves up to 43 new production wells located along pre-identified 500 m wide corridors within the application area as shown in **Figure 3**. These corridors have been delineated based on underlying geological features (known fractures/fault lines) which are the most suitable location to intercept gas reserves.

Although the final positions of the proposed production wells are subject to change during the development campaign as new data becomes available, the final well locations will still remain within the 500 m development corridors as assessed in this application process and will be guided by the sensitivities identified from the specialist assessments to position the well sites in such a manner to avoid sensitivities as far as possible. The sensitivity mapping undertaken during this scoping phase will be updated during the EIA phase once public input has been received and further considered as well as final specialist sensitivity mapping is completed.

Based on the above, no location alternatives for well sites are being assessed other than the positioning of well sites within the 500 m corridors. The sensitivity mapping based on input from all specialist disciplines will further guide the development of buffer-zones within the corridors in which highly sensitive or no-go areas should be avoided.

7.2.1.2 PIPELINE ROUTES

Further to the above well site location alternative description, the pipeline routes are largely dependent on the location of the gas-bearing wells in order to connect these wells to the main gas trunklines leading to the gas processing plant. The pipelines will be constructed, again using the sensitivity mapping approach as described above. Therefore, no location alternatives are to be assessed other than the sensitivity planning approach.

7.2.1.3 HELIUM RECOVERY FACILITY AND GAS PROCESSING PLANT

One helium recovery and gas processing plant with the optionality of producing either gaseous or liquified helium and methane will be required. Two options for the plant are currently proposed, both of which are in proximity of the Virginia fault line. The location of the 3 existing wells along the Virginia fault line which will form

part of the initial phase of the project were also taken into consideration when deciding on the location of the plant. Therefore, no location alternatives are to be assessed other than the sensitivity planning approach.

7.2.2 PRODUCTION ACTIVITIES WITHIN PRELIMINARY IDENTIFIED PRODUCTION CORRIDORS EXCLUDING DIRECTLY AFFECTED RENEWABLE ENERGY PROJECTS

This alternative (**subject to alignment on co-existence arrangements to the extent that this is reasonably possible**) would entail undertaking the activities within preliminary identified production corridors but excluding the directly affected renewable energy developments[2]. It would entail a process where the production activities are restricted to within the 500m corridors and/or within 25m of the preliminary seismic transects but excluding land directly earmarked for renewable energy development infrastructure where the production activities and the planned renewable energy development overlap. This would entail undertaking the production activities within areas assessed in detail, with known sensitivities to be avoided and avoidance of renewable energy developments. This process would reduce the production areas and restrict access to identified resource targets but would allow the renewable energy developments to proceed without any interference.

For this alternative those wells which overlap with the renewable energy facilities footprints are relocated to other areas within the defined production right boundary (**Figure 4**). This will allow for the exclusion of those wells that intersect or may interfere with the solar developments in the area.

These location alternatives for development footprint shall be referred to as:

- Production activities within preliminary identified production corridors – L1
- Excluding directly affected renewable energy projects – L2

7.2.3 ADVANTAGES AND DISADVANTAGES OF LOCATION ALTERNATIVES

Preliminary advantages and disadvantages of location alternatives are indicated in **Table 14**.

Table 14: Advantages and disadvantages of undertaking activities within different location alternatives.

ADVANTAGE	DISADVANTAGE
Undertaking the activities within preliminary identified production corridors (L1)	
Activities will be on known site-specific areas whose environmental sensitivities are known and with mitigation controls in place.	Final drilling site/s may fall outside of the assessed area which would limit effective assessment of the gas resource.
Site-specific controls would be in place for the activities in these areas.	Additional specialist studies, applications or approvals may still be required depending on the final location (i.e. outside assessed areas).
Restricting activities and subsequent disturbance / impacts to specific locations within the PR.	
Can be undertaken taken with the renewable energy developments through co-existence arrangements.	There may be reduced footprint and/or rescheduling of the gas production development on the affected areas to allow for renewable energy developments which may affect capacity / timing of gas production.
Undertaking activities within preliminary identified production corridors excluding directly affected renewable energy projects (L2)	
Activities will be on known site-specific environmental sensitivities and controls in place.	Final drilling site/s may fall outside of the assessed area which would limit effective assessment of the gas resource.

[2] Approved renewable energy projects within the PR.

ADVANTAGE	DISADVANTAGE
Site-specific controls would be in place for the activities in these areas.	Additional specialist studies, applications or approvals may still be required depending on the final location
Restricting exploration activities and subsequent disturbance / impacts to specific locations within the ER.	Reduced exploration activities on areas already assessed which may negatively affect the outcome of the exploration activities by impeding the detailed analysis of quantity and quality of gas reserves.
Allowance of renewable energy developments to proceed without interference	Depending on the final renewable energy facility layout and final drilling location, there is a positivity that the two projects do not interfere with each other. Therefore, there would be an unnecessary restriction to prevent potential valuable gas information.
Undertaking the activities outside preliminary production corridors (L3)	
Final drilling site/s may fall outside of the assessed area based on the outcome of the seismic surveys. Strict measures to be included in the EMPr will allow activities to proceed in these areas. It must be noted that there may be a requirement to undertake additional site-specific environmental assessments and specify additional controls.	Activities will be located on areas with little knowledge of specific environmental sensitivities.
	Minimal site-specific controls would be in place for the activities in these areas.
	This would open up the entire exploration footprint for exploration activities and potential disturbance / impacts.
	Additional specialist studies, applications or approvals may be required to allow for activities to be undertaken in these areas.

Based on the advantages and disadvantages indicated in **Table 14** above, it is recommended that the proposed activities ideally be undertaken within the preliminary identified production corridors through co-existence agreements (L1) , should that not be successful, then the second preferred alternative (L2) would be undertaking activities within preliminary identified production corridors excluding directly affected renewable energy projects. The undertaking of the production activities outside preliminary identified corridors is the least preferred alternative. However, the nature of the activities is such that the target sites are somewhat adjustable. This provides the operator with flexibility to move the sites for on-the-ground- activities to avoid local sensitivities (e.g. residence, wetlands and watercourse, etc.) and/or buffers where required provided that the relevant processes to be outlined in the EMPr which will be compiled in the EIA Phase are followed. The specific locality of the exact drilling location can only be identified once the initial phases have been undertaken, environmental sensitivities identified and faults / fractures within the target rocks identified. This will be further assessed during the EIA phase. It is therefore recommended that, both areas inside the pre-identified corridors (L1 and L2) and outside the corridors (L3) be considered for approval provided that relevant impact management measures are in place.

7.3 TECHNOLOGY OR PROCESS ALTERNATIVES

7.3.1 DRILLING ALTERNATIVES

Drilling penetration into rock becomes more difficult with increasing hole diameters and rock compressive strength. In piling applications, hard rock formations have to be cut and excavated prior to the installation of the foundation piles and/or piled retaining walls. Commonly, conventional rotary drill tools are used for bored piles in medium to very high strength rocks. For harder rock formations different methods have to be adopted as much larger cutting energy and force input are normally required to break the material at the rock tool interface.

Different drilling methods include rotary, percussion, rotary-percussion drilling and core drilling techniques, each utilizing distinct techniques to penetrate various soil and rock conditions, with rotary drilling using a rotating drill bit and percussion drilling using a hammering action.

7.3.1.1 ROTARY DRILLING METHOD

Rotary drilling uses a rotating drill bit to create boreholes by cutting or grinding through materials, and it is a versatile technique used in various applications, including well drilling, soil sampling, and geotechnical investigations. Rotary drilling is a method of creating boreholes in the ground using a spinning drill bit. This technique utilises a rotary drilling rig, which applies downward pressure and rotational force to the drill string, effectively cutting through soil and rock layers. As the drill bit advances, it grinds and chips away at the subsurface material, creating a cylindrical hole. The process uses a special fluid, often called drilling mud, which flows through the drill and out of small openings in the drill bit (refer to **Figure 13**). This fluid has several important jobs:

- Cooling the drill bit to prevent overheating;
- Lubricating the drilling components;
- Carrying cuttings from the borehole to the surface; and
- Stabilising the borehole walls to prevent collapse.

Rotary drilling rigs come in various sizes and configurations, including compact, rubber-tracked units designed for accessing confined spaces to large truck-mounted rigs capable of drilling deep boreholes in challenging conditions. Common uses of rotary drilling are deep water well drilling, geothermal wells, and oil & gas drilling.

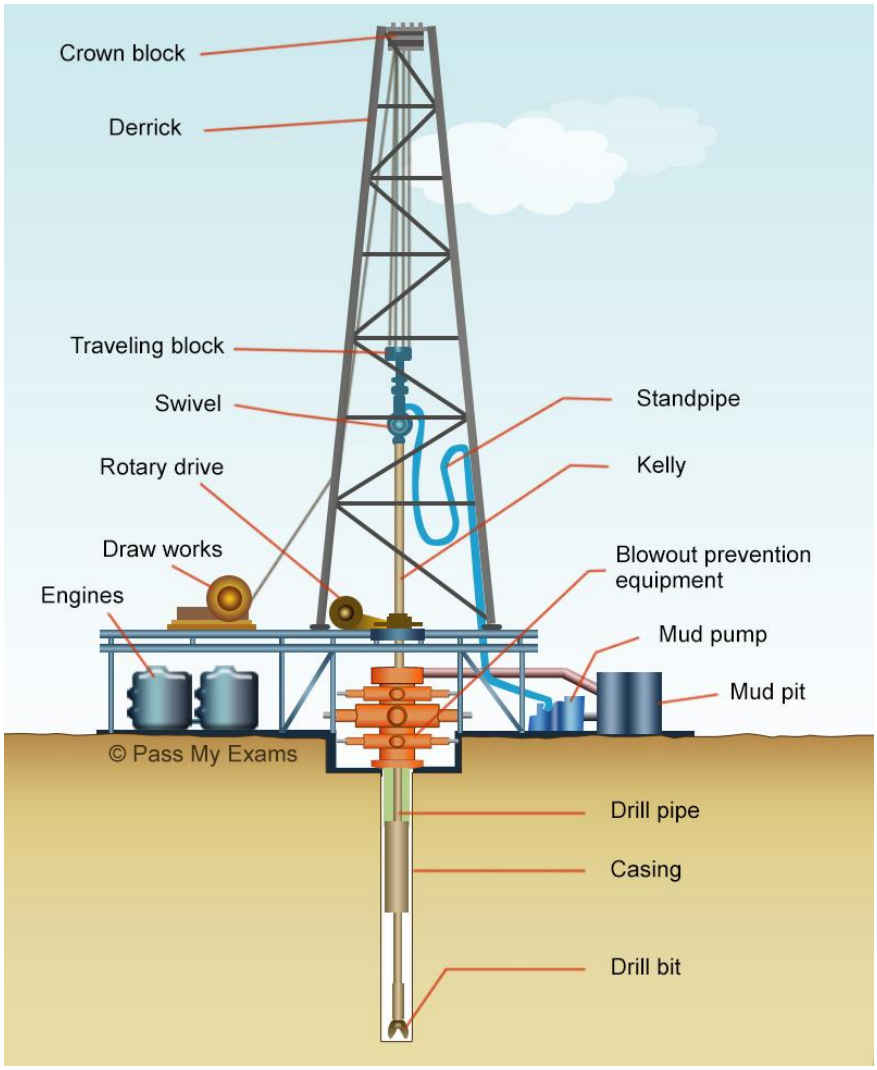


Figure 13: Fully cased drilling with rotary drive (https://www.passmyexams.co.uk/GCSE/chemistry/drilling-crude-oil-1.html).

7.3.1.2 PERCUSSION DRILLING METHOD

Percussion drilling is a technique where a hammering bit is attached to a long cable that is then lowered into a wide-open hole. As such, it is also called cable drilling, wherein the driller uses a tripod to support the tools. By going back and forth with the bit, the action loosens the soil in the borehole, which is then extracted with the help of a bailer. At intervals, the bit is removed while the cuttings are suspended in water, which is then removed by pumping to the surface. The percussion or churn drill digs a vertical hole. It employs the principle of freely falling chisel bit hung on a cable to which percussive motion is imparted by one of the various types of power units. The power units are manual lift and drop, compressed air, and electrically driven winches. The tungsten carbide bit fitted in a hammer is lifted few meters and allowed to drop (**Figure 14**) to hit the bottom of the hole. The process continues in succession. The churning motion of the bit crushes and scraps the ground, and so a hole is dug. The cutting of rocks thus produces mud or slurry by lowering water. The crushed material is removed from the bottom of the hole at a regular interval to make a sample. Churn drilling is suitable for soft and medium formation. In harder formation resharpening of cutting bit is required frequently resulting in lowering of progress. The capacity of the churn drill in its original form is limited to relatively short holes, under 40 m. Unless the formation is consolidated, a steel casing is necessary to prevent the collapse of the hole. Similarly, the casing may have to be cemented/isolated in order to protect the hole from contamination or prevent the hole from being a vehicle to bring various layers in communication (triggering environmental concerns). Only an uncemented casing can be used temporarily after permanent screen or casing is installed.

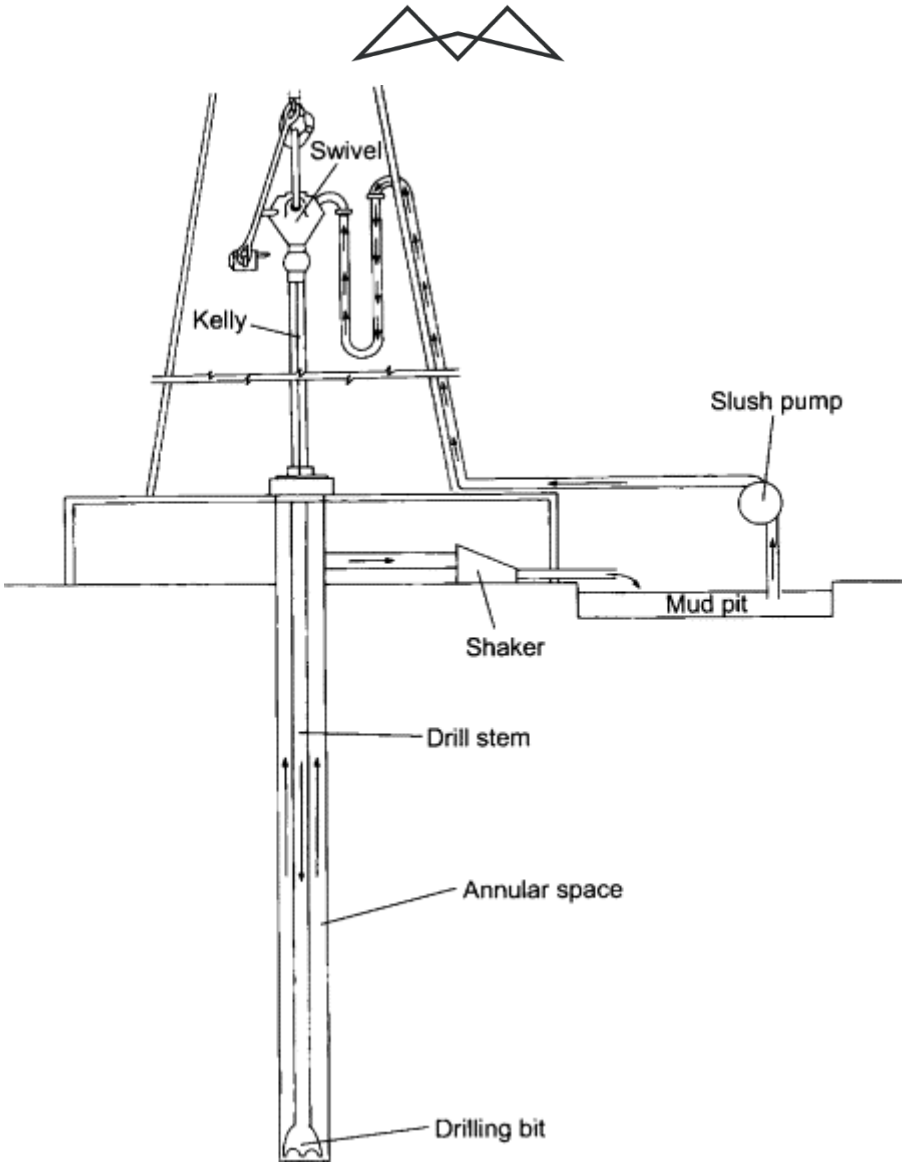


Figure 14: Typical example of percussion drilling technique (https://www.sciencedirect.com/topics/engineering/percussion-drilling).

7.3.1.3 ROTARY-PERCUSSION DRILLING METHOD

Rotary-percussion drilling, also known as down-the-hole hammer drilling, combines rotary and percussive drilling techniques to penetrate various soil and rock conditions efficiently, using a hammer tool to produce percussion while rotating the drill bit. A hammer drill (located directly in the borehole) delivers blows to a drill bit, breaking up the material. The drill pipes are rotated, and a flushing medium (like compressed air or water) is used to remove debris. The hammer drill is connected to the drill pipes, and the drill bit is forced through the drill pipes, hammer drill, and borehole. Refer to **Figure 15** for the excavation processes of the rotary-percussion composite excavation method: (**A**) excavating the shaft with rotary drilling; (**B**) completing the rotary drilling segment; (**C**) excavating the shaft with percussion drilling; (**D**) completing the percussion drilling segment

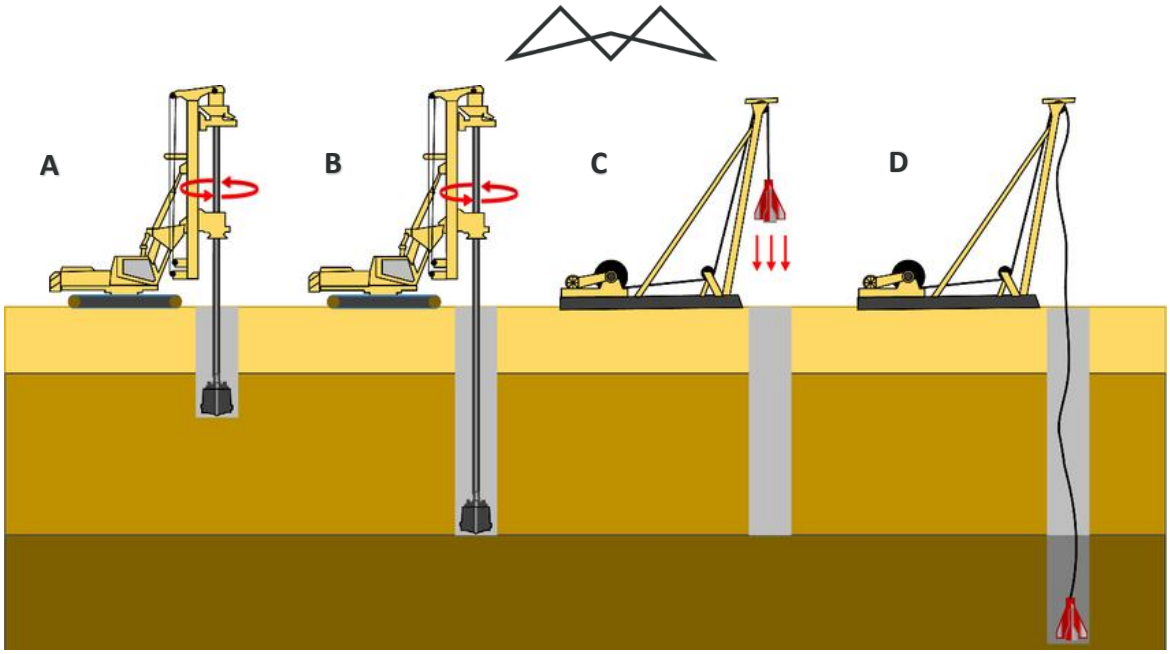


Figure 15: Typical example of rotary-percussion drilling technique (Hu *et al.,* 2023).

7.3.1.4 DIAMOND CORE DRILLING METHOD

Diamond drilling is a type of rotary drilling that uses a diamond studded drill bit (**Figure 16A**) to drill through and collect samples of sub-surface rock. The drill bit is attached to a core barrel which consists of an inner and outer barrel and a core lifter. The core barrel is then attached to a 6m drill rod (together called the "drill string") which is connected to a rotary / diamond drill rig (**Figure 16A**). During drilling, the inner barrel remains stationary while the outer barrel rotates with the drill bit. Water and other drilling fluids are injected into the drill string to prevent overheating. The drill bit cuts through the rock as it rotates and the opening at the end of the drill bit allows a solid column of rock (known as "drill core") to move up into the core barrel. When 6m has been drilled, a steel cable is used to latch the inner barrel and winch the drill core to the surface. The core lifter prevents the drill core from slipping out through the opening at the end of the drill bit while this is happening. Once at the surface, the drill core is removed from the inner barrel, washed, cracked into shorter lengths and placed in a core tray with markers inserted to track depth. Another 6m drill rod is attached to the top of the drill string and it is lowered back into the drill hole to continue drilling until the desired depth is reached. At least once a shift, core trays are transported to a separate core processing area to be marked up, photographed and logged by a qualified geologist. Once the geologist has finished with the drill core, it is cut in half longitudinally, so that half can be sent to a laboratory for analysis and half stored for future reference / use. Upon completion of drilling, it is a requirement that rehabilitation is undertaken to ensure that all areas impacted by drilling are restored to the condition that existed prior to undertaking the drilling, and no hazards are left behind that would impact the surrounding environment or land use.

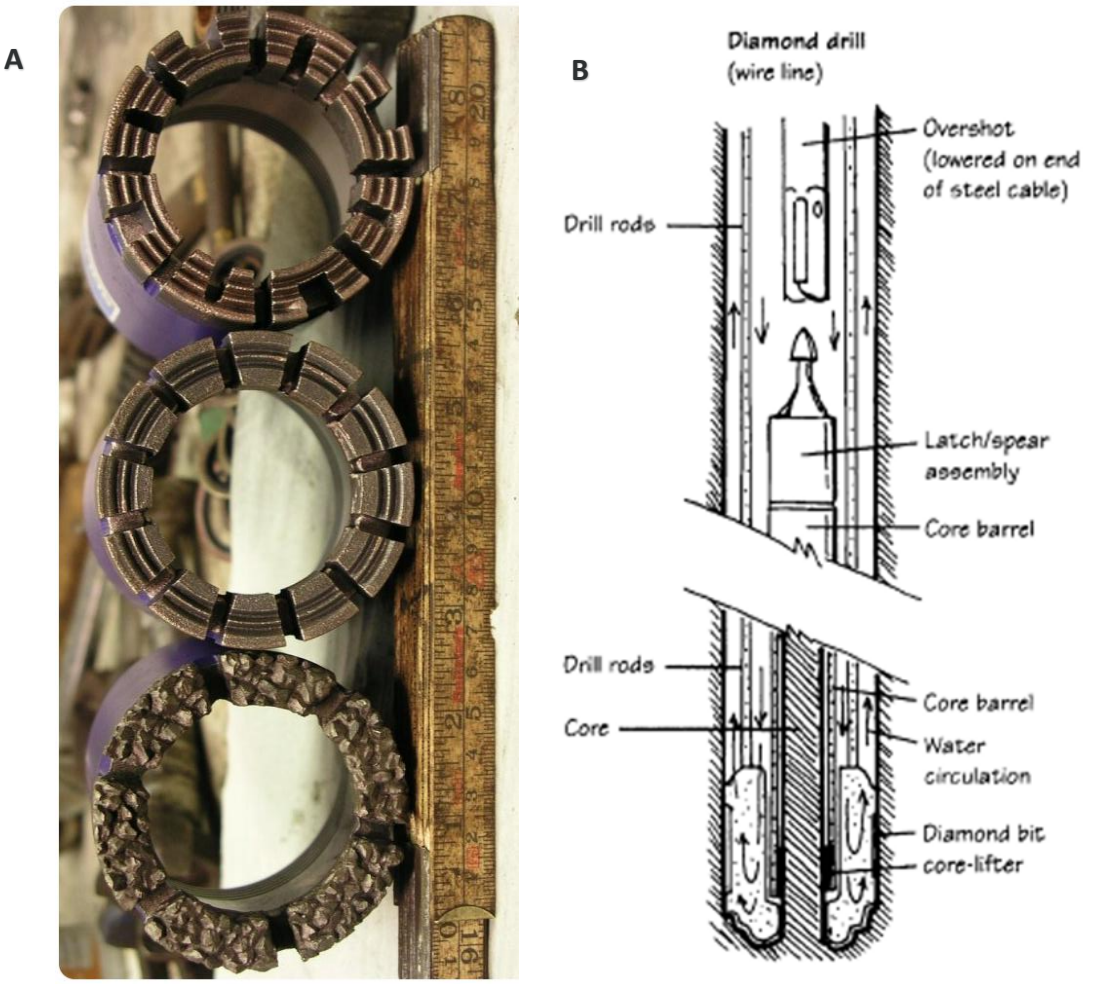


Figure 16: Diamond core drilling technique (Wai: https://www.precisiondrillingaustralia.com.au and Igo: ttps://www.igo.com.au)

7.3.1.5 ADVANTAGES AND DISADVANTAGES OF DIFFERENT DRILLING METHODS

Preliminary advantages and disadvantages of drilling methods are indicated in **Table 15.**

Table 15: Advantages and disadvantages of different drilling alternatives.

METHOD	ADVANTAGE	DISADVANTAGE
Rotary Drilling	Versatile, efficient, good for various formations.	Rotary drilling equipment and operations can be more expensive than percussive drilling.
	Faster drilling speeds due to continuous rotation.	The machinery used in rotary drilling can generate significant noise and vibration, which can be disruptive, especially in residential areas.
	Enhanced safety as fewer manual connections are required.	Can be slower and more challenging than percussive methods in extremely hard rock.

METHOD	ADVANTAGE	DISADVANTAGE
	Ideal for deep boreholes and gas applications.	Disposal of drilling waste, including large volumes of water if drilling below the water table, can be costly.
	Reduced risk of borehole collapse.	Can cause environmental impacts including noise and vibration pollution, air pollution from exhaust emissions, and potential soil and water contamination from drilling fluids.
	High penetration rate in hard rock, durable.	Expensive, requires specialized equipment.
Percussion Drilling	In general, percussion drilling is relatively fast and efficient.	Percussion drilling cause noise pollution, potential for soil disturbance and contamination, and the need for proper waste disposal.
	Percussion drilling is a cost-effective method.	Percussion drilling can cause significant damage to the rock formation being drilled, making it unsuitable for some geological projects.
	Can be used in a variety of geological formations, including hard rock, soft rock, and unconsolidated formations.	The equipment can be very heavy and relatively expensive.
	It is a straightforward method to operate and maintain, making it accessible for a range of projects and drilling environments.	Especially in harder rock, the method is slower than rotary-percussion and/or core methods.
Rotary-percussion Drilling	Can drill in consolidated or broken formations, as well as transitional hard or soft formation changes.	Generally slower than pure rotary drilling, especially in softer materials or for deep boreholes.
	Can increase rate of penetration (ROP) and drilled meters per shift.	Can be prone to hole deviation in certain conditions, especially in hard or unstable formations.
	Can be more cost-effective than other drilling methods, especially for deep drilling.	May require more specialized equipment and expertise compared to simpler drilling methods.
	Allows for the collection of continuous core samples, which is useful for detailed geological analysis.	Some rotary-percussion drilling techniques have limitations on the maximum drilling depth.
	Causes less surface disruption compared to some other drilling	Depending on the specific method and fluids used, there can be

METHOD	ADVANTAGE	DISADVANTAGE
	methods, making it suitable for urban or residential areas.	environmental concerns related to drilling fluids and waste disposal.
Diamond Core Drilling	Diamond core drilling is more precise than its offshoots of earth burying. Diamond core drilling produces clean, accurate holes with minimal vibration or damage to surrounding materials.	Diamond drilling can be noisy and create vibrations, which can be unpleasant for workers and nearby residents.
	Where the rotary and percussion drill mechanisms chip or crush the earth beneath tools, the core drill type is able to pull a slither of rock delicately from the earth.	Diamond drilling can lead to soil and water contamination if not managed properly. The drilling process can introduce harmful substances into the ground, affecting both soil quality and nearby water sources.
	Has the drill to power through the hardest of rock materials.	Local ecosystems, including plants and animals, are often more disrupted by diamond drilling activities.
	Diamond core drilling is important for geological analysis. By examining the extracted core a geologist can determine the relationship between the rock layers and examine the earth's condition in fault zones.	Diamond drilling equipment and diamond bits are expensive, and require regular maintenance, making the process costly.
	Diamond drilling is usually faster and more effective than conventional drilling methods.	Compared to other drilling methods, diamond core drilling can be slower, especially in hard rock formations.
	Diamond core drilling produces minimal dust and debris, which reduces cleanup time and environmental impact.	There's a risk of losing or damaging the core sample during the drilling process, which can hinder geological analysis.
	While the initial investment may be higher, diamond drills are durable and can last longer than other types of drills, which can lead to cost savings in the long run.	Diamond drilling equipment can be prone to failure, especially in harsh conditions, leading to downtime and increased costs.

In general, percussion drilling is a versatile and cost-effective method of geological exploration/production that is widely used in the gas industry. While it has some drawbacks, such as its limited depth capabilities and potential for rock damage, it remains a popular choice for many projects. As with any drilling method, it is important to weigh the pros and cons carefully before deciding whether to use percussion drilling for a specific geological drilling task. Based on the advantages and disadvantages indicated in **Table 15** above, each method has its own pros and cons, the seismic surveys will inform the type of drilling technique required but from an environmental point and previous exploration activities in the area, percussion drilling has the least impacts and is the most preferred method of drilling.

7.3.2 SEISMIC SURVEYS ALTERNATIVES

A seismic survey is a method used to investigate the subsurface structure, primarily for gas exploration, by sending sound waves into the ground and analysing the reflected signals. Offshore surveys use airguns to create low-frequency sound waves that travel through the water and reflect off the seafloor, allowing geophysicists to map geological features and potential hydrocarbon deposits. While onshore seismic surveys are used to investigate the subsurface structure of land areas, commonly for exploring hydrocarbon reservoirs, mineral deposits, and natural gas, by using sound waves and the principles of reflection seismology. The proposed activities are onshore seismic surveys and thus, this report will only focus on onshore seismic surveys. Onshore seismic surveys utilize sound waves, which are generated and then reflected off subsurface layers. By analysing the reflected waves, geoscientists can create images of the subsurface structure. The design of a seismic survey depends on the specific objectives, the geological setting, and the availability of historical data. Factors to consider include the size of the survey area, the spacing of seismic lines, and the type of seismic acquisition techniques used. For purposes of this report, the types of seismic surveys techniques used will be based on three common methods used for gas explorations namely, Vibroseis technique, Accelerated Weight Drop (AWD) and Magnetotelluric Survey (MT) (refer to **Section 4.1.1** for detailed information).

7.3.2.1 VIBROSEIS TECHNIQUE

Vibroseis seismic surveys use vehicles to generate artificial seismic waves through mechanical vibration, offering a low-impact method for gathering data to interpret geological features beneath the earth's surface, similar to how sound waves are used in an ultrasound. Vibroseis trucks travel slowly, stopping at intervals to send seismic waves into the earth using vibrators mounted on the trucks. These waves travel through the earth and are reflected (echoed) off rock formations. Sensitive microphones on the surface, called geophones, record these reflected waves. Geoscientists analyse the recorded data to build knowledge of the underlying geology.

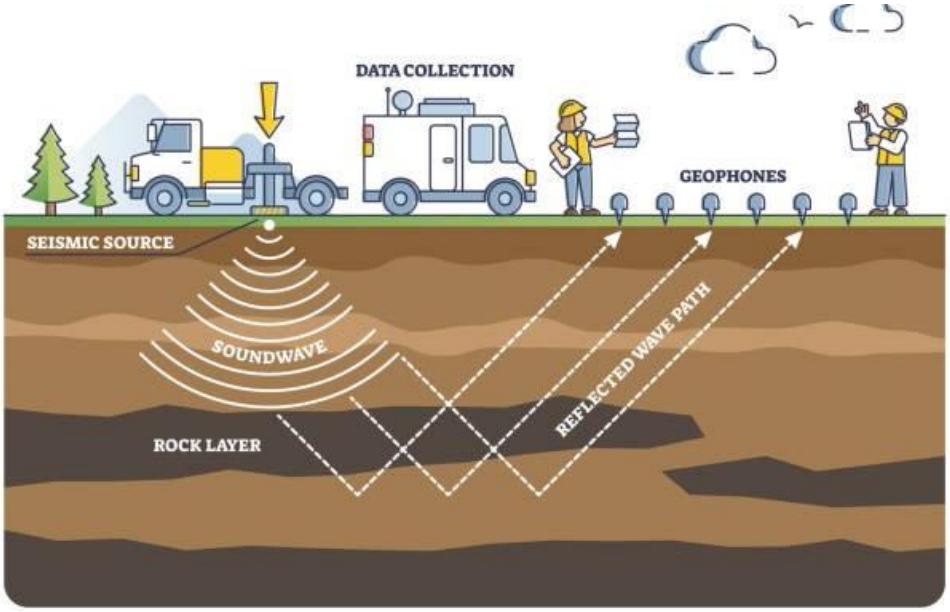


Figure 17: Illustration of Vibroseis technique (Bhardwaj, 2024).

7.3.2.2 ACCELERATED WEIGHT DROP TECHNIQUE

An accelerated weight drop (AWD) seismic survey uses a heavy weight that is accelerated and dropped onto a base plate, generating seismic waves to image the subsurface. An AWD seismic source is a type of surface impact source that uses a weight striking a base plate coupled to the ground. The falling weight strikes the base plate, transmitting kinetic energy to the ground, which creates seismic waves that travel through the subsurface. These seismic waves are then recorded by geophones or other sensors, and the data is used to create images of the subsurface, which is useful for various applications, such as gas exploration, groundwater studies, and engineering investigations (see **Figure 18**).

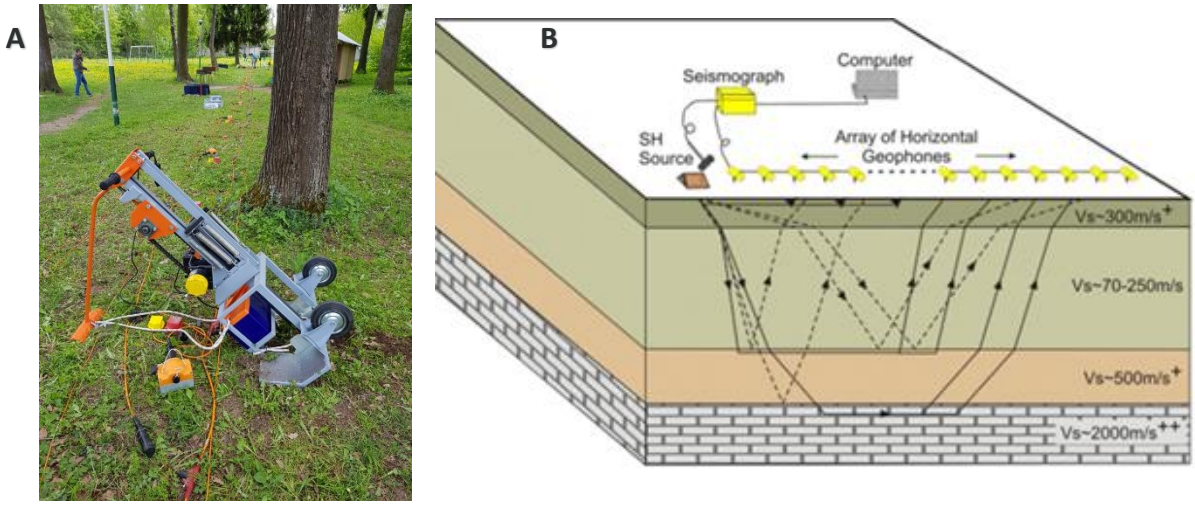


Figure 18: Illustration of AWD technique after Stephenson *et al.,* 2022. (A) AWD on site and (B) illustration of the process.

7.3.2.3 MAGNETOTELLURIC SURVEY

Magnetotellurics (MT) are electro-magnetic survey and imaging techniques that use naturally-occurring ionospheric current sheets and lightning storms — passive energy sources — to map geologic structures to depths of 500 meters or more. The MT geophysical survey method combines measurements of the earth's electric field and magnetic field over a wide band of frequencies. Low frequencies sample deep into the earth and high frequencies correspond to shallow samples. For hydrocarbon exploration, MT is mainly used as a complement to the primary technique of reflection seismology exploration. While seismic imaging is able to image subsurface structure, it cannot detect the changes in resistivity associated with hydrocarbons and hydrocarbon-bearing formations. MT does detect resistivity variations in subsurface structures, which can differentiate between structures bearing hydrocarbons and those that do not.

At a basic level of interpretation, resistivity is correlated with different rock types. High-velocity layers are typically highly resistive, whereas sediments – porous and permeable – are typically much less resistive. While high-velocity layers are an acoustic barrier and make seismic ineffective, their electrical resistivity means the magnetic signal passes through almost unimpeded. This allows MT to see deep beneath these acoustic barrier layers, complementing the seismic data and assisting interpretation (**Figure 19**).

A

B

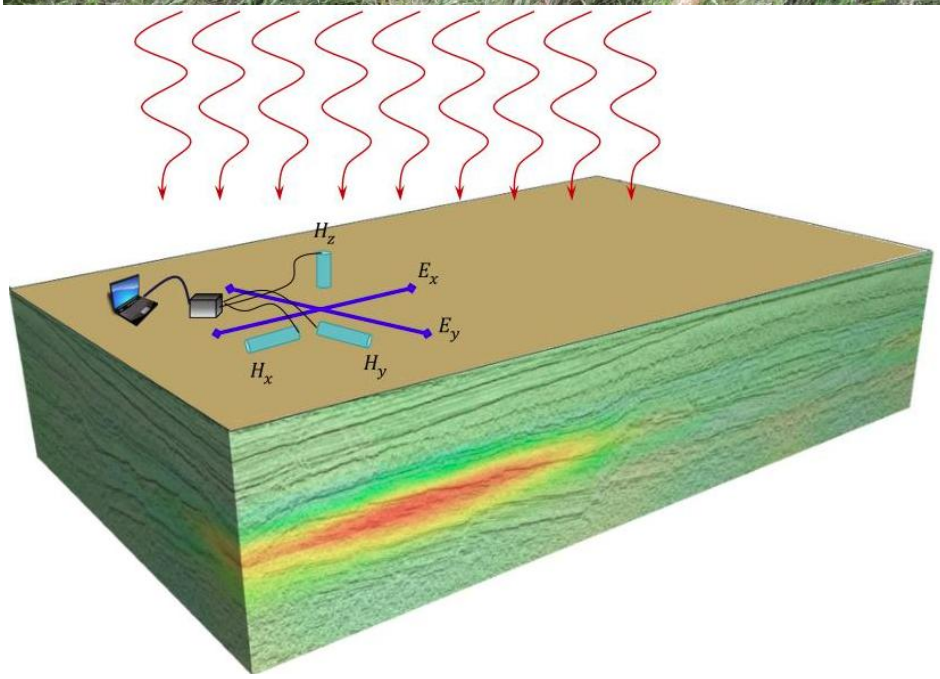


Figure 19: Illustration of MT survey (geopartner: https://geopartner.pl). (A) MT setup on site and (B) illustration of the MT process.

7.3.2.4 ADVANTAGES AND DISADVANTAGES OF DIFFERENT SEISMIC SURVEYS ALTERNATIVES

Preliminary advantages and disadvantages of different seismic survey techniques are indicated in **Table 16**.

Table 16: Advantages and disadvantages of different seismic survey alternatives.

TECHNIQUE	ADVANTAGE	DISADVANTAGE
Vibroseis Survey	Vibroseis allows for precise control over the frequencies and energy of the generated seismic waves, which is beneficial for tailoring the survey to specific geological targets.	Although Vibroseis surveys are generally quicker, they can be affected by weather and terrain conditions resulting in longer survey periods.
	Vibroseis sweeps can be repeated easily, allowing for high-quality data acquisition.	Vibroseis trucks may have difficulty navigating rugged or steep terrain.
	Vibroseis surveys are generally quicker.	Can be more expensive than some other geophysical methods
Accelerated Weight Drop Surveys	AWD surveys can be significantly faster than Vibroseis surveys	Repeated thumping can cause soil disturbance, potentially leading to long-lasting effects
	AWD systems can be mounted on crawlers or other vehicles, allowing them to operate in more varied terrain.	Depending on local regulations, AWD surveys may require more permits than vibroseis surveys.
	AWD can produce more energy than vibroseis, potentially allowing for deeper penetration.	May not be as effective as other seismic methods in deeper areas
	AWD surveys can be used in areas where explosives or vibroseis are not practical or safe.	AWD methods are primarily designed for shallow subsurface investigations, making them less suitable for exploring deeper geological structures
Magnetotelluric Surveys	MT relies on naturally occurring electromagnetic fields, reducing the need for active sources and equipment, making it a cost-effective and environmentally friendly method.	Cannot provide the resolution of seismic surveys and may not be suitable for all geological environments.
	MT surveys can provide information about the subsurface at great depths and can be used in areas where seismic data collection is difficult or impractical.	MT surveys can be more complex and time-consuming than other geophysical methods.
	MT can map large areas and provide a regional perspective on subsurface resistivity variations.	MT surveys can be expensive, particularly for large-scale projects or surveys in challenging terrains.
	MT surveys do not require drilling or ground disturbance, minimizing environmental impact.	MT surveys may have limited resolution, particularly for shallow subsurface structures.

Based on the advantages and disadvantages indicated in **Table 16** above, it can be seen that the suitability for each is based on the nature of the project and the environmental conditions. It can also be seen that where one

technique lacks, the other can abound. Therefore, it is **recommended that a multi-survey technique be used based as and when necessary, with the appropriate control measures in place.**

7.3.3 GAS TESTING ALTERNATIVES

During the exploration phase, gas venting (direct release into the atmosphere) and flaring (controlled burning of excess natural gas) may occur intermittently during well clean-up and flow testing or during emergencies. These activities may be required to remove drilling fluids, stabilise the well, and obtain reservoir performance data, including pressure, flow rate, and gas composition. At this stage of development, permanent gas capture or processing infrastructure is not yet installed, necessitating the controlled release or combustion of gas for limited periods.

7.3.3.1 GAS VENTING

Gas venting is the deliberate release of natural gas directly into the atmosphere without combustion. It is typically used to relieve pressure or manage gas during certain operational activities in the gas industry. Gas is released through valves, vents, or piping systems and disperses into the atmosphere. The gas is primarily methane, often with small amounts of other hydrocarbons. Gas venting may occur during:

- Well testing and well clean-up, particularly at low flow rates.
- Equipment commissioning, maintenance, or depressurisation.
- Start-up and shutdown of facilities.
- Situations where flaring is not technically feasible or safe.

7.3.3.2 GAS FLARING

Gas flaring is the controlled burning of excess or unwanted natural gas at a facility or well site, typically through a vertical or horizontal flare stack. It is used to safely dispose of gas when it cannot be captured, processed, or transported. The gas is ignited at the flare tip, where it burns in an open flame. This combustion converts methane (a potent greenhouse gas) primarily into carbon dioxide and water vapour. Gas flaring commonly occurs in various industries during:

- Gas exploration and well testing, before permanent infrastructure is in place.
- Start-up, shutdown, or maintenance of facilities.
- Emergency situations to relieve pressure and prevent equipment failure.
- Operational safety to manage excess gas.

7.3.3.3 ADVANTAGES AND DISADVANTAGES OF DIFFERENT GAS TESTING ALTERNATIVES

Preliminary advantages and disadvantages of different gas testing alternatives are indicated in **Table 17**.

Table 17: Advantages and disadvantages of different gas testing alternatives.

TECHNIQUE	ADVANTAGE	DISADVANTAGE
Gas Venting	Minimal infrastructure and equipment required.	Releases methane (a highly potent greenhouse gas) directly into the atmosphere with a much higher global warming potential than CO_2.
	Practical for small, short-duration releases.	Venting contributes directly to climate change.
	Avoids nitrogen oxides (NO_x) and soot emissions associated with flaring.	Potential for localised air quality impacts.

TECHNIQUE	ADVANTAGE	DISADVANTAGE
		Potential for explosive gas accumulation if poorly managed.
Gas Flaring	Controlled combustion reduces the risk of uncontrolled gas accumulation and explosions.	Flame, heat radiation, and noise can affect surrounding communities.
	It emits CO_2, NO_x, and small amounts of other pollutants significantly reducing global warming potential.	Still contributes CO_2 emissions and climate change.
	Impacts are usually localised and temporary when flaring is well managed.	Gas that could potentially be captured or utilised is destroyed.
	Flaring reduces climate impact compared to venting by burning off methane.	Requires flare systems, safety zones, and monitoring.

Based on the advantages and disadvantages indicated in **Table 17** above, it can be seen that flaring is widely considered preferable to venting from a climate and safety perspective. However, there may be instances where flaring presents a significant safety risk. Therefore, it is **recommended that both alternatives be assessed further in the EIA phase.**

7.4 DESIGN OR LAYOUT ALTERNATIVES

Design alternatives are the consideration of different designs for technical efficiency, aesthetic purposes or different construction materials in an attempt to optimise local benefits and sustainability. Two options for surface drill fluid management are identified, aboveground tanks and underground sumps. Underground sumps are used in underground mining operations to collect and pump water from working and therefore, not feasible nor applicable for the proposed project. Subsequently, for purposes of this report, design or layout alternatives are based on the two options for aboveground drill sumps, namely the traditional excavated plastic lined pond (sump pit) or above ground tanks with secondary steel or plastic containment (pit-less drilling).

In exploration/production drilling, a conventional sump pit (or sump) is a contained area usually a pit dug in the ground and lined, used to collect drill cuttings and manage drilling fluids, allowing for water recycling and efficient solids settling. Pit-less drilling sumps on the other hand are aboveground systems often made of steel or plastic tanks. Sumps are designed to prevent the escape of drilling fluids and cuttings into the environment. Ramps are often included in sump design to allow wildlife to escape if they enter the sump. Proper planning and construction of sumps are crucial for minimizing environmental impact and ensuring a safe drilling operation. It is important to note that the type of drilling method used will influence the size and design of the sump required.

7.4.1 TRADITIONAL EXCAVATED LINED POND (DRILL SUMP PITS)

In this alternative, a sump pit is used to collect drill cuttings and manage drilling fluids, allowing for water recycling and efficient solids settling. The drilling team will excavate a hole depending on the drilling method, then line the top portion (typically 0.5 meters) with an impermeable barrier material and fenced to prevent animals from entering. The typical lining material used are high density polyethylene sheets (refer to **Figure 20**). After drilling operations are completed, the sump pit and the surrounding area must be rehabilitated to restore the site to its original condition. This may involve removing the accumulated solids, cleaning the pit, backfilling, and restoring the vegetation.

Figure 20: Typical traditional sump pit used for drilling activities in the region.

7.4.2 ABOVEGROUND TANKS WITH SECONDARY CONTAINMENT

Above-ground tanks with secondary containment are designed to capture and contain spills or leaks of drill fluids, acting as a secondary barrier to prevent environmental contamination. Secondary containment is a system designed to prevent the release of hazardous materials into the environment in case of a spill or leak from a primary storage container (like a tank). It is a crucial safety measure, especially for above-ground storage tanks (ASTs) that hold flammable or hazardous liquids. Common methods include containment sumps, bunds (earthen dykes), spill pallets, or double-walled tanks. Aboveground tanks are often made of materials that are impervious to the stored liquid, such as steel, concrete, asphalt, clay, or plastic. In exploration drilling, feasible material includes steel or plastic (**Figure 21**). The sumps are either emptied or disposed by a hazardous waste service provider at a hazardous waste facility.

Figure 21: Examples of aboveground sumps with secondary containment (Ultratech International Inc: https://spillcontainment.com/ultratech-university/spill-containment/).

7.4.3 ADVANTAGES AND DISADVANTAGES OF DIFFERENT DRILL FLUID CONTAINMENT SUMPS

Based on the analysis of the different feasible aboveground drill sumps proposed for the project, the advantages and disadvantages are provided in **Table 18**.

Table 18: Advantages and disadvantages different aboveground drill sumps.

ADVANTAGE	DISADVANTAGE
Traditional excavated lined pond (drill sump pits)	
Lined ponds prevent water seepage into the soil, conserving water resources, especially important in areas with intermittent water availability.	Requires dredging causing disturbance to soil.
For drilling activities, it is a cost-effective method compared to aboveground tanks with secondary containment	Waste material can settle and rot on the bottom, leading to ammonia buildup, which is toxic to aquatic life.
Liners prevent soil particles from dissolving into the water, maintaining water clarity and chemistry, which is beneficial for aquaculture and other water-based activities.	Requires constant monitoring to ensure there's no seepage.
Appropriate liners for the specific activity and site are highly resistant to UV damage, chemicals, and punctures, ensuring long-term durability.	Animals can easily be trapped by the fence and/or fall into the pit.
Potentially fewer truck movements during drilling when on-site containment volume is sufficient.	Lined ponds can suffer from leaks, liner damage, and require sump pumps. Punctures and tears are common, and repairs can be difficult and costly.
Can provide surge capacity and settlement during drilling and testing.	Damage to liner results in immediate contamination and may affect groundwater and/or nearby aquatic systems.
	Larger surface disturbance and visual footprint; typically requires more earthworks and post-drilling rehabilitation.
Aboveground tanks with secondary containment (Pitless / Closed-loop)	
Aboveground tanks are easier to install and are accessible for repairs and troubleshooting.	Secondary containment systems can be expensive to install and maintain and requires constant monitoring and maintenance.
Aboveground tanks can be designed to fit various spaces and needs, offering design flexibility.	Sediment can settle in the sump, reducing its capacity and requiring more frequent pumping.
Have a longer lifespan, leading to lower long-term costs.	Aboveground sumps can be unsightly and may not blend in with the surrounding landscape.
They are more effective in containing spills from primary container which can be easily identified and addressed compared to excavated lined sumps.	Aboveground sumps can be expensive to install, especially if they are large or complex.
Portable allowing for easy transport and setup at different drill sites.	Secondary containment systems, like bunds or containment berms, require additional space around the primary tank or sump, increasing the overall area needed for storage.
Substantially reduced surface disturbance and visual footprint; better alignment with sensitive sites or small pads.	Vehicles can back into them, vandals can deface or damage them, and trespassers can steal their

ADVANTAGE	DISADVANTAGE
	contents. Exposure also increases the chance of leaks.
Reduced risk to soil, groundwater and wildlife by eliminating open pits; improved containment and spill response.	Regular inspections and maintenance are crucial to ensure the integrity of both the primary and secondary containment systems.
Often faster post-drilling demobilisation with minimal rehabilitation.	If the secondary containment fails, the spilled material can contaminate the surrounding soil and water.

Based on the advantages and disadvantages indicated in **Table 18** above, it is the **EAPs opinion that both alternatives be considered further going into the EIA phase.**

7.5 NO GO ALTERNATIVE

The "No Go" or "No Action" alternative refers to the alternative of not embarking on the proposed project at all. It assumes that the activity does not go ahead, implying a continuation of the current situation or the status quo. It is important to note that the No Go alternative is the baseline against which all other alternatives and the project proposal are assessed. When considering the No Go alternative, the impacts (both positive and negative) associated with any other specific alternative, or the current project proposal would not occur and in effect the impacts of the No Go alternative are therefore inadvertently assessed by assessing the other alternatives. In addition to the direct implications of retaining the status quo, there are certain other indirect impacts, which may occur should the No Go alternative be followed. The 'no-go' alternative provides the means to compare the impacts of project alternatives with the scenario of a project not going ahead. In evaluating the 'no-go' alternative it is important to take into account the implications of foregoing the benefits of the proposed project. The approval of the proposed activities would allow the applicant to extract and produce an economically viable resource (natural gas including Helium) available in the area.

Exploration and/or production of natural gas reserves is considered important and would be well received by the local market. The Department of Energy's Integrated Resource Plan (2025) supports this view, stating that regional and domestic gas options should be pursued. The government's official position is that exploration and development of gas fields should be encouraged. The proposed project provides an opportunity to develop a South African gas industry resulting in long-term benefits consisting of access to new energy sources, improved security of supply, major in-country investments in a development project and reduced dependence on the importation of hydrocarbons. There is also potential in the long-term for local economic stimulation through direct employment, future business opportunities, royalties and tax revenues, as well as indirect economic effects. In addition, there are known mitigation measures to avoid and/or reduce potential impacts mentioned above as per the various specialist studies and knowledge from past exploration and production activities. The preference for the no-go option is linked to the outcome of the impact assessment for the proposed project and the degree of predicted impact significance (i.e. high impact requires more robust consideration of the no-go, whereas low impact suggests that retention of the status quo is not preferred). Although the no go alternative is **not considered reasonable for this application, it will be assessed in the EIA Phase**.

8 STAKEHOLDER ENGAGEMENT

The Public Participation Process (PPP) is a requirement of several pieces of South African legislation and aims to ensure that all relevant Interested and Affected Parties (I&APs) are consulted, involved and their comments are considered, and a record included in the reports submitted to the Authorities. The process ensures that all stakeholders are provided this opportunity as part of a transparent process which allows for a robust and comprehensive environmental study. The PPP for the proposed project needs to be managed sensitively and according to best practises to ensure and promote:

- Compliance with international best practice options;
- Compliance with national legislation;
- Establishment and management of relationships with key stakeholder groups; and
- Involvement and participation in the environmental study and authorisation/approval process.

As such, the purpose of the PPP and stakeholder engagement process is to:

- Introduce the proposed project;
- Explain the authorisations required;
- Explain the environmental studies already completed and yet to be undertaken (where applicable);
- Solicit and record any issues, concerns, suggestions, and objections to the project;
- Provide opportunity for input and gathering of local knowledge;
- Establish and formalise lines of communication between the I&APs and the project team;
- Identify all significant issues for the project; and
- Identify possible mitigation measures or environmental management plans to minimise and/or prevent negative environmental impacts and maximize and/or promote positive environmental impacts associated with the project.

8.1 LEGAL COMPLIANCE

The PPP must comply with several important sets of legislation that require public participation as part of an application for authorisation or approval, namely:

- The Mineral and Petroleum Resources Development Act (Act No. 28 of 2002 – MPRDA); and
- The National Environmental Management Act (Act No. 107 of 1998 – NEMA).

Adherence to the requirements of the above-mentioned Acts will allow for an Integrated PPP to be conducted, and in so doing, satisfy the requirement for public participation referenced in the Acts. The details of the Integrated PPP followed for the project are provided below.

8.2 PRE-CONSULTATION WITH THE COMPETENT AUTHORITY

A pre-application meeting with the Petroleum Agency of South Africa (PASA) was held on the 30th of October 2025. The objective of the meeting was to present the project, confirm identified triggered and applicable listed activities and the applicable application process to be followed as well as the identified applicable specialist studies. The pre-application meeting was also used to confirm the current application form and submission methods.

8.3 GENERAL APPROACH TO SCOPING AND PUBLIC PARTICIPATION

The PPP for the proposed project has been undertaken in accordance with the requirements of the Mineral and Petroleum Resources Development Act 28 of 2002 (MPRDA) and National Environmental Management Act

(NEMA) Environmental Impact Assessment (EIA) Regulations (2014), and in line with the principles of Integrated Environmental Management (IEM). IEM implies an open and transparent participatory process, whereby stakeholders and other I&APs are afforded an opportunity to comment on the project and have their views considered and included as part of project planning.

8.3.1 IDENTIFICATION OF INTERESTED AND AFFECTED PARTIES

An initial I&AP database has been compiled based on known key I&AP's, Windeed searches, and stakeholders as well as trust information obtained from the regional deeds office (Bloemfontein Justice Department). The I&AP database includes amongst others, landowners, communities, farming groups, regulatory authorities and other special interest groups. The I&APs database will continually be updated throughout the duration of the application process.

8.3.2 LIST OF PRE-IDENTIFIED ORGANS OF STATE/ KEY STAKEHOLDERS IDENTIFIED AND NOTIFIED

National, Provincial and Local Government Authorities as well as State Owned Entities (SOE's) were notified of the proposed project and include but not limited to:

Table 19: List of Government Authorities, SOE's and other key I&APs.

ORGANS OF STATE	KEY I&APS
• Council for Scientific and Industrial Research (CSIR) • Department of Mineral and Petroleum Resources: Free State • Free State Department of Agriculture & Rural Development • Free State Department of Cooperative Governance and Traditional Affairs • Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs • Free State Department of Police, Roads and Transport • Free State Department of Public Works and Infrastructure • Free State Department of Water and Sanitation • Free State Development Corporation • Free State Heritage Resources Authority • Free State Provincial Shared Services Centre (PSSC) Offices • Lejweleputswa Development Agency • Lejweleputswa District Municipality • Matjhabeng Local Municipality • Masilonyana Local Municipality • Municipal Ward Councillors	• Afgri • Afgri Agri Services • African Conservation Trust • African Carbon Energy • AfriForum • Agri Free State • Agri SA • Air Traffic and Navigation Services (ATNS) • Birdlife South Africa • Botanical Society of Southern Africa • Centre for Environmental Rights • Conservation South Africa (CSA) • Council of Geoscience • Earth Life Africa • Endangered Wildlife Trust • Federation for a Sustainable Environment • FrackFree South Africa • Free State Wetland Forum • GroundWork SA • GUBICO • Harmony Gold • Hennenman Farmers Union

• National Department of Agriculture, Land Reform and Rural Development (DALRRD) • National Department of Forestry, Fisheries and Environment (DFFE) • National Department of Transport • National Department of Water and Sanitation (DWS) • National Energy Regulator of South Africa (NERSA) • National House of Traditional Leaders • Petroleum Agency SA (PASA) • Petroleum Oil and Gas Corporation of South Africa (PetroSA) • Sedibeng Water • South African Civil Aviation Authority (SACAA) • South African Defence Force (SANDF) • South African Heritage Resources Agency (SAHRA) • South African National Biodiversity Institute • South African National Roads Agency Ltd (SANRAL) • South African Radio Astronomy Observatory • Telkom SA SOC LTD • Transnet SOC LTD • Vaal Central Water • National Transmission Company South Africa (NTCSA)	• Matjhabeng Ratepayers Association • Mining and Environmental Justice Community Network of South Africa (MEJCON-SA) • Mining Affected Communities United in Action (MACUA) • Mulilo Renewable Project Developments (Pty) Ltd • Natural Justice • Tara Wildlife SA • Vaal Environmental Justice Alliance (VEJA) • Vrystaat Landbou/ Free State Agriculture • Warburtons Attorneys • WESSA • Wild Trust

In addition to the above, attempts to consult with directly affected landowners, adjacent landowners, community and farming representatives, occupiers of land, etc. were made.

8.3.3 PROJECT NOTIFICATION AND REQUEST FOR INITIAL COMMENTS

The PPP commenced on the 14th of November 2025 with an initial notification and call to register. The notification was given in the following manner:

8.3.3.1 REGISTERED LETTERS, FAXES AND EMAILS

Notification letters in English, Afrikaans and Sesotho, faxes, and emails were distributed to all pre-identified key I&APs including government organisations, NGOs, relevant municipalities, ward councillors, landowners and other organisations that might be interested or affected. Background Information Document in English, Afrikaans and Sesotho was compiled and uploaded to the EIMS website.

The notification letters included the following information to I&APs:

- The purpose of the proposed project;
- High level list of anticipated activities to be authorised;

- Scale and extent of activities to be authorised;
- Information on the intended production activities to enable I&APs to assess/surmise what impact the activities will have on them or on the use of their land;
- Map showing affected properties;
- Summary of the relevant legislation pertaining to the application process;
- Initial registration period timeframes; and
- Contact details of the EAP.

8.3.3.2 NEWSPAPER ADVERTISEMENTS / GOVERNMENT GAZETTE

Advertisements describing the proposed project and EIA process were placed in the local newspaper with circulation in the vicinity of the study area. The initial advertisement was placed in the Vista Newspaper (in English, Afrikaans and Sesotho) on the 20th of November 2025. Gazette Notice was published in the National Gazette on the 14th of November 2025. The newspaper advert and the Gazette included the following information:

- Project name;
- Applicant name;
- Project location;
- Nature of the activity and application;
- Where additional information could be obtained; and
- Relevant EIMS contact person for the project.

8.3.3.3 SITE NOTICE PLACEMENT

A1 correx site notices in English, Afrikaans and Sesotho were placed at 50 locations within and around the application area between the 17th and 18th of November 2025. The on-site notices included the following information:

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

8.3.3.4 POSTER PLACEMENT

A3 posters in English, Afrikaans and Sesotho were placed at local public gathering places in Virginia, Welkom, Ventersburg and Theunissen.

The notices, posters and written notification afforded all I&APs who may be interested in the project with the opportunity to register for the project as well as to submit any issues/queries/concerns and indicate the contact details of any other potential I&APs that they feel should be contacted. The contact person at EIMS, contact number, email and faxes were stated on the posters. Comments/concerns and queries were encouraged to be submitted in either of the following manners:

- Electronically (fax, email);

- Telephonically; and/or
- Written letters (postal).

8.3.4 AVAILABILITY OF SCOPING REPORT

Notification regarding the availability of this Scoping Report for public review was given in the following manner to all registered I&APs (which includes key stakeholders and landowners):

- Registered letters with details on where the scoping report can be obtained and/or reviewed, EIMS contact details as well as the public review comment period;
- Facsimile notifications with information similar to that in the registered letter described above;
- Email notifications with a letter attachment containing the information; and/or
- SMS notifications with the relevant information.

The scoping report was made available for public review and comment from the **23rd of January 2026 to the 23rd of February 2026** for a period of 30 days.

8.4 COMMENTS AND RESPONSES REPORTING

Comments raised to date have been addressed in a transparent manner and included in the Public Participation Report (**Appendix C**). Please note that where relevant, personal information was omitted from the public domain due to the restrictions imposed by the Protection of Personal Information Act (Act 4 of 2013 - POPIA).

To date the general comments that have been received are summarised below:

- I&APs requesting to register for the project.

A table of comments and responses is included as **Appendix 6** of the attached Public Participation Report (PPR) and then **Appendix 7** of the attached PPR includes the proof of correspondence.

9 ENVIRONMENTAL ATTRIBUTES AND BASELINE ENVIRONMENT

This section of the Scoping Report provides a description of the environment that may be affected by the proposed project. Aspects of the biophysical, social and economic environment that could be directly or indirectly affected by, or could affect, the proposed project have been described. This information has been sourced from existing information available for the area as well as baseline information received from certain specialists' assessments. Please note that detailed specialist assessments are being completed to inform the EIA-phase report. The DFFE screening tool was also used to inform this section, and a copy of the screening report is included in **Appendix D**.

9.1 TOPOGRAPHY

Information on the area's topography was obtained from the Baseline Geohydrological Assessment Report undertaken by Gradient Groundwater Consulting in October 2025 (**Appendix F7**). The topography of the greater study area has a generally flat to gently undulating topography becoming more undulating and hillier towards the east and can be classified as a lowland with hills. Large dolerite intrusions are observed throughout the study area and because of its relative resistance to erosion, the Karoo dolerite sheets generally give rise to very prominent high-standing topographic features (DWAF, 2004). The relief of the area varies between 0 – 130.0m towards the far northern and western perimeters and 30 – 450.0m to the south and east. The landscape gradually flattens out towards the lower laying drainage system towards the northwest (approximate elevation low of 1260.0mamsl), while the southern and southwestern perimeters are shaped by ridges also forming the surface water catchment water divide (approximate elevation high of 1695.0mamsl) (based on elevations extracted from the SRTM DEM raster interpolation). Elevations generally increase towards the southern and central parts of the study area, with the highest on-site elevation recorded as 1467.0mamsl also shaping the local water divide. The lowest on-site elevation is recorded as 1320.0mamsl forming part of the drainage system situated on the northern edge of the study area. On-site gradients are variable, especially towards the south zone of the study area, however the gradient is gentle to moderate. The average slope is calculated at ~-2.50% to +3.50% with an elevation loss of approximately 140.0m over a lateral distance of 7.0km in a general northeastern orientation. **Figure 22** shows the regional topographical contours and setting.

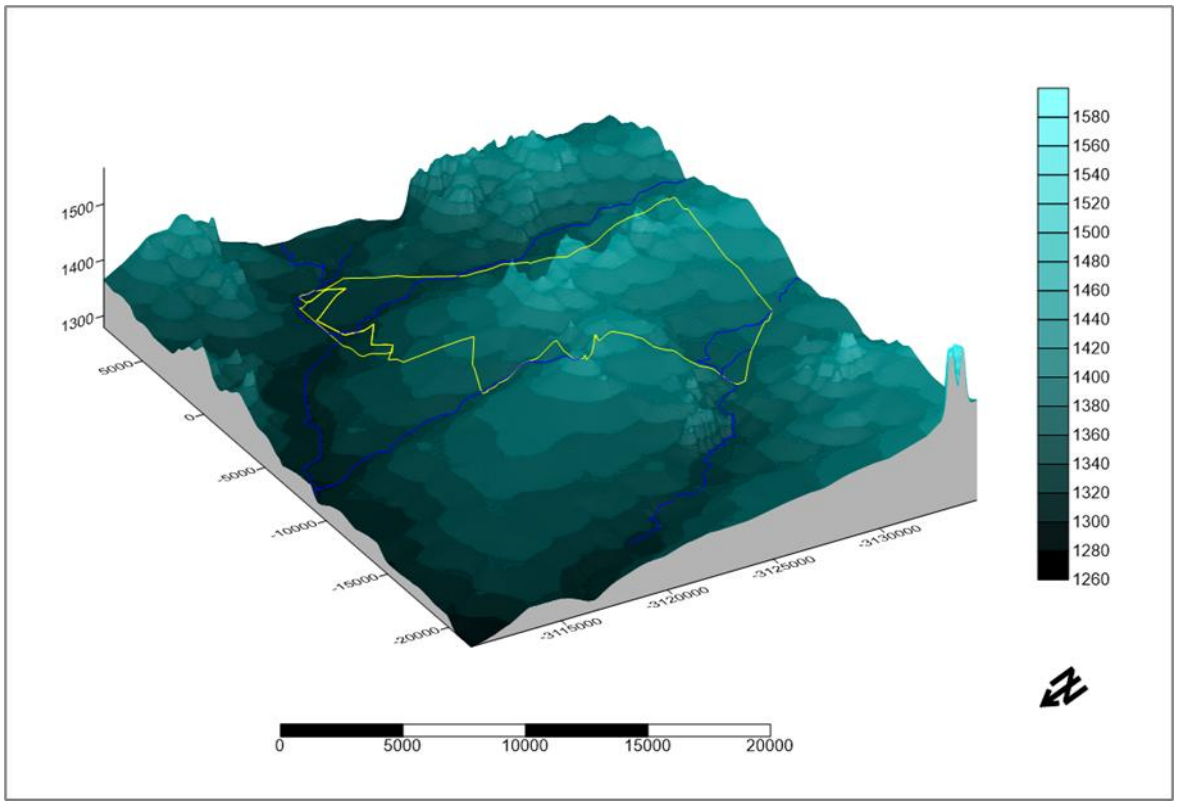


Figure 22: General topography of the study area (Gradient Groundwater Consulting, 2025).

9.2 GEOLOGY

According to information obtained from the Baseline Geohydrological Assessment Report undertaken by Gradient Groundwater Consulting in October 2025 (**Appendix F7**), based on the Council for Geoscience (CGS) 1:250 000 geological maps (Geological Map Sheet 2826 Winburg) the surface geology of the study area is characterized by a variety of lithologies, formations, and intrusions. These include geologically recent Quaternary deposits; sediments of the Beaufort Group within the Karoo Supergroup; dolerite dykes, sheets, and sills associated with the Karoo Dolerite Suite; and post-Karoo kimberlite pipes and dykes **Figure 23** depicts the regional geology and stratigraphy.

The Quaternary deposits, which were deposited less than 0.01 million years ago (DWA, 2012), cover most of the northern and central parts of the study area, while also being present in the southern parts of the study area. These deposits include aeolian (wind-blown) dune sand in the northern and central parts of the study area; alluvium, including calcified alluvium and river gravel, in the northern, northeastern, central, and southern parts of the study area along the banks and floodplains of surface water drainage features; and patches of calcrete and surface limestone in the western and northwestern parts of the study area.

The sediments of the Beaufort Group, which are primarily of fluvial and deltaic origin (Baran, 2003), were deposited during the late Permian Period between approximately 248 and 239 million years ago and are associated with the orogeny and tectonic paroxysm of the Cape Fold Belt (Woodford and Chevallier, 2002). The Adelaide Subgroup within the Beaufort Group occurs toward the northeastern parts of the study area, while also being present in the central and southern parts of the study area. Specifically, the Normandien Formation within the Adelaide Subgroup occurs towards the northeast of the study area and comprises of greenish grey (bottom of formation) to red (top of formation) mudstone and siltstone, grey shale and rhythmite, and sandstone. The Adelaide Subgroup covering the central and southern parts of the study area is not differentiated into specific formations and comprises of mudstone with subordinate sandstone.

A vast network of dolerite dykes, sheets, and sills associated with the Karoo Dolerite Suite occurs throughout the study area and is especially prominent in the southern and central parts of the study area. The Karoo Dolerite Suite intruded into the Karoo Supergroup approximately 180 million years ago during the early stages of the break-up of Gondwanaland (Woodford and Chevallier, 2002). Furthermore, kimberlite and associated alkaline-rich intrusive rocks, including carbonatite and olivine melelitite, intruded into the Karoo Basin between approximately 130 and 70 million years ago (Woodford and Chevallier).

According to the CGS 1:250 000 geological maps (Geological Map Sheet 2826 Winburg) large dolerite intrusions in the form of dykes and sills are observed throughout the study area. The Karoo sediments in this portion of the WMA are much intruded by sub accordant sheets, and to a lesser extent by near-vertical dykes of Karoo dolerite (DWAF, 2004). The Karoo Basin is characterised by a vast network of post-Karoo intrusive dolerite (Jd) sills and dykes that rapidly intruded at 183.0 to 182.3Ma (Svensen et al., 2012). The intrusive Karoo dolerite suite represents a shallow feeder system which occurs as an interconnected network of dykes, sills as well as sheets which typically form resistant caps of hills compromising softer sedimentary strata (Chevallier and Woodford, 1999). A high resolution airborne magnetic survey identified various southwest-northeast as well as southeast-northwest striking magnetic lineaments inferred as dolerite dykes towards the western and central zones of the production right area. Regional fault zones include the known fault Virginia and Ventersburg fault lines. Structural analysis also suggests a potential east-west striking fault zone towards the central zone of the production right area. The latter may have an impact on the local hydrogeological regime as it can serve as potential mechanisms and preferred pathways for groundwater flow and contaminant transport.

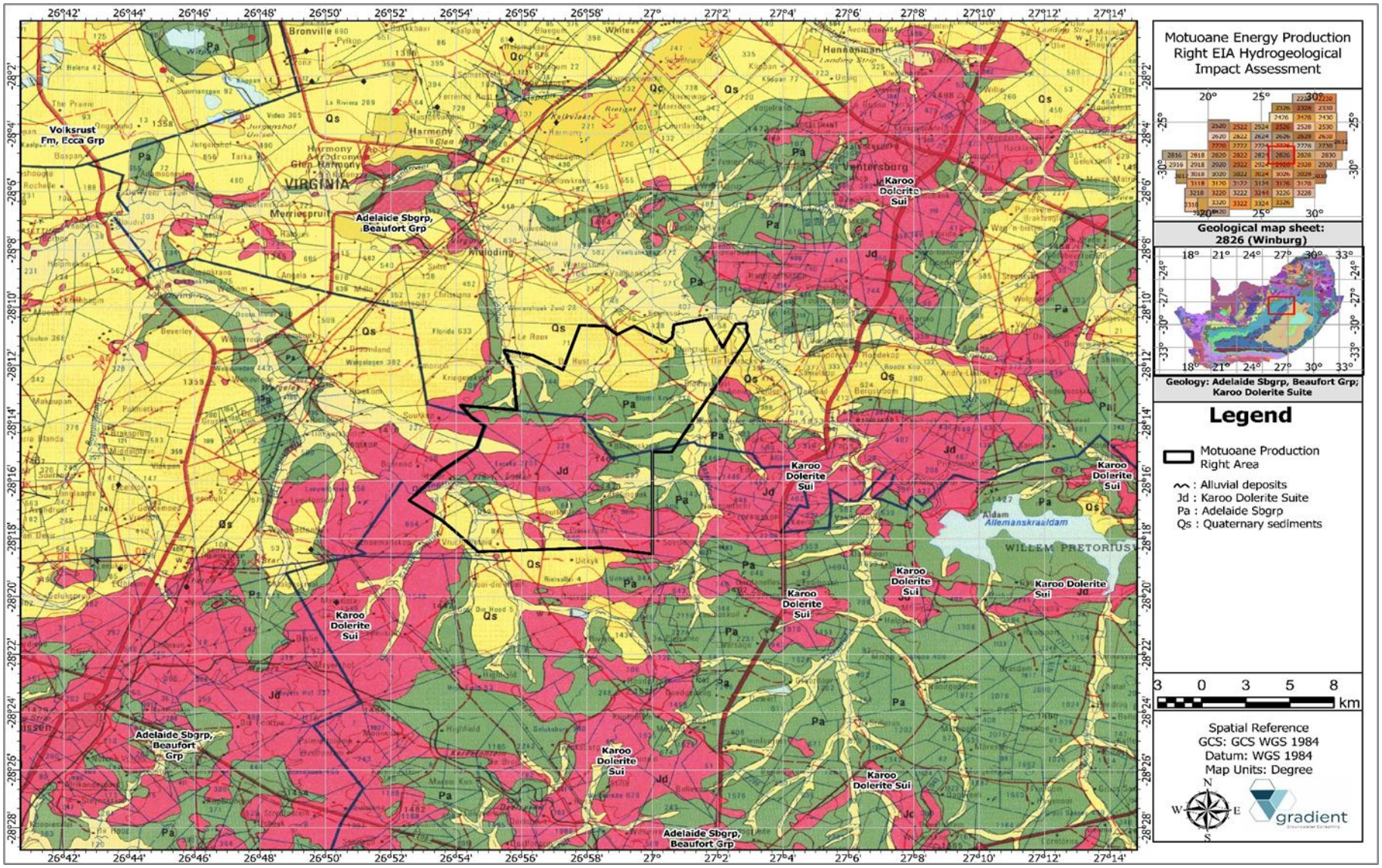


Figure 23: Regional geology and stratigraphy from Geological map sheet 2826: Winburg at 1:250 000 scale (Gradient Groundwater Consulting, 2025).

9.3 CLIMATE

According to the Koppen-Geiger climate classification system, the climate of the study area is classified as BSk (Climate Change & Infectious Diseases Group, 2023). This classification indicates that the study area has a cold, semi-arid climate characterized by cold, dry winters and warm summers. The average temperature in the greater study area ranges between 11.5 °C in the winter (July) and 24.4 °C in the summer (January), while the mean annual temperature is 18.8 °C (Climate-Data, 2021). Refer to **Figure 24** for the Mean Yearly Temperature Distribution of the greater study area. Based on the Baseline Climate Change Assessment by Airshed Planning Professionals in November 2025 (**Appendix F3**), Baseline annual average temperature was in the range 15.9°C three very hot days per year and seven heat wave days per year.

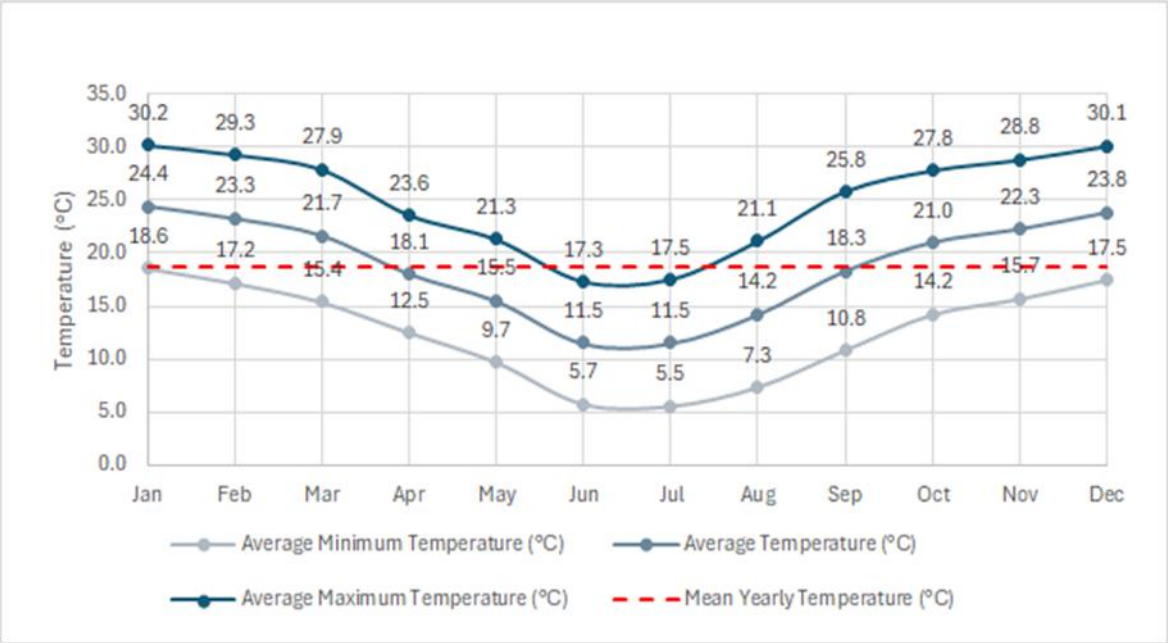


Figure 24: Mean Yearly Temperature Distribution of the greater study area, 1991 – 2024 (Climate-Data, 2021).

Recent change in climatic conditions near the project site were accessed from MeteoBlue[3] a weather forecasting platform developed at the University of Basel, Switzerland and based on models of National Oceanic and Atmospheric Administration (NOAA) or National Centres for Environmental Prediction (NCEP). The data sets also include historical climate data tracking changes in climate by referencing ERA5, the fifth generation ECMWF (European Centre for Medium-Range Weather Forecasts) atmospheric reanalysis of the global climate, for the period between 1979 to 2024, with a spatial resolution of 30 km. Based on the study area, an increasing trend in the annual average temperatures has been observed with temperatures measuring 16.7°C in 1979 to 18.1°C in 2024 (**Figure 25**– top panel). The lower part the graph shows the so-called warming stripes. Each coloured stripe represents the average temperature for a year - blue for colder and red for warmer years. The change in rainfall over the same period (1979 – 2024) displays a slight decreasing trend (**Figure 26**), where the difference from long-term average for each year in the data set is visualised by the stripes in the lower panel of (**Figure 25** (brown stripes indicate lower than average rainfall and green stripes above average rainfall).

[3] https://www.meteoblue.com

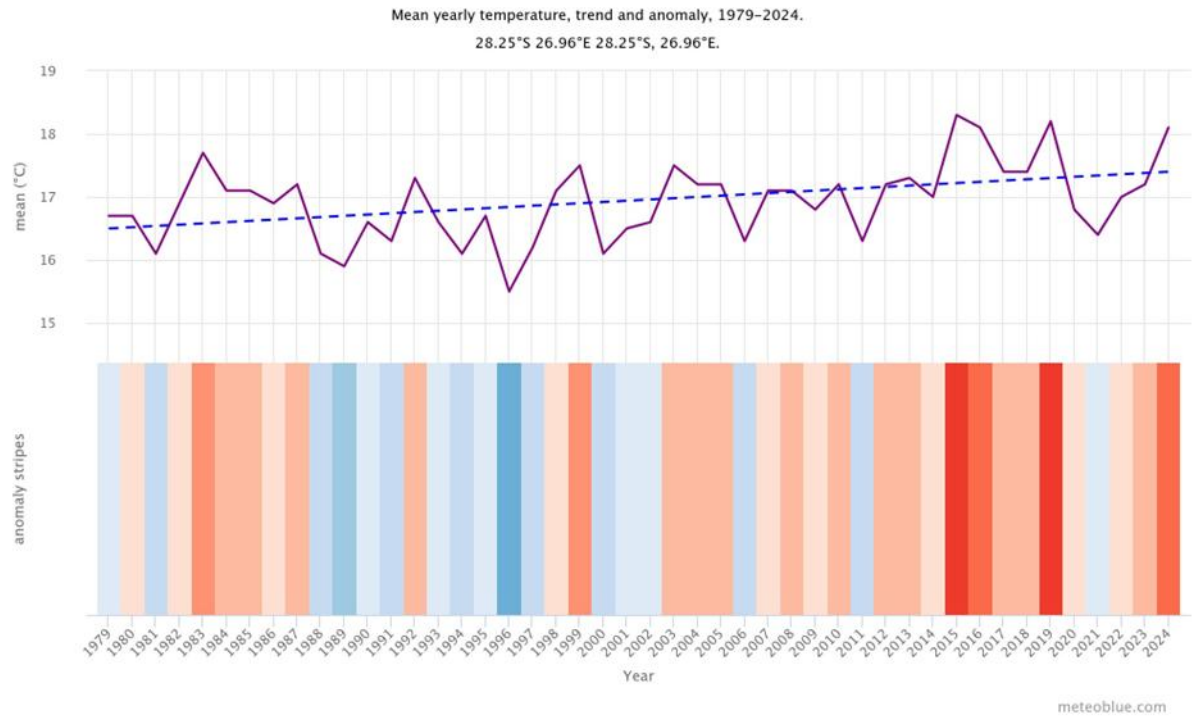


Figure 25: Annual average temperature (top panel) and temperature anomaly (lower panel) between 1979 and 2024 (Meteoblue, 2025).

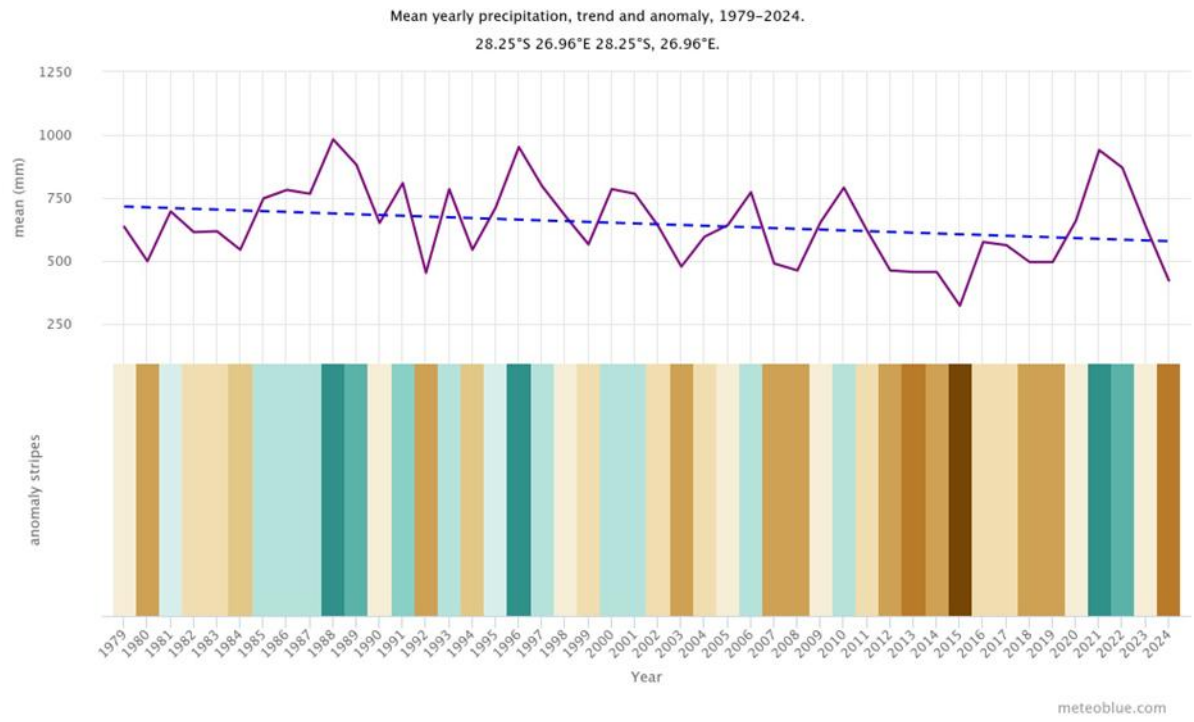


Figure 26: Annual average rainfall (top panel) and rainfall anomaly (lower panel) between 1979 and 2024 (Meteoblue, 2025).

The mean annual precipitation (MAP) for the study area is estimated at approximately 535.98 mm/a, based on patched monthly precipitation data (ranging from 1920 to 2009), obtained from the WR2012 database (WRC, 2016). The 5th percentile of the dataset, which approximately represents a 1:20 year drought, is calculated as 353.24 mm/a. The 95th percentile of the dataset, which approximately represents the 1:20 year flood, is calculated as 774.02 mm/a. The results from the analysis of the WR2012 datasets indicate that the study area

has a summer rainfall regime, with the majority of the precipitation occurring from October to March (~80.0%) as high intensity thunderstorms, while the winter months, June to August, are particularly dry. Refer to **Figure 27** for graphical representations of the monthly precipitation distributions for the study area. The study area falls within evaporation zone 19C with the mean annual evaporation (MAE), measured by Symons Pan, ranging between 1 560 and 1 600 mm/a (WRC, 2016).

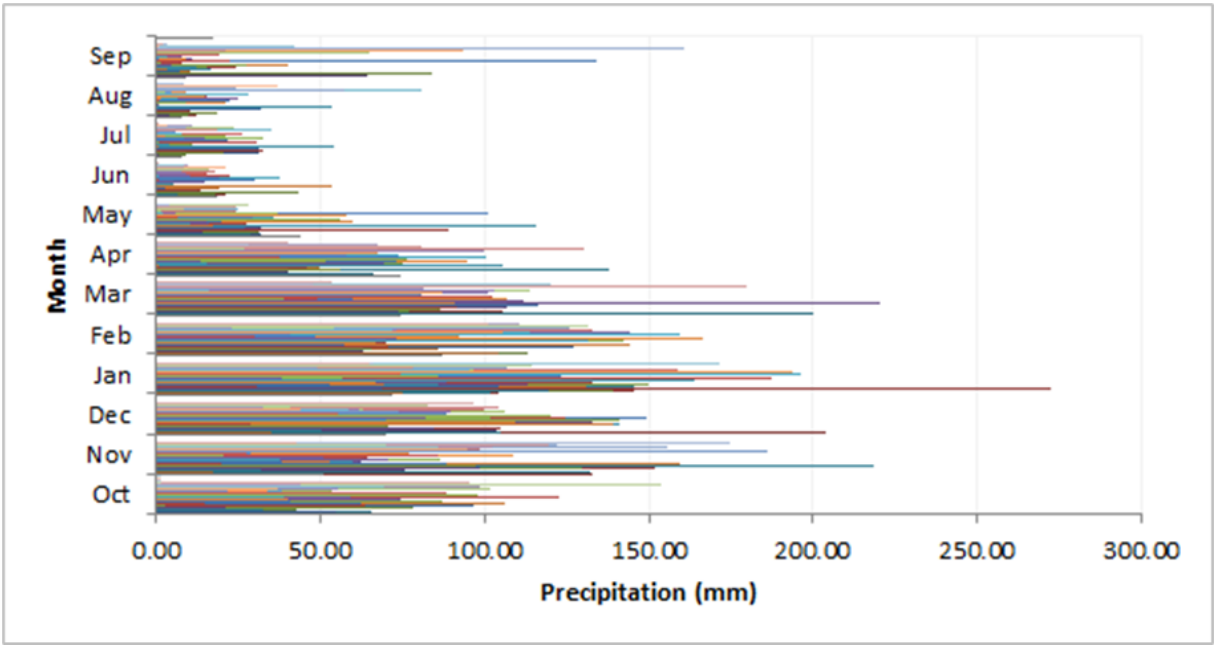


Figure 27: Monthly Precipitation Distribution (WRC, 2016).

9.4 SOCIAL

Information on the area's topography was obtained from the Baseline Social Assessment Report undertaken by Equispectives Research and Consulting Services in September 2025 (**Appendix F8**). The proposed project is located in Wards 1, 3, and 4 of the Matjhabeng Local Municipality and Ward 6 of the Masilonyana Local Municipality that both forms part of the Lejweleputswa District Municipality in the Free State Province (2016 municipal boundaries). The baseline description of the environment will include these areas. **Figure 28** shows the location of the proposed project as well as social and physical infrastructure in the area.

The Free State is a rural province, and its economic activities are dominated by mining, agriculture, and manufacturing. The province is the fifth-largest producer of gold in the world and is also home to Sasol, a large synthetic fuels company. About 90% of the Free State is used for crop production (www.municipalities.co.za). About 34% of the total maize production of South Africa, 37% of wheat, 53% of sorghum, 33% of potatoes, 18% of red meat, 30% of groundnuts and 15% of wool is produced in the Free State.

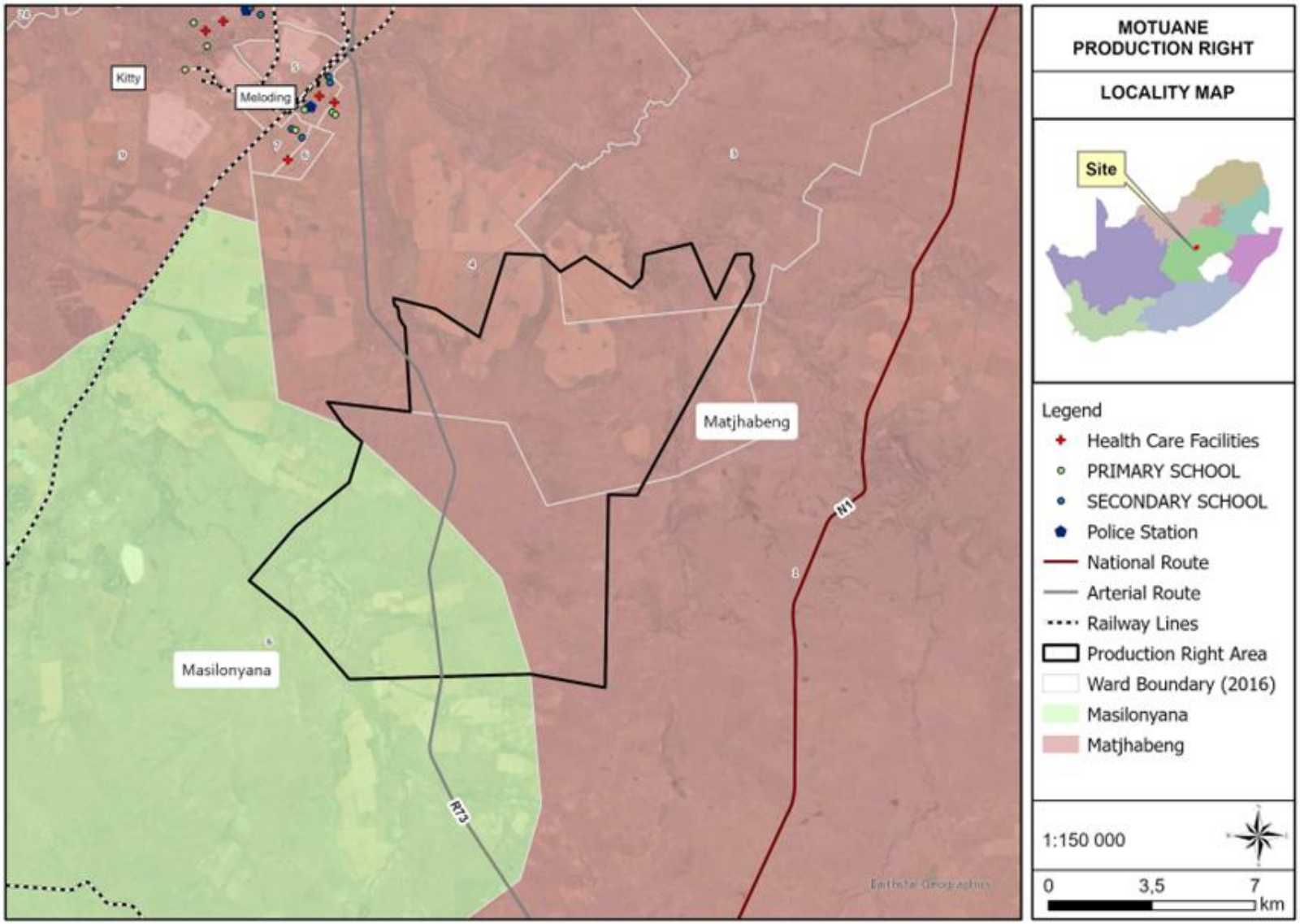


Figure 28: Location of the proposed Motuoane Production Right (Equispectives Research and Consulting Services, 2025).

9.4.1 LEJWELEPUTSWA DISTRICT MUNICIPALITY

The Lejweleputswa District Municipality (LDM) is situated in the north western part of the Free State and borders the North West Province to the north; the Fezile Dabi and Thabo Mofutsanyane District Municipalities to the north-east and east respectively; the Xhariep District Municipality and Mangaung Metropolitan Municipality to the south; and the Northern Cape Province to the west. The LDM is accessible from Johannesburg, Cape Town, Klerksdorp and Kimberley through one of South Africa's main national roads, the N1. The district covers an area of 32 286 km^2 and makes up almost a third of the Free State province. It consists of the Masilonyana, Matjhabeng, Nala, Tokologo and Tswelopele Local Municipalities (www.lejweleputswa.co.za). The economy of the district relies heavily on the gold mining sector which is dominant in the Matjhabeng and Masilonyana Local Municipalities (Lejweleputswa DM IDP 2021/22). The mining sector is on a downward trend and many businesses that have traditionally depended on the mining sector have either closed down are in the process of closing down. The other municipalities are dominated by agriculture.

9.4.1.1 MATJHABENG LOCAL MUNICIPALITY

The main towns in the Matjhabeng Local Municipality are Welkom, Odendaalsrus, Virginia, Hennenman, Allanridge and Ventersburg (www.matjhabeng.fs.gov.za). The economy of the municipality is centred on mining activities in and around Welkom, Allanridge, Odendaalsrus and Virginia. Manufacturing aimed at the mining sector exists to a limited extent in the above towns, with other activities being limited. Other main economic sectors include manufacturing, tourism, agriculture, gold jewellery, transportation (logistics), and retail (Matjhabeng LM IDP 2022/2023).

9.4.1.2 MASILONYANA LOCAL MUNICIPALITY

The main towns in the Masilonyana Local Municipality are Theunissen, Brandfort, Winburg, Verkeerdevlei, and Soutpan. It is a semi-rural municipality whose economy is primarily driven by mining and agriculture. Mining remains the largest contributor to economic output, accounting for about 40.2% of Gross Value Added (GVA) in 2022, although it provides only around 8% of local employment due to its capital-intensive nature (Masilonyana Local Municipality IDP 2024/2025). Agriculture dominates land use and contributes significantly to rural livelihoods, but its overall economic value is modest. The largest sources of employment are trade, community services, agriculture, and private households, which together absorb the bulk of the workforce. While the municipality continues to recognise the potential of tourism linked to its central location and heritage assets, its current development focus is on infrastructure upgrades, improving financial sustainability, and fostering partnerships with the mining sector to support inclusive growth.

9.4.2 DESCRIPTION OF THE POPULATION

The baseline description of the population will take place on three levels, namely provincial, district and local. Impacts can only truly be comprehended by understanding the differences and similarities between the different levels. The baseline description will focus on the Matjhabeng Local Municipality in the Lejweleputswa District Municipality in the Free State Province (referred to in the text as the study area), as these are the areas that will be most affected by the proposed project. Where possible, the data will be reviewed on a ward level. The data used for the socio-economic description was sourced from Census 2022, Community Survey 2016, and Census 2011. Both Census 2022 and Census 2011 were de facto censuses where individuals were counted based on where they were on the census reference night. For Census 2022 the reference night was the night of 2 February 2022 and for Census 2011 it was the night of 9 October 2011. The results should be viewed as indicative of the population characteristics in the area and should not be interpreted as absolute.

StatsSA released limited data for Census 2022 on 10 October 2023 and will release more detailed data in future following a phased approach. ***The data that was released is only available up to local municipal level, and not on ward level.*** As such the data from Census 2022 will be supplemented by data from Census 2011 and Community Survey 2016. Census 2011 that contains the latest ward level data has been categorised according to the 2016 ward delineations, but not according to the current ward delineations. For this reason, the baseline data according to ward level will be analysed according to the 2016 delineations, which are different from the latest ward delineations. Perhaps the most striking feature of Census 2022 is the very high undercount of 31% of people and 30% of households. While census undercounts are the norm rather than the exception (about a

5% undercount is acceptable), the undercount of this census may set a new international record (www.wits.ac.za). At aggregate level Census 2022 is robust, but at sub-national, and especially sub-provincial levels it might be less so.

9.4.2.1 POPULATION AND HOUSEHOLD SIZES

According to the Census 2022, the population of South Africa is approximately 62 million and has shown an increase of about 19.8% since 2011. The household density for the country is estimated on approximately 3.48 people per household, indicating an average household size of 3-4 people for most households, which is down from the 2011 average household size of 3.58 people per household. Smaller household sizes are in general associated with higher levels of urbanisation. The greatest increase in population since 2011 has been on local level (**Table 20**), but still lower than the national average. Population density refers to the number of people per square kilometre and the population density on a national level has increased from 42.4 people per km^2 in 2011 to 50.8 people per km2 in 2022. In the study area the population density has increased since 2011 with the highest density in the Matjabeng LM.

Table 20: Population density and growth estimates (sources: Census 2011, Census 2022).

Area	Size in km2	Population 2011	Population 2022	Population density 2011	Population density 2022	Growth in population (%)
Free State Province	129,825	2,745,590	2,964,412	21.15	22.83	7.97
Lejweleputswa DM	31,930	624,746	679,746	19.35	21.05	8.80
Matjhabeng LM	5,155	407,020	439,034	71.53	77.16	7.87
Masilonyana LM	6,618	59,895	63,800	9.05	9.64	6.52

Poverty is a complex issue that manifests itself in economic, social, and political ways and to define poverty by a unidimensional measure such as income or expenditure would be an oversimplification of the matter. Poor people themselves describe their experience of poverty as multidimensional. The South African Multidimensional Poverty Index (SAMPI) (Statistics South Africa, 2014) assess poverty on the dimensions of health, education, standard of living and economic activity using the indicators child mortality, years of schooling, school attendance, fuel for heating, lighting, and cooking, water access, sanitation, dwelling type, asset ownership and unemployment.

The poverty headcount refers to the proportion of households that can be defined as multi-dimensionally poor by using the SAMPI's poverty cut-offs (Statistics South Africa, 2014). The poverty headcount has increased on all levels since 2011 (**Table 21**), indicating an increase in the number of multi-dimensionally poor households.

The intensity of poverty experienced refers to the average proportion of indicators in which poor households are deprived (Statistics South Africa, 2014). The intensity of poverty has increased slightly on all levels. The intensity of poverty and the poverty headcount is used to calculate the SAMPI score. A higher score indicates a very poor community that is deprived on many indicators. The SAMPI score in the Matjhabeng LM area has decreased between 2011 and 2016, suggesting an improvement in some respects relating to poverty in this area. In the Masilonyana LM the SAMPI score has increased, indicating an increase in poverty in the area. SAMPI scores based on the 2022 Census data is not yet available.

Table 21: Poverty and SAMPI scores (sources: Census 2011 and Community Survey 2016).

Area	Poverty headcount 2011 (%)	Poverty intensity 2011 (%)	SAMPI 2011	Poverty headcount 2016 (%)	Poverty intensity 2016 (%)	SAMPI 2016
Free State Province	5.5	42.2	0.023	5.5	41.7	0.023
Lejweleputswa DM	5.6	42.8	0.024	4.8	42.2	0.020
Matjhabeng LM	5.5	43.0	0.024	4.3	41.8	0.018
Masilonyana LM	5.3	41.8	0.022	6.5	41.8	0.027

9.4.2.2 POPULATION COMPOSITION, AGE, GENDER AND HOME LANGUAGE

In all the areas under investigation, the majority of the population belongs to the Black population group except in Ward 11 where almost half of the population belongs to the Coloured population group. The age distribution of the areas under investigation shows that the population on local, district or provincial level tend to be slightly older, with older populations in Wards 3, of Matjhabeng LM and Ward 6 of Masilonyana LM (**Figure 29**).

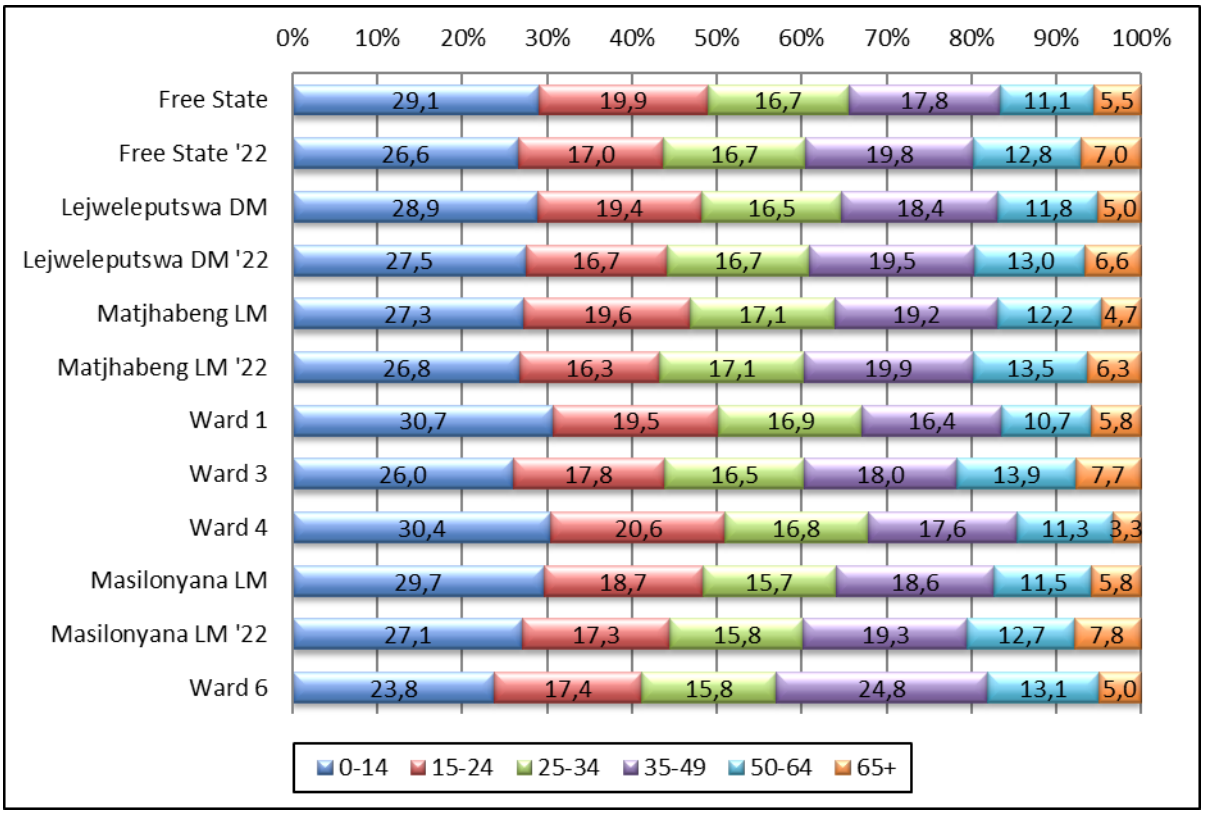


Figure 29: Age distribution (shown in percentage, source: Census 2011), Census 2022.

9.4.2.3 LANGUAGE

The majority of people in the area under investigation have Sesotho as home language. Ward 3 has a relatively high incidence of people with Afrikaans as home language. Home language should be taken into consideration when communicating with the local communities and based on the profile of the area communication should

take place in Sesotho, Afrikaans, and English. It must be noted that the public participation process for the project is undertaken in the three main languages spoken in the area namely, Sesotho, Afrikaans, and English (refer to **Appendix C**).

9.4.2.4 ACCESS TO WATER AND SANITATION

Ward 3 of the Matjhabeng LM has the lowest incidence of households that access to water from a local or a regional water scheme, but the highest incidence of households that get their water from a borehole (**Figure 30**). Census 2011 does not specify what the 'other' water sources include. Almost 16% of households in Ward 3 get their water from a borehole. It is therefore important that all drilling sites each borehole shall be steel cased and have cement barriers to prevent leaks as well as plugged at the end of exploration to prevent groundwater seepage as per the proposed drilling procedure.

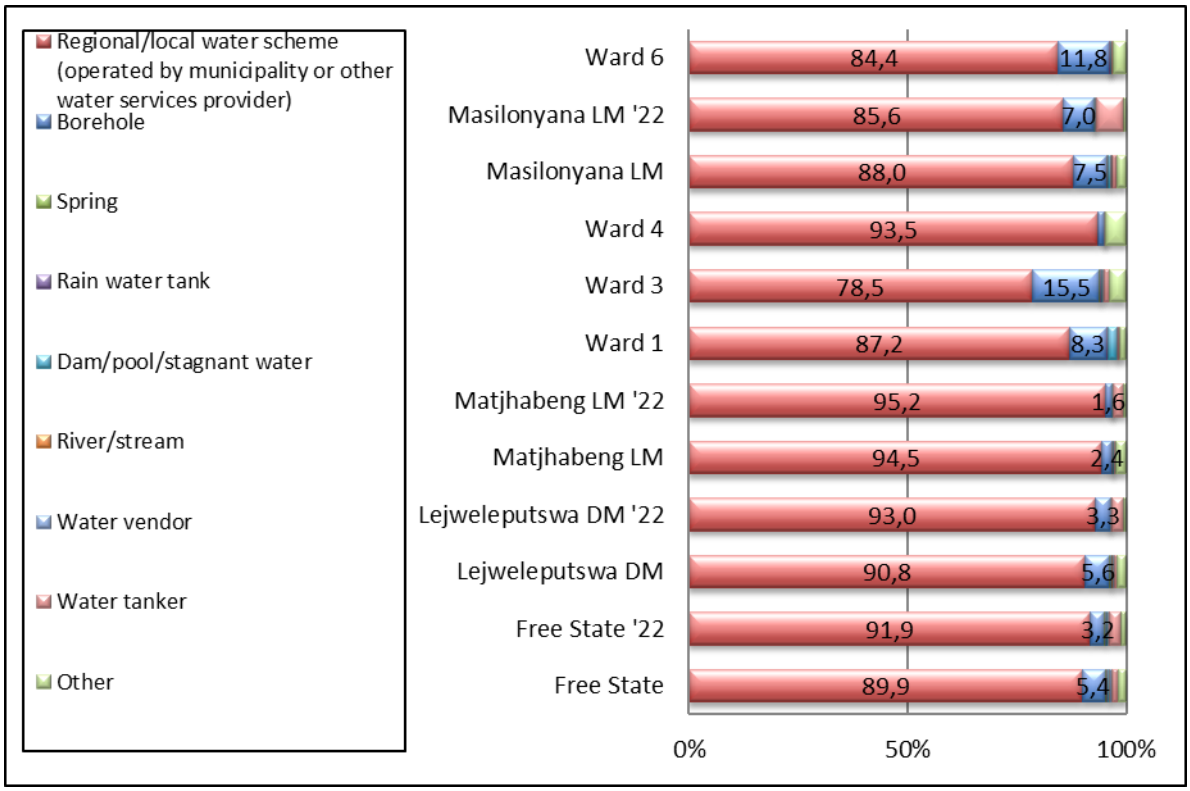


Figure 30: Water source (shown in percentage, source: Census 2011, Census 2022).

Access to piped water, electricity and sanitation relate to the domain of Living Environment Deprivation as identified by Noble et al (2006). Almost half of households in Ward 4 has access to piped water inside the dwelling (**Figure 31**). The proportion of households in the other wards with access to water inside their dwellings are lower than on local and district level.

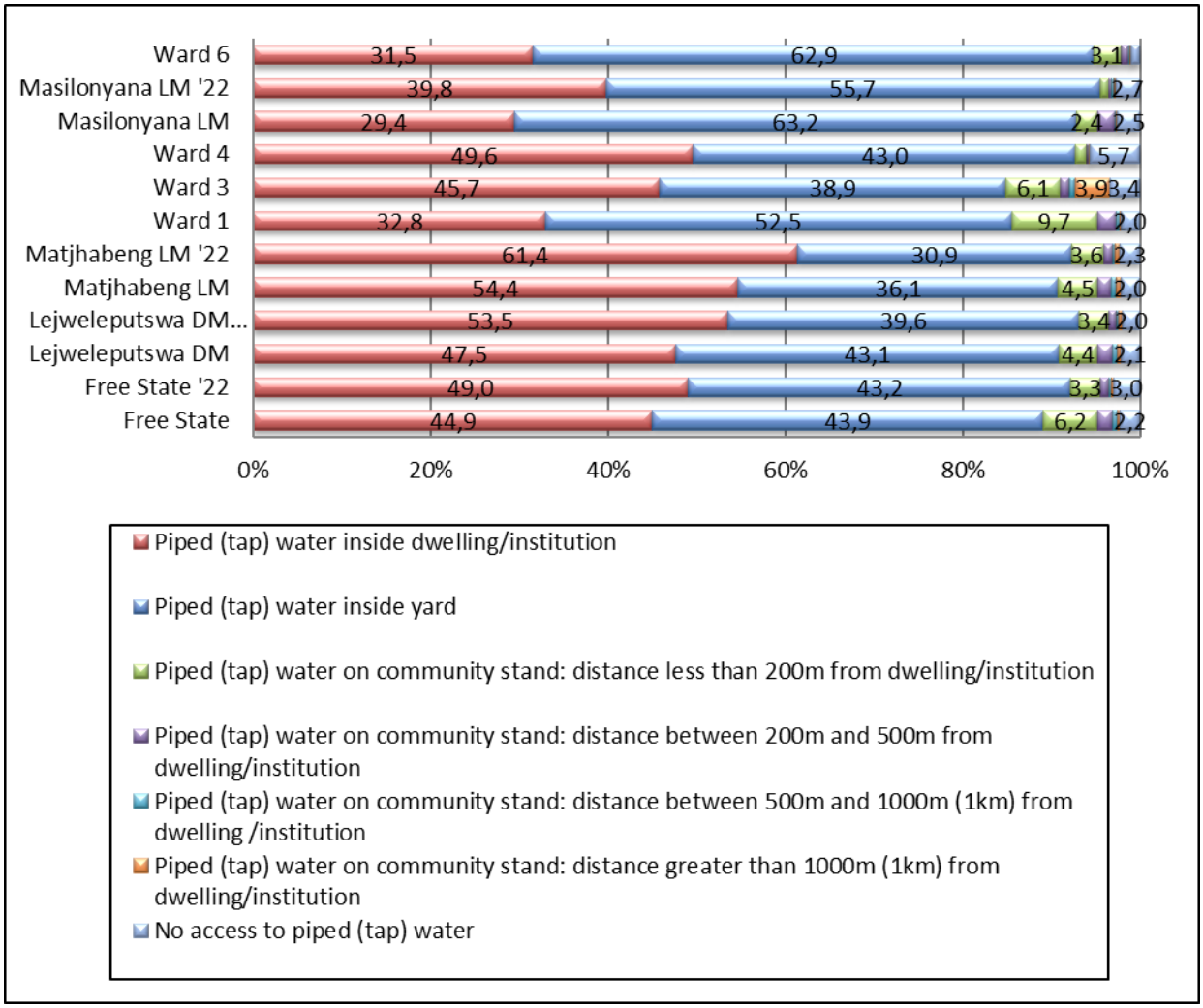


Figure 31: Piped water (shown in percentage, source: Census 2011, Census 2022).

The level of access to flush toilets that are connected to a sewerage system varies between the wards. Ward 1 had the highest incidence of households that don't have access to sanitation (**Figure 32**). The level of access to flush toilets that are connected to a sewerage system varies between the wards.

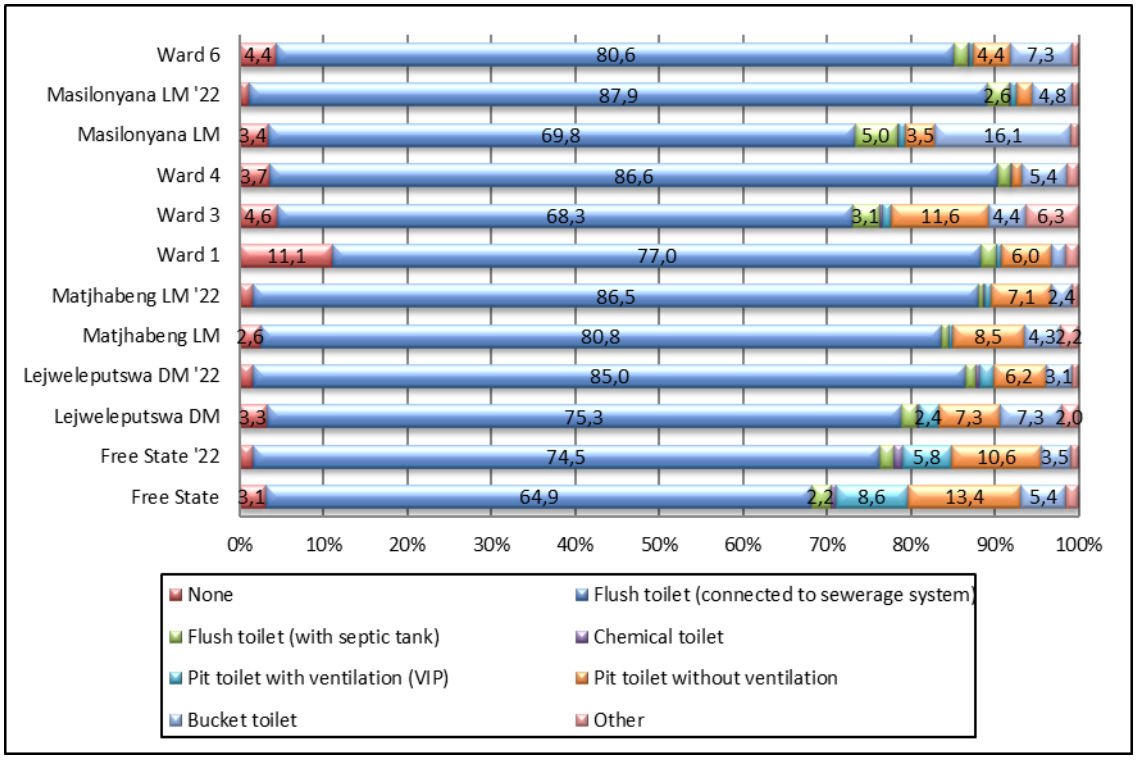


Figure 32: Sanitation (shown in percentage, source: Census 2011).

9.4.2.5 ENERGY

Electricity is seen as the preferred lighting source (Noble *et al.,* 2006) and the lack thereof should thus be considered a deprivation. Even though electricity as an energy source may be available, the choice of energy for cooking may be dependent on other factors such as cost. Wards 1 and 3 of Matjhabeng LM have the lowest proportion of households with access to electricity as energy source for lighting (**Figure 33**). It is evident from the energy source usage that gas is underutilized in the area although there is direct evidence of gas-emitting boreholes, nearby commercial gas production, gas encountered during drilling and underground mining operations in the region.

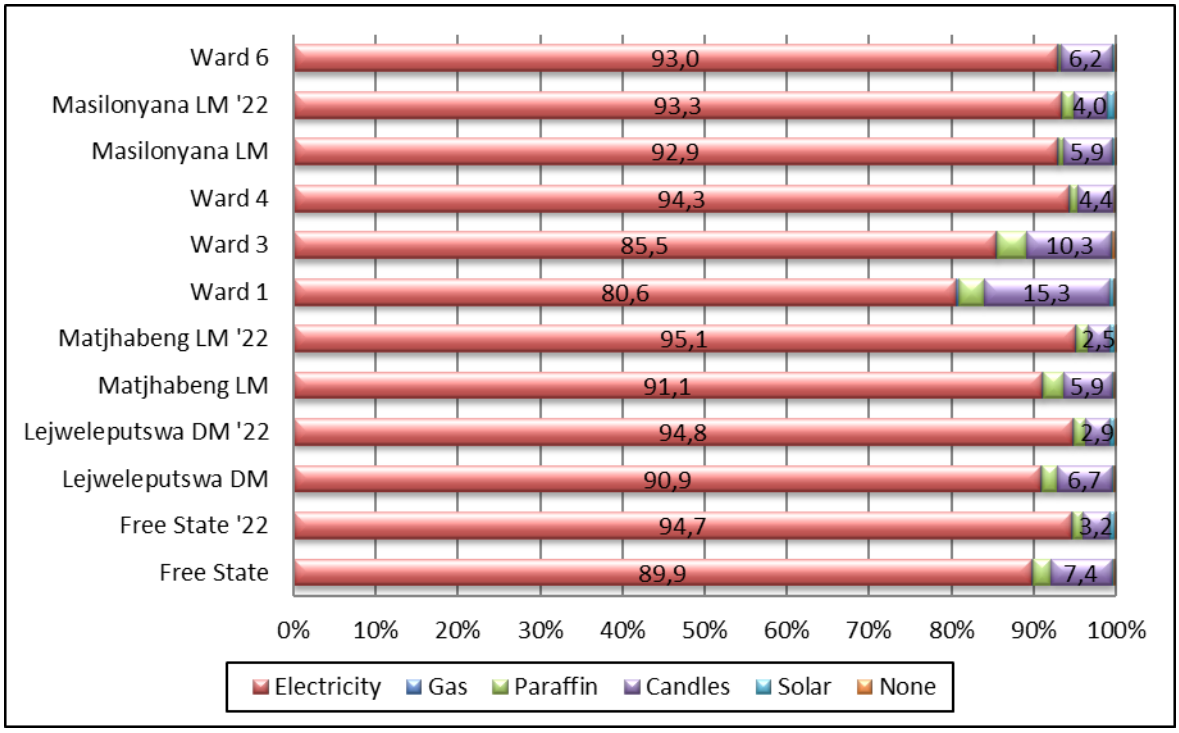


Figure 33: Energy source for lighting (shown in percentage, source: Census 2011, Census 2022).

9.5 CULTURAL HERITAGE RESOURCES

The objective of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) is to introduce an integrated system for the management of national heritage resources. The Act defines a 'heritage resource' as any place or object of cultural significance (aesthetic, architectural, historical, scientific, social, spiritual, linguistic, or technological value or significance). The identification, evaluation and assessment of any cultural heritage site, artefact or find in South Africa is required by this Act. This section of the report presents the heritage status of the proposed Motuoane Production Right area in Virginia Free State Province.

According to the Baseline Heritage Impact Assessment Report undertaken by Dr Lucien James (EIMS, 2025), the Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter-gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902).

9.5.1 RELATIVE ARCHAEOLOGICAL AND CULTURAL HERITAGE THEME SENSITIVITY

According to the DFFE Screening Tool Report, the proposed study area is located within an area of *low* relative archaeological and cultural heritage theme sensitivity (see **Figure 34**). An assessment of the NHRA and preliminary project information revealed that the proposed project triggers Section 38(1) of the NHRA. Therefore, a Heritage Impact Assessment is required and will be undertaken in the EIA Phase. The South African Heritage Resources Agency (SAHRA), the Free State Heritage Resources Authority (FSPHRA) and Association of Southern African Professional Archaeologists (ASAPA) are I&APs in the project and will be provided with a copy of the report for review and comment.

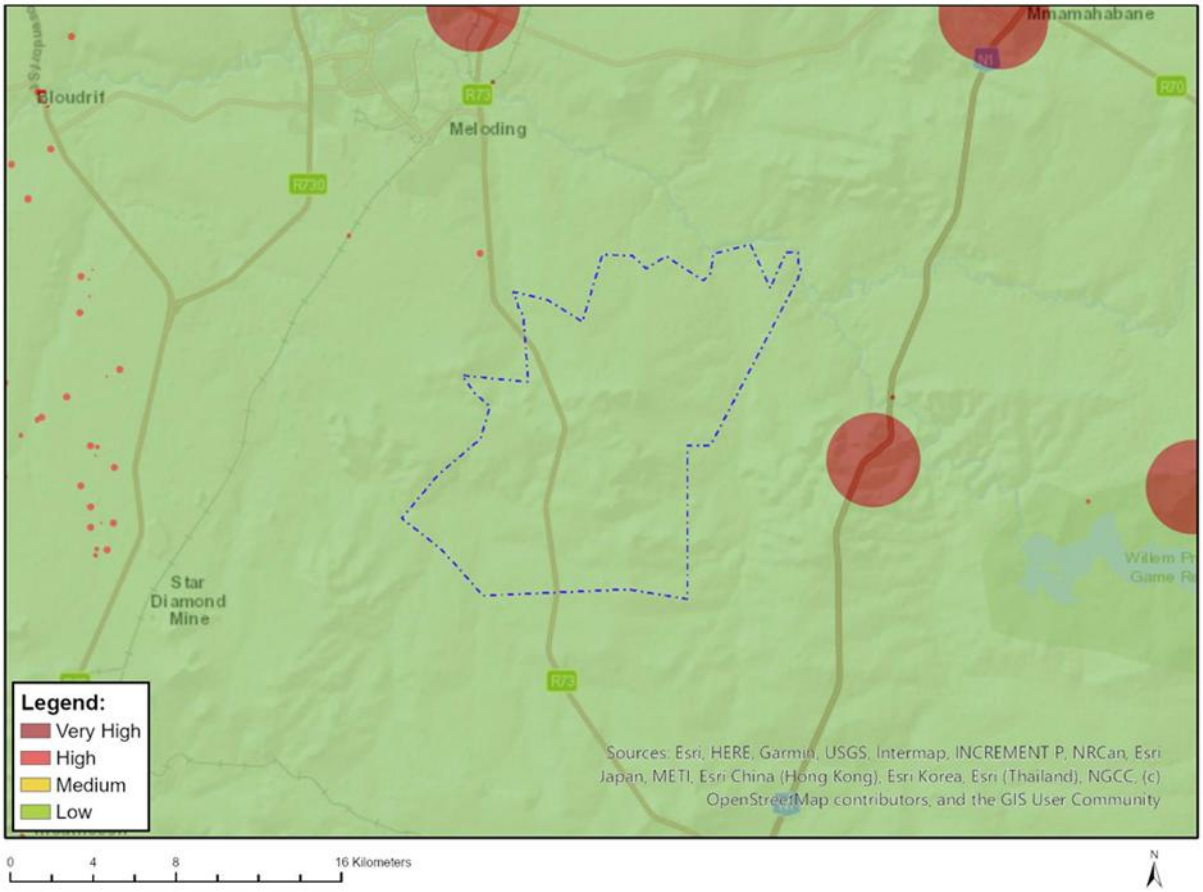


Figure 34: Map of relative archaeological and cultural heritage theme sensitivity (DFFE, 2025).

Based on the Baseline Heritage Impact Assessment Report undertaken by Dr Lucien James (**Appendix F5)**, the proposed PR area was assessed using Google Earth as well as available surveys and mapping resources via the CDNGI Geospatial Portal (http://www.cdngiportal.co.za/cdngiportal/). First Edition Topographic maps (2826BB, 2827AA, 2826BD and 2827AC) of the area were analysed. As the maps were drawn between 1945 and 1975, it would include information on observations within the footprint of the development. An assessment of the maps revealed that the area in question has included several features such as settlements. The earliest map (2826BB dated 1945) indicates the presence of such settlements or "native huts" along a proposed seismic transect (**Figure 35**). The features can be seen in aerial photographs from as early as 1944 (**Figure 36**). The features seem to have been disturbed and destroyed since, as they do not appear in current satellite imagery.

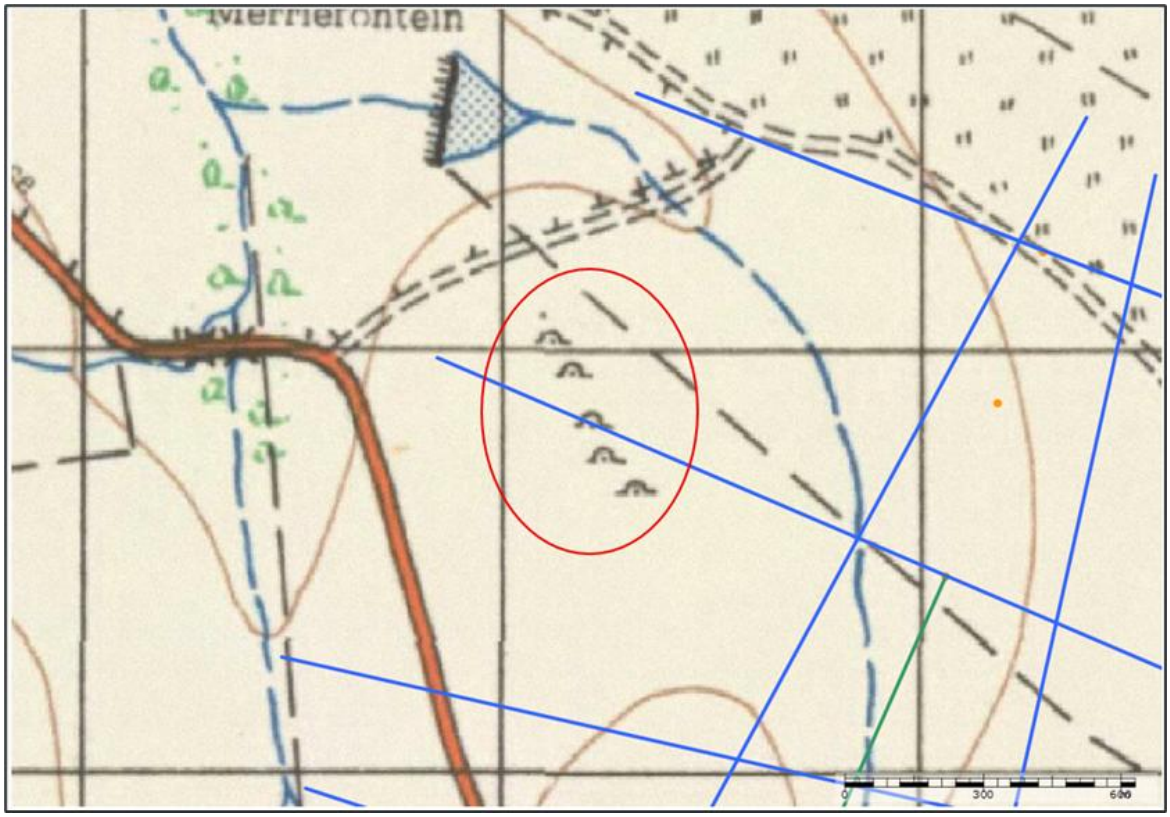


Figure 35: Extract of the First Edition Topographic map 2826BB dated 1945 indicating the presence of settlements (circled in red). Blue lines = seismic transects, green lines = gas line, orange dots = wells. (EIMS, 2025).

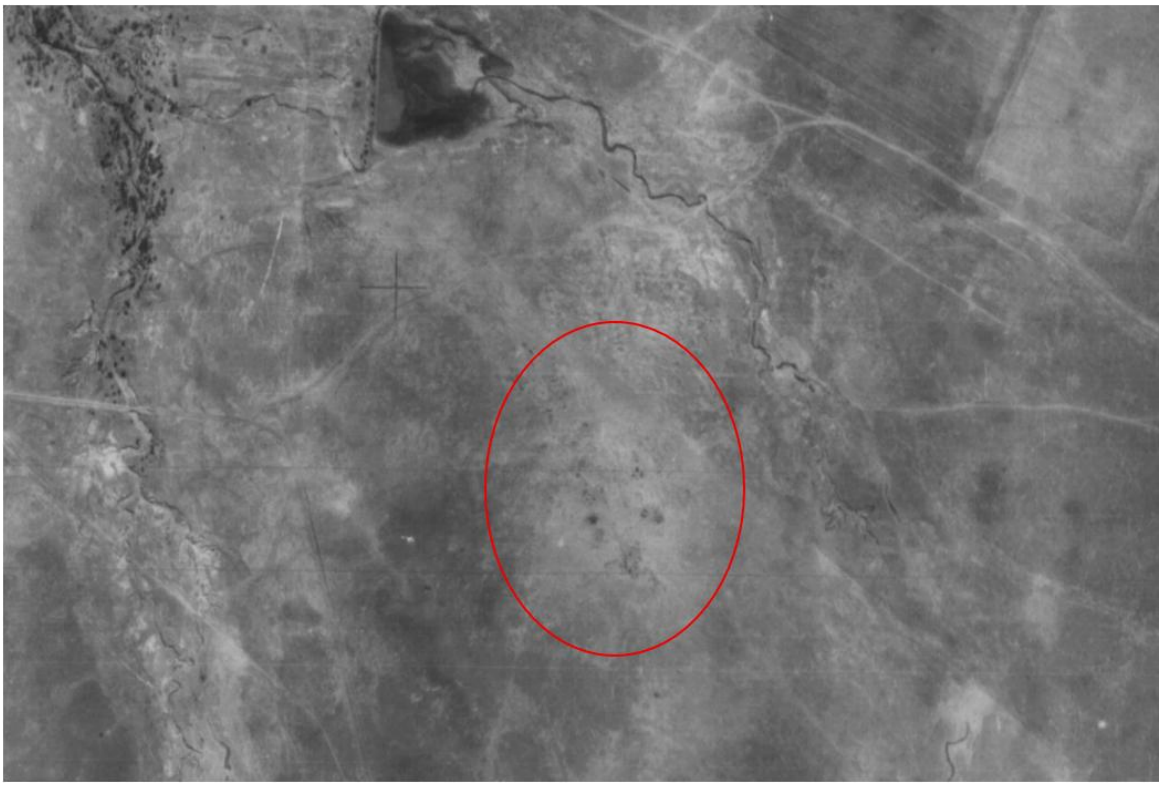


Figure 36: Aerial photograph of 1944. Note the presence of features (circled in red) corresponding with observations made in the First Edition Topographic maps.

To corroborate the above observation, the impact of agriculture and similar activities on heritage features is noted in examples illustrated below. For example, settlements were noted near the historical farm complex Azeka (**Figure 37**). The complex has since been demolished and the settlement destroyed making way for cultivated land as depicted in **Figure 38**.

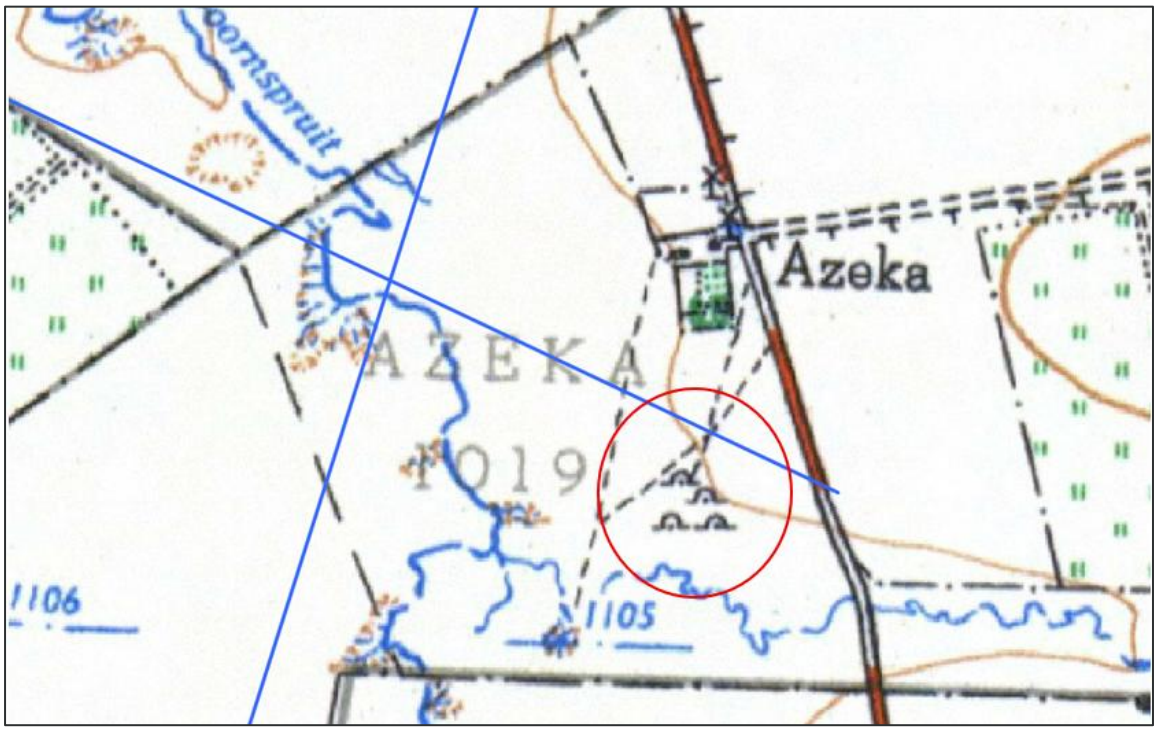


Figure 37: Extract of the First Edition Topographic map 2826BD dated 1947 indicating the presence of settlements (circled in red). Blue lines = seismic transects.

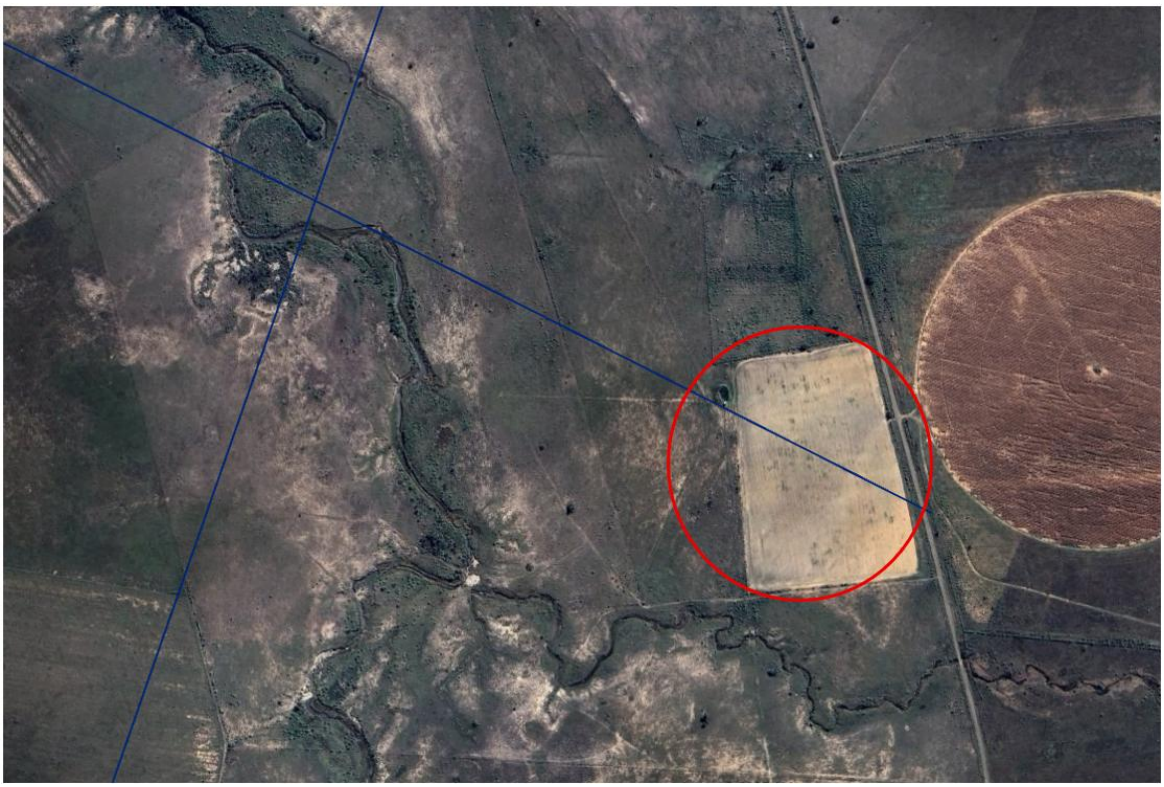


Figure 38: Google Earth imagery of a disturbed area which once held settlements (general location circled in red) as heritage features along the proposed seismic transects (illustrated in blue).

Another important feature noted through the desktop assessment was the farm complex Siberiasfontein, which appeared on first edition topographic maps, and is still present and in use (**Figure 39**). The complex includes, not only historical buildings, but also a graveyard which fall along a seismic transect.

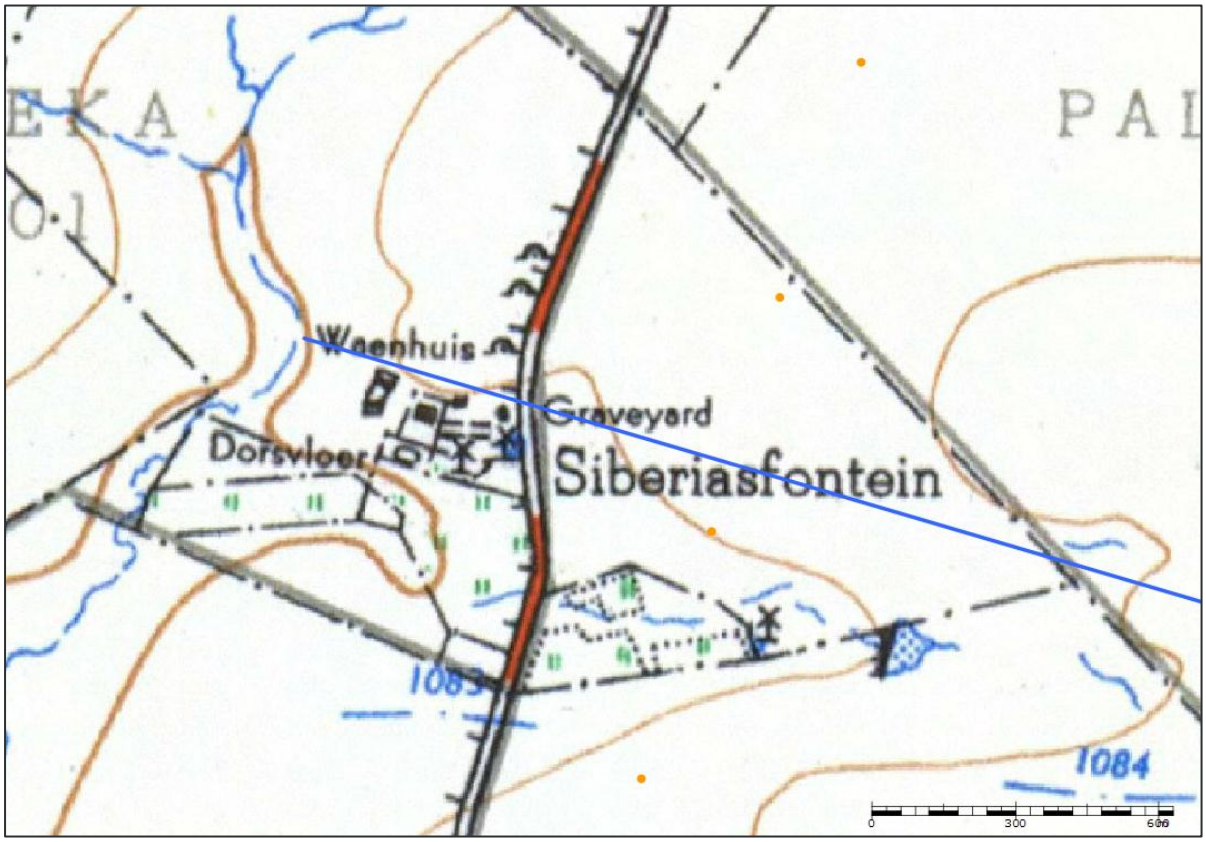


Figure 39: Extract of the First Edition Topographic map 2826BD dated 1947. Map includes the farm complex, Siberiasfontein. Note the grave and historical structures which fall along the proposed seismic transect (blue line).

9.5.2 SUMMARY OF BASELINE HERITAGE FINDINGS

Altogether, 12 potential heritage features were identified in proximity and intersecting the project footprint including, burials and cemeteries, historical period remains, historical farmsteads and structures, and a potential iron age/colonial settlement. **Table 22** provides a summary of the different features identified, a description of the feature, as well as the coordinates of where the feature are located or associated relative central points.

Table 22: Summary of different finds identified (EIMS, 2025).

Feature No.	Description	Rating and Significance	Coordinate
MPR001	Historical Farmstead or farm complex known as Bloemskraal identified by Kruger (2021).	Grade IIIC Medium	28°14'46.46"S 26°58'35.47"E
MPR002	Historical Period remains including an ash midden and material culture of metal and plastic. Identified by Kruger (2021).	Grade IIIC Medium	28°12'30.85"S 27° 0'17.46"E
MPR003	Historical Period burial site including at least two graves. Identified by Kruger (2021).	Grade IIIA High	28°14'40.01"S 26°58'28.38"E
MPR004	Burial site holding a large number of graves. Some graves include headstones dating as far back as 1976. Site was identified by Kruger (2023).	Grade IIIA High	28°13'55.72"S 26°59'2.22"E
MPR005	Potential Historical Period Settlement. Identified by Kruger (2022).	Grade IIIC Medium	28°13'27.13"S 26°56'41.00"E
MPR006	Burial site holding at least 4 graves. Identified most recently by Angel (2024).	Grade IIIA High	28°15'44.99"S 26°56'23.73"E
MPR007	Kraal Structure which may not be older than 60 years. Identified by Angel (2024).	NCW	28°15'49.82"S 26°56'42.76"E
MPR008	Historical structures part of old farmstead or complex.	Grade IIIC Medium	28°15'42.27"S 26°56'16.51"E
MPR009	Historical Farmstead and associated structures.	Grade IIIC Medium	28°17'0.54"S 26°59'17.14"E
MPR010	Historical Farmstead and associated structures.	Grade IIIC Medium	28°11'25.25"S 27° 0'33.82"E
MPR011	Potential historical settlement identified through archival study.	To be verified through site visit	28°12'22.01"S 26°56'11.30"E
MPR012	Grave site including 15-18 graves. Identified by Angel (2024).	Grade IIIA High	28°12'31.02"S 26°56'20.19"E
MPR013	Foundation of stone-built structure identified by Angel (2024).	Grade IIIA High	28°12'26.10"S 26°56'15.43"E
MPR014	Burial or grave site including 1-2 graves. No headstones included. Identified by Angel (2024).	Grade IIIA High	28°12'25.70"S 26°56'14.50"E

Feature No.	Description	Rating and Significance	Coordinate
MPR015	Midden including ash, glass and metal cultural material remains. Identified by Angel (2024).	Grade IIIA High	28°12'24.80"S 26°56'16.58"E
MPR016	Possible grinding stone identified by Angel (2024).	Grade IIIC Medium	28°12'20.66"S 26°56'15.04"E
MPR017	Foundation of stone-built structure identified by Angel (2024).	Grade IIIA High	28°12'27.65"S 26°56'39.95"E
MPR018	Foundation of stone-built structure identified by Angel (2024).	Grade IIIA High	28°15'45.68"S 26°56'41.75"E

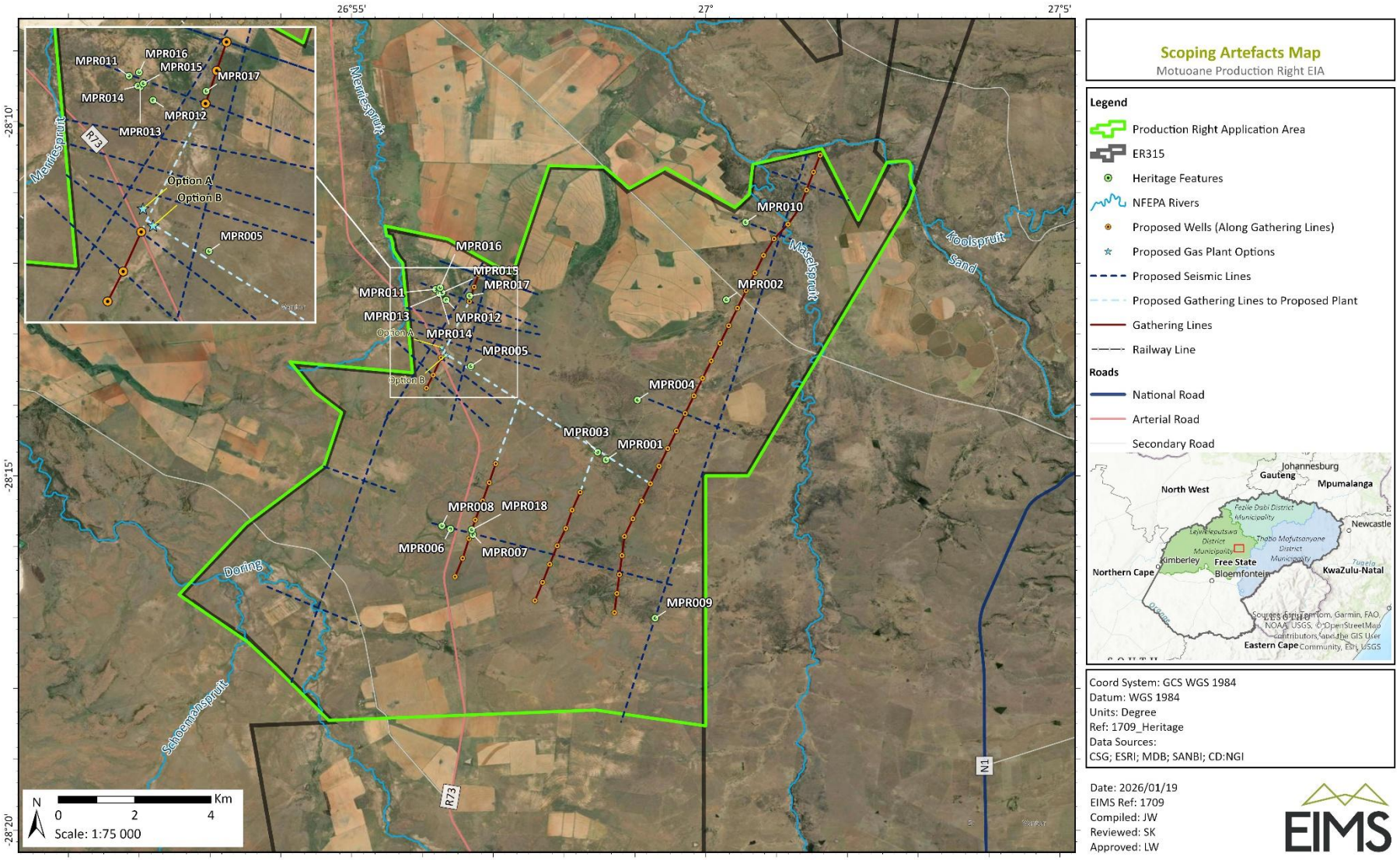
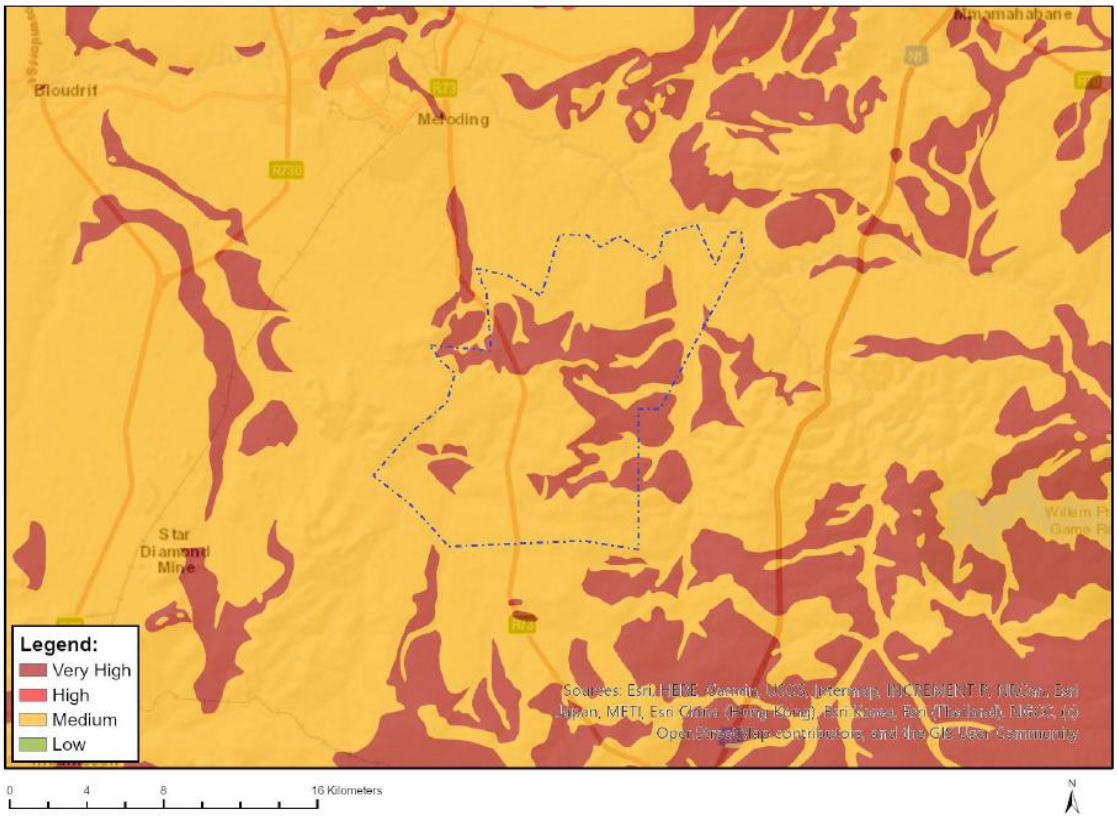


Figure 40: Map of potential heritage features across the PR Area (EIMS, 2025).

9.6 PALAEONTOLOGY

Cultural Heritage in South Africa, including all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include "all objects recovered from the soil or waters of South Africa, including archaeological and **palaeontological objects** and material, meteorites and rare geological specimens". Palaeontological heritage is exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and may not be unearthed, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

Based on the 1:250 000 SAHRIS PalaeoMap and the National Web-Based Screening Tool Report, the study area is located within a *Very High* Palaeo-Sensitivity area (see **Figure 41**). The study area is located on an area which has largely been transformed by mining and agriculture, but the proposed project entails deep excavations (650m production wells). A Palaeontological Impact Assessment (PIA) will be undertaken for the project to confirm the preliminary findings and/or identify fossil resources and the potential impact by the proposed project as well as mitigation measures. The findings and mitigation measures of the PIA will be discussed in the EIA phase.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
Medium	Features with a Medium paleontological sensitivity
Very High	Features with a Very High paleontological sensitivity

Figure 41: Map of relative palaeontology theme sensitivity (DFFE, 2025).

According to the Baseline Palaeontological Impact Assessment Report for the ER (Banzai, 2025), the study area is underlain by Quaternary sands (Qs) and alluvium, (yellow single bird figure), unfossiliferous Jurassic dolerite (Jd, red), and the Adelaide Subgroup (Pa, Beaufort Group, Karoo Supergroup). The PalaeoMap of the South African Heritage Resources Information System (SAHRIS) indicates that the Palaeontological Sensitivity of the Adelaide Subgroup is Very High, that of the Quaternary sediments is Moderate, and that of the that of the Jurassic Dolerite is Zero (Almond and Pether, 2009; Almond et al., 2013, Groenewald et al 2014).

According to the Council for Geoscience (CGS) 1:250 000 geological maps (Geological Map Sheet 2826 Winburg), the surface geology of the study area is characterized by a variety of lithologies, formations, and intrusions. The Beaufort Group, the third major subdivision of the Karoo Supergroup, overlays the Ecca Group and consists mostly of mudrocks alternating with sandstones, deposited in the Karoo Basin from the Middle Permian to the Early Triassic (Viglietti et al., 2016; Li et al., 2017). This constitutes the first entirely continental period within the Karoo Supergroup, with an extensive outcrop area of 140,000 km² in South Africa (Linol et al., 2021). The group is separated into two subgroups: the Tarkastad Subgroup and the Adelaide Subgroup.

The Adelaide Subgroup reaches a maximum thickness of 3,500 m in the southern region of the basin but significantly diminishes to under 200 m towards the north (Linol et al., 2021). Deposition occurred under humid circumstances conducive to expansive floodplains with elevated water tables, often considered to be fluvio-lacustrine environments (Viglietti et al., 2018). The lithologies consist of alternating greyish-red, bluish-grey, and greenish-grey mudrocks interspersed with fine- to medium-grained sandstones. Sandstones often display multi-storey formations, characterised by cut-and-fill structures, internal ripple lamination, horizontal lamination, and sporadic trough cross-bedding, whereas mudrocks erode into blocky profiles and may retain desiccation fractures or raindrop imprints (Li et al., 2017).

The Beaufort Group floodplains are globally recognised for their preservation of the early diversification of terrestrial vertebrates, offering one of the most comprehensive fossil records of the evolutionary shift from reptiles to mammals (Rubidge, 1995; Smith et al., 2020). Vertebrate assemblages serve as the basis for biostratigraphic subdivision (Kitching, 1977; Keyser & Smith, 1977; Viglietti et al., 2016).

However, it is anticipated that no visible evidence of fossiliferous outcrops will be found in within the project areas and seismic transects during the EIA Phase based on previous studies in the area and thus an overall medium palaeontological significance is likely to be allocated for the project area. It is therefore, currently considered that the proposed project will not lead to detrimental impacts on the palaeontological reserves of the area and construction of the project may be authorised in its whole extent. The ECO for this project must be informed that the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) has a Very High Palaeontological Sensitivity. If Palaeontological Heritage is uncovered during surface clearing and excavations the Chance find Protocol attached should be implemented immediately. Fossil discoveries ought to be protected and the ECO/site manager must report to South African Heritage Resources Agency (SAHRA) so that mitigation (recording and collection) can be carried out.

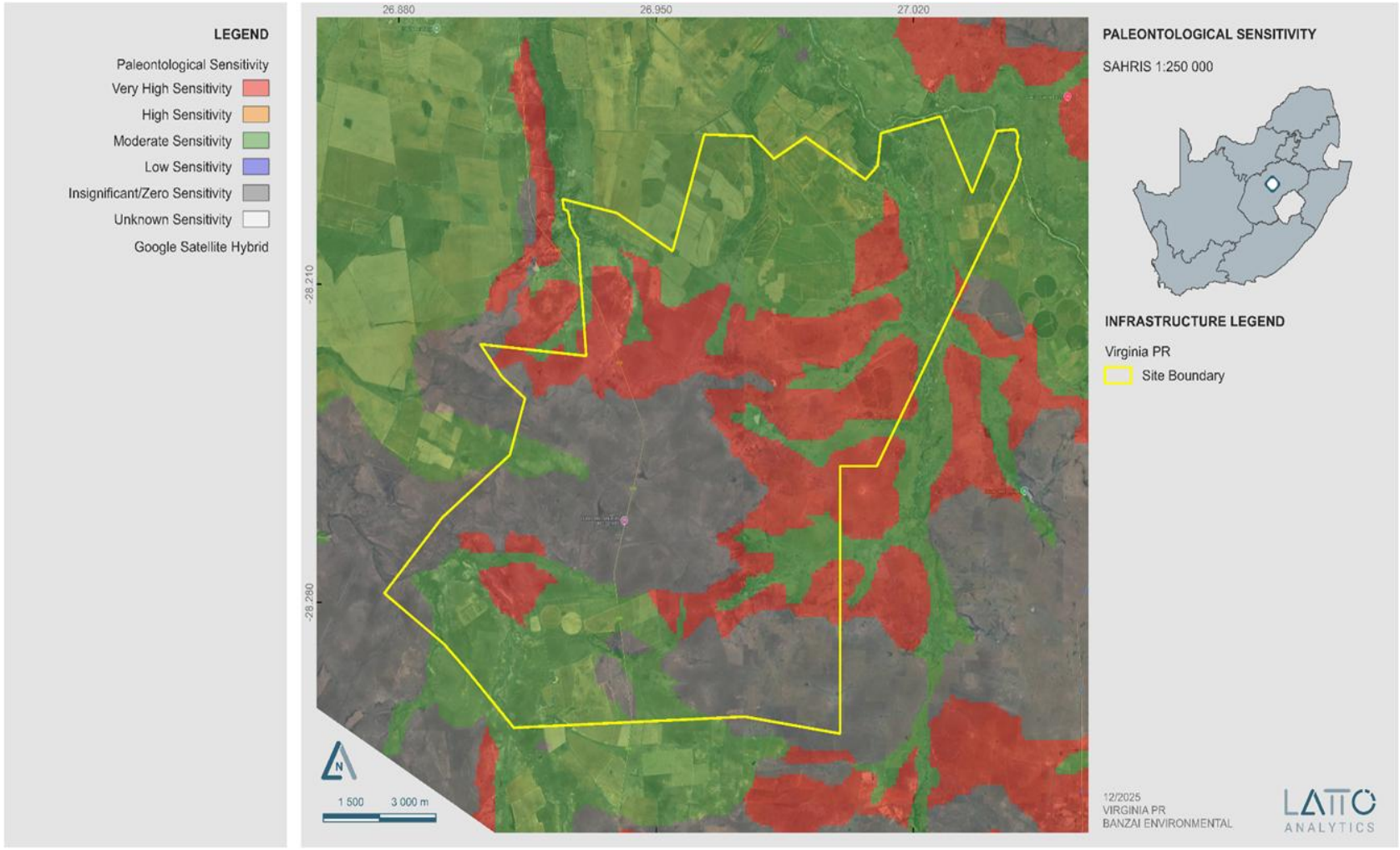


Figure 42: Extract of the SAHRIS PalaeoMap map (Banzai, 2025).

9.7 SOILS AND AGRICULTURAL POTENTIAL

As part of the Baseline Soils, Agriculture, Freshwater and Terrestrial Biodiversity Assessment (The Biodiversity Company, 2025), baseline soil information was obtained using published South African Land Type Data. Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC) (Land Type Survey Staff, 1972 - 2006). The land type data is presented at a scale of 1:250 000 and comprises of the division of land into land types. In addition, a Digital Elevation Model (DEM) as well as the slope percentage of the area was calculated by means of the NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data by means of QGIS and SAGA software.

The land capability will be determined by using the guidelines described in "The farming handbook" (Smith, 2006) which the DAFF land capabilities were further developed from. The baseline soil land capability classes will be compared to the National Land Capability data (DAFF, 2017), respectively. According to the land type database (Land Type Survey Staff, 1972 – 2006), the study area is characterised by land type Bd 20, Dc 12 and Dc 8 (**Figure 42**). **Figure 44** illustrates the respective terrain units relative to the proposed project area. The dominant Dc 12 land type is characterised by Mispah, Mayo, Swartland and Rensburg soil forms, with the possible occurrence of other soil forms throughout the landscape. The Bd 20 land type is characterised by the Clovelly, Avalon, Hutton and Valsrivier soil forms; while the Dc 8 land type is characterised by the Arcadia, Valsrivier, Rensburg, Oakleaf and Fernwood soil forms, with the possible occurrence of other soil forms throughout the landscape.

The land capability sensitivity is evenly dominated by the "Moderate to High" and the "Low to Moderate", with few isolated areas associated with the "Very Low to Low" sensitivity. If the crop fields found within the study area are active, the production activities will have an overall high residual impact on the agricultural production ability of the land. However, if the crop fields within the study area are inactive, the production activities will have an overall low to medium residual impact on the agricultural production ability of the land. The state of the crop fields as well as the soils present within the study area will need to be confirmed following a site visit.

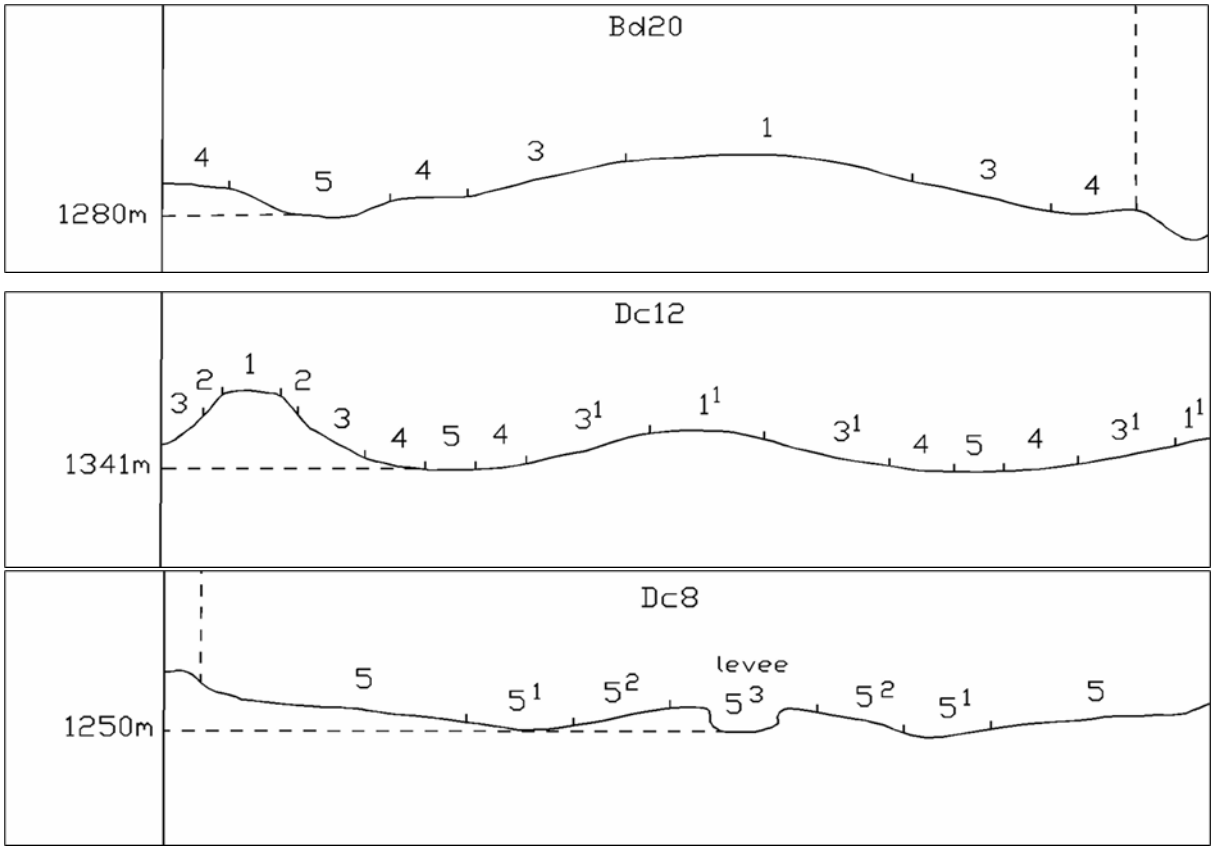


Figure 43: Illustration of the Bd 20, Dc 12 and Dc 8 land type terrain units (Land Type Survey Staff, 1972 – 2006) (The Biodiversity Company, 2025).

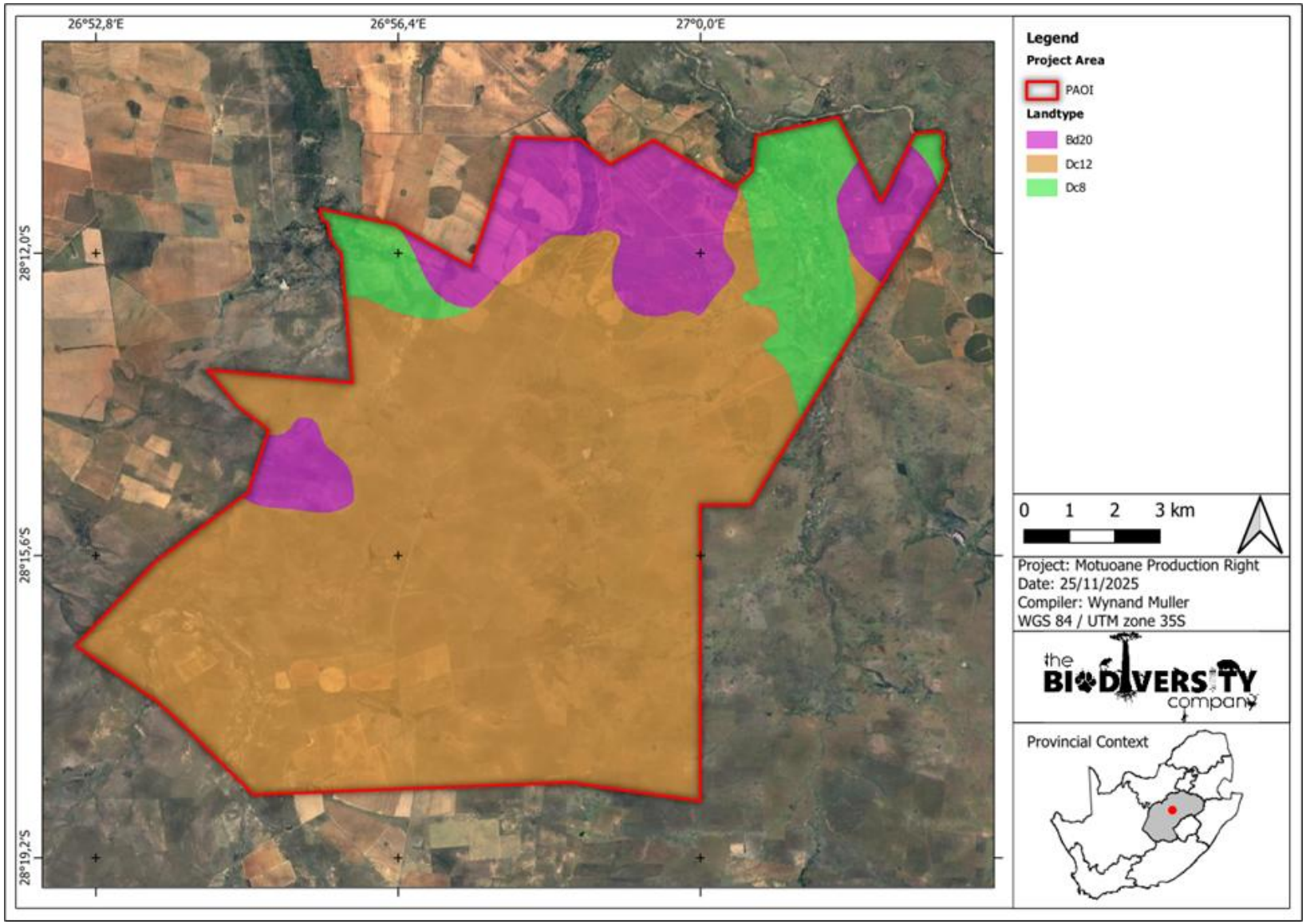


Figure 44: The land type associated with the exploration right (The Biodiversity Company, 2025).

9.8 TERRESTRIAL BIODIVERSITY AND VEGETATION

Terrestrial biodiversity is the variety of life forms on the land surface of the Earth. High biodiversity is an indicator of a healthy ecosystem, which is directly linked to human health. Animals and plants are responsible for many vital services our lives depend on, including oxygen production; water regulation; soil retaining; and providing flood protection.

Biodiversity is both a part of nature and affected by it. Some biodiversity loss is because of events such as seasonal changes or ecological disturbances (wildfires, floods, etc.), but these effects are usually temporary, and ecosystems have managed to adapt to these threats. Human-driven biodiversity loss, in contrast, tends to be more severe and long-lasting. The human-made climate crisis is leading to environmental destruction, habitat loss, and species extinction. Terrestrial biodiversity is decreasing rapidly through habitat loss: a process where a natural habitat becomes incapable of supporting its native species, which are consequently displaced or killed. In the recent past, there have Increased efforts implemented to prevent further loss of terrestrial biodiversity and the ecosystem services they provide. The characteristics and implications of the terrestrial biodiversity within the study area are discussed below.

9.8.1 ECOLOGICALLY IMPORTANT LANDSCAPE FEATURES

The following features describe the general area and habitat; this assessment is based on spatial data that are provided by various sources such as the provincial environmental authority and the South African National Biodiversity Institute (SANBI).

Table 23: Desktop and background spatial features examined (The Biodiversity Company, 2025).

Desktop Information Considered	Relevant/Irrelevant
Ecosystem Threat Status (RLE 2022)	Relevant. Overlaps with 'Endangered (EN) and 'Least Concern (LC)' ecosystems.
Ecosystem Protection Level	Relevant. Overlaps with 'Not Protected (NP)' and 'Poorly Protected (PP)' ecosystems.
Provincial Conservation Plan	Relevant. Overlaps with Other Natural Areas (ONAs), Ecological Support Areas 1 & 2 (ESAs 1 & 2), Degraded Areas (DAs) as well as Critical Biodiversity Areas 1 & 2 (CBAs 1 & 2).
South Africa Protected Areas Database - SAPAD and South Africa Conservation Areas Database - SACAD	Relevant. Falls within >5 km of H. J. Joel Private Nature Reserve, Tara Wildlife Safaris, and LM Safaris Nature Reserve.
National Protected Areas Expansion Strategy (NPAES)	Relevant. The PR overlaps with NPAES Priority Focus Areas.
Key Biodiversity Areas (KBA)	Irrelevant. The nearest KBA is situated over 30 km from the PR.
South African Inventory of Inland Aquatic Ecosystems (SAIIAE)	Relevant. The PR overlaps with 'Least Concern' (LC) and 'Critically Endangered' (CR) wetlands.
National Freshwater Priority Area	Relevant. The PR overlaps with non-priority FEPA wetlands as well as NFEPA rivers.
Mining and Biodiversity Guidelines	Relevant. The PR overlaps with an area of Highest and Moderate Biodiversity Importance.
Strategic Water Source Areas (SWSA)	Irrelevant. The PR does not overlap with any SWSA.

Desktop Information Considered	Relevant/Irrelevant
Coordinated Avifaunal Roadcount (CAR)	Irrelevant. No CAR routes are located within the Project Area.
Coordinated Waterbird Counts (CWAC)	Relevant. 14 km from Allemanskraal Dam and 30 km from the other nearest CWAC sites in the region (Flamingo pan, Toronto pan and St Helena Mine Dams)

9.8.2 PROTECTED AREAS

The DFFE maintains a spatial database on Protected Areas and Conservation Areas. Protected Areas and Conservation Areas (PACA) Database scheme that used for classifying protected areas (South Africa Protected Areas Database-SAPAD) and conservation areas (South Africa Conservation Areas Database-SACAD) into types and sub-types in South Africa. The study area falls within >5 km of H. J. Joel Private Nature Reserve, Tara Wildlife Safaris, and LM Safaris Nature Reserve (**Figure 45**).

9.8.3 NATIONAL PROTECTED AREA EXPANSION STRATEGY

The National Protected Area Expansion Strategy 2010 (NPAES) was identified through a systematic biodiversity planning process. They present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES. They are also not a replacement for fine scale planning which may identify a range of different priority sites based on local requirements, constraints and opportunities (NPAES, 2010). The study area overlaps with NPAES Priority Focus Areas (**Figure 46**).

9.8.4 FREE STATE BIODIVERSITY PLAN

Bioregional plans are one of a range of decision support tools provided for in the Biodiversity Act that can be used to enable biodiversity conservation in priority areas. The purpose of a bioregional plan is to inform land-use planning, environmental assessment and authorisations, and natural resource management, by a range of sectors whose policies and decisions impact on biodiversity (Desmet *et al.*, 2013). The purpose of the conservation plans is to inform land-use planning and development on a provincial scale and to aid in natural resource management, with one of the outputs being a map of Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These are classified into different categories, namely Protected Areas, CBA1 areas, CBA2 areas, ESA1 areas, ESA2 areas, Other Natural Areas (ONAs) and areas with No Natural Habitat Remaining (NNR) based on biodiversity characteristics, spatial configuration and requirements for meeting targets for both biodiversity patterns and ecological processes.

Critical Biodiversity Areas (CBAs) – Areas considered critical for meeting biodiversity targets and thresholds, and which are required to ensure the persistence of viable populations of species and the functionality of ecosystems. Ecological Support Areas (ESAs) - Areas are required to support and sustain the ecological functioning of Critical Biodiversity Areas (CBAs). For terrestrial and aquatic environments, these areas are functional but are not necessarily pristine natural areas. They are however required to ensure the persistence and maintenance of biodiversity patterns and ecological processes within the CBAs, and which also contributes significantly to the maintenance of Ecological Infrastructure.

The Free State Department of Environment and Nature Conservation has developed a Free State Biodiversity Sector Plan which classifies areas within the province on the basis of their contributions to reaching the associated conservation targets within the province. These areas are primarily classified as either Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs). These biodiversity priority areas, together with protected areas, are important for the persistence of a viable representative sample of all ecosystem types and species as well as the long-term ecological functioning of the landscape. The identification of Critical Biodiversity Areas for the Free State was undertaken using a Systematic Conservation Planning approach. Available data on biodiversity features (incorporating both pattern and process, and covering terrestrial and inland aquatic realms), their condition, current Protected Areas and Conservation Areas, and opportunities and constraints for

effective conservation were collated. Based on the Free State Biodiversity Sector Plan, the proposed study area overlaps ESAs 1 & 2, CBAs 1 & 2, DAs, as well as ONAs (**Figure 47**).

It must be noted that the proposed study area is situated in within an area dominated by mining activities, crop farming and grazing. Residential areas, waterbodies, wetlands, mines and quarries are also located in the extended surrounding areas. A terrestrial biodiversity impact assessment will be undertaken to determine the presence, type, implications and/or mitigation measures of biodiversity species within the study area. The findings will be presented and discussed in the EIA Report. The approach that will be adopted for the fauna and flora assessment will take cognisance of the recently published Government Notice 320 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".

9.8.5 THE NATIONAL VEGETATION MAP 2018

The Vegetation Map of South Africa, Lesotho and Swaziland is a fundamental data set that is updated periodically. The National Biodiversity Assessment (NBA) 2018 process provided an opportunity for a more comprehensive revision of the NVM and better alignment between the terrestrial, marine and estuarine ecosystem maps. Based on the NVM, the ER is located within a Grassland Biome. Grassland Biome is centrally located in southern Africa, and adjoins all except the desert, fynbos, and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include seasonal precipitation; and the minimum temperatures in winter (Mucina & Rutherford, 2006). The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is mainly flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level. Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire, and grazing maintain the grass dominance and prevent the establishment of trees. The study area overlaps with the Vaal-Vet Sandy Grassland, Central Free State Grassland, Highveld Alluvia Vegetation and the Winburg Grassy Shrubland vegetation types (**Figure 48**).

9.8.5.1 VAAL-VET SANDY GRASSLAND

The Vaal-Vet Sandy Grassland occurs in North-West and Free State Provinces from its northern distribution, in an area south of Lichtenburg and Ventersdorp, stretching to Klerksdorp, Leeudoringstad, Bothaville and Brandfort in the of Bloemfontein. The altitude ranges from 1220 – 1560 meters, generally between 1260 -1360 meters. The landscape is plains-dominated with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an abundant karroid element.

The landscape is dominated by plains with some scattered, slightly irregular undulating plains and hills. Low-tussock grasslands with strong karroid elements and the relative dominance of the grass species *Themeda triandra* are important features of Vaal-Vet Sandy Grassland. Dominant and other significantly occurring grasses are *Anthephora pubescens, Aristida congesta, Brachiaria serrata, Chloris virgata, Cymbopogon caesius, C. pospischilii, Cynodon dactylon, Digitaria argyrograpta, D. eriantha, Elionurus muticus, Eragrostis curvula, E. chloromelas, E. lehmanniana, E. plana, E. obtusa, E. racemosa, E. superba, E. trichophora, Heteropogon contortus, Panicum coloratum, P. gilvum, Pogonarthria squarrosa, Setaria sphacelata, Themeda triandra Trichoneura grandiglumis, Triraphis andropogonoides and Tragus berteronianus.* Dominant and characteristic herbs and low shrubs generally include *Stachys spathulata (d), Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala, Bulbine narcissifolia, Ledebouria marginata, Tripteris aghillana var. integrifolia, Felicia muricata (d), Pentzia globosa (d), Anthospermum rigidum subsp. pumilum, Helichrysum dregeanum, H. paronychioides, and Ziziphus zeyheriana*

This vegetation type is described as endangered because approximately 63% of it has been transformed for commercial crop cultivation and grazing pressure from cattle and sheep. Only 0.3% of this vegetation type is

statutorily conserved in Bloemhof Dam, Schoonspruit, Sandveld, Faan Meintjies, Wolwespruit and Soetdoring Nature Reserves (Mucina and Rutherford, 2010). Vaal-Vet Sandy Grassland is comparable with Dry Cymbopogon-Themeda Veld (VT 50) (Acocks, 1953) and Dry Sandy Highveld Grassland (LR 37) (Low and Rebelo, 1996).

9.8.5.2 CENTRAL FREE STATE GRASSLAND

The Central Free State Grassland mostly occurs in the Free State Province and marginally into Gauteng Province in a broad zone from around Sasolburg in the north to Dewetsdorp in the south, also including towns such as Kroonstad, Ventersburg, Steynsrus, Lindley, Winburg and Edenvale in its distribution area. It is situated in the summer rainfall region of South Africa with a mean annual precipitation of 560 mm. Summers are generally mild and frost occurs frequently during winter months. The geology of this vegetation type is generally dominated by sedimentary mudstones and sandstone of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) as well as those of the Ecca Group (Karoo Supergroup). These rock formations give rise to vertic, melanic and red soils, typically of the Arcadia, Bonheim, Kroonstad, Valsrivier and Rensburg soil forms (Mucina and Rutherford, 2010).

The landscape is characterised by undulating plains supporting short grassland. Under natural conditions it is dominated by *Themeda triandra* but is dominated by *Eragrostis curvula* and *E. chloromelas* in disturbed habitats. Dwarf Karoo-shrubs establish in severely degraded clayey bottomlands and overgrazed and trampled low-lying areas are prone to Vachellia karroo encroachment. Dominant and other characteristic plant species include the grasses *Aristida adscensionis, A. congesta, A. bipartite, A. canescens, Andropogon appendiculatus, Agrostis lachnantha, Cynodon dactylon, C. transvaalensis, Cymbopogon pospischilii, Digitaria argyrograpta, Eragrostis curvula, E. chloromelas, E. lehmanniana, E. micrantha, E. plana, E. obtusa, E. racemosa, E. trichophora, Elionurus muticus, Heteropogon contortus, Microchloa caffra, Panicum coloratum, Setaria sphacelata, S. incrassata, Sporobolus discosporus, Themeda triandra and Tragus koelerioides.* Also, the herbs and low shrubs *Anthospermum rigidum, Berkheya onopordifolia, Conyza pinnata, Crabbea acaulis, Euphorbia inaequilatera, Felicia muricata, Geigeria aspera, Helichrysum dregeanum, Hermannia depressa, Hibiscus pusillus, Melolobium candicans, Oxalis depressa, Pentzia globosa, Pseudognaphalium luteo-album, Raphionacme dyeri and Tripteris aghillana* (Mucina and Rutherford, 2010).

Central Free State Grassland is compared to Acocks' (1953) Dry Cymbopogon-Themeda Veld (VT 50) and also to Low and Rebelo's (1996) Dry Sandy Highveld Grassland (LR 37). From a conservation point of view, this unit is described as vulnerable due to almost a quarter of the area of it being transformed for crop cultivation and building of large dams such as Allemanskraal, Erfenis, Groothoek, Koppies, Weltevrede and Kroonstad Dams. Small portions are conserved in the Willem Pretorius, Rustfontein and Koppies Dam Nature Reserves as well as in some private nature reserves (Mucina and Rutherford, 2010).

9.8.5.3 HIGHVELD ALLUVIAL VEGETATION

The Highveld Alluvial Vegetation occurs in the Free State, North-West, Mpumalanga and Gauteng Provinces, and also in Lesotho and Swaziland and are associated with alluvial drainage lines and floodplains along rivers embedded in the Grassland Biome, and marginally along eastern Kalahari rivers in the Savanna Biome. Important rivers that fall in this unit are the Riet, Harts, Vals, Vet, Wilge, Mooi, Sand, middle and upper Vaal, upper Modder and upper Caledon Rivers as well as their many tributaries. Climatically this unit is situated in the summer rainfall region of southern Africa with MAP over the distribution range of the unit at about 500 mm. Summers are generally hot and winters are cold with frequent frost. Deep sandy to clayey alluvial soils, which developed over Quaternary alluvial sediments, with Oakleaf, Dundee, Shortlands, Glenrosa and Mispah soil forms, generally dominate this unit. The topography is generally flat, and the river banks support riparian thickets accompanied by seasonally flooded grasslands and disturbed herblands, often dominated by alien flora. The rivers in this unit are perennial, often flooding in the high rainfall summer months and erosion of river banks and the deposition of fine soil on alluvium is a general phenomenon (Mucina and Rutherford, 2010).

Important plant species in riparian thickets are the trees and woody shrubs *Celtis africana, Diospyros lycioides, Ehretia rigida, Grewia flava, Gymnosporia buxifolia, Lycium hirsutum, Searsia lancea, S. pyroides, Salix mucronata, Vachellia karroo* and *Ziziphus mucronata*, the herbs and herbaceous shrubs *Asparagus laricinus, A. suaveolens, Clematis brachiata, Pollichia campestris and the grasses Panicum maximum* and *Setaria verticillata*.

Reed beds are dominated by Phragmites australis and flooded herb- and grasslands by the graminoids *Agrostis lachnantha, Andropogon appendiculatus, A. eucomus, Brachiaria marlothii, Chloris virgata, Cynodon dactylon, Cyperus denudatus, C. longus, Echinochloa holubii, Eragrostis obtusa, E. plana, E. porosa, Fimbristylis ferruginea, Hemarthria altissima, Imperata cylindrica, Ischaemum fasciculatum, Miscanthus junceus, Panicum coloratum, Paspalum distichum, Pycreus mundii, Sporobolus africanus, S. fimbriatus, Themeda triandra* and *Urochloa panicoides*, as well as the herbs and herbaceous shrubs *Alternanthera sessilis, Barleria macrostegia, Corchorus asplenifolius, Crinum bulbispermum, Equisetum ramosissimum, Felicia muricata, Galium capense, Gomphocarpus fruticosus, Haplocarpha lyrata, Hibiscus pusillus, Lobelia angolensis, Myriophyllum spicatum, Nidorella residifolia, Persicaria amphibia, P. lapathifolia, P. hystricula, Pseudognaphalium oligandrum, Pulicaria scabra, Rorippa fluviatilis, Senecio inoratus, Stachys hyssopoides* and *Vahlia capensis* (Mucina and Rutherford, 2010).

From a conservation point of view Highveld Alluvial Vegetation is not threatened and about 10% of the unit is statutorily conserved in Baberspan (a Ramsar site), Bloemhof Dam, Christiana, Faan Meintjies, Soetdoring, Sandveld and Schoonspruit Nature Reserves. More than 25% has been transformed by crop cultivation and the building of the Bloemhof, Erfenis, Krugersdrif, Mockes and Vaalharts Dams (Mucina and Rutherford, 2010). The unit is prone to invasion by a number of alien weeds and invaders such as the trees and woody shrubs *Celtis sinensis, Melia azedarach, Morus alba, Salix babylonica, Schinus molle, Nicotiana glauca, N. longiflora* and *Populus x canescens*, and also the herbs *Argemone ochroleuca, Chenopodium strictum, Conyza canadensis, Datura stramonium, Melilotus alba, Oenothera indecora, Tagetes minuta, Verbena bonariensis, Xanthium strumarium, Zinnia peruviana, and the grasses Paspalum dilatatum , P. urvillei* and *Pennisetum clandestinum*.

9.8.5.4 BLOEMFONTEIN KARROID SHRUBLAND

The Bloemfontein Karroid Shrubland is a unique vegetation type found as an archipelago of isolated patches on koppies, butts, and ridges, mainly within dry highveld grasslands. It extends over large distances between Bloemfontein in the southwest, Verkeerdevlei and Lindley in the southeast, Standerton in the northeast, and Heilbron and Bultfontein in the northwest. The altitude ranges from 1,320 to 1,840 m, mostly between 1,400 and 1,440 m. This vegetation type is found on plateaus or slightly sloping flanks of dolerite outcrops, supporting low shrubland dominated by dwarf small-leaved karroid and succulent shrubs. Grasses are restricted to depressions and crevices filled with fine soils.

Important Plant Taxa includes Tall Shrubs such as *Diospyros austro-africana, Euclea crispa subsp. ovata, Rhus burchellii, R. erosa, R. tridactyla.* Low Shrubs: *Eriocephalus ericoides (d), Euryops empetrifolius (d), Anthospermum rigidum subsp. pumilum, Asparagus suaveolens, Felicia muricata, Helichrysum dregeanum, Heliophila suavissima, Jamesbrittenia pristisepala, Nenax microphylla, Pentzia globosa, Phyllanthus parvulus, Selago albida.* Succulent Shrubs: *Chasmatophyllum musculinum (d), Euphorbia mauritanica (d), Ruschia spinosa (d), Stomatium mustellinum (d), Cotyledon orbiculata var. dactylopsis, Euphorbia rectirama, Kalanchoe paniculata, Othonna protecta, Pachypodium succulentum, Ruschia hamata, R. unidens, Sarcocaulon salmoniflorum, Stapelia grandiflora.* Succulent Woody Climber: *Sarcostemma viminale.* Graminoids: *Aristida diffusa (d), Eragrostis nindensis (d), Heteropogon contortus (d), Oropetium capense (d), Aristida adscensionis, A. congesta, Cymbopogon caesius, C. pospischilii, Cyperus rupestris var. rupestris, Digitaria eriantha, Enneapogon scoparius, Eragrostis chloromelas, E. obtusa, E. superba, E. trichophora, Eustachys paspaloides, Melinis repens subsp. repens, Microchloa caffra, Themeda triandra, Tragus koelerioides, T. racemosus.* Herbs: *Berkheya onopordifolia var. onopordifolia, B. rigida, Chamaesyce inaequilatera, Commelina africana, Gazania linearis var. linearis, Geigeria aspera var. aspera, G. filifolia, Hermannia coccocarpa.* Geophytic Herbs: *Cheilanthes eckloniana (d), Albuca setosa, Dipcadi ciliare, D. viride, Nerine laticoma, Pellaea calomelanos, Trachyandra saltii.* Succulent Herbs: *Senecio radicans (d), Adromischus trigynus, Aloe grandiden-tata, Anacampseros telephiastrum, Avonia ustulata, Crassula nudicaulis, Duvalia corderoyi, Orbea cooperi, Orbeopsis lutea, Tripteris aghillana var. integrifolia.* Endemic Taxon Geophytic Herb: *Brachystelma glenense.*

The Bloemfontein Karroid Shrubland is classified as “Least threatened.” The conservation target is 28%. Almost 2% is statutorily conserved in the Willem Pretorius Nature Reserve. More than 10% has been transformed for cultivation and by urban sprawl. Erosion is generally low (57%), very low (24%), and moderate (18%) (Mucina & Rutherford, 2006).

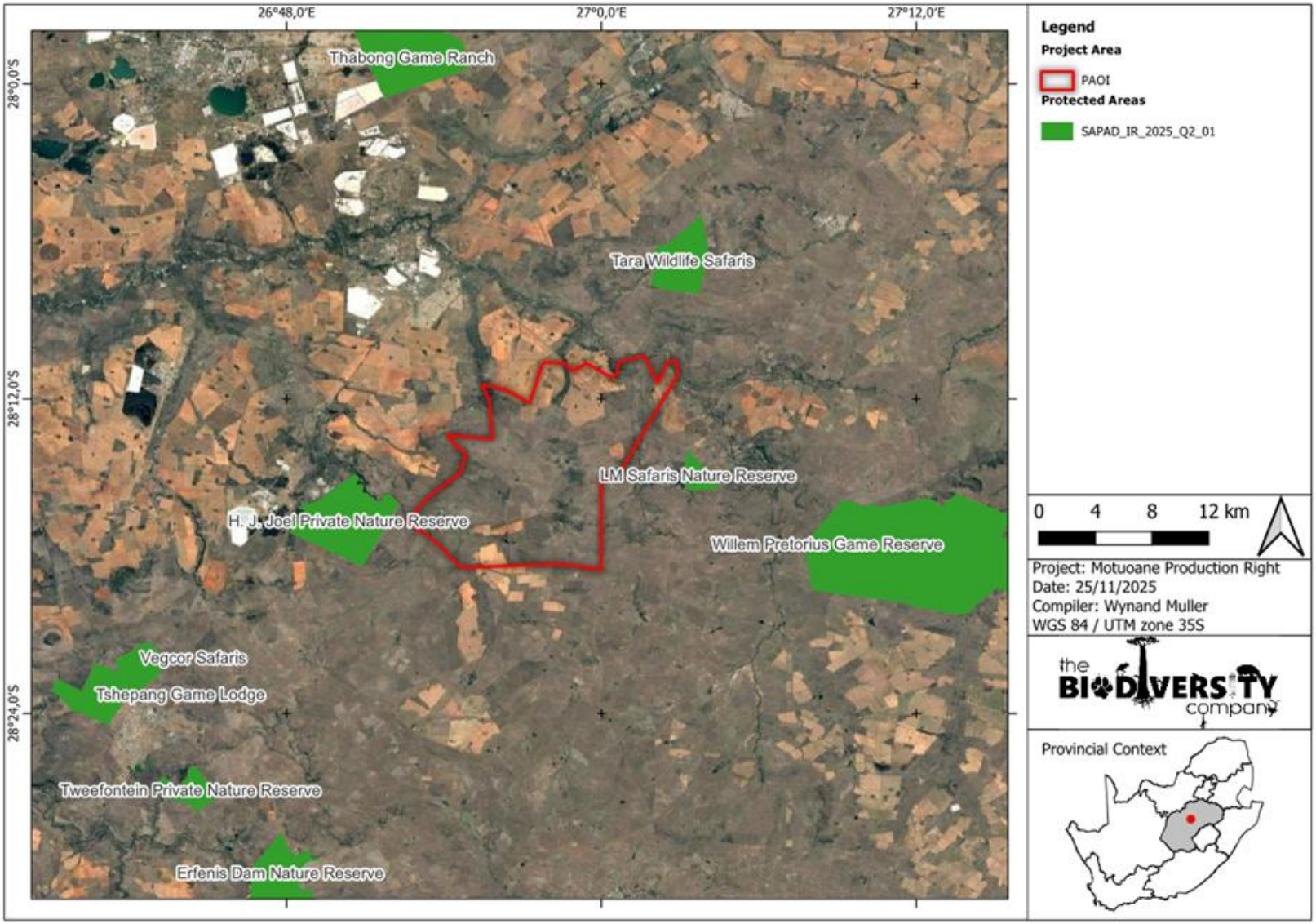


Figure 45: Map illustrating the PR in relation to the SAPAD areas.

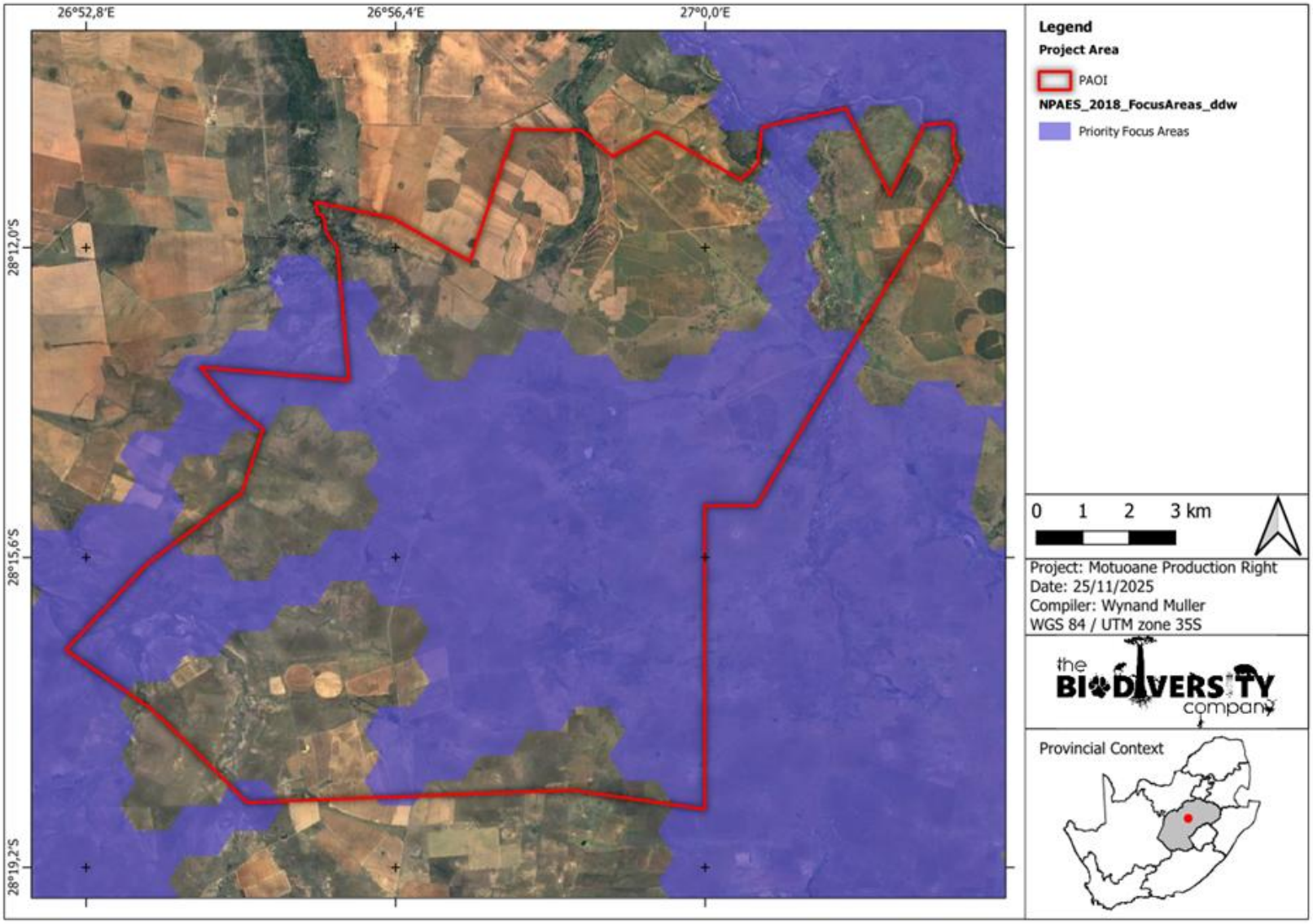


Figure 46: Map illustrating the PR in relation to the NPAES areas (The Biodiversity Company, 2025).

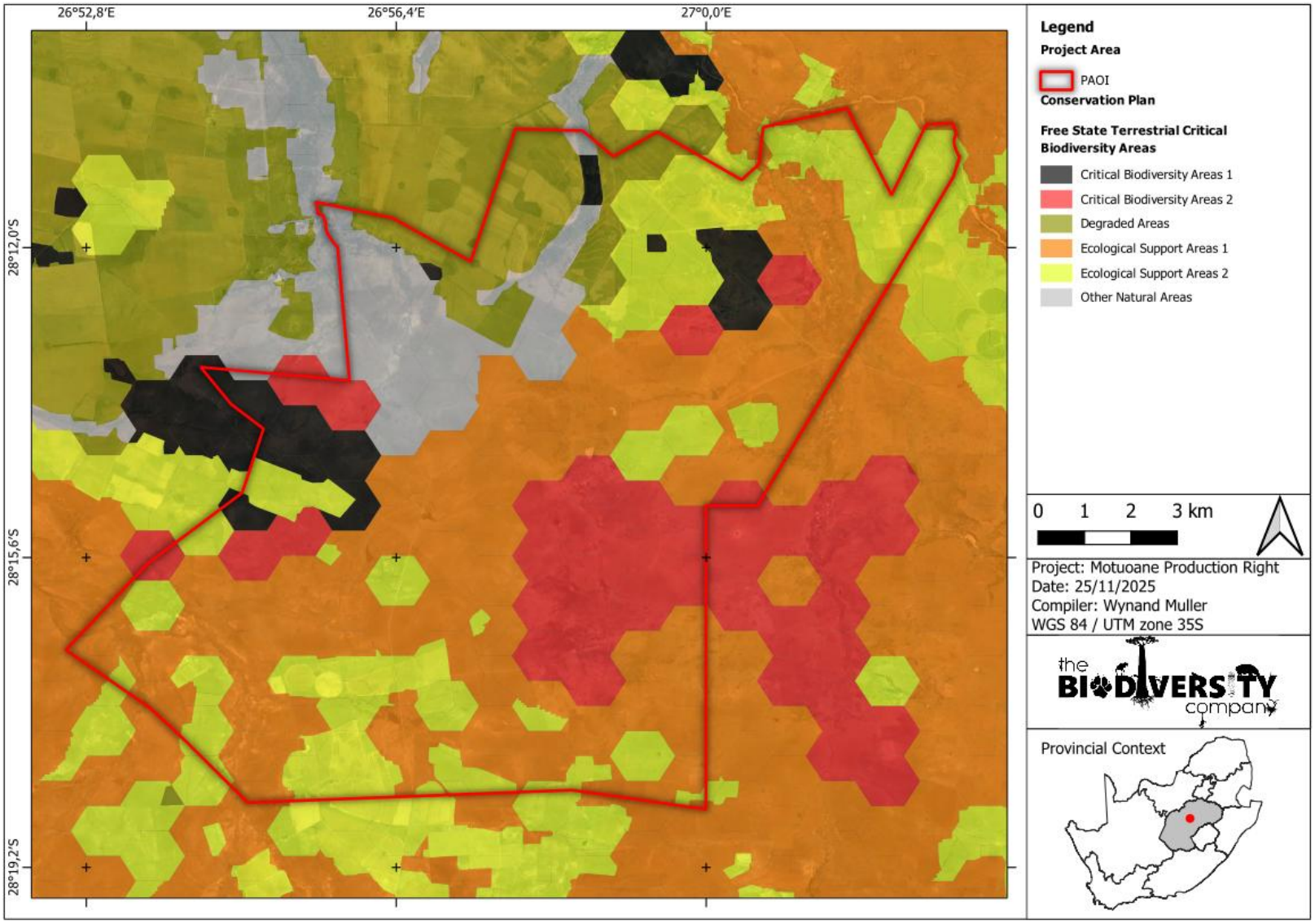


Figure 47: Map illustrating the PR in relation to the provincial conservation plan.

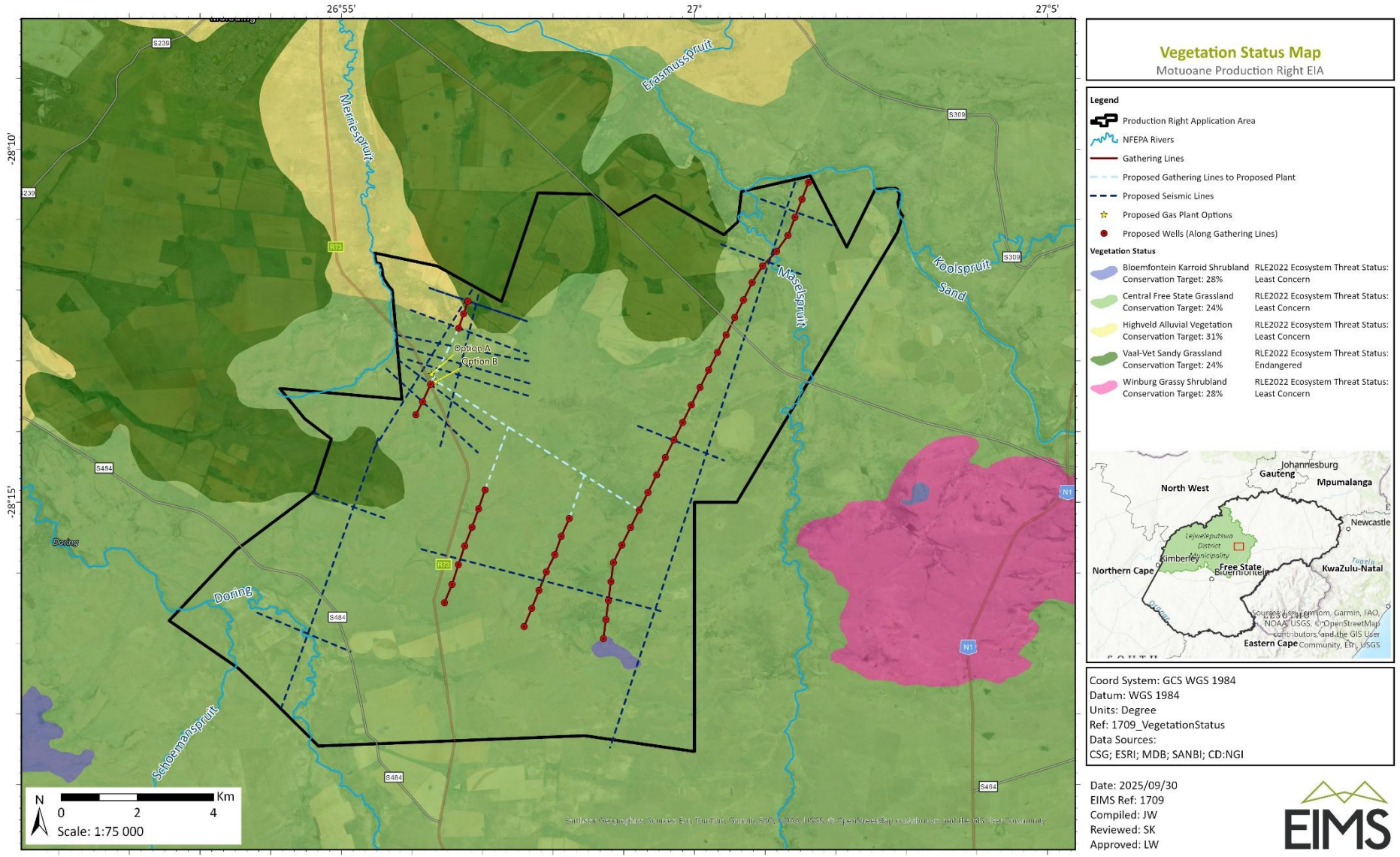


Figure 48: Vegetation types and status associated with the study area.

9.8.6 THE NATIONAL BIODIVERSITY ASSESSMENT

The National Biodiversity Assessment (NBA) was completed as a collaboration between the SANBI, the DFFE and other stakeholders, including scientists and biodiversity management experts throughout the country over a three-year period. The purpose of the NBA is to assess the state of South Africa's biodiversity with a view to understanding trends over time and informing policy and decision-making across a range of sectors.

The two headline indicators assessed in the NBA are Ecosystem Threat Status and Ecosystem Protection Level (Skowno *et al.,* 2019).

9.8.6.1 **ECOSYSTEM THREAT STATUS**

Ecosystem Threat Status (ETS) outlines the degree to which ecosystems are still intact or alternatively losing vital aspects of their structure, function, and composition, on which their ability to provide ecosystem services ultimately depends. Ecosystem types are categorised as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Least Concern (LC) or Protected, based on the proportion of each ecosystem type that remains in a good or healthy ecological condition (Skowno *et al*., 2019). CR, EN, VU or Protected ecosystem types are collectively referred to as threatened ecosystems. Critically Endangered (CR) ecosystems experiencing severe ecological degradation due to human intervention and facing an extremely high risk of irreversible transformation. Endangered (EN) ecosystems that have undergone degradation but are not critically endangered, meaning they have a high risk of further decline. Vulnerable (VU) ecosystems at a high risk of significant degradation, although not currently endangered or critically endangered. Protected ecosystems of high conservation value or national/provincial importance, regardless of whether they are critically endangered, endangered, or vulnerable. According to the spatial dataset, the study overlaps with EN and LC ecosystems (**Figure 49**).

9.8.6.2 **ECOSYSTEM PROTECTION LEVEL**

Ecosystem Protection level (EPL) informs on whether ecosystems are adequately protected or under-protected. Ecosystem types are categorised as Not Protected (NP), Poorly Protected (PP), Moderately Protected (MP) or Well Protected (WP), based on the proportion of each ecosystem type that occurs within a protected area recognised in the Protected Areas Act (Skowno et al., 2019). NP, PP or MP ecosystem types are collectively referred to as under-protected ecosystems. In South Africa, approximately 33% of ecosystem types are considered well protected, while 59% are not protected. The country aims for at least 17% of terrestrial ecosystems to be conserved through protected areas, but currently only has 8.37%. Ecosystems like estuaries and wetlands are among the most threatened and least protected, and freshwater fish are the most threatened species group.

Ecosystem protection level is based on the target achievement (%) of each vegetation type by type 1 protected areas. Well-protected (WP) ecosystems are defined as vegetation types with 100% of their target area conserved; similarly, MP ecosystems, PP, and NP ecosystems have at least 50%, 25%, and 5% of their target areas conserved, respectively. According to the National Vegetation Data (2018) obtained from SANBI, the study area overlaps with NP, MP and PP ecosystems (**Figure 50**).

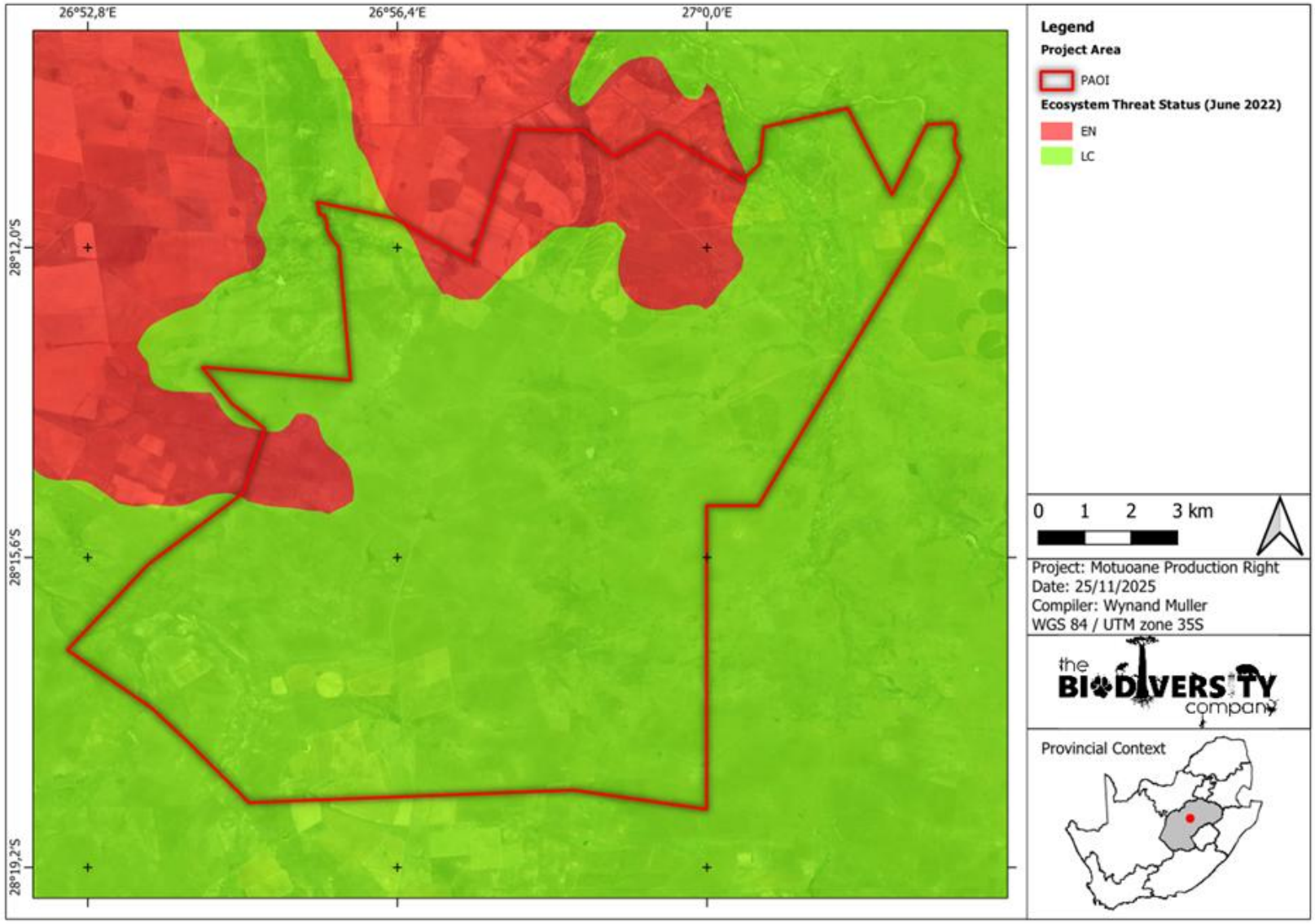


Figure 49: Map illustrating the ecosystem threat status associated with the study area (The Biodiversity Company, 2025).

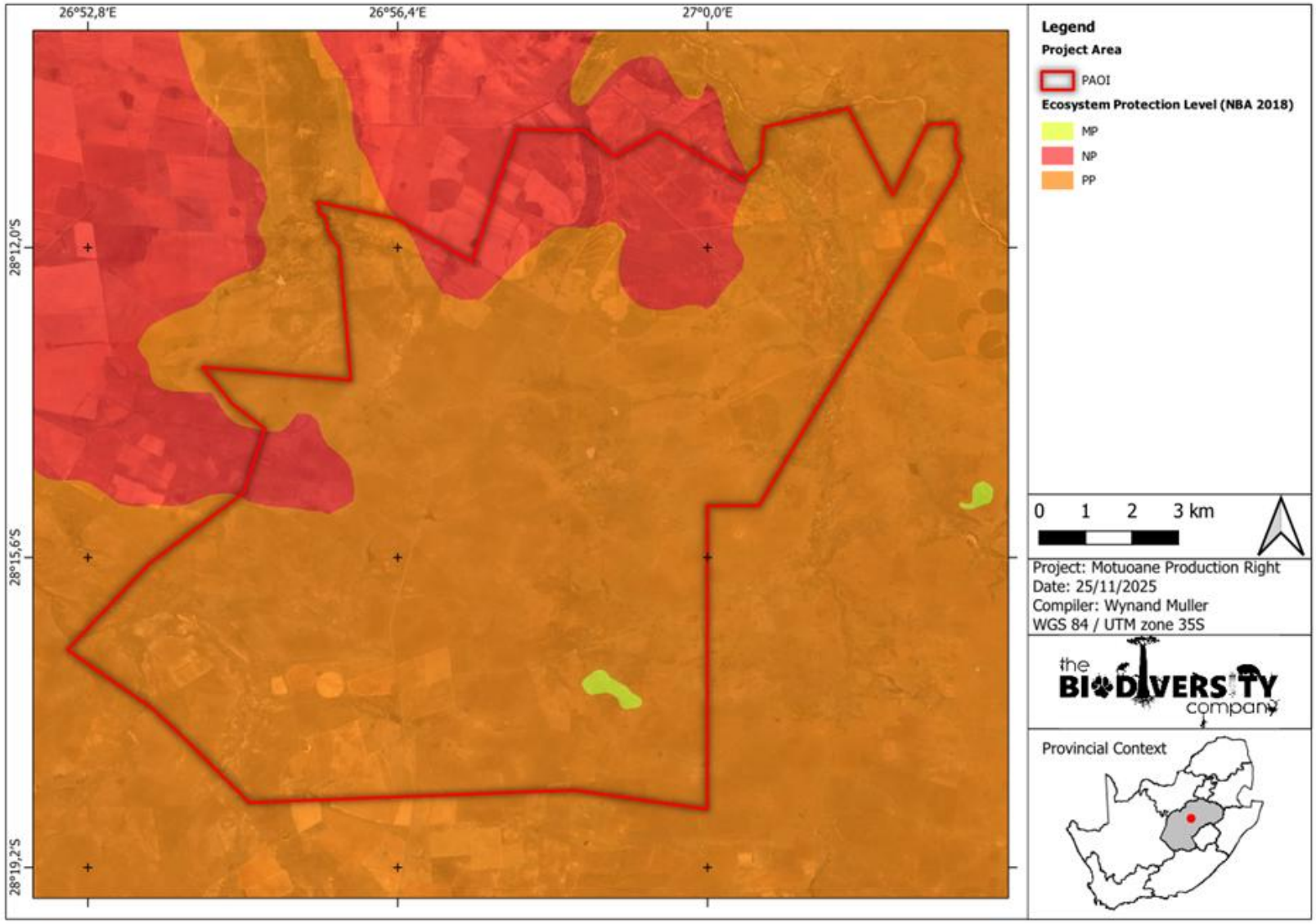


Figure 50: Map illustrating the ecosystem protection level associated with the study area (The Biodiversity Company, 2025).

9.8.6.3 FLORA

According to the Baseline Terrestrial Biodiversity Assessment undertaken by the Biodiversity Company (2025), the Plants of southern Africa (POSA) database indicates that 463 species of plants are expected to occur within the study area, of which 215 are indigenous. The full list of species will be provided in the final EIA report. The POSA database does not indicate the likely presence of any Species of Conservation Concern (SCC), similarly, the DFFE Screening Tool does not list any extra SCC.

9.8.6.4 FAUNA

9.8.6.4.1 AMPHIBIANS

Based on the iNaturalist database 15 amphibian species have the potential to occur in the ER. One of the expected species is an SCC (**Table 24**). No additional amphibian SCC were listed by the screening tool.

9.8.6.4.2 REPTILES

Based on the iNaturalist database 47 reptile species are expected to occur within the area, two of which are regarded as threatened (**Table 24**). No sensitive species were highlighted by the screening tool.

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 project 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 note, 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.*

9.8.6.4.3 MAMMALS

The iNaturalist database lists 89 mammal species that could be expected to occur within the area. Excluding large mammal species that are normally restricted to protected areas, ten SCC are likely to occur in the PR. One species is listed as sensitive according to the DFFE screening tool (**Table 24**).

Table 24: Threatened fauna species that are expected to occur within the PR (The Biodiversity Company, 2025).

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional	Global	
Threatened amphibian species that are expected to occur within the PR				
Pyxicephalus adspersus	Giant Bullfrog	NT	LC	Moderate
Threatened reptile species that are expected to occur within the PR				
Homoroselaps dorsalis	Striped Harlequin Snake	NT	LC	Moderate
Psammophis leightoni	Cape Sand Snake	VU	LC	Unlikely
Mammal species of conservation concern that may occur within the PR				
Aonyx capensis	Cape Clawless Otter	NT	NT	High
Atelerix frontalis	South Africa Hedgehog	NT	LC	Low
Eidolon helvum	African Straw-colored Fruit Bat	LC	NT	Low
Felis nigripes	Black-footed Cat	VU	VU	Low
Hydrictis maculicollis*	Spotted-necked Otter	VU	NT	Low
Leptailurus serval	Serval	NT	LC	High
Mystromys albicaudatus	White-tailed Rat	VU	EN	Low
Panthera pardus	Leopard	VU	VU	Low

Species	Common Name	Conservation Status		Likelihood of occurrence
		Regional	Global	
Parahyaena brunnea	Brown Hyaena	NT	NT	Low
Poecilogale albinucha	African Striped Weasel	NT	LC	Low
Threatened mammal species that are expected to occur within the PR				
Aonyx capensis	Cape clawless otter	NT	NT	Medium
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Medium

Note: LC = Least Concern, NT = Near Threatened, VU = Vulnerable.

Leptailurus serval (Serval) occurs widely through sub-Saharan Africa and is commonly recorded from most major national parks and reserves (IUCN, 2023). The Serval's status outside reserves is not certain, but they are inconspicuous and may be common in suitable habitat, as they are tolerant of farming practices, provided there is cover and food available. In sub-Saharan Africa, they are found in habitat with well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. Due to the presence of likely habitat within the study area, the likelihood of occurrence for this species is rated as High.

Aonyx capensis (Cape clawless otter) is widely distributed throughout sub-Saharan Africa, including across South Africa, and is regularly recorded in a variety of freshwater and coastal habitats (IUCN, 2023). The species is semi-aquatic and is typically associated with rivers, streams, lakes, estuaries, and coastal environments that provide permanent water and dense riparian or aquatic vegetation for cover and foraging. Cape clawless otters are adaptable and may persist in areas with moderate human disturbance, provided that water quality is maintained and sufficient prey (such as crabs, fish, and amphibians) is available. Within the study area, suitable habitat is present in the form of perennial watercourses and associated riparian zones, which offer both foraging opportunities and shelter. Due to the availability of high-quality habitat and the species' adaptability, the likelihood of occurrence for the Cape clawless otter at the site is rated as High.

9.8.6.4.4 AVIFAUNA

Southern African Bird Atlas Project 2 (SABAP2) data indicate that 264 avifauna species are expected within the study area and surrounding areas. Of these 298 avifauna species, 31 are considered SCC (**Table 25**). The likelihood of occurrence within the ER are included in the table. The DFFE screening tool lists three one medium sensitivity species. The bird species and likelihood of occurrence of these species will be determined by the ecologist following the site visit.

Table 25: List of bird species of conservation importance expected to occur within the ER (The Biodiversity Company, 2025).

Common Name	Scientific Name	Conservation Status		Screening Tool Sensitivity	Likelihood of occurrence
		Regional	Global		
Fulvous Whistling Duck	*Dendrocygna bicolor*	NT	LC	-	Moderate
Southern Pochard	*Netta erythrophthalma*	NT	LC	-	High
Maccoa Duck	*Oxyura maccoa*	VU	EN	-	Moderate
White-backed Duck	*Thalassornis leuconotus*	NT	LC	-	Moderate
Secretarybird	*Sagittarius serpentarius*	VU	EN	-	High
Lanner Falcon	*Falco biarmicus*	NT	LC	-	High
Red-footed Falcon	*Falco vespertinus*	VU	VU	-	Moderate
Lesser Kestrel	*Falco naumanni*	VU	LC	-	High
Black-winged Kite	*Elanus caeruleus*	NT	LC	-	High
Verreaux's Eagle	*Aquila verreauxii*	VU	LC	-	Low

Common Name	Scientific Name	Conservation Status		Screening Tool Sensitivity	Likelihood of occurrence
		Regional	Global		
Martial Eagle	*Polemaetus bellicosus*	EN	EN	-	Moderate
Yellow-billed Egret	*Ardea brachyrhyncha*	NT	LC	-	High
Blue Korhaan	*Eupodotis caerulescens*	VU	NT	-	High
Kittlitz's Plover	*Charadrius pecuarius*	NT	LC	-	High
Curlew Sandpiper	*Calidris ferruginea*	VU	VU	-	High
Black-winged Pratincole	*Glareola nordmanni*	LC	NT	-	High
Caspian Tern	*Hydropogne caspia*	VU	LC	Medium	Moderate
Marsh Owl	*Asio capensis*	NT	LC	-	High
Great Crested Grebe	*Podiceps cristatus*	VU	LC		Moderate
Melodious Lark	*Mirafra cheniana*	NT	LC		Moderate
African Darter	*Anhinga rufa*	NT	LC		High
Great Egret	*Ardea alba*	NT	LC		Moderate
Black-crowned Night Heron	*Nycticorax nycticorax*	NT	LC		Moderate
Hamerkop	*Scopus umbretta*	NT	LC		High
Yellow-billed Stork	*Mycteria ibis*	VU	LC		High
Black Stork	*Ciconia nigra*	EN	LC		Low
Greater Flamingo	*Phoenicopterus roseus*	NT	LC		High
Lesser Flamingo	*Phoeniconaias minor*	VU	NT		High
Cape Shoveler	*Spatula smithii*	NT	LC		High
Yellow-billed Duck	*Anas undulata*	NT	LC		High
Red-billed Teal	*Anas erythrorhyncha*	NT	LC		High

Note: LC = Least Concern, NT = Near Threatened, VU = Vulnerable, EN = Endangered, CR = Critically Endangered

Anhinga rufa (African Darter) is widely distributed in sub-Saharan Africa and is closely associated with large water bodies, including rivers, lakes, and wetlands (IUCN, 2023). It requires open water for foraging and trees or reeds for roosting and nesting. The presence of perennial watercourses and wetlands within the study area provides suitable habitat, and the likelihood of occurrence is rated as High.

Anas undulata (Yellow-billed Duck) is widespread in southern Africa, inhabiting a range of freshwater wetlands, including rivers, lakes, and dams (IUCN, 2023). It forages for aquatic plants and invertebrates. The availability of suitable wetland habitats within the study area results in a High likelihood of occurrence.

Anas erythrorhyncha (Red-billed Teal) is common in southern Africa and is associated with a variety of freshwater wetlands, including lakes, pans, and marshes (IUCN, 2023). It feeds on seeds, aquatic plants, and invertebrates. The presence of suitable wetland habitats within the study area provides foraging and breeding opportunities, resulting in a High likelihood of occurrence.

Ardea brachyrhyncha (Yellow-billed Egret) is found in a variety of wetland habitats across sub-Saharan Africa, including marshes, floodplains, and the margins of rivers and lakes (IUCN, 2023). It forages in shallow water for fish, amphibians, and invertebrates. The presence of wetlands and watercourses within the study area provides suitable habitat for this species, resulting in a High likelihood of occurrence.

Calidris ferruginea (Curlew Sandpiper) is a Palearctic migrant that winters in southern Africa, frequenting coastal and inland wetlands, mudflats, and estuaries (IUCN, 2023). It is dependent on shallow water and exposed mud

for foraging. The presence of suitable wetland habitats within the study area supports a High likelihood of occurrence for this species during the non-breeding season.

Charadrius pecuarius (Kittlitz's Plover) is widespread in southern Africa and is typically associated with the shores of lakes, pans, and other open, sparsely vegetated wetland habitats (IUCN, 2023). The presence of open wetland margins and exposed mudflats within the study area offers suitable foraging and breeding habitat for this species. The likelihood of occurrence is rated as High.

Circus ranivorus (African Marsh Harrier) is listed as EN in South Africa (ESKOM, 2014). This species has an extremely large distributional range in sub-equatorial Africa. South African populations of this species are declining due to the degradation of wetland habitats, loss of habitat through over-grazing and human disturbance and possibly, poisoning owing to over-use of pesticides (IUCN, 2017). This species breeds in wetlands and forages primarily over reeds which may be present surrounding water resources within the study area.

Calidris ferruginea (Curlew Sandpiper) is migratory species which breeds on slightly elevated areas in the lowlands of the high Arctic, and may be seen in parts of South Africa during winter. During winter, the species occurs at the coast, but also inland on the muddy edges of marshes, large rivers and lakes (both saline and freshwater), irrigated land, flooded areas, dams and saltpans (IUCN, 2017). The marshes and wetlands within the study area may be suitable for this species.

Coracias garrulous (European Roller) is a winter migrant from most of South-central Europe and Asia occurring throughout sub-Saharan Africa (IUCN, 2017). The European Roller has a preference for bushy plains and dry savannah areas, but the grasslands within the study area may also be suitable for this species (IUCN, 2017).

Elanus caeruleus (Black-winged Kite) is widely distributed across sub-Saharan Africa and is commonly associated with open grasslands, agricultural areas, and savannas (IUCN, 2023). It is often observed perched on trees or poles, hunting for small mammals and insects. The availability of open habitats and perching sites within the study area makes it highly likely that this species occurs at the site. The likelihood of occurrence is rated as High.

Eupodotis caerulescens (Blue Korhaan) is endemic to South Africa and Lesotho and occurs in grassveld usually over 1 500 m above sea level, preferring open, fairly short grassland and a mixture of grassland and karoo dwarf-shrubland within 1 km of water, with termite mounds and few or no trees (BirdLife International, 2017). The total global population is estimated to number between 12 000-15 000 individuals, equivalent to 8 000-10 000 mature individuals, with a decreasing population trend. The main threat is intensive agriculture, especially within the east of its range. The grasslands present within the study area may be suitable for this species to occur in.

Falco biarmicus (Lanner Falcon) is native to South Africa and inhabits a wide variety of habitats, from lowland deserts to forested mountains (IUCN, 2017). Global population estimates is more than 30000 breeding pairs, in South Africa it is estimated to be 1400 pairs. They may occur in groups up to 20 individuals, but have also been observed solitary. They are partial and facultative migrants, that breeds from May to early September. Nests are mostly found on cliff ledges, and they may alternate between more than one nest. Their diet is mainly composed of small birds such as pigeons and francolins. Anecdotal evidence suggest these species are susceptible to agrochemicals, another threat to their population is the clearing of grassland habitats (Roberts *et al.,* 2023). The grasslands and agricultural fields within the study area may be suitable foraging grounds for this SCC.

Falco naumanni (Lesser Kestrel) is a migratory falcon that breeds in Eurasia and winters in southern Africa, including South Africa (IUCN, 2023). It is typically found in open grasslands, agricultural fields, and savanna habitats, where it forages for insects and small vertebrates. The presence of open habitats within the study area provides suitable foraging grounds for this species during its non-breeding season. Therefore, the likelihood of occurrence for the Lesser Kestrel at the site is rated as High.

Glareola nordmanni (Black-winged Pratincole) is a migratory species which is listed as NT both globally and regionally. This species has a very large range, breeding mostly in Europe and Russia, before migrating to southern Africa. Overall population declines of approximately 20% for this species are suspected (IUCN, 2017). This species generally occurs near water and damp meadows, or marshes overgrown with dense grass, which

may be present within the study area. Due to it's migratory nature, this species will only be present in South Africa for a few months during the year and will not breed locally.

Mycteria ibis (Yellow-billed Stork) is found in a variety of wetland habitats across sub-Saharan Africa, including marshes, floodplains, and the margins of lakes and rivers (IUCN, 2023). It forages in shallow water for fish, amphibians, and invertebrates. The presence of suitable wetlands within the study area results in a High likelihood of occurrence.

Phoenicopterus roseus (Greater Flamingo) is widely distributed throughout sub-Saharan Africa and inhabits shallow eutrophic waterbodies such as saline lagoons, saltpans and large saline or alkaline lakes (BirdLife International, 2019b). Juveniles, and to a lesser extent adults undertake irregular nomadic or partially migratory movements throughout the species' range in response to water-level changes. In sub-Saharan Africa, the species may also join large flocks of non-breeding *Phoeniconaias minor* (Lesser Flamingo). The sub-Saharan African populations between 100 000 and 120 000 mature individuals. The species suffers from low reproductive success if exposed to disturbance at breeding colonies, or if water-levels surrounding nest-sites lower resulting in increased predation from ground predators. Further threats include effluents mining, pollution from sewage and heavy metal effluents from industries and collisions with powerlines (BirdLife International, 2019b). Larger and smaller water resources in and around the study area were found on a desktop basis and may be suitable for this species.

Rostratula benghalensis (Greater Painted-snipe) shows a preference for recently flooded areas in shallow lowland freshwater temporary or permanent wetland, it has a wide range of these freshwater habitats which they occur in, such as, sewage pools, reservoirs, mudflats overgrown with marsh grass (IUCN, 2017). The wetlands in the study area may be deemed suitable for this species.

Phoeniconaias minor (Lesser Flamingo) is widely distributed throughout sub-Saharan Africa but mainly breeds in the Rift Valley Lakes in East Africa, with smaller breeding congregations in West Africa and southern Africa. This species is nomadic and makes extensive movements in response to environmental conditions and southern African populations are partially migratory, with many making regular movements from their breeding sites inland to coastal wetlands when not breeding (BirdLife International, 2018). The species is an obligate filter feeder and feeds during the night and early morning when the surface of the water is calm, primarily by swimming and filtering the algae near the surface. The global population has been estimated at between 2 220 000-3 240 000 individuals, with a declining population trend. The main threat is breeding habitat loss due to mining and hydro-electric power (BirdLife International, 2018). Further threats include effluents mining, pollution from sewage and heavy metal effluents from industries and collisions with powerlines. Larger and smaller water resources in and around the study area may be suitable for this species.

Phoenicopterus roseus (Greater Flamingo) is widely distributed in southern Africa, frequenting large, shallow saline or alkaline lakes, pans, and estuaries (IUCN, 2023). It feeds on algae, invertebrates, and small crustaceans in shallow water. The presence of suitable wetland habitats within the study area provides foraging opportunities, resulting in a High likelihood of occurrence.

Sagittarius serpentarius (Secretarybird) is listed as EN on a global scale (BirdLife International, 2020). The species has a wide distribution across sub-Saharan Africa but surveyed densities suggest that the total population size does not exceed a five-figure number. Ad-hoc records, localised surveys and anecdotal observations indicate apparent declines in many parts of the species' range, especially in South Africa where reporting rates decreased by at least 60% of quarter degree grid cells used in Southern African Bird Atlas Projects. Threats include excessive burning of grasslands that may suppress populations of prey species, whilst the intensive grazing of livestock is also probably degrading otherwise suitable habitat. Disturbance by humans is likely to negatively affect breeding. The species is captured and traded; however, it is unknown how many deaths occur in captivity and transit. Direct hunting and nest-raiding for other uses and indiscriminate poisoning at waterholes are also further threats. A proposed conservation action is that landowners of suitable properties should join biodiversity stewardship initiatives and to manage their properties in a sustainable way for the species' populations. The grasslands and agricultural fields within the study area may be suitable foraging grounds for this SCC.

Scopus umbretta (Hamerkop) is a widespread resident in sub-Saharan Africa, inhabiting a range of wetland habitats, including rivers, dams, and marshes (IUCN, 2023). It is often seen foraging in shallow water and is known for its large, conspicuous nests. Suitable wetland habitats within the study area support a High likelihood of occurrence for this species.

Spatula smithii (Cape Shoveler) is endemic to southern Africa and is commonly found in a variety of wetland habitats, including lakes, pans, and marshes (IUCN, 2023). It feeds on aquatic invertebrates and plant material in shallow water. The presence of suitable wetlands within the study area supports a High likelihood of occurrence.

9.9 FRESHWATER ECOLOGY - SURFACE WATER AND WETLAND

9.9.1 DRAINAGE AND CATCHMENT

This section provides an overview of the regional hydrological (surface water) environment across the extent of the project area. Information in this section has been sourced from the Baseline Geohydrological Assessment undertaken by Gradient Groundwater Consulting (**Appendix F7**) and the Baseline Soils, Agriculture, Freshwater and Terrestrial Biodiversity Assessment undertaken by the Biodiversity Company (**Appendix F1**).

South Africa was originally divided into nineteen Water Management Areas (WMAs) which were later consolidated to nine. The delegation of water resource management from central government to catchment level is achieved by establishing Catchment Management Agencies (CMAs) at WMA level. Each CMA progressively develops a Catchment Management Strategy (CMS) for the protection, use, development, conservation, management and control of water resources within its WMA. This is to ensure that on a regional scale, water is protected, used, developed, conserved, managed and controlled in a sustainable and equitable manner for the benefit of all persons. The main instrument that guides and governs the activities of a WMA is the CMS which, while conforming to relevant legislation and national strategies, provides detailed arrangements for the protection, use, development, conservation, management and control of the region's water resources. The greater study area is situated in primary catchment (C) of the Vaal River drainage system which covers a total area of approximately 598.0km^2. The resource management falls under the Vaal Water Management Area (WMA5) (previously Middle Vaal WMA[4]) which spans portions of the North West Province, northern Free State as well as northern sections of the Northern Cape. The study area encompasses several quaternary catchments of the Vaal WMA. These include Quaternary Catchments C42G, C42H and C42K. The main watercourses within the Middle Vaal WMA are the Mooi, Vet, Sand and Vaal Rivers (WRC, 2016). The Vaal River is a major tributary of the Orange River, which generally drains in an eastern direction towards the Atlantic Ocean.

The hydrology of the region is characterised by predominately perennial watercourses with primary rivers in and around the study area the Merriespruit, Steenbokspruit and Maselspruit, draining the northern section of the production right area in a general northwestern direction, forming a confluence with the Sand River flowing on the northern perimeter in a general southwestern direction. The southern section of the production right area is drained by the Doringspruit as well as Schoemanspruit flowing in a general western direction.

Major surface water bodies in close proximity to the greater study area include the Allemanskraal Dam (a surface area of approximately 28.64 km^2), which is situated approximately 13.0 km due east and located within the Sand The mean annual runoff (MAR) for the study area is estimated at approximately 12.34 Mm^3/a, based on MAR data obtained from WR2012 (WRC, 2016). **Table 26** provides a summary of relevant climatological and hydrogeological information for the relevant quaternary catchments. Refer to **Figure 51** for the hydrological conditions.

[4] It should be noted that the Department of Water Affairs (DWA), now the Department of Water and Sanitation (DWS), replaced the original 19 WMAs established in 2004 by 9 new WMAs as defined in Government Gazette No. 35517, July 2012. This resulted in the grouping of the Upper, Middle, and Lower Vaal WMAs into the single Vaal WMA.

Table 26: Study Area Catchment and Hydrological Properties (Gradient Groundwater Consulting, 2025).

Quaternary Catchment	Area (km^2)	% Covered by Study Area	MAP (mm/a)	MAE (mm/a)	MAR (Mm^3/a)	Rainfall Zone	Evaporation Zone
C42G	555.01	38.92	549.39	1560	13.83	C4C	19C
C42H	445	25.24	540	1 590	10.16	C4C	19C
C42K	668.01	35.66	521.15	1 600	13.02	C4C	19C

9.9.2 SOUTH AFRICAN INVENTORY OF INLAND AQUATIC ECOSYSTEMS

The South African Inventory of Inland Aquatic Ecosystems spatial dataset is part of the South African Inventory of Inland Aquatic Ecosystems (SAIIAE) which was released as part of the National Biodiversity Assessment (NBA 2018). National Wetland Map 5 includes inland wetlands and estuaries, associated with river line data and many other data sets within the South African Inventory of Inland Aquatic Ecosystems (SAIIAE, 2018). Ecosystem threat status (ETS) of river and wetland ecosystem types are based on the extent to which each river ecosystem type has been altered from its natural condition. Ecosystem types are categorised as CR, EN, VU or LT, with CR, EN and VU ecosystem types collectively referred to as 'threatened' (Van Deventer *et al.,* 2019; Skowno *et al.,* 2019). The study area overlaps with multiple wetlands and river ecosystems identified by the dataset. The wetlands identified include numerous LC depressions and one CR seep. The identified river lines are CR (**Figure 52**).

9.9.3 NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREA STATUS

To better conserve aquatic ecosystems, South Africa has categorised its river systems according to set ecological criteria (i.e., ecosystem representation, water yield, connectivity, unique features, and threatened taxa) to identify Freshwater Ecosystem Priority Areas (FEPAs) (Driver *et al.,* 2011). The FEPAs 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 (NEM:BA) biodiversity goals (Nel *et al.,* 2011). **Figure 53** shows that the study area overlaps numerous non-priority wetlands and multiple NFEPA rivers.

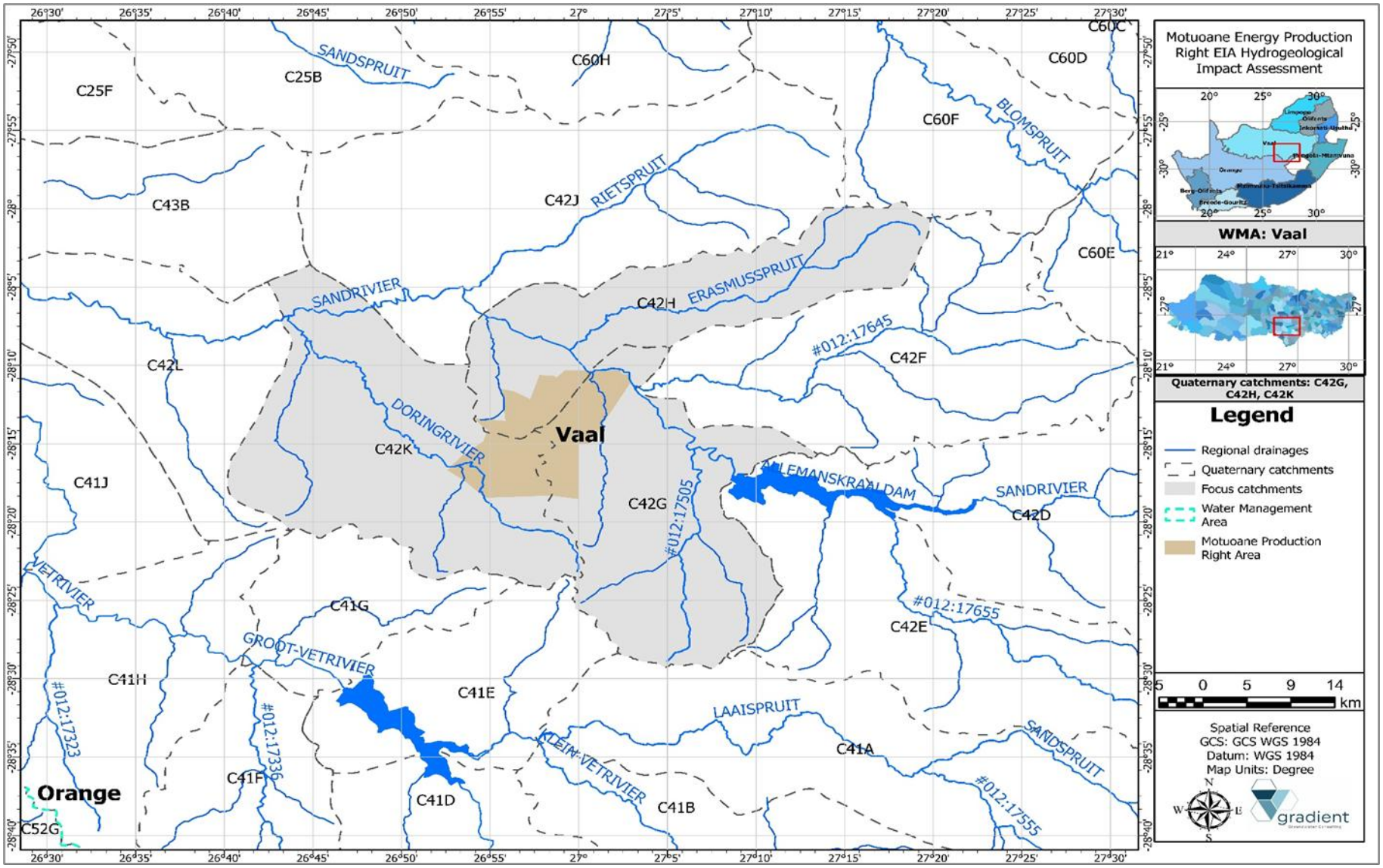


Figure 51: Quaternary catchments and water management area (Gradient Groundwater Consulting, 2025).

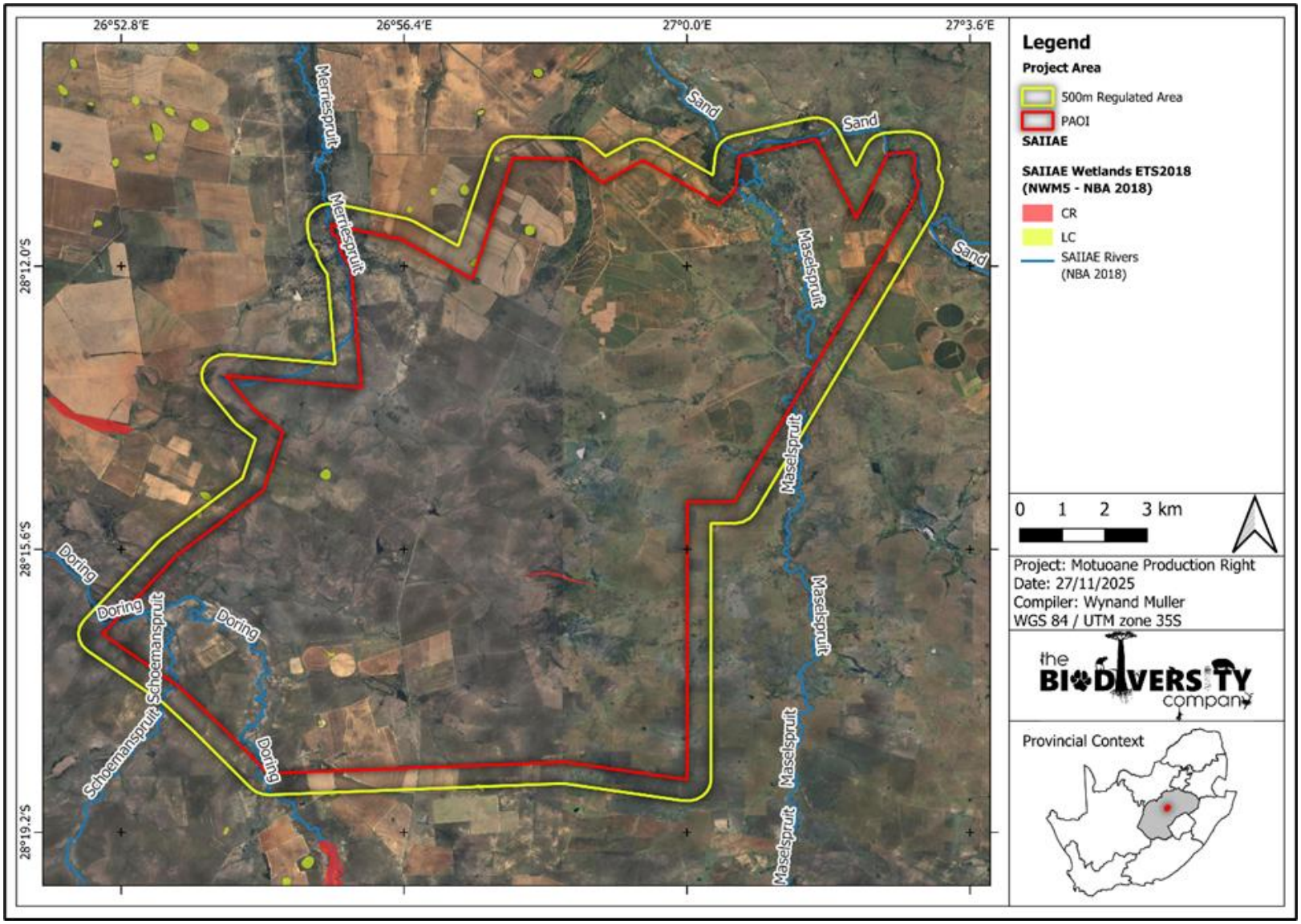


Figure 52: Map illustrating ecosystem threat status of rivers and wetlands in the study area (The Biodiversity Company, 2025).

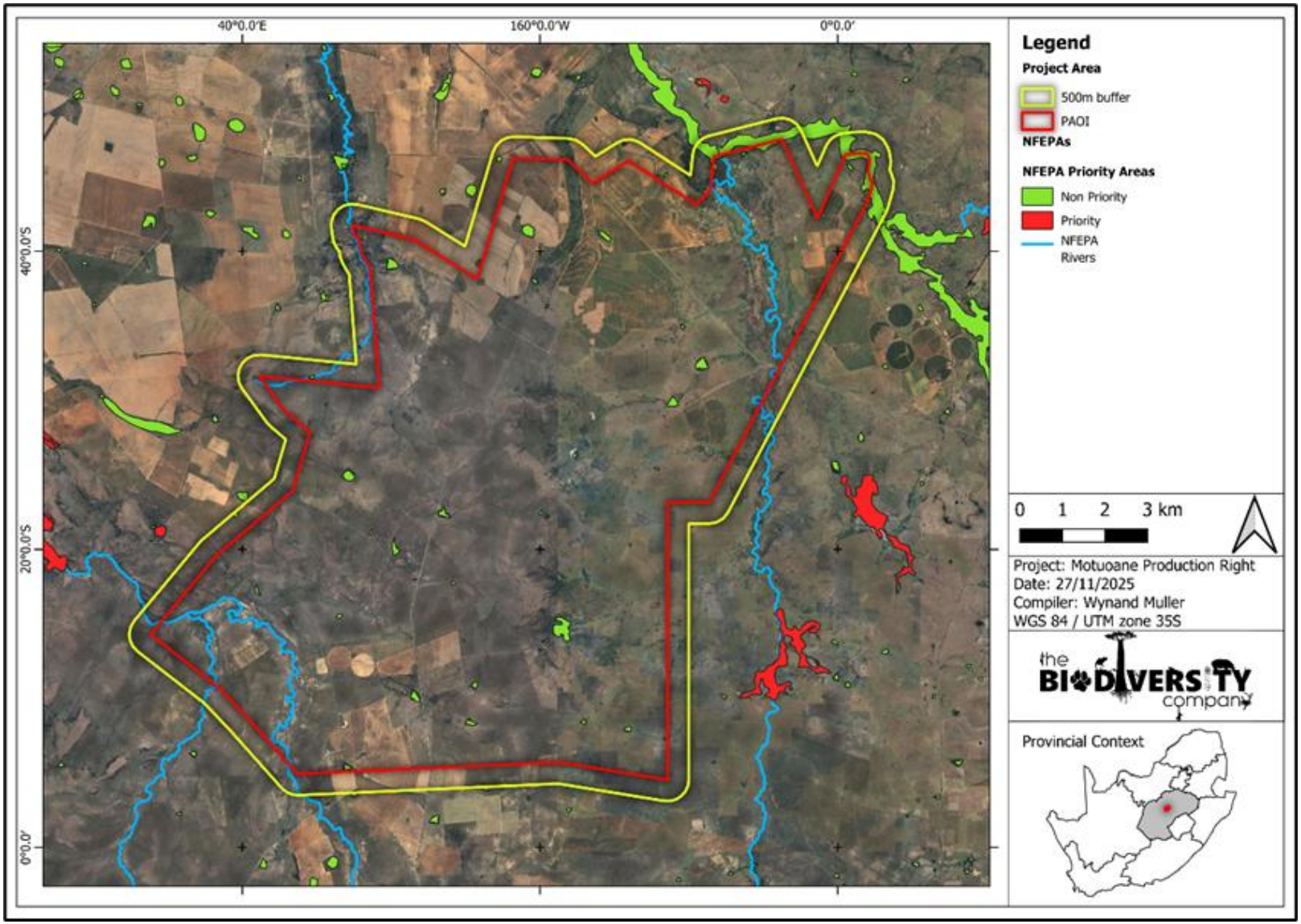


Figure 53: The PR in relation to the National Freshwater Ecosystem Priority Areas (The Biodiversity Company, 2025).

9.10 HYDROGEOLOGY - GROUNDWATER

This section summarises the regional and site-specific hydrogeology as obtained from the Baseline Geohydrological Assessment by Gradient Groundwater Consulting (2025) attached as **Appendix F7**. A detailed geohydrological specialist study will be conducted as part of this EIA and included in the EIA phase report. The geohydrological setting and conceptual model of the study area is described according to the following criteria:

- Regional hydrogeology information;
- Local hydrostratigraphic units;
- Unsaturated zone;
- Groundwater-surface water interaction; and
- Hydraulic parameters.

9.10.1 REGIONAL HYDROGEOLOGY INFORMATION

The Department of Water and Sanitation have characterised South African aquifers based on host-rock formations in which it occurs together with its capacity to transmit water to boreholes drilled into relative formations. The water bearing properties of respective formations can be classified into four aquifer classes defined below. Each of these classes is further subdivided into groups relating to the capacity of an aquifer to transmit water to boreholes, typically measured in Litres per second (L/s). The groups therefore represent various ranges of borehole yields:

a. **Class A:** Intergranular Aquifers associated either with loose and unconsolidated formations such as sands and gravels or with rock that has weathered to only partially consolidated material.

b. **Class B:** Fractured Aquifers associated with hard and compact rock formations in which fractures, fissures and/or joints occur that are capable of both storing and transmitting water in useful quantities.

c. **Class C:** Karst Aquifers associated with carbonate rocks such as limestone and dolomite in which groundwater is predominantly stored in and transmitted through cavities that can develop in these rocks.

d. **Class D:** Intergranular and fractured Aquifers that represent a combination of Class A and B aquifer types. This is a common characteristic of South African aquifers. Substantial quantities of water are stored in the intergranular voids of weathered rock but can only be tapped via fractures penetrated by boreholes drilled into it.

According to the DWS Hydrogeological map (DWS Hydrogeological map series 2726 Kroonstad) the study area is predominantly underlain by a Class d2 intergranular and fractured aquifer (typically associated with median borehole yields ranging between 0.1 and 0.5 L/s), with host aquifers consisting primarily of arenaceous and argillaceous strata. It should however be noted that higher yielding boreholes (>5.0l/s) may occur along intruding dyke contact zones and other structural features i.e., fault zones etc. (Barnard, 2000). Most hard-rock aquifers are secondary in nature with groundwater associated with fracturing, fault zones as well as contact zones of the dolerite intrusions. Aquifer hosts in the Beaufort Group comprise of mudstone and sandstone intruded by dolerite dykes and sheets, however will not only be multi-layered, but also multi-porous with variable thicknesses. The contact plane between two different sedimentary layers will cause a discontinuity in the hydraulic properties of the composite aquifer.

According to Vegter's groundwater regions delineated (2000) the study area can be classified as falling under the Northeastern Upper Karoo Region (Region 30). Groundwater Region 30 comprises of mudstone and sandstone (with dolerite dyke and sill intrusions) of the Adelaide and Tarkastad Subgroups within the Beaufort Group of the Karoo Supergroup (WRC, 2016). The maximum aquifer thickness i.e., shallow, intergranular aquifer system within the Northeastern Upper Karoo Region is 20 – 30m with water stored mainly in decomposed/partly decomposed rock and water bearing fractures principally restricted to a shallow zone below the static

groundwater level. Refer to **Figure 55** for a map illustrating the typical groundwater occurrence for the greater study area while **Figure 56** depicts the hydrogeological map of the greater study area.

9.10.2 LOCAL HYDROSTRATIGRAPHIC UNITS

For the purposes of this investigation, three main hydrostratigraphic units/aquifer systems can be inferred in the saturated zone[5]:

i. A **shallow Quaternary (perched and unconfined) aquifer**: These aquifers consist of recent types of sediments and are characteristically primary porosity aquifers, such that groundwater flow occurs in the pore spaces between soil and sediment particles. These aquifers are formed by alluvial material along the riparian zone of local drainages and are limited to a zone of variable width and depth. Clay lenses in the soil and unsaturated zones may cause local, perched water tables which occur above the regional water table.

ii. A **shallow, intergranular and fractured aquifer within the Beaufort Group and Karoo Dolerite Suite**: These aquifers occur in the transitional soil and weathered bedrock formations underlain by more consolidated bedrock. Groundwater flow patterns usually follow the topography, discharging as natural springs at topographic low-lying areas. Usually, these aquifers can be classified as a secondary porosity aquifer and is generally unconfined with phreatic water levels. In secondary porosity aquifers, groundwater flow occurs along fractures, while water is stored within the rock matrix. Due to higher effective porosity (n) this aquifer is more susceptible to impacts from contaminant sources compared to confined aquifers.

iii. A **deeper, fractured aquifer within Beaufort Group and Karoo Dolerite Suite formations**: In fractured aquifers, pores are well-cemented and do not allow any significant flow of water. Groundwater flow is dictated by transmissive secondary porosity structures such as bedding planes fractures, faults and contact zones fracture zones that occur in the relatively competent host rock. Fractured mudstone, sandstone, shales sequences as well as dolerite dykes and sills are considered as fractured rock aquifers holding water in storage in both pore spaces and fractures. Groundwater yields, although more heterogeneous, can be expected to be higher than the weathered zone (shallow) aquifer. This aquifer system usually displays semi-confined or confined characteristics with potentiometric heads often significantly higher than the water-bearing fracture position.

9.10.3 UNSATURATED ZONE

The unsaturated (vadose) zone is defined as the subsurface zone between the ground surface and the main water table where pores are filled with both air and water as depicted in **Figure 54** (Fetter and Kreamer, 2023). According to the 1.0×1.0 km groundwater level grid obtained from WR2012 (WRC, 2016), the thickness of the unsaturated zone i.e., depth to groundwater ranges between ~30.0 m to >55.0 m.

9.10.4 GROUNDWATER-SURFACE WATER INTERACTION

Groundwater and surface water interaction is an essential component of the hydrological cycle. The hyporheic zone (stream bed) is the zone of most interaction (Adams *et. al*.,2012). According to records documented by Van Tonder and Dennis (2003), under natural conditions this area exhibits certain regions where there is pronounced interaction between surface and groundwater. The two regimes are therefore well-linked and should be integrated to manage any water-related issues in these catchments. Regional drainages can be generally classified as influent or gaining stream systems as the groundwater head elevation of the water table in the vicinity of the stream is higher than the altitude of the stream bed and, accordingly, there definitely exists groundwater discharge as baseflow to local drainages. The alluvial associated with the floodplains within the greater study area forms a primary aquifer and may potentially be directly connected with surface water resources, especially during high flow conditions.

[5] Refer to project assumptions and limitations, it should be noted that no site characterisation boreholes have been drilled to confirm this statement.

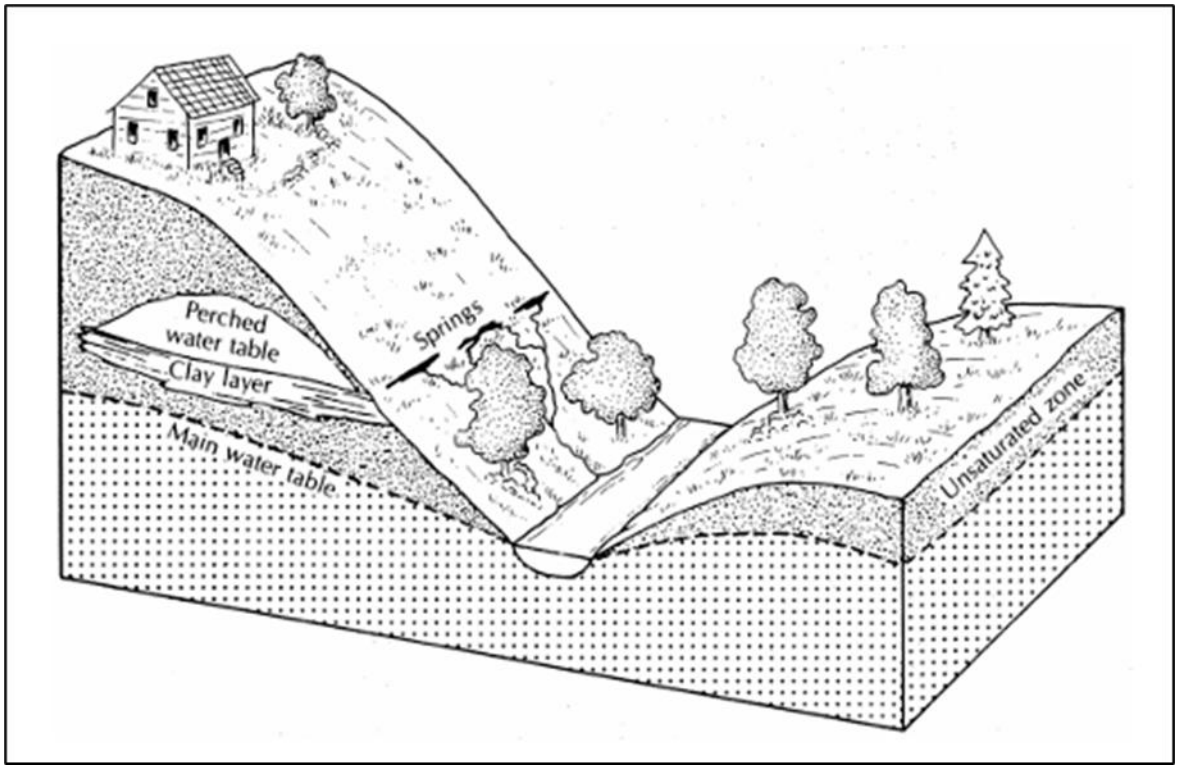


Figure 54: Illustration of the Unsaturated Zone (Fetter and Kreamer, 2023).

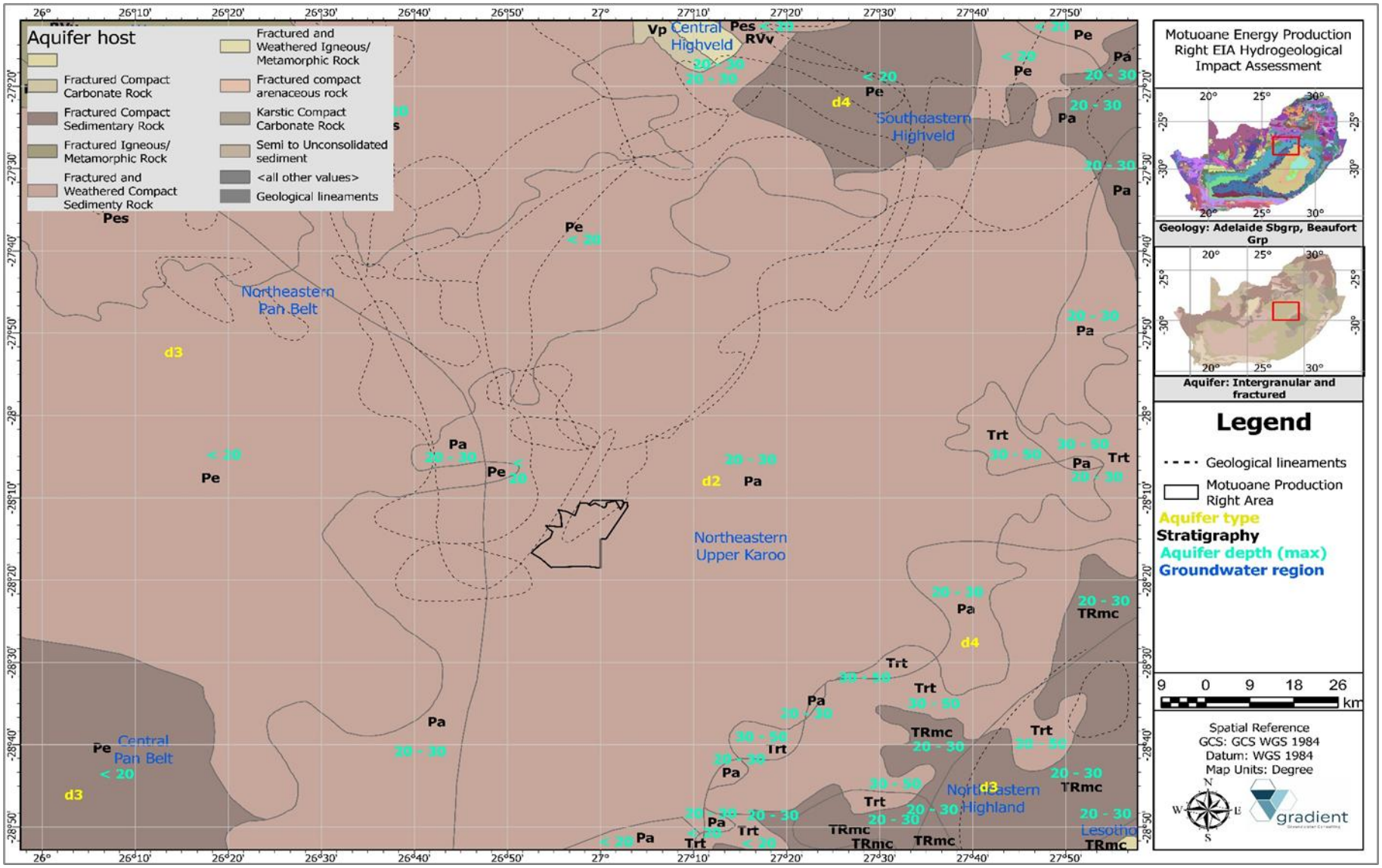


Figure 55: Typical aquifer hosts and groundwater occurrence for the study region (Gradient Groundwater Consulting, 2025).

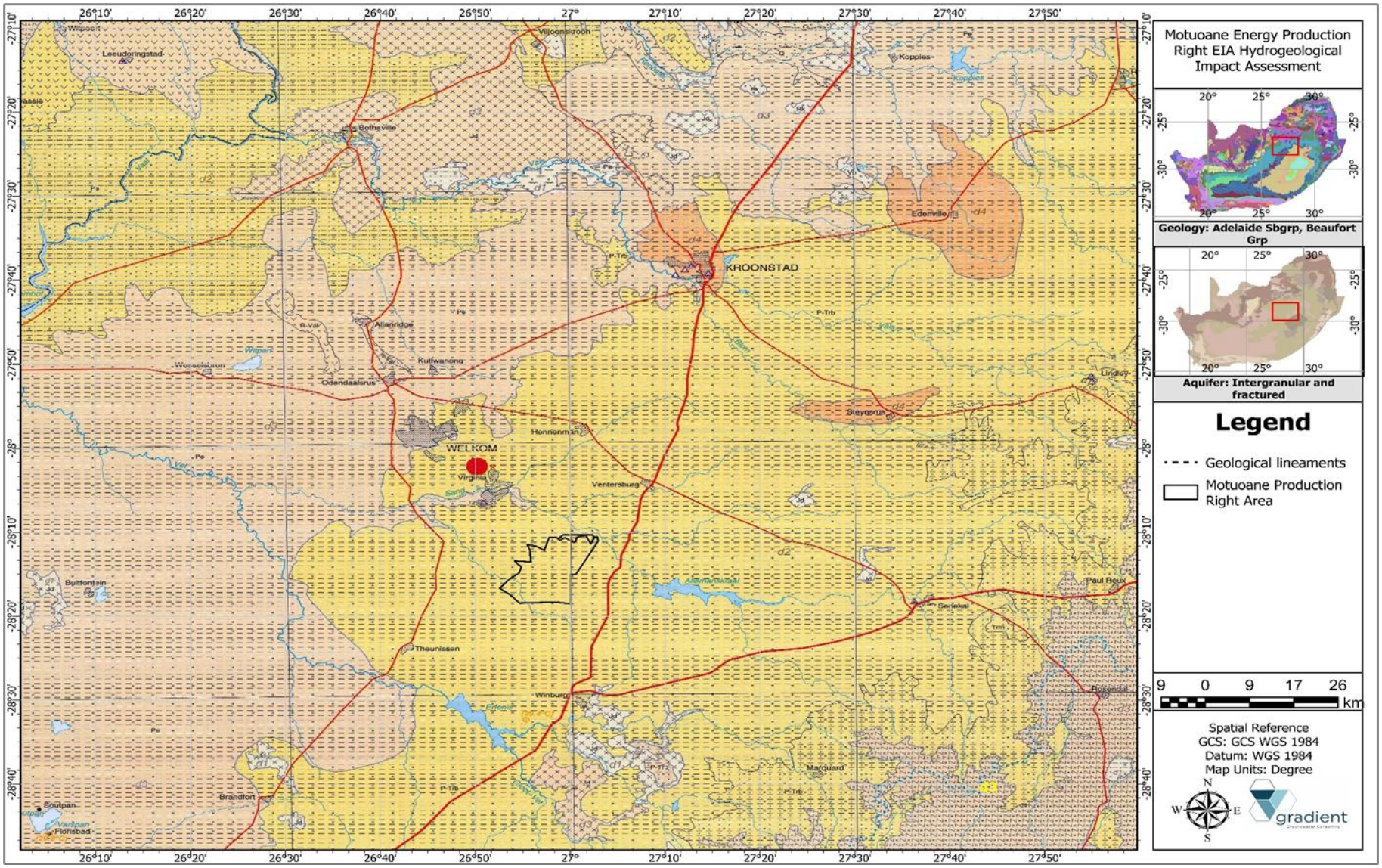


Figure 56: Hydrogeological map of the greater study region (Gradient Groundwater Consulting, 2025).

9.10.5 HYDRAULIC PARAMETERS

This section provides a brief overview of aquifer hydraulic parameters based on published literature for similar hydrogeological conditions as well as historical reports.

9.10.5.1 HYDRAULIC CONDUCTIVITY AND TRANSMISSIVITY

Hydraulic conductivity is the constant of proportionality in Darcy's Law which states that the rate of flow through a porous medium is proportional to the loss of head, and inversely proportional to the length of the flow path as indicated in the following equation for Hydraulic Conductivity (Darcy's Law)**:**

$$K = \frac{Q}{A\left(\frac{dh}{dl}\right)}$$

where:

K = Hydraulic Conductivity (m/d).

Q = Flow of water per unit of time (m^3/d).

dh/dl = Hydraulic gradient.

A = is the cross-sectional area, at a right angle to the flow direction, through which the flow occurs (m^2)

The hydraulic conductivity of sedimentary formations such as evident on site can range from $10E^{-6}$ – $10E^{-2}$ m/d. The hydraulic conductivity of fractured igneous rocks (i.e. dolerite) varies between $10E^{-6}$ – $10E^{-1}$ m/d, while conductivity values for un-fractured igneous rocks (i.e. fresh dolerite sill) ranges between $10E^{-9}$ – $10E^{-6}$ m/d. The hydraulic conductivity of quaternary deposits and alluvial pockets associated with the drainage system i.e., riverbed aquifers can be orders higher and can vary between $10E^{-2}$ – $10E^{1}$ m/d (Freeze and Cherry, 1979). Refer to **Figure 57** for the typical hydraulic conductivity values for on-site hydrostratigraphical units.

Transmissivity can be expressed as the product of the average hydraulic conductivity (K) and thickness (b) of the saturated portion of an aquifer and expressed by:

$$T = Kb$$

where:

T = Transmissivity (m^2/d).

K = Hydraulic Conductivity (m/d).

b = Saturated aquifer thickness.

According to the transmissivity GIS data provided by WR2012 (WRC, 2016), the entire study area is underlain by a Class d2 intergranular and fractured aquifer with an average transmissivity of 17.5 m^2/day (WRC, 2016)[6].

[6] It should be noted that no aquifer tests were conducted to support site representative hydraulic parameters.

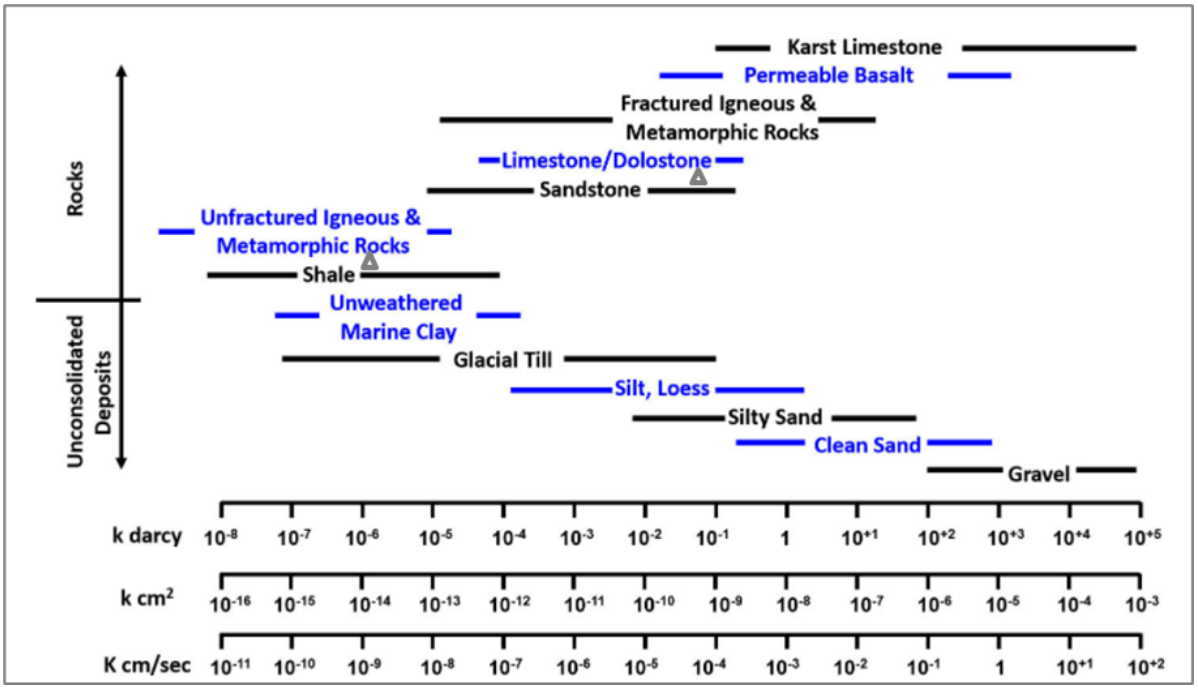


Figure 57: Typical hydraulic conductivity values for on-site hydrostratigraphical units (Gradient Groundwater Consulting, 2025).

9.10.5.2 STORATIVITY

Storativity refers to the volume of water per volume of aquifer released as a result of a change in head. For a confined aquifer, the storage coefficient is equal to the product of the specific storage and aquifer thickness. Typical storativity values for fractured rock systems is in the order of $10E^{-5}$ – $10E^{-3}$ (Freeze and Cherry, 1979). Storativity values of the shallow, weathered aquifer will be slightly higher i.e., $10E^{-2}$.

9.10.5.3 POROSITY

Porosity is an intrinsic value of seepage velocity and hence contamination migration. The porosity of fractured sedimentary formations ranges between 3% – 10%, while porosity of weathered formations can range between 10% to 15% depending on the nature and state of weathering. The intrinsic porosity of primary aquifers i.e., alluvial deposits can be as high as 20% depending on the nature of sorting (Freeze and Cherry, 1979).

9.10.5.4 RECHARGE

An approximation of recharge for the study area is estimated at at ~3.27% of MAP i.e. ~17.52 mm/a as summarised in **Table 27**. According to the 1 × 1 km recharge grid obtained from WR2012, the average recharge in the greater study area ranges is approximately 1% (5.0 mm/a) whereas the upper limit is approximately 5.0% (26.50mm/a) (WRC, 2016). Groundwater recharge was calculated using the RECHARGE Program1 (van Tonder and Xu, 2000), which includes using qualified guesses as guided by various schematic maps. The following methods/sources were used to estimate the recharge: (i) Geology (ii) Vegter Groundwater Recharge Map (**Figure 58**) (iii) Harvest Potential (**Figure 59**) (iv) Baseflow as a minimum of recharge (v) Qualified opinion and, (vi) Literature review.

Table 27: Recharge estimation (after van Tonder and Xu, 2000) (Gradient Groundwater Consulting, 2025).

Recharge method/ Reference	Recharge (mm/a)	Recharge (% of MAP)	Weighted Average (High = 5; Low = 1)
Geology	22.00	4.10	1.00
Vegter	20.00	3.73	4.00

Recharge method/ Reference	Recharge (mm/a)	Recharge (% of MAP)	Weighted Average (High = 5; Low = 1)
Harvest Potential	15.00	2.80	3.00
Baseflow	15.00	2.80	3.00
Qualified Opinion	17.50	3.27	3.00
Literature	17.80	3.32	3.00
Weighted average	**17.52**	**3.27**	**17.00**
Notes: Recharge per annum were calculated using a MAP of 535.98 mm/a.			

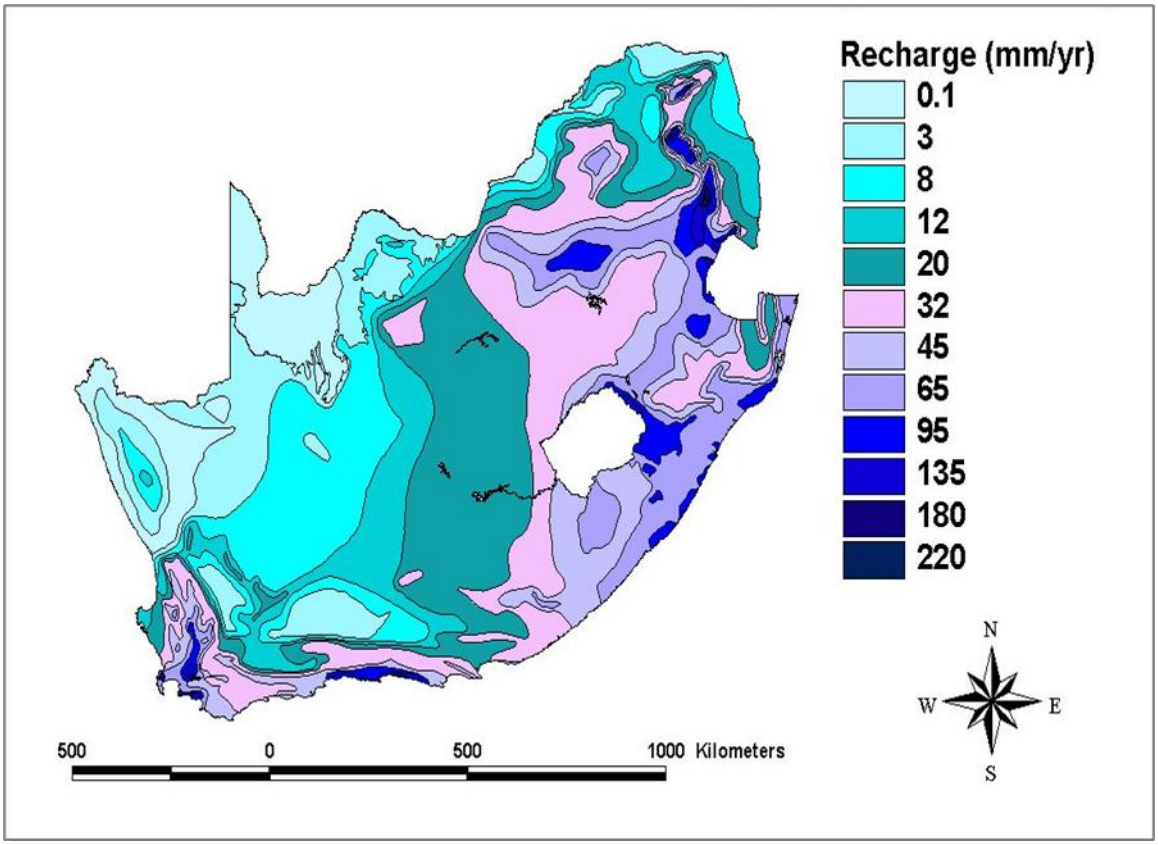


Figure 58: Groundwater recharge distribution in South Africa (After Vegter, 1995).

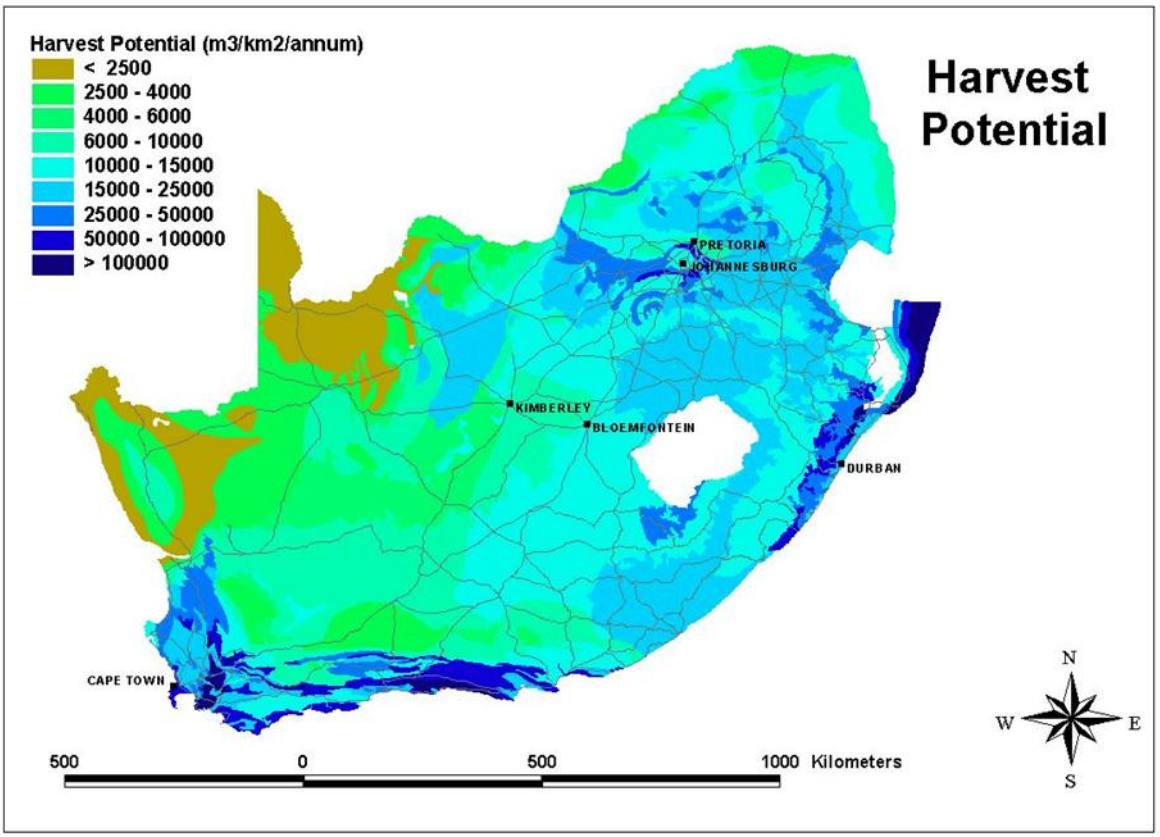


Figure 59: Harvest potential distribution in South Africa (DWS, 2013).

9.10.6 AQUIFER CLASSIFICATION AND GROUNDWATER MANAGEMENT INDEX

The most widely accepted definition of groundwater contamination is defined as the introduction into water of any substance in undesirable concentration not normally present in water e.g. microorganisms, chemicals, waste or sewerage, which renders the water unfit for its intended use (UNESCO, 1992). The objective is to formulate a risk-based framework from geological and hydrogeological information obtained as part of this investigation. Two approaches were followed in an estimation of the risk of groundwater contamination as discussed below. As part of the aquifer classification, a Groundwater Quality Management (GQM) Index is used to define the level of groundwater protection required. The GQM Index is obtained by multiplying the rating of the aquifer system management and the aquifer vulnerability. A **GQM Index = 4** was calculated for the local aquifer system and according to this estimate, a "**Medium**" level groundwater protection is required for this aquifer system.

$$\textit{GQM Index} = \textit{Aquifer system management x Aquifer vulnerability}$$

9.10.6.1 AQUIFER CLASSIFICATION

An aquifer classification system provides a framework and objective basis for identifying and setting appropriate levels of groundwater resource protection. This would facilitate the adoption of a policy of differentiated groundwater protection. The aquifer classification system used to classify the aquifers is the proposed National Aquifer Classification System of Parsons (1995). This system has a certain amount of flexibility and can be linked to second classifications such as a vulnerability or usage classification. Parsons suggests that aquifer classification forms a very useful planning tool that can be used to guide the management of groundwater systems. Parsons also suggests that some level of flexibility should be incorporated when using such a classification system.

The South African Aquifer System Management Classification is presented by five major classes:

- Sole Source Aquifer System;
- Major Aquifer System;

- Minor Aquifer System;
- Non-Aquifer System; and
- Special Aquifer System.

The following definitions apply to the aquifer classification system:

- Sole source aquifer system: “An aquifer that is used to supply 50 % or more of domestic water for a given area, and for which there are no reasonable alternative sources should the aquifer become depleted or impacted upon. Aquifer yields and natural water quality are immaterial”.
- Major aquifer system: “Highly permeable formations, usually with a known or probable presence of significant fracturing. They may be highly productive and able to support large abstractions for public supply and other purposes. Water quality is generally very good”.
- Minor aquifer system: “These can be fractured or potentially fractured rocks that do not have a high primary permeability, or other formations of variable permeability. Aquifer extent may be limited and water quality variable. Although this aquifer seldom produces large quantities of water, they are both important for local supplies and in supplying base flow for rivers”.
- Non-aquifer system: “These are formations with negligible permeability that are generally regarded as not containing groundwater in exploitable quantities. Water quality may also be such that it renders the aquifer unusable. However, groundwater flow through such rocks does occur, although imperceptible, and needs to be considered when assessing risk associated with persistent pollutants”.
- Special aquifer system: “An aquifer designated as such by the Minister of Water Affairs, after due process”.

According to the aquifer classification map of South Africa the project area is underlain by a “**Minor aquifer**”.

9.10.6.2 AQUIFER VULNERABILITY

Aquifer vulnerability can be defined as the tendency or likelihood for contamination to reach a specified position in the groundwater system after introduction at some location above the uppermost aquifer. According to the aquifer vulnerability map of South Africa the project area is underlain by an aquifer system with a “**Moderate**” vulnerability rating.

9.10.6.3 AQUIFER SUSCEPTIBILITY

Aquifer susceptibility is a qualitative measure of relative ease with which a groundwater body can be potentially contaminated by anthropogenic activities. According to the Aquifer susceptibility map of South Africa the project area is underlain by an aquifer system with a **“Medium”** susceptibility rating. Refer to **Table 28**.

Table 28: Groundwater Quality Management Index (Gradient Groundwater Consulting, 2025).

Aquifer system		**Aquifer vulnerability**	
Management qualification		**Classification**	
Class	**Points**	**Class**	**Points**
Sole Source Aquifer System	6	High	3
Major Aquifer System	4	**Moderate**	**2**
Minor Aquifer System	**2**	Low	1
Non-Aquifer System	0		
Special Aquifer System	0-6		

Aquifer system	Aquifer vulnerability
Management qualification	**Classification**
GQM INDEX	**Level of protection**
<1	Limited Protection
1 to 3	Low Level Protection
3 to 6	**Medium Level Protection**
6 to 10	High Level Protection
>10	Strictly Non- Degradation
GQM Index:	**4**

9.10.6.4 SOURCE-PATHWAY-RECEPTOR EVALUATION

In order to evaluate the risk of groundwater contamination, potential sources of contamination should be identified, as well as potential pathways and receptors. The pollution linkage concept relies on the identification of a potential pollutant (i.e. source) on-site which is likely to have the potential to cause harm to a receptor by means of a pathway by which the receptor may be exposed to the contaminant (**Figure 60**).

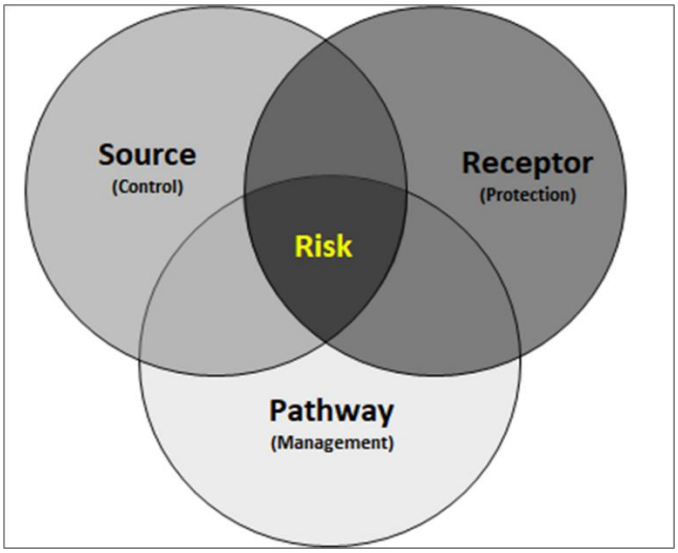


Figure 60: Source pathway receptor principle (Gradient Groundwater Consulting, 2025).

9.10.6.4.1 POTENTIAL SOURCES

The following potential sources have been identified:

i. Seepage of poor-quality water and leachate of waste products.

ii. Seepage of poor-quality water and leachate of waste products including drilling mud sump(s).

iii. Migration of saline groundwater from the deep, fractured aquifer to the overlying, potable aquifer(s) during the gas production phase.

iv. Migration of stray gas from the deep, fractured aquifer to the overlying, potable aquifer(s) during the gas production phase.

v. Migration of contaminants from the plant footprint as well as associated waste facilities and infrastructure into local water resources and host aquifers.

vi. Mobilisation and maintenance of heavy vehicles and machinery on-site may cause hydrocarbon contamination of groundwater resources.

9.10.6.4.2 POTENTIAL PATHWAYS

The following aquifer pathways have been identified:

i. Vertical flow through the unsaturated/vadose zone as well as saturated zone to the underlying intergranular and fractured rock aquifers. The rate at which seepage will take place is governed by the permeability of sub-surface soil layers and host-rock formations.

ii. Preferential flow-paths include the contact between the depth of weathering and fresh un-weathered rock, fractures, faults, joints and bedding planes. Secondary fractures may also potentially act as transport mechanisms.

iii. If not adequately sealed and suitably mitigated, gas production wells will form preferential flow paths and serve as a direct connection between the deeper, fractured aquifer and shallow, potable aquifer unit(s)

9.10.6.4.3 POTENTIAL RECEPTORS

The following receptors were identified:

i. Shallow, inter-granular as well as the intermediate, fractured aquifer units situated within the plume migration footprint(s). The riparian zone aquifer associated with drainage patterns throughout the greater study area can also be viewed as a sensitive groundwater receptor.

ii. Down-gradient drainages and streams including associated riparian zone aquifer system(s) and baseflow contribution.

iii. Private or neighbouring boreholes associated with relevant fracture zones and/or structures(s)if intercepted by the pollution plume migration footprint.

9.10.7 HYDROGEOLOGICAL CONCEPTUAL MODEL

The hydrogeological conceptual model consists of a set of assumptions, which will aid in reducing the problem statement to a simplified and acceptable version. Data gathered during the desk study has been incorporated to develop a conceptual understanding of the regional hydrogeological system. **Figure 61** depicts a generalised hydrogeological conceptual model for similar environments and illustrates the concept of primary porous media aquifers and secondary fractured rock media aquifers. In porous aquifers, flow occurs through voids between unconsolidated rock particles whereas in double porosity aquifers, the host rock is partially consolidated, and flow occurs through the pores as well as fractures in the rock. In secondary aquifers the host rock is consolidated, and porosity is generally restricted to fractures that have formed after consolidation of the rock.

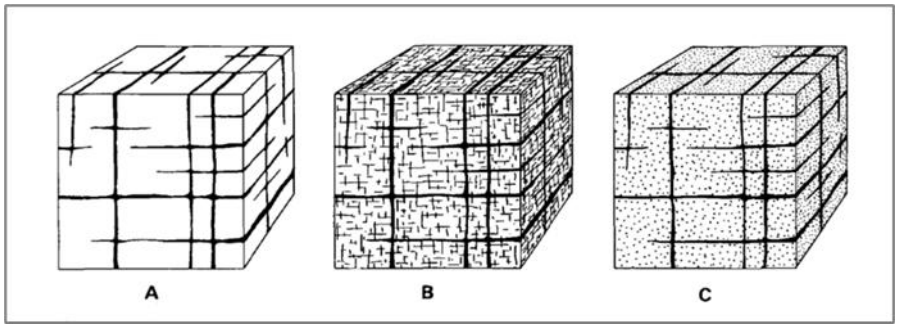


Figure 61: Generalised conceptual hydrogeological model (after Kruseman and de Ridder, 1994).

9.11 AIR QUALITY

The information presented in this section was obtained from the Baseline Air Quality Assessment Report undertaken by Airshed Planning Professionals (**Appendix F3**). Air quality sensitive receptors (AQSRs) refer to

places where humans reside. Ambient air quality guidelines and standards, as discussed under **Section 5.1.6**, have been developed to protect human health. Ambient air quality, in contrast to occupation exposure, pertains to areas outside of an industrial site or boundary where the public has access to and according to the Air Quality Act, excludes air regulated by the Occupational Health and Safety Act (Act No 85 of 1993). Potential sensitive receptors within the project area, include individual households and residential areas (i.e., Virginia (suburbs of Meloding and Calabria) as well as surrounding mines (Beatrix and Harmony Joel) residential areas).

9.11.1 CLIMATE AND ATMOSPHERIC DISPERSION POTENTIAL

Meteorological mechanisms direct the dispersion, transformation and eventual removal of pollutants from the atmosphere. The extent to which pollution will accumulate or disperse in the atmosphere is dependent on the degree of thermal and mechanical turbulence within the earth's boundary layer. This dispersion comprises vertical and horizontal components of motion. The stability of the atmosphere and the depth of the surface-mixing layer define the vertical component. The horizontal dispersion of pollution in the boundary layer is primarily a function of the wind field. The wind speed determines both the distance of downwind transport and the rate of dilution as a result of plume 'stretching'. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness. The wind direction, and the variability in wind direction, determines the general path pollutants will follow, and the extent of crosswind spreading. The pollution concentration levels therefore fluctuate in response to changes in atmospheric stability, to concurrent variations in the mixing depth, and to shifts in the wind field (Tiwary and Colls, 2010).

The spatial variations, and diurnal and seasonal changes, in the wind field and stability regime are functions of atmospheric processes operating at various temporal and spatial scales (Goldreich and Tyson, 1988). The atmospheric processes at macro- and meso-scales need therefore be taken into account in order to accurately parameterise the atmospheric dispersion potential of a particular area. A qualitative description of the synoptic systems determining the macro-ventilation potential of the region may be provided based on the review of pertinent literature. These meso-scale systems may be investigated through the analysis of meteorological data observed for the region.

For the purpose of the scoping assessment, surface and profile weather data for the period January 2019 to December 2021 was obtained from the South African Weather Service (SAWS) station at Welkom. **Updated meteorological data for the period 2022 – 2024 will be used for the AQIA.**

9.11.2 LOCAL WIND FIELD

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness (Tiwary and Colls, 2010).

Period and diurnal wind roses drawn from the Welkom SAWS station shown in **Figure 62**. During the period 2019 to 2021, the wind field was dominated by winds from the northeastern sector. Calm conditions occurred for 3.5% of the time. Wind speeds decreased during night-time conditions with an increase in calms to 4.65%.

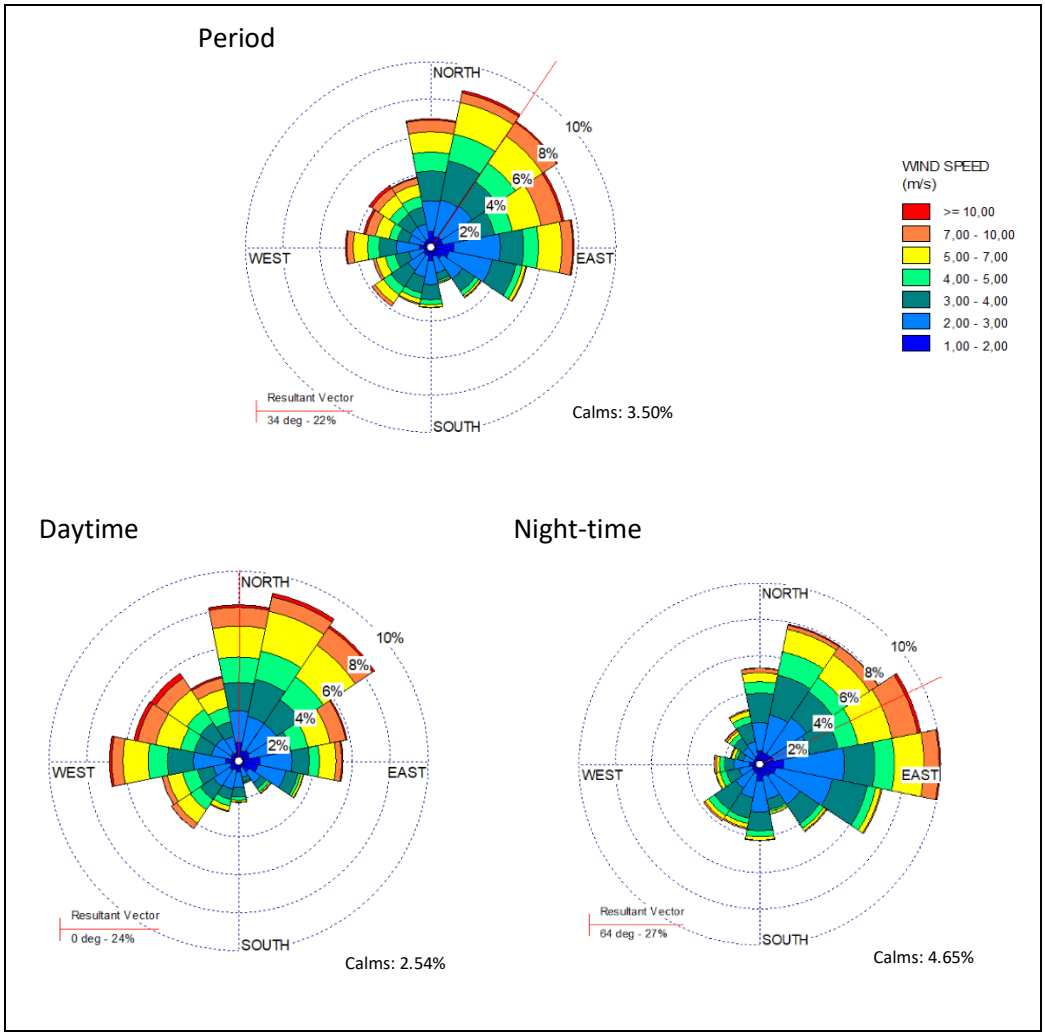


Figure 62: Period average, daytime and night-time wind roses measured data; January 2019 to December 2021 from SAWS Welkom monitoring station (Airshed Planning Professionals, 2025)

9.11.3 ATMOSPHERIC STABILITY AND MIXING DEPTH

The new generation air dispersion models differ from the models traditionally used in a number of aspects, the most important of which are the description of atmospheric stability as a continuum rather than discrete classes. The atmospheric boundary layer properties are therefore described by two parameters: the boundary layer depth and the Monin-Obukhov length, rather than in terms of the single parameter Pasquill Class. The Monin-Obukhov length (LMo) provides a measure of the importance of buoyancy generated by the heating of the ground and mechanical mixing generated by the frictional effect of the earth's surface. Physically, it can be thought of as representing the depth of the boundary layer within which mechanical mixing is the dominant form of turbulence generation (CERC, 2004). The atmospheric boundary layer constitutes the first few hundred metres of the atmosphere. During the daytime, the atmospheric boundary layer is characterised by thermal turbulence due to the heating of the earth's surface. Night times are characterised by weak vertical mixing and the predominance of a stable layer. These conditions are normally associated with low wind speeds and less dilution potential. During windy and/or cloudy conditions, the atmosphere is normally neutral. For low level releases, the highest ground level concentrations would occur during weak wind speeds and stable (night-time) atmospheric conditions.

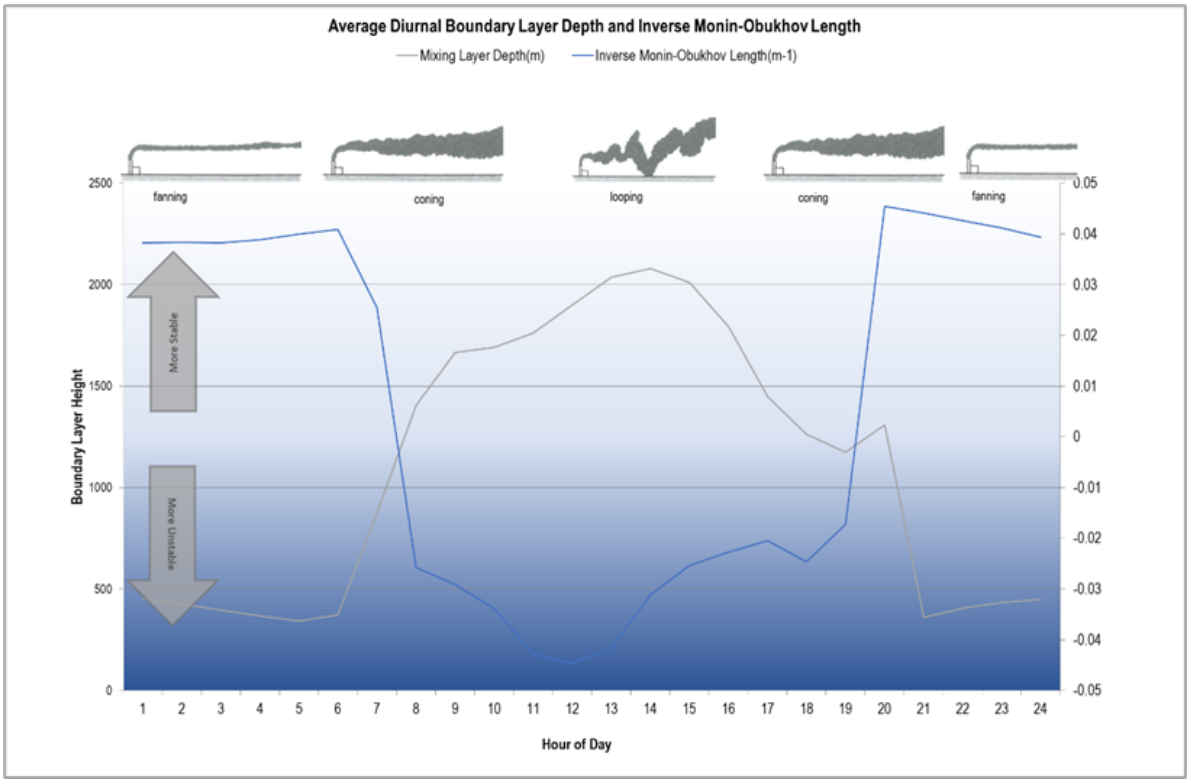


Figure 63: Diurnal atmospheric stability as described by the inverse of the measured Monin-Obukhov length (SAWS Welkom Data: 2019 to 2021)

9.11.4 AMBIENT AIR QUALITY WITHIN THE REGION

9.11.4.1 SOURCES OF POLLUTION IN THE REGION

Neighbouring land-use in the surrounding of the proposed project comprises predominantly of agriculture activities. These land-uses contribute to baseline pollutant concentrations via fugitive and process emissions, vehicle tailpipe emissions, household fuel combustion, biomass burning and windblown dust from exposed areas.

9.11.4.1.1 AGRICULTURE

Agriculture is a major land-use activity within and beyond the Project boundary. These activities include crop farming such as maize, and livestock farming. Particulate matter is the main pollutant of concern from agricultural activities as particulate emissions are derived from windblown dust, burning crop residue, and dust entrainment as a result of vehicles travelling along dirt roads. In addition, pollen grains, mould spores and plant and insect parts from agricultural activities all contribute to the particulate load. Should chemicals be used for crop spraying, they would typically result in odiferous emissions. Crop residue burning is also an additional source of particulate emissions and other toxins.

Livestock farms, especially cattle, are also significant sources of fugitive dust especially when feedlots are used and the cattle trample in confined areas. Pollutants associated with dairy production for instance include ammonia (NH_3), hydrogen sulfide (H_2S), methane (CH_4), carbon dioxide (CO_2), oxides of nitrogen (NOx) and odour related trace gasses. According to the US-EPA, cattle emit methane through a digestive process that is unique to ruminant animals called enteric fermentation. The calf-cow sector of the beef industry was found to be the largest emitter of methane emissions. Where animals are densely confined the main pollutants of concern include dust from the animal movements, their feed and their manure, NH_3 from the animal urine and manure, and H_2S from manure pits.

Organic dust includes dandruff, dried manure, urine, feed, mould, fungi, bacteria and endotoxins (produced by bacteria, and viruses). Inorganic dust is composed of numerous aerosols from building, materials and the environment. Since the dust is biological it may react with the defence system of the respiratory tract. Odours

and VOCs associated with animal manure is also a concern when cattle are kept in feedlots. The main impact from methane is on the dietary energy due to the reduction of carbon from the rumen. Dust and gasses levels are higher in winter or whenever animals are fed, handled or moved.

9.11.4.1.2 MINING SOURCES

Particulates represent the main pollutant of concern at mining operations, whether it is underground or opencast. The amount of dust emitted by these activities depends on the physical characteristics of the material, the way in which the material is handled and the weather conditions (e.g. high wind speeds, rainfall, etc.). Mining of gold, including ore extraction, processing plants, waste rock dumps and tailings storage facilities are all commercial activities situated in the region of the project.

9.11.4.1.3 DOMESTIC FUEL COMBUSTION

Domestic households are known to have the potential to be one the most significant sources that contribute to poor air quality within residential areas. Individual households are low volume emitters, but their cumulative impact is significant. It is likely that households within the local communities or settlements utilize coal, paraffin and/or wood for cooking and/or space heating (mainly during winter) purposes. Pollutants arising from the combustion of wood include respirable particulates, CO and SO_2 with trace amounts of polycyclic aromatic hydrocarbons (PAHs), in particular benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons.

Coal is relatively inexpensive in the region and is easily accessible due to the proximity of the region to coal mines and the well-developed coal merchant industry. Coal burning emits a large amount of gaseous and particulate pollutants including SO_2, heavy metals, PM including heavy metals and inorganic ash, CO, PAHs (recognized carcinogens), NO2 and various toxins. The main pollutants emitted from the combustion of paraffin are NO_2, particulates, CO and PAHs.

9.11.4.1.4 BIOMASS BURNING

Biomass burning includes the burning of evergreen and deciduous forests, woodlands, grasslands, and agricultural lands. Within the project vicinity, crop-residue burning and wildfires (locally known as veld fires) may represent significant sources of combustion-related emissions. The frequency of wildfires in the grasslands varies between annual and triennial. Biomass burning is an incomplete combustion process (Cachier, 1992), with carbon monoxide, methane and nitrogen dioxide gases being emitted. Approximately 40% of the nitrogen in biomass is emitted as nitrogen, 10% is left in the ashes, and it may be assumed that 20% of the nitrogen is emitted as higher molecular weight nitrogen compounds (Held, *et al.,* 1996). The visibility of the smoke plumes is attributed to the aerosol (particulate matter) content. In addition to the impact of biomass burning within the vicinity of the project activity, long-range transported emissions from this source can be expected to impact on the air quality between the months of August to October. It is impossible to control this source of atmospheric pollution loading; however, it should be noted as part of the background or baseline condition before considering the impacts of other local sources.

9.11.4.1.5 FUGITIVE DUST SOURCES

These sources are termed fugitive because they are not discharged to the atmosphere in a confined flow stream. Sources of fugitive dust identified in the study area include paved and unpaved roads and wind erosion of sparsely vegetated surfaces.

9.11.4.1.6 UNPAVED AND PAVED ROADS

Emissions from unpaved roads constitute a major source of emissions to the atmosphere in the South African context. When a vehicle travels on an unpaved road the force of the wheels on the road surface causes pulverization of surface material. Particles are lifted and dropped from the rolling wheels, and the road surface is exposed to strong turbulent air shear with the surface. The turbulent wake behind the vehicle continues to act on the road surface after the vehicle has passed. Dust emissions from unpaved roads vary in relation to the vehicle traffic and the silt loading on the roads. Unpaved roads in the region are mainly haul and access roads.

Emissions from paved roads are significantly less than those originating from unpaved roads, however they do contribute to the particulate load of the atmosphere. Particulate emissions occur whenever vehicles travel over a paved surface. The fugitive dust emissions are due to the re-suspension of loose material on the road surface. Paved roads in the region include the N1, R73 and the R30.

9.11.4.1.7 WIND EROSION OF OPEN AREAS

Windblown dust generates from natural and anthropogenic sources. For wind erosion to occur, the wind speed needs to exceed a certain threshold, called the threshold velocity. This relates to gravity and the inter-particle cohesion that resists removal. Surface properties such as soil texture, soil moisture and vegetation cover influence the removal potential. Conversely, the friction velocity or wind shear at the surface is related to atmospheric flow conditions and surface aerodynamic properties. Thus, for particles to become airborne, its erosion potential has to be restored; that is, the wind shear at the surface must exceed the gravitational and cohesive forces acting upon them, called the threshold friction velocity. Every time a surface is disturbed, its erosion potential is restored (US EPA, 2006). Erodible surfaces may occur as a result of agriculture and/or grazing activities.

9.11.4.1.8 VEHICLE TAILPIPE EMISSIONS

Emissions resulting from motor vehicles can be grouped into primary and secondary pollutants. While primary pollutants are emitted directly into the atmosphere, secondary pollutants form in the atmosphere as a result of chemical reactions. Significant primary pollutants emitted combustion engines include CO_2, carbon (C), SO_2, oxides of nitrogen (mainly NO), particulates and lead. Secondary pollutants include NO_2, photochemical oxidants such as ozone, sulfur acid, sulphates, nitric acid, and nitrate aerosols (particulate matter). Vehicle type (i.e. model-year, fuel delivery system), fuel (i.e. oxygen content), operating (i.e. vehicle speed, load) and environmental parameters (i.e. altitude, humidity) influence vehicle emission rates.

9.11.4.2 AIR QUALITY SAMPLING RESULTS

There are no publicly accessible ambient measurements in the vicinity of the project. A detailed air quality impact assessment will be undertaken in the EIA phase and results presented in the EIA report and EMPr.

10 ENVIRONMENTAL IMPACT ASSESSMENT

This section aims to identify and do a preliminary assessment on the potential environmental impacts associated with the proposed Motuoane Production project. This impact assessment will be used to guide the identification and selection of preferred alternatives, and management and mitigation measures, applicable to the proposed activities. The preliminary assessment will also serve to focus the subsequent EIA phase on the key issues and impacts.

10.1 IMPACT ASSESSMENT METHODOLOGY

The impact significance rating methodology, as presented herein and utilised for all EIMS Impact Assessment Projects, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the significance (S) of an environmental risk or impact by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relating this to the probability/ likelihood (P) of the impact occurring. The S is determined for the pre- and post-mitigation scenario. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the S to determine the overall final significance rating (FS). The impact assessment will be applied to all identified alternatives.

10.1.1 DETERMINATION OF SIGNIFICANCE

The final significance (FS) of an impact or risk is determined by applying a prioritisation factor (PF) to the post-mitigation environmental significance. The significance is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and Reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$\boldsymbol{C = \frac{(E + D + M + R) * N}{4}}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in **Table 29** below.

Table 29: Criteria for Determining Impact Consequence.

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. Highly localised, limited to the area applicable to the specific activity)
	2	Site (i.e. within the development property or site boundary, or the area within a few hundred meters of the site)
	3	Local (i.e. beyond the site boundary within the Local administrative boundary (e.g. Local Municipality) or within consistent local geographical features, or the area within 5 km of the site)
	4	Regional (i.e. Far beyond the site boundary, beyond the Local administrative boundaries within the Regional administrative boundaries (e.g. District Municipality), or extends into different distinct geographical features, or extends between 5 and 50 km from the site).

Aspect	Score	Definition
	5	Provincial / National / International (i.e. extends into numerous distinct geographical features or extends beyond 50 km from the site).
Duration	1	Immediate (<1 year, quickly reversible)
	2	Short term (1-5 years, less than project lifespan)
	3	Medium term (6-15 years)
	4	Long term (15-65 years, the impact will cease after the operational life span of the project)
	5	Permanent (>65 years, no mitigation measure of natural process will reduce the impact after construction/ operation/ decommissioning).
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected)
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected, or affected environmental components are already degraded)
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; moderate improvement for +ve impacts; or where change affects area of potential conservation or other value, or use of resources).
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease; high improvement for +ve impacts; or where change affects high conservation value areas or species of conservation concern)
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease, substantial improvement for +ve impacts; or disturbance to pristine areas of critical conservation value or critically endangered species)
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring very high time and cost.
	5	Irreversible Impact.

Once the C has been determined, the significance is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per **Table 30**.

It is noted that both environmental risks as well as environmental impacts should be identified and assessed. Environmental Risk can be regarded as the potential for something harmful to happen to the environment, and in many instances is not regarded as something that is expected to occur during normal operations or events (e.g. unplanned fuel or oil spills at a construction site). Probability and likelihood are key determinants or variables of environmental risk. Environmental Impact can be regarded as the actual effect or change that

happens to the environment because of an activity and is typically an effect that is expected from normal operations or events (e.g. vegetation clearance from site results in loss of species of concern). Typically, the probability of an unmitigated environmental impact is regarded as highly likely or certain (management and mitigation measures would ideally aim to reduce this likelihood where possible). In summary, environmental risk is about what could happen, while environmental impact is about what does happen.

Table 30: Probability/ Likelihood Scoring

Probability	1	Improbable (Rare, the event may occur only in exceptional circumstances, the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <5% chance).
	2	Low probability (Unlikely, impact could occur but not realistically expected; >5% and <20% chance).
	3	Medium probability (Possible, the impact may occur; >20% and <50% chance).
	4	High probability (Likely, it is most probable that the impact will occur- > 50 and <90% chance).
	5	Definite (Almost certain, the impact is expected to, or will, occur, >90% chance).

The result is a qualitative representation of relative significance associated with the impact. Significance is therefore calculated as follows:

$$\boldsymbol{S = C \, x \, P}$$

Table 31: Determination of Significance

Consequence	5- Very High[7]	5	10	15	20	25
	4- High	4	8	12	16	20
	3- Medium	3	6	9	12	15
	2- Low	2	4	6	8	10
	1- Very low	1	2	3	4	5
		1- Improbable	2- Low	3- Medium/ Possible	4- High/ Probable	5- Highly likely/ Definite
	Probability					

The outcome of the significance assessment will result in a range of scores, ranging from 1 through to 25. These significance scores are then grouped into respective classes as described in **Table 32**.

Table 32: Significance Scores

S Score	Description
≤4.25	Low (i.e. where this impact is unlikely to be a significant environmental risk/ reward).
>4,25, ≤8.5	Low-Medium (i.e. where the impact could have a significant environmental risk/ reward).

[7] In the event that an impact or risk has very high or catastrophic consequences, but the likelihood/ probability is low, then the resultant significance would be Low-medium. This does in certain instances detract from the relative important of this impact or risk and must consequently be flagged for further specific consideration, management, mitigation, or contingency planning.

S Score	Description
>8.5, ≤13.75	High-Medium (i.e. where the impact could have a significant environmental risk/ reward).
>13.75	High (i.e. where the impact will have a significant environmental risk/ reward).

The impact significance will be determined for each impact without relevant management and mitigation measures (pre-mitigation significance), as well as post implementation of relevant management and mitigation measures (post-mitigation significance). This allows for a prediction in the degree to which the impact can be managed/mitigated.

10.1.2 IMPACT PRIORITIZATION

Further to the assessment criteria presented in the section above, it is necessary to consider each potentially significant impact in terms of:

1. Cumulative impacts; and

2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impacts' post-mitigation significance (post-mitigation). This prioritisation factor does not aim to detract from the significance ratings but rather to focus the attention of the decision-making authority on the higher priority/significance issues and impacts. The PF will be applied to the post-mitigation significance based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 33: Criteria for Determining Prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/ definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions).

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in **Table 34**. The impact priority is therefore determined as follows:

$$\boldsymbol{Priority = CI + LR}$$

The result is a priority score which ranges from 2 to 6 and a consequent PF ranging from 1 to 1.5 (Refer to **Table 34**).

Table 34: Determination of Prioritisation Factor

Priority	Prioritisation Factor
2	1
3	1.125
4	1.25
5	1.375
6	1.5

In order to determine the final impact significance (FS), the PF is multiplied by the post-mitigation significance scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a factor of 0.5, if all the priority attributes are high (i.e. if an impact comes out with a high medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a higher significance).

Table 35: Final Environmental Significance Rating

Significance Rating	Description
<-25	Very High (Impacts in this class are extremely significant and pose a very high environmental risk. In certain instances, these may represent a fatal flaw. They are likely to have a major influence on the decision and may be difficult or impossible to mitigate. Offset's may be necessary.
<-13.75 to -25	High negative (These impacts are significant and must be carefully considered in the decision-making process. They have a high environmental risk or impact and require extensive mitigation measures).
-8.5 to -13.75	Medium-High negative (i.e. Impacts in this class are more substantial and could have a significant environmental risk. They may influence the decision to develop in the area and require more robust mitigation measures).
<-4.25 to <-8.5	Medium- Low negative (i.e. These impacts are slightly more significant than low impacts but still do not pose a major environmental risk. They might require some mitigation measures but are generally manageable).
-1 to -4.25	Low negative (i.e. Impacts in this class are minor and unlikely to have a significant environmental risk. They do not influence the decision to develop in the area and are typically easily mitigated.
0	No impact
1 to 4.25	Low positive
>4.25 to <8.5	Medium-Low positive
8.5 to 13.75	Medium-High positive

Significance Rating	Description
>13.75	High positive

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

10.2 IMPACTS IDENTIFIED

This Section presents the potential impacts that have been identified during the scoping phase assessment. It should be noted that this report has been made available to I&AP's for review and comment and their comments and concerns will be addressed in the final Scoping report submitted to the CA for adjudication. The results of the public consultation will be used to update the identified potential impacts which will be further refined during the course of the EIA assessment and consultation process.

Potential environmental impacts identified during the scoping process were identified by the EAP, the appointed specialists, as well as the public. **Table 36** provides the list of potential impacts identified.

Without proper mitigation measures and continual environmental management, most of the identified impacts may potentially become cumulative, affecting areas outside of their originally identified zone of impact. The potential cumulative impacts have been identified, evaluated, and mitigation measures suggested which will be updated during the detailed EIA level investigation.

When considering cumulative impacts, it is important to bear in mind the scale at which different impacts occur. There is potential for a cumulative effect at a broad scale, such as regional deterioration of air quality, as well as finer scale effects occurring in the area surrounding the activity. The main impacts which have a cumulative effect on a regional scale are related to the transportation vectors that they act upon. For example, air movement patterns result in localised air quality impacts having a cumulative effect on air quality in the region. Similarly, water acts as a vector for distribution of impacts such as contamination across a much wider area than the localised extent of the impacts source. At a finer scale, there are also impacts that have the potential to result in a cumulative effect, although due to the smaller scale at which these operate, the significance of the cumulative impact is lower in the broader context.

Table 36: Identified environmental impacts.

Main Activity / Action / Process	Ancillary Activity	Geo-physical (geology, topography, air, water)	Biological	Socio-economic	Heritage and cultural
Site preparation (Planning: pre-construction)	Removing vegetation, trees, and shrubs to create a clear drilling / exploration area Ensuring access to power and water sources if needed Installing warning signs and fencing to protect the area and prevent unauthorized access		○ Loss/ destruction of natural habitat ○ Introduction/ Invasion by Alien Species ○ Loss of floral species. ○ Displacement of faunal species	○ Visual impact and impact on sense of place ○ Perceptions and expectations Employment opportunities	○ Disturbance of archaeological sites or historic structures (if any)
Human resources management (Planning: pre-construction	Employment/recruitment I&AP consultations Integration with Municipalities' strategic long-term planning Comprehensive safety and environmental awareness training for all personnel Developing emergency plans to address potential accidents or incidents, such as drilling equipment failures or spills Establishing and maintaining effective communication/grievance systems between the exploration crew, landowners and community members			○ Employment opportunities. ○ Improving the knowledge of local team through training and awareness.	
Earthworks (Construction)	Stripping and stockpiling of soils Levelling, grubbing and bulldozing Removing vegetation, trees, and shrubs to create a clear drilling / exploration area Preparing trenches and foundations Establishment of drilling pads to provide a stable base for the drill rig Constructing or improving roads to allow for the transportation of	○ Erosion due to storm water runoff ○ Impact due to topsoil stripping ○ Surface water contamination ○ Contamination of soils ○ Loss of fertility ○ Loss of flow paths ○ Emissions and dust	○ Loss/ destruction of natural habitat ○ Introduction/ Invasion by Alien Species ○ Nuisance and impacts on farming ○ Displacement of faunal species	○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e., noise, dust, etc.). ○ Safety and security (i.e., access to properties, theft, fire hazards, etc.). ○ Impact on existing infrastructure (i.e., roads, fences, etc.) ○ Perceptions and expectations	○ Disturbance/ destruction of archaeological sites or historic structures ○ Disturbance/ destruction of fossils

Main Activity / Action / Process	Ancillary Activity	Geo-physical (geology, topography, air, water)	Biological	Socio-economic	Heritage and cultural
	equipment and personnel to the drilling site	○ Impacts on wetlands ○ Traffic impacts		○ Employment opportunities	
	Setting up site camps for drilling and seismic team and vehicles				
	Setting up systems for managing drilling fluids, which may include containment sumps				
Exploration (Construction)	Drilling and seismic surveys	○ Erosion due to storm water runoff ○ Impact due to topsoil stripping ○ Surface water contamination (contaminant transport) ○ Surface water, quantity (baseflow contributions) ○ Groundwater contamination ○ Contamination of soils ○ Loss of fertility ○ Loss of flow paths ○ Emissions and dust ○ Impacts on wetlands ○ Traffic impacts	○ Loss/ destruction of natural habitat ○ Introduction/ Invasion by Alien Species ○ Displacement of faunal species ○ Nuisance and impacts on farming	○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e., noise, dust, etc.). ○ Safety and security (i.e., access to properties, theft, fire hazards, etc.). ○ Impact on existing infrastructure (i.e., roads, fences, etc.) ○ Perceptions and expectations of employment opportunities	○ Disturbance/ destruction of archaeological sites or historic structures ○ Disturbance/ destruction of fossils
	Transportation of equipment and personnel to the drilling site				
	Collecting, storing, and transporting drill core samples				
	Collecting, storing, and disposing of drilling waste, including cuttings, fluids, and debris				
	Surface and groundwater water management				
	Trenching and Pipeline installation				
Production (Operation)	Drilling and seismic surveys	○ Erosion due to storm water runoff ○ Impact due to topsoil stripping ○ Surface water contamination (contaminant transport) ○ Surface water, quantity (baseflow contributions) ○ Groundwater contamination ○ Contamination of soils	○ Loss/ destruction of natural habitat ○ Introduction/ Invasion by Alien Species ○ Displacement of faunal species ○ Nuisance and impacts on farming	○ Visual impact and impact on sense of place ○ Nuisance and impact on sense of place (i.e., noise, dust, etc.). ○ Safety and security (i.e., access to properties, theft, fire hazards, etc.). ○ Impact on existing infrastructure (i.e., roads, fences, etc.) ○ Perceptions and expectations of employment opportunities	○ Disturbance/ destruction of archaeological sites or historic structures ○ Disturbance/ destruction of fossils
	Collecting, storing, and transporting drill core samples				
	Collecting, storing, and disposing of drilling waste, including cuttings, fluids, and debris				
	Trenching and Pipeline installation				
	Surface and groundwater water management				
	Trucking operations				
	Maintenance inspections				
	Plant operations				

Main Activity / Action / Process	Ancillary Activity	Geo-physical (geology, topography, air, water)	Biological	Socio-economic	Heritage and cultural
		○ Loss of fertility ○ Loss of flow paths ○ Emissions and dust ○ Impacts on wetlands ○ Traffic impacts			
Post Construction Rehabilitation (Decommissioning of drilling and seismic surveys)	Revegetation Soil / slope stabilisation Backfilling (if necessary) Erosion control	○ Emissions and dust	○ Alien and invasive species	○ Safety and security (i.e., access to properties, theft, fire hazards, etc.). ○ Perceptions and expectations ○ Visual and dust	
Gas Analysis and Maintenance (Post construction)	Continuous analysis of gas quantity and quality Initiate maintenance and aftercare program Environmental aspect monitoring	○ Surface and groundwater quality ○ Accidental damage of blower resulting in air quality & climate change impacts	○ Alien and invasive species	○ Visual ○ Site security and access control	
Final Rehabilitation, Decommissioning and Closure	Plugging of boreholes Revegetation Soil / slope stabilisation Backfilling (if necessary) Erosion control	○ Emissions and dust	○ Alien and invasive species	○ Safety and security (i.e., access to properties, theft, fire hazards, etc.). ○ Perceptions and expectations ○ Visual and dust	
Monitoring, Maintenance and Relinquishment	Groundwater monitoring Floral monitoring Gas emissions monitoring	○ Emissions ○ Emissions and dust	○ Alien and invasive species	○ Safety and security (i.e., access to properties, theft, fire hazards, etc.) ○ Perceptions and expectations	

10.3 DESCRIPTION AND PRELIMINARY ASSESSMENT OF IMPACTS

The following potential impacts were identified during the scoping phase assessment and were assessed in terms of nature, significance, consequence, extent, duration and probability. These preliminary impact calculations will be subject to amendment based on the EIA phase assessment and the results of public consultation undertaken during the Scoping as well as EIA phases. **Table 37** provides a description of each impact with preliminary mitigation measures and an indication of which impacts are to be assessed in greater detail in the EIA phase assessment. Preliminary mitigation / management measures to minimise potential negative impacts or enhance potential benefits are put forward in this Scoping Report and will be adjusted where relevant during the EIA phase once detailed specialist assessments are concluded and input from the public has been considered.

Table 37: Preliminary impact assessment based on normal operations or events (refer to **Appendix G** to for detailed assessment).

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
1	Interference with Existing Land Uses (Damage / Disruption of activities / services / infrastructure)	Planning (pre-	Medium to high -	Low -	Medium to low -	The drill rig and supporting machinery may require temporary gravel access roads and the establishment of drilling pads within largely farming areas which may cause an interference with the existing land uses. In addition, although exploration drilling plays a crucial role in the mining industry as it helps identify and assess potential mineral deposits, it can also come with its own set of challenges on existing mining operations. The drilling activity can penetrate a mine shaft destabilizing the shaft and/or affect mining operations. The Vibroseis truck may need access across boundary fences used for grazing or game farming which may be affected if access gates are left open. The seismic transects may also overlap with farming grounds which may result in temporary loss and/impact on agricultural fields and production. In addition, there are approved renewable energy projects from various applicants located within PR. It is recommended that Motuoane and the renewable energy applicants discuss the way forward and/or make necessary arrangements to coexist in areas where there is an overlap of projects. The proposed activities are not intensive in nature and do not require a large footprint and are of short duration. The seismic surveys are expected to last for a couple of weeks and the drilling activities to be completed within months, therefore the period of activities is also reduced. It must also be noted that in the event that a Vibroseis truck is used, it will be equipped with very wide, low-pressure tires and will not leave ruts. There is also a chance of using an alternative method of a portable weight drop method, which is much smaller than the Vibroseis truck and has lesser impacts. In addition, the activities are largely located on low-laying grassland. Therefore, the cumulative impact of proposed activities on existing land uses is medium-high negative without mitigation and medium-low negative with mitigation. Preliminary mitigation measures include: • Prior to accessing and commencement of project activities on any portion of land, the Applicant must enter into formal written agreement with the affected landowner; • Before the project commences, an asset and services baseline of services that may be affected within 50 m of the affected exploration area must be compiled. A copy of the baseline records should be given to each landowner/ service provider, and a master document kept by the applicant; • Underground mining companies (if any) within the identified drilling locations must be engaged during the planning phase to ensure the drilling activities do not interfere with underground mining activities; • If any damage occurs to services / infrastructure, the applicant will be liable for the damage caused to any third-parties and will be required to fix or cover the costs to fix the damage, and • A services impact and interruption plan must be developed for sites which intersect existing services in order to minimise and manage potential interruptions should they occur due to an incident.	An asset and services baseline of services that may be affected within 50 m of the production area must be compiled before the project commences
		Construction / Operational	Medium to high -	Medium to low -	Medium to low -		
		Construction / Operational	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
2	Impact on Soils and Agricultural Activities	Planning (pre-construction)	Medium to low -	Low -	Low -	Existing land uses may be affected by the proposed activities and in particular during the drilling of the wells. The drill rig and supporting machinery may require new access roads and the establishment of drilling pads within largely farming areas which may affect the soils and agricultural activities. The geochemical and soil sampling activities are anticipated to have a low impact on existing soils and agricultural activities. Existing land uses may be affected by the proposed activities and in particular during the seismic surveys. The seismic transects may overlap with agricultural and game farming grounds which may result in temporary loss and/impact on soils agricultural fields and production. The seismic activities will have a short duration, use existing gravel roads as far as possible and are therefore anticipated to have a low impact on existing soils and agricultural activities. It is anticipated that there will be minimal impact on soil and agricultural potential. Considering the small extent of the proposed activities compared to the large extent of the agricultural land, the proposed activities and associated infrastructure will not result in the segregation or fragmentation of any high production agricultural land. Therefore, the cumulative impact on soil and agricultural potential is low subject to adherence to the mitigation measures. Preliminary mitigation measures include: • As far as possible interference with existing land uses/livelihoods should be avoided. If any interference or disruption takes place, the landowner should be fairly compensated for their losses; • The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on soils and agricultural activities; • Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities; • Soils and agricultural fields outside the direct project footprint, should under no circumstances be disturbed; and • Landowner engagement must be undertaken during the project phases to investigate possible scenarios for appropriate compensation of landowners for loss / disturbance of high land capability and/or grazing areas where necessary.	Soils and Agricultural Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to high -	Medium to low -	Medium to low -		
		Construction / Operational	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Low -		
3	Soil erosion and sedimentation	Planning (pre-	Medium to low -	Low -	Low -	Clearing of vegetation for the drilling activities such as vehicular movement of drill rig and supporting vehicles will result in compaction of soils which will impact the soils and increase the rate of erosion, especially on sloping terrain. Clearing of vegetation for the seismic activities such as vehicular movement of Vibroseis truck and supporting vehicles will result in compaction of soils which will impact the soils and increase the rate of erosion, especially on sloping terrain.	Soils and Agricultural Impact Assessment & EIA Phase impact assessment

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational (Drilling)	Medium to high -	Medium to low -	Medium to low -	The proposed activities and associated infrastructure will result in compaction and increased soil erosion during the construction / exploration phase and accumulatively increase the erosion rate in the area through the removal of the vegetation soil disturbance from vehicular movement and drilling. However, considering that no seismic activities nor drilling activities are permitted on or near to watercourses, the risk of sedimentation of watercourses is considered very low. Through the implementation of the proposed mitigation measures, this impact is considered to have an overall low negative cumulative impact significance subject to adherence of the mitigation measures as the area has small soil erosion surfaces (i.e. drainage lines) and the activities will not be permitted on the erosion surfaces to further enlarge them. Preliminary mitigation measures include: • The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on soils; • Best known techniques of soil erosion and management should be adopted for the project if necessary; • Construction / exploration impacts associated with the proposed project must be contained within the footprint of the assessed areas; • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey; and • No seismic activities nor drilling activities are to be permitted within wetlands or watercourses (32m prelitigation and a 15m post-mitigation buffer).	
		Construction / Operational	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Low -		
4	Landownership and displacement of landowners and livestock	Planning (pre-construction)	Medium to low -	Low -	Medium to low -	The proposed project activities are located across various farms owned by different landowners. There may be a need to temporary disrupt the current farming activities so that the proposed project activities may be undertaken especially for seismic surveys and pipeline installation which traverses various farm properties. The temporary disruption of the current farming activities so that the proposed project activities may be undertaken may result in agricultural land lost and/or reduced livestock production which may affect the farming community's enablement to sustain themselves. Negotiations with affected landowners are currently ongoing and will be undertaken in detail before activities are undertaken. Measures will be in place to prevent displacement of landowners and livestock. Therefore, the cumulative impact is considered low negative overall subject to adherence to the mitigation measures. Preliminary mitigation measures include:	EIA Phase impact assessment
		Construction /	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational	Medium to low -	Low -	Low -	• Ensure that all affected landowners are identified, and relevant information is provided to the landowners during the application phase; • Prior to accessing any portion of land, the Applicant must enter into formal written agreements with the affected landowner. This formal agreement should additionally stipulate landowner's special conditions which would form a legally binding agreement; and • Negotiations with affected landowners must be undertaken and any loss of revenue caused by the exploration works must be reasonably compensated.	
		Closure & Rehab	Medium to low -	Low -	Low -		
5	Air quality / greenhouse gas emissions	Planning (pre-construction)	Medium to low -	Low -	Low -	Different types of gases can be encountered while drilling, depending on the geology and depth of the well being drilled. Some common gases encountered during drilling operations include Hydrocarbon gases, condensate gases, Carbon dioxide (CO_2), Helium (He), etc. Gas exploration may release amounts of methane, a potent greenhouse gas, either by accident or design. Equipment and operational techniques can be applied across exploration and production chains to significantly reduce these emissions, and because methane (natural gas) is a valuable commodity, this can often be done at no cost or even at a profit. Therefore, the potential short-term releases of greenhouse gasses from drilling activities arising from the drill rig, support machinery and vehicles are not anticipated to significantly impact on the regional or global greenhouse gas emissions and as such this impact is rated to have a low negative significance with mitigation. Hydrocarbon exploration and production activities, including seismic operations, emit greenhouse gases. However, GHG emission from seismic surveys are mainly offshore seismics from the large vessel and supporting vessel operations over a period of several months. While onshore seismic surveys have a short duration (weeks) and GHG are mainly limited to the gas testing phase during flaring and/or venting as well as the processing plant. Therefore, the potential short-term releases of greenhouse gasses are not anticipated to significantly impact on the regional or global greenhouse gas emissions and as such this impact is rated to have a low negative significance with mitigation. The area is known to have good hydrocarbon reserves which the current project aims to extract. There are also several existing gas emitting wells in the area and the proposed activities will result in an increase of gas emitting wells substantially. Based on the GHG emissions report for similar project in the region, the most substantial emission source is expected to be the testing of the wells and gas released during the drilling phase. Collectively, these wells would increase gas emissions if they were leaking, however as indicated in Section 4.1.3, depending on the results of the sampling, each well will be steel cased and have	Climate Change and Air Quality Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to high -	Medium to low -	Medium to low -		
		Construction / Operational	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Closure & Rehab	Medium to low -	Low -	Medium to low -	cement barriers to prevent leaks as well as plugged at the end of production to prevent groundwater seepage. The well cap will be engraved with the borehole number according to industry specifications and have pressure readings to identify potential leaks. As the quantification of GHG for the project will only be undertaken during the impact assessment phase, the significance rating can only be provided once the impact assessment has been undertaken. No fatal flaws, however, are expected due to air quality impacts. Preliminary mitigation measures include: • Limit air emissions as far as practically possible through best practice design and implementation; • Reduce to nuisance factor of dust to neighbouring residents; • All drilling sites must be properly sealed to trap all gases from escaping; • Implement dust suppression measures in all areas that will be affected by construction activities and where dust will be generated. Dust suppression must also be undertaken during windy and dry weather conditions; and • Speed restriction of no more than 20 km/h must be implemented for all construction vehicles within the construction site.	
6	Safety and security (Health and Safety of the Community)	Planning (pre-construction)	Medium to low -	Low -	Low -	The proposed activities (seismic, drilling and trenching) may have health and safety implications for the personnel that will be working on the project. Required access to the property for project activities may result in a risk to the safety and security of landowners, lawful occupiers, and community members due to the increase in number of unfamiliar people in the area. Property gates may also be left open resulting in the robbery, loss or theft of livestock. The drilling activities may also expose gases which may ignite during the project causing fire that may result in loss of fauna and flora, livestock and/or human life. With the proposed mitigations, it is anticipated there will be low negative cumulative Safety and security impacts as there will be an implementation of security as well as fire control during the activities. Preliminary mitigation measures include: • All farm gates must be closed immediately upon entry/exit; • Fencing of all drill sites with security access control and warning signs; • All drilling sites must be properly sealed to trap gases from escaping. Wells should be plugged to prevent crossflow of gas into aquifers and isolate all potential hydrocarbon / water bearing formations by utilizing placed cement plugs extending at least 30m above and below the reservoir; • There must be access control to the entry / exit points of the project sites; • Vehicles should be clearly marked as construction vehicles; and • An emergency response plan should be complied and all workers on site must be trained to respond to known emergencies associated with hydrocarbon exploration and production.	EIA Phase impact assessment
		Construction /	Medium to high -	Medium to low -	Medium to low -		
		Construction / Operational	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Closure & Rehab	Medium to low -	Low -	Low -		
7	Noise Impacts	Planning (pre-construction)	Medium to low -	Low -	Low -	Construction sites are synonymous with noise impacts. High noise levels such as blasting, drilling and excavating can have an adverse impact on the farming community, adjacent landowners and fauna. Construction activities and traffic during the drilling phase are anticipated to produce minimal noise. The onsite drilling activities will pose the potential for noisy conditions due to machinery and vehicles. Construction activities and traffic during the seismic survey phase are anticipated to produce minimal noise. The onsite seismic activities will pose the potential for noisy conditions due to Vibroseis truck, machinery and supporting vehicles. The noise associated with the proposed activities are not expected to be excessive in nature relative to the surrounding agricultural / rural area extent. The small number of vehicles and temporary exploration works are anticipated to generate minimal noise. Considering that excessive noise impacts (if any) will be limited to the site and the area and will be short-term, the cumulative impact on noise pollution due to the proposed activity is anticipated to be low negative. Preliminary mitigation measures include: • The working hours stipulated in the Construction permit, where applicable, must be adhered to. Where this is not applicable, the following working hours must be adhered to: Monday to Friday from sunrise to sunset and where applicable on a Saturday which must be agreed upon between the affected parties and the Contractor; • The contractor must attempt to restrict noisy activities as far as possible to times and locations whereby the potential for noise nuisance is reduced; and • All construction plant and other equipment must be in a good working order to reduce possible noise pollution.	Noise Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to high -	Low -	Low -		
		Construction /	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
8	Nuisance and Impact on Sense of Place	Planning (pre-construction)	Medium to low -	Low -	Low -	The proposed drilling activities and development of the processing plant will impact on the established sense of place of adjacent properties. The character of the area would change due to the drilling and construction activities being undertaken I in the area. Additional vehicles, increased noise and dust, the removal of vegetation for drilling well site/s, and potential influx of workers will all contribute to the alteration of the sense of place. The proposed seismic activities will temporarily impact on the established sense of place of a particular property. The character of the area would change due to the seismic activities being undertaken on that particular place. Additional vehicles including Vibroseis truck, increased noise and dust, the potential removal of vegetation along the seismic transect and pipeline routes, and potential influx of workers will all contribute to the alteration of the sense of place. The study area is generally a rural area in nature. It can be described as an open swath of land that has few homes or other buildings, and not very many people with very low population density. The area consists of minimal activities that are nuisance and have an impact on sense of place. With the proposed production activities, minimal changes to the current sense of place are anticipated and low cumulative impact is expected. Preliminary mitigation measures include: • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities; • All construction/operational access must make use of the existing roads as far as possible and as agreed to with the particular landowner; • Noise producing activities should be limited to day-time after 07h00 and 17h00 on weekdays; • Adequate dust suppression measures should be utilized to minimize dust production; • The duration of the construction should be minimized to as short term as possible, to reduce the period of disturbance on the area; and • Areas outside the direct project footprint, should under no circumstances be disturbed.	Various Specialist Assessments & EIA Phase impact assessment
		Construction / Operational (Drilling)	Medium to high -	Low -	Low -		
		Construction / Operational (Survey)	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
9	Impact on Groundwater Quality and Quantity	Planning (pre-construction)	Medium to low -	Low -	Low -	A major concern associated with onshore gas exploration/production is the potential for the drilling to have an adverse impact on groundwater quality and quantities. Existing stressors that affect ground water condition include application of pesticides and fertilizers to the land, waste from livestock and other animals, landfills, mining operations, and unintentional releases such as chemical spills or leaks from hydrocarbon tanks. There is always a risk of potential spills from a leaking vehicle, drilling rig, drilling fluid, drilling sump, Vibroseis truck, chemical toilets etc. occurring during the construction / operation. The spill can then infiltrate into the groundwater and contaminate the water resource. There is also a potential of incorrect handling of waste such as the drilling mud and cuttings which may impact the water resource. Potential formation water (water found within geological formations, particularly in gas reservoirs, that has the potential to be produced during extraction) coexists with gas and can contain various dissolved substances which may contaminate the water resource. Exploration drilling activities require water which will be sourced from existing license holders. The utilisation of groundwater for drilling and other associated activities may result in the alteration/ reduction of groundwater levels on site thereby affecting local users. Potential contamination of groundwater through drilling activities is a risk without proper mitigation measures in place. All alternative drilling methods may potentially result in contamination a water resource if strict measures are not in place and/or adhered to. Although during the exploration activities, there is potential for alteration of the hydraulic regimes (head). However, the small scale of the impacts that would be perceived would not significantly alter the water table and/or groundwater flow patterns over a large area and if perceived would be of short duration. This will likely be limited to the site and surrounding areas. Considering that the Mining Best Practice Guidelines (MBPG) and that mining activities must comply with the National Water Act (NWA), which includes regulations related to water use and pollution, Motuoane will insert casing in the underground aquifer zones as per the project description indicated in **Section 4.1.3** which will ensure compliance with the MBPG and NWA and subsequently preventing any adverse impacts on groundwater quantity and quality for surrounding groundwater users. Furthermore, a monitoring programme will be proposed in the EMPr for the continued monitoring of surface and groundwater quantity and quality. As such, this impact is anticipated to have a low negative cumulative significance through the implementation of these mitigation measures. The potential risk to groundwater from the project activities is in relation to the potential of spills from leaking vehicles/mobile plant, construction materials, supporting plant or from the site camp facilities (i.e. chemical toilets) occurring during the	Hydrogeological Impact Assessment & EIA Phase impact assessment
		Construction / Operational (Drilling)	Medium to high -	Medium to low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational (Survey)	Medium to low -	Low -	Low -	construction and operational phases. The spills/leaks can then infiltrate into the groundwater and contaminate the water resource. Preliminary mitigation measures include: • Ensure that detailed baseline water quality and quantity samples are obtained and analysed for reference purposes; • Ensure that all mitigation measures as stipulated in the EMPr relating to the drilling (specifically technical specifications) as well as the MPRDA regulations are adhered to; • The best drilling fluid option should be selected during construction towards minimising the potential for groundwater contamination and the exploration wells should be constructed such no gas leakage occurs during the operational phase; • The correct type of fluids should be used during the construction phase and the wells should be correctly constructed so that no gas leakage occurs during the construction or operational phases. Biodegradable drilling fluids should be used wherever possible; • Excavations should be open for as short period as practically possible and drilling circulation fluid sumps be cleaned out and rehabilitated; • Construction vehicles and machines must be maintained properly to ensure that hydrocarbon spillages are kept at a minimum; • Spill trays must be provided if refuelling of drilling rig and vehicles are done on site; • Chemical sanitary facilities should be provided for drilling crew. Construction workers should only be allowed to use temporary chemical toilets on the site. Chemical toilets shall not be within close proximity of the drainage system. Frequent maintenance should include the removal without spillages; • Adequate fuel containment facilities to be used during exploration phase; • The use of all materials, fuels and chemicals which could potentially leach into the environment must be controlled; • All materials, fuels and chemicals must be stored in a specific and secured area to prevent pollution from spillages and leakages; • No potential formation water must be discharge into the environment, it was be managed as a hazardous waste and disposed at a registered hazardous waste disposal facility; • No uncontrolled discharges from the drilling pad or site shall be permitted; and • Any spills that occur during the exploration phase must immediately be cleaned up and the contaminated soils, etc. suitably disposed of at a registered waste disposal facility; and • Sound groundwater management measures need to be developed based on the results of the impact assessment.	
		Closure & Rehab	Medium to low -	Low -	Low		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
10	Impact on Surface water Quality and Quantity	Planning (pre-construction)	Medium to low -	Low -	Low -	When surface water becomes polluted by contaminants, it puts strains on local and regional drinking water supplies and aquatic ecosystems that rely on surface water environments. Because of their geographical location, surface waters easily become polluted, and some leading causes of water pollution come from contaminated rainwater runoff, from fertilizers and other harmful chemicals that are used on farms, in homes, industries, and on infrastructure such as roads. Surface water pollution can also come from sewage leaks and waste products that leach into the environment. Surface water may be impacted through the clearing of vegetation close to the water resource habitat, introduction of pollutants onto the water resource (i.e. leak from chemical toilets) and/or hydrocarbon spills from drill rig or supporting plant. This disturbance may also result in the proliferation of alien and invasive species within the surrounding watercourses. Surface water may be impacted through the clearing of vegetation close to the water resource habitat, introduction of pollutants onto the water resource (i.e. leak from chemical toilets) and/or hydrocarbon spills from Vibroseis truck and/or supporting plant. This disturbance may also result in the proliferation of alien and invasive species within the surrounding watercourses. There are concerns surrounding the potential for contamination of water resources (including surface water resources). In terms of the relevant legislation, no drilling may take place on or near to surface water features and furthermore, mitigation measures have been put forward to prevent pollution on or near to the drill sites which will prevent contaminated surface water runoff from entering water resources. There is also a potential of incorrect handling of waste such as the drilling mud and cuttings which may impact the water resource. Potential formation water (water found within geological formations, particularly in gas reservoirs, that has the potential to be produced during extraction) coexists with gas and can contain various dissolved substances which may contaminate the water resource if improperly handled or discharged. However, mitigation measures have been put in place to ensure proper handling of hazardous waste including drilling fluid, sumps and potential water formation. The accumulative surface water impact associated with the proposed project is low and this impact has been rated with a low negative significance. Preliminary mitigation measures include: • Ensure that detailed baseline water quality and quantity samples are obtained and analysed for reference purposes; • Construction/drilling should preferably not be conducted during rainy days. If drilling is to be undertaken during rainy days, additional precautionary measures in consultation with the ECO must be implemented to prevent contamination of surface water; • Excavations should be open for as short period as practically possible and drilling circulation fluid sumps be cleaned out and rehabilitated; • Construction vehicles and machines must be maintained properly to ensure that oil spillages are kept at a minimum; • Spill trays must be provided if refuelling of drilling rig and vehicles are done on site;	Freshwater and Wetlands Impact Assessment & EIA Phase impact assessment
		Construction / Operational (Drilling)	Medium to high -	Low -	Medium to low -		
		Construction /	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Closure & Rehab	Medium to low -	Low -	Low -	• Chemical sanitary facilities should be provided for drilling crew. Construction workers should only be allowed to use temporary chemical toilets on the site. Chemical toilets shall not be within close proximity of the drainage system. Frequent maintenance should include the removal without spillages; • Adequate fuel containment facilities to be used during exploration phase; • The use of all materials, fuels and chemicals which could potentially leach into the environment must be controlled; • All materials, fuels and chemicals must be stored in a specific and secured area to prevent pollution from spillages and leakages; • No potential formation water must be discharge into the environment, it was be managed as a hazardous waste and disposed at a registered hazardous waste disposal facility; • No uncontrolled discharges from the drilling pad or site shall be permitted; • Any spills that occur during the exploration phase must immediately be cleaned up and the contaminated soils, etc. suitably disposed of at a registered waste disposal facility; and • No seismic activities nor drilling activities are to be permitted within wetlands or watercourses (32m prelitigation and a 15m post-mitigation buffer).	
11	Impacts on natural habitat	Planning (pre-construction)	Medium to high -	Medium to low -	Medium to high -	The proposed project activities on site will lead to localised disturbance to an area approximately 50 x 50 m per well with a total of up to 43 production wells across the entire study area as well as approximately 1,5 ha for the processing plant. There will possibly also be damage to habitats associated with travelling from existing access routes to sites selected for wells. The activities will fragment these habitat units regarded as important, not only within the within the local landscape, but also regionally as they are used for habitat, foraging and movement corridors for fauna within a landscape fragmented by agriculture to more natural areas where they may reproduce. Impacts will also possibly result from damage to habitats associated with travelling from existing access routes to areas with no current access routes which will require temporary gravel access roads and/or clearance of vegetation. However, due to the small scale of clearing required for the proposed activities, the short duration thereof and the rehabilitation that will occur, this impact is anticipated to have a low negative cumulative impact on natural habitats upon implementation of the mitigation measures. Preliminary mitigation measures include: • Minimise vegetation clearance. • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities;	Terrestrial Biodiversity Impact Assessment & EIA Phase impact assessment
		Construction / Operational (Drilling)	Medium to low -	Low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational (Survey)	Medium to low -	Low -	Medium to low -	• An Invasive Species Management Plan must be compiled and implemented during the lifecycle of the project; All construction/exploration and access must make use of the existing roads as far as possible; • A suitable qualified Environmental Officer (EO) or Environmental Compliance Officer (ECO) must be appointed prior to the construction / exploration phase. If the final seismic transect route and/or the drilling location changes from the currently proposed areas, but within the assessed footprint and is situated within the high sensitive area, the EO / ECO must undertake final walkdown along the specific final planned transect route/s and drilling location/s in order to ensure that no sensitive vegetation or floral SCC are to be impacted; • Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed further; • Areas rated as High sensitivity outside of the direct project areas should be declared as 'no-go' areas during the life of the project, and all efforts must be made to prevent project access to these areas from construction workers and machinery; and • All laydown, chemical toilets etc. should be restricted to low / medium sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction/exploration phase has been concluded.	
		Closure & Rehab	Medium to low -	Low -	Low -		
12	Impacts on Microorganisms	Planning (pre-construction)	Medium to high -	Medium to low -	Medium to high -	A microorganism, or microbe, is an organism of microscopic size, which may exist in its single-celled form or as a colony of cells. The movement of drill rigs and supporting vehicles, trenching as well as the establishment of drill pads and processing plant will directly impact on microorganisms within that particular site. One of the main impacts of seismic surveys is impacts on microorganisms through the use of Vibroseis technology. As explained in detail in **Section 4.1.1**, seismic surveying along the transects is proposed to be undertaken through a Vibroseis technique by deploying an array of energy sources from a small-sized Seismic Vibrator and an array of sensors or receivers (geophones) on the identified area of interest. A single Seismic Vibrator consisting of a vibrating baseplate that is connected to the ground may be used. The vibrating plate will emit a low frequency signal (4-80 Hz) into the ground, called a sweep. The vibrator vehicle will move slowly along the pre-determined lines (transects) using GPS for navigation. It will stop, emit a signal 8-20 seconds long, moves approximately 10 meters ahead, stops, emits a signal and so on until all the transects have been traversed. Without mitigation, there will be substantially impacts on microorganisms from the proposed activities which will result in less presence of microbes in the area. However, with the implementation of the mitigation measures such as the uses of frequency signal (4-80 Hz), existing gravel roads and reducing the period of exploration, there will be acceptable impacts on the microorganisms. It must also be noted that in the event that a Vibroseis truck is used, it will be equipped with very wide, low-pressure tires and will not leave ruts. There is also a chance of using an alternative method of the AWD or MT Survey methods, which are much smaller than the Vibroseis truck and have lesser impacts. In addition, microorganisms are mobile and likely to	Terrestrial Biodiversity Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to low -	Medium to low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational	Medium to high -	Medium to low -	Medium to low -	temporary migrate nearby where they may not be directly impacted. Furthermore, the activities are limited to specific areas and over a short period of time. Therefore, the overall cumulative impact on microorganisms is anticipated to be low negative with mitigations. Preliminary mitigation measures include: • Minimise vegetation clearance. • The duration of the exploration should be minimized to as short term as possible. This will reduce the period of disturbance on microorganisms; • All construction/exploration activities and access must make use of the existing roads as far as possible; and • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities. This will allow for microorganism to reestablish / recover.	
		Closure & Rehab	Medium to low -	Low -	Low -		
13	Impacts on Vegetation and Flora species	Planning (pre-construction)	Medium to high -	Medium to high -	Medium to high -	The clearance of vegetation is required in order to prepare the drill site, pipeline corridor, processing plant and may be required for new access roads. No clearance of vegetation is required for the geochemical and soil sampling activity. The clearance of vegetation may be required for the seismic activities. Localised loss of floral habitat and diversity may occur within areas of increased ecological sensitivity. Due to the clearance of indigenous vegetation for new temporary access roads and drilling pads, drilling activities and vehicular movement and Vibroseis, disturbance and mortalities of flora species is anticipated. Clearing of vegetation for construction purposes as well as compaction of soils due to vehicular movement will result in reduced floral habitat availability and re-establishment success post construction phase. Disturbances to soil and vegetation on site will also favour alien plants in places. The proposed activities will result in a loss of vegetation supporting the floral and fauna. However, due to the small scale of clearing required for the proposed activities, the short duration thereof and the rehabilitation that will occur, this impact has a low negative significance. In addition, the impacts are mainly anticipated during the drilling phase, and the vegetation cover is expected to recover during the operation, closure and rehabilitation phases. The cumulative impact for impact on floral species is, therefore, expected to be low negative. Preliminary mitigation measures include:	Terrestrial Biodiversity Impact Assessment & EIA Phase impact assessment
		Construction /	Medium to low -	Low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational (Survey)	Medium to low -	Low -	Medium to low -	• Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities; • All construction / exploration and access must make use of the existing roads as far as possible; • A suitable qualified Environmental Officer (EO) or Environmental Compliance Officer (ECO) must be appointed prior to the construction / exploration phase. If the final seismic transect route and/or the drilling location changes from the currently proposed areas, but within the assessed footprint and is situated within the high sensitive area, the EO / ECO must undertake final walkdown along the specific final planned transect route/s and drilling location/s in order to ensure that no sensitive vegetation or floral SCC are to be impacted; • Areas of indigenous vegetation, even secondary communities outside of the direct project footprint, should under no circumstances be fragmented or disturbed; • Areas rated as High sensitivity outside of the direct construction / exploration areas should be declared as 'no-go' areas during the life of the project, and all efforts must be made to prevent impacts and access to these areas from construction workers and machinery; and • All laydown, chemical toilets etc. should be restricted to low / medium sensitivity areas. Any materials may not be stored for extended periods of time and must be removed from the project area once the construction/exploration phase has been concluded.	
		Closure & Rehab	Medium to low -	Low -	Low -		
14	Impacts on Fauna species	Planning (pre-construction)	Medium to high -	Medium to high -	Medium to high -	Localised loss of habitat may occur within the remaining areas providing shelter for faunal species due the clearance of vegetation for new temporary access roads, drilling pads, drilling areas, site camp, vehicular movement and seismic transects. The loss of habitat will directly result in the loss of fauna community (i.e. amphibians and birds). Disturbance and mortalities of fauna species such as amphibians, reptiles and birds are anticipated. Loss of habitat also means loss of food and nesting resources, cover and movement corridors, which could lead to the disappearance of the affected species from the area. Although fauna species will be negatively impacted due to the construction / exploration, there is a high likelihood that they can easily relocate to the adjacent properties and may even resettle during the post exploration phase of the project. The cumulative impact for impact on fauna species is, therefore, expected to be low with mitigation. Preliminary mitigation measures include: • The duration of the construction / exploration should be minimized to as short term as possible, to reduce the period of disturbance on fauna; • Noise must be kept to an absolute minimum during the evenings and at night to minimize all possible disturbances to amphibian species and nocturnal mammals;	Terrestrial Biodiversity Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to low -	Low -	Medium to low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational	Medium to low -	Low -	Medium to low -	• No trapping, killing, or poisoning of any wildlife is to be permitted on site; • Outside lighting should be designed and limited to minimize impacts on fauna; • Rehabilitation of the disturbed areas must be made a priority. Any disturbed area must be re-habilitated to its pre-disturbed state as defined in the pre-drill survey. Disturbed areas must be rehabilitated to support its post-closure land use, and this must be undertaken within six (6) months post drilling activities; • All construction/operational and access must make use of the existing roads as far as possible; • Construction impacts associated with the proposed project must be contained within the footprint of the demarcated areas as indicated on the final approved project layout plan; and • A suitable qualified Environmental Officer must be appointed prior to the construction / exploration phase. The ECO must undertake walkdowns / surveys along the final planned transect routes and drilling locations in order to ensure that no sensitive, protected or SCC fauna species are to be directly impacted; • Areas rated as High sensitivity outside of the direct project areas should be declared as 'no-go' areas during the life of the project, and all efforts must be made to prevent impacts / access to these areas from construction workers and machinery; and • Identified protected or SCC fauna species that will be impacted upon must be relocated by a suitably qualified environmentalist / ecologist.	
		Closure & Rehab	Medium to low -	Low -	Low -		
15	Disturbance / Destruction of Heritage Features	Planning (pre-construction)	High -	Medium to low -	Medium to high -	Construction activities such as vegetation clearance, excavations, drilling, seismic transects, site establishment and/or vehicular movement could expose or damage features of heritage and cultural value beneath the surface. The main impact on archaeological sites/ remains will be the physical disturbance of the material and its context. The clearing of vegetation for the proposed activities may expose, disturb and displace archaeological sites / material. However, from the specialist investigations, it appears that the cultural heritage features are easily identifiable and with the recommended buffer zones, these will not be impacted upon. However, there is always a risk of impacts on new discoveries during the construction / exploration phase which will impact on irreversible loss of cultural heritage features. Therefore, the cumulative impact on heritage resources is medium negative. Preliminary mitigation measures include: • The planning of all additional exploration footprints must take cognizance of the heritage sensitivities depicted on the heritage sensitivity maps;	Heritage Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to high -	Medium to low -	Medium to high -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational	High -	Medium to low -	Medium to high -	• An independent and suitably qualified ECO must be appointed and should be able to recognise potential heritage features; • All burial grounds and graves should be retained and avoided with a buffer zone of 30m as per SAHRA guidelines. If this is not possible, the graves could be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of s36 of the NHRA and its regulations as well as the National Health Act and its regulations; and • Should any heritage features be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the ECO shall be notified within 24hours, and a Chance Find Protocol must be implemented. The responsible heritage resources authority (FSPHRA), as well as the South African Police Service (SAPS) must be notified within 72hours.	
		Closure & Rehab	Medium to high -	Medium to low -	Medium to high -		
16	Disturbance / Destruction of Palaeontological Features	Planning (pre-construction)	High -	Medium to low -	Medium to high -	Threats to palaeontological resources are earth moving equipment/machinery for example haul trucks, drilling rigs, Vibroseis truck, front end loaders, excavators, graders, dozers during drilling activities and/or seismic activities. The main impact on palaeontology remains (if any) will be the physical disturbance of the material and its context. The clearing of vegetation, excavations and/or drilling may expose, disturb and displace archaeological sites/material. However, impact (if any) on palaeontological features will be local and not result in extensive significant loss of palaeontological features in the regional scale as there will likely be more similar features in the extended area. Therefore, the cumulative impact on palaeontological resources is low negative with mitigation. Preliminary mitigation measures include: • The planning of all additional exploration footprints must take cognizance of the heritage sensitivities depicted on the heritage sensitivity maps. • Once the drilling sites are final, the applicant should invite a professional palaeontologist to monitor drilling samples for subsurface fossil remains that may be intersected by the drilling process; • The palaeontologist must apply for a valid permit from SAHRA for the collection / removal of fossils if necessary; • All known heritage features should be retained and avoided with a buffer zone of 30m as per SAHRA guidelines. If this is not possible, the graves could be relocated after completion of a detailed grave relocation process, that includes a thorough stakeholder engagement component, adhering to the requirements of s36 of the NHRA and its regulations as well as the National Health Act and its regulations; • An independent and suitably qualified ECO must be appointed and should be able to recognise potential palaeontological features; and	Palaeontological Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Medium to high -	Medium to low -	Medium to high -		
		Construction / Operational	Medium to low -	Medium to low -	Medium to high -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Closure & Rehab	Medium to high -	Medium to low -	Medium to high -	• Should any palaeontological features be exposed during excavation, work on the area where the artefacts were discovered, shall cease immediately and the ECO shall be notified within 24hours, and a Chance Find Protocol must be implemented. The responsible heritage resources authority (FSPHRA), as well as the South African Police Service (SAPS) (where necessary) must be notified within 72hours.	
17	Impacts on Traffic and road infrastructure	Planning (pre-construction)	Medium to low -	Low -	Low -	The movement of construction vehicles during the construction of the proposed roads can result in an increase in traffic congestion on local roads. Activities during the construction / exploration phase of the project for both the drilling and seismic survey such as the movement of abnormal loads of infrastructure in and out of the project area can impact on the overall traffic and subsequently damage the road infrastructure. It was noted during the site inspection that the road leading to the southern section (R73) was in poor condition and movement of heavy vehicles associated with the exploration activities may cause further degradation. However, during visits to the study area, it was also noted that there is very little to no traffic in the area as it is located on the outskirts. The short duration of increased traffic as a result of the exploration works as well as few vehicle trips (especially heavy vehicles) are not anticipated to have a significant impact on the existing road networks and subsequent damage to road infrastructure. Therefore, it is anticipated that there will be low negative cumulative impact on traffic and damage to road infrastructure. However, the applicant must monitor the condition of roads to ensure that any damage caused by the exploration works is adequately rectified. Preliminary mitigation measures include: • All construction vehicles using public roads must be in a roadworthy condition and their loads secured. They must adhere to the speed limits and all local, provincial and national regulations with regards to road safety and transport; • Damage caused to public roads as a result of the construction activities must be repaired in consultation with the relevant municipal authorities; • The working hours stipulated in the Construction permit, where applicable, must be adhered to. Where this is not applicable, the normal construction working hours (Monday – Friday: 07H00 -17h00) must be adhered to; and • Construction vehicles must not exceed speed limits of 20 km/h within the construction site.	EIA Phase impact assessment
		Construction / Operational	Medium to low -	Low --	Low -		
		Construction / Operational	Medium to low -	Low -	Low -		
		Closure & Rehab	Medium to low -	Low -	Low -		

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
18	Stakeholder Fatigue / Public Participation Fatigue	Planning (pre-construction)	Medium to low -	Low -	Medium to low -	Signs of stakeholder fatigue are visible in the communities. There are a number of applications for onshore oil and gas activities, mining and renewable energy developments in the area that the stakeholders continue to be invited to. The most obvious way to deal with this would be to avoid working with communities, suffering from stakeholder fatigue (Durham et *al.,* 2014), but this is not always possible and infringes on their rights. The EIA process requires public participation and information sharing. The volume of consultation and information shared are confusing to the communities. Stakeholders start to feel overloaded, which negatively affects their willingness to participate and lessens the quality of their input. Over time only those who are deeply interested, that is strongly supportive or strongly opposing may still participate. This can hinder potential projects and can particularly occur when the stakeholders consulted are not actively involved in decision-making. To be effective and to reduce stakeholder fatigue, engagements need to be targeted, with clear aims and results. Stakeholders need to be clear on what the goal or end benefits to themselves would be for participating. It must be kept in mind that the more stakeholders contribute their time and knowledge, the more they will expect in return from the project, so one always need to ensure that the relationship remains balanced. It should however be noted that there are only two planned public meetings for this application, one during the scoping phase and another during the EIA phase. Preliminary mitigation measures include: • Undertake fewer, but more informative / effective stakeholder consultations; • Where possible, avoid prolonged engagements with communities suffering from stakeholder fatigue; and • To be effective and to reduce stakeholder fatigue, engagements need to be targeted, with clear aims and results.	Social Impact Assessment & EIA Phase impact assessment
		Construction / Operational	Low -	Low -	Low -		
		Construction / Operational	Low -	Low -	Low -		
		Closure & Rehab	Low -	Low -	Low -		
19	Upliftment of Communities / Employment	Planning (pre-construction)	Low to medium +	Low to medium +	Medium to low +	The proposed activities will have a small short-term positive impact in the area as suppliers of construction / exploration materials will experience economic growth during the drilling and/or seismic survey phase. During the exploration phase, the creation of skilled and semiskilled jobs will be created. The use of local labour, as far as possible, is recommended as this would have a positive impact on the local economy and would prevent the influx of job seekers from outside the area. Employment opportunities for some unskilled, skilled labour as well as providing services during construction (e.g. accommodation, transportation, etc.) may arise from this project. It is important to note that employment opportunities for locals will be minimal as the project entails aspects which require qualified and skilled personnel (i.e. Vibroseis techniques and	Social Impact Assessment & EIA Phase impact assessment

#	Impact	Phase	Pre-mitigation	Post-mitigation Risk	Final Significance	Description and Preliminary Mitigation	Further Assessment
		Construction / Operational	Low +	Low +	Low +	drilling). The proposed activities also cover a small footprint and a short period of survey. Therefore, there will be minimal opportunities for locals for tasks largely related to unskilled labour, resulting in low positive cumulative impact on socioeconomics. Preliminary mitigation measures include: • Developer must allow for a transparent employment opportunity for locals; and • Local suppliers and workers must be prioritised as far as possible for economic and professional growth.	
		Construction / Operational	Low +	Low +	Low +		
		Closure & Rehab	Low -	Low -	Low -		

11 SENSITIVITY MAPPING

Environmental sensitivity mapping provides a strategic overview of the environmental, cultural and social assets in a region. The sensitivity mapping technique integrates numerous datasets (base maps and shapefiles) into a single consolidated layer making use of Geographic Information System (GIS) software and analysis tools. Environmental sensitivity mapping is a rapid and objective method applied to identify areas which may be particularly sensitive to development based on environmental, cultural and social sensitivity weightings – which is refined by specialists' input within each respective specialist field based on aerial or ground-surveys. Therefore, the sensitivity mapping exercise assists in the identification of sensitive areas within and surrounding the proposed application area.

This sensitivity mapping approach allows for the identification of lower risk areas for positioning the project infrastructure whilst protecting identified sensitive environmental areas/ features through more rigorous mitigation (where possible). Areas identified as no-go would be fully excluded from any project related development regardless of the level of mitigation put forward. Furthermore, environmental sensitivity is used to aid in decision-making during consultation processes, forming a strategic part of environmental assessment processes. The compilation of this map has taken into consideration the individual raking of sensitivity by all the identified specialist disciplines (e.g. Air Quality, Geohydrology, Terrestrial and Aquatic Ecology, Heritage, Social, etc.). Work within the various sensitivity rankings must be managed according to the EMPr as well as the recommendations in the individual specialist reports.

Table 38 below provides a breakdown of the sensitivity rating and weightings applied to determine the sensitivity score of each aspect. **Figure 64** presents the preliminary combined sensitivity map for the project. These areas and sensitivities will be further refined in the EIA phase once further detailed assessments are completed. This map will be updated for the EIA phase of the project once detailed specialist studies are completed.

Table 38: Sensitivity rating and weighting system.

Sensitivity Rating	Description	Weighting
Least concern	The inherent feature status and sensitivity is already degraded. The proposed development will not affect the current status and/or may result in a positive impact. These features would be the preferred alternative for mining or infrastructure placement.	0
Low	The proposed development will have not have a significant effect on the inherent feature status and sensitivity.	1
Medium	The proposed development will negatively influence the current status of the feature.	2
High	The proposed development will negatively significantly influence the current status of the feature.	3
No-Go	**The proposed development cannot legally or practically take place. No development permitted under any circumstances.**	99

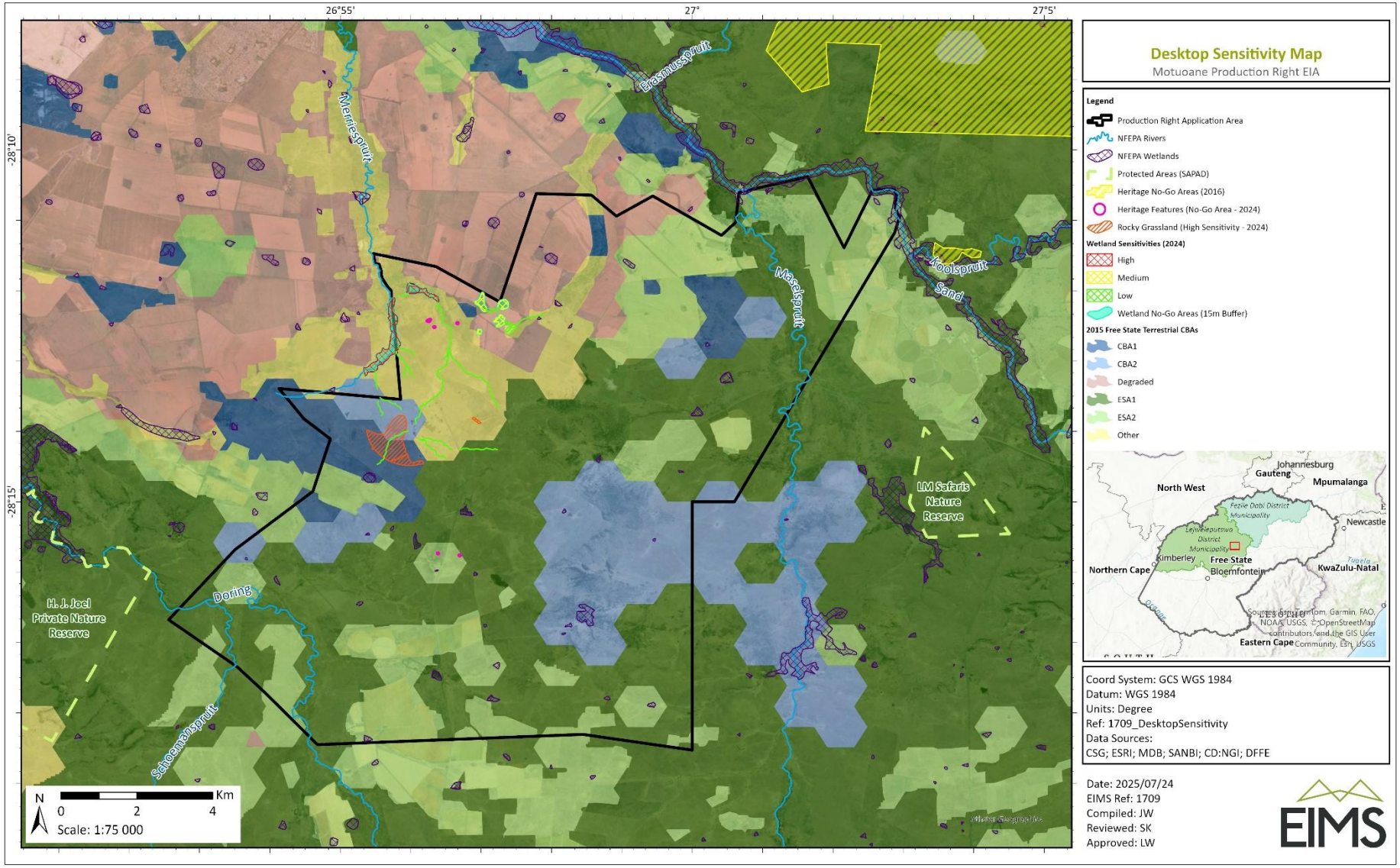


Figure 64: Combined scoping sensitivity map.

12 PLAN OF STUDY FOR ENVIRONMENTAL IMPACT ASSESSMENT

The section below outlines the proposed plan of study which will be conducted for the various environmental aspects during the EIA Phase. It is also important to note that the plan of study will also be guided by comment obtained from I&AP's and other stakeholders during the PPP.

12.1 DESCRIPTION OF ALTERNATIVES TO BE CONSIDERED IN EIA PHASE

Only incremental and/or feasible alternatives will be considered further going into the EIA phase. Incremental and/or feasible alternatives typically arise during the EIA process and are usually suggested as a means of addressing identified impacts. These alternatives are closely linked to the identification of mitigation and management measures and are not specifically identified as distinct alternatives. Alternatives to be considered by the applicant and which will be explored further during the EIA phase include those preliminary identified in this report which are summarized as follows (refer to **Section 7** for detailed information):

a) Locality Property Alternatives

   (i) L1; or
   (ii) L2; or
   (iii) L3.

b) Technology/Process Alternatives:

   (i) Exploration Drilling Alternatives

      - Rotary Drilling Method;
      - Percussion Drilling Method;
      - Rotary-Percussion Drilling Method; or
      - Diamond Core Drilling Method.

   (ii) Seismic Survey Alternatives

      - Vibroseis Technique;
      - Accelerated Weight Drop; or
      - Magnetotelluric Survey.

   (iii) Gas Testing Alternatives

      - Gas Venting; or
      - Gas Flaring.

c) Design or Layout Alternatives:

   (i) Traditional lined pond (drill sump pits); or

   (ii) Aboveground sumps with secondary containment (Pitless drilling).

d) No-Go Alternative.

The abovementioned alternatives and any other incremental and/or feasible alternatives identified during the Scoping Phase will be investigated further during the EIA phase and will form part of the EMPr.

12.2 DESCRIPTION OF THE ASPECTS TO BE ASSESSED AS PART OF THE EIA PROCESS

The following aspects will be assessed further during the EIA phase investigation to be undertaken:

- Agricultural Potential, Soils & Land Capability;

- Air Quality;
- Climate Change;
- Aquatics and Wetland;
- Archaeological and Cultural Heritage;
- Palaeontological Heritage;
- Terrestrial Biodiversity;
- Geohydrology;
- Hydrology;
- Socioeconomics;
- Noise; and
- Financial Provisions.

No aspect has been disregarded at scoping:

12.3 ASPECTS TO BE ASSESSED BY SPECIALISTS

Table 39 below details the various aspects of the project to be addressed in the EIA phase through detailed specialist studies.

Table 39: Details of specialist input during the EIA phase.

Aspect	Component	Scope of Work / Terms of Reference
Soils and Agriculture	Soils and Agriculture	The following will be undertaken as part of the EIA phase study: • Land use identification using aerial imagery and ground-truthing; • Confirmation of "Low" and "High" sensitivities; • Confirmation and identification of impacts on Protected Agricultural Area; • Identifying the effects that the proposed activities will have on food security, agricultural production, grazing or game farming in the area; • Outline potential mitigation measures to be included in the EMPr; and • Compilation of a comprehensive report.
Air quality	Air Quality Impact Assessment	The following will be undertaken as part of the EIA phase study: • Discussion of updated meteorological data from the SAWS Welkom station for the period 2022 – 2024; • The compilation of an emissions inventory, comprising the identification and quantification of potential sources of emissions due to the project; • Dispersion simulations of all potential pollutants from the project for applicable averaging periods; • Evaluation of potential for human health and nuisance dustfall impacts; • Determination of environmental risk according to stipulated impact assessment methodology; • Recommendation of mitigation and management measures, where applicable; and • Compilation of a comprehensive report
Climate Change	Climate Change Impact Assessment	The following will be undertaken as part of the EIA phase study: • An estimation of the CO_2-equivalent (CO_2e) emissions from the project, associated fuel use, vegetation clearing activities, and electricity use; • Estimate the impact of the project on national greenhouse gas emissions;

Aspect	Component	Scope of Work / Terms of Reference
		• Evaluation of the potential impact of global climate change on the project by identifying potential physical risks to the project, employees, and communities; • Provide the potential risk of climate change on the project and the risk of the project on climate change; • Determination of environmental risk according to stipulated Impact Assessment methodology; and • Recommendation of mitigation and management measures, where applicable Compilation of a comprehensive report
Noise	Noise Impact Assessment	The following will be undertaken as part of the EIA phase study: • Sampling will be carried out using a Type 1 sound level meter (SLM) that meets all appropriate International Electrotechnical Commission (IEC) standards and is subject to annual calibration by an accredited laboratory. • The acoustic sensitivity of the SLM will be tested with a portable acoustic calibrator before and after each measurement session. • Samples representative and sufficient for statistical analysis, will be taken with the use of the portable SLM capable of logging data continuously over the time. Measurements representative of the day- and night-time conditions will be taken. • As generally recommended, the following acoustic indices will be recorded: L_{Aeq} (T), L_{AIeq} (T); L_{AFmax}; L_{AFmin}; statistics and 3rd octave frequency spectra. • The SLM will be located approximately 1.5 m above the ground and 10 m from reflecting surfaces. • SANS 10103 states that one must ensure (as far as possible) that the measurements are not affected by the residual noise and extraneous influences, e.g., wind, electrical interference and any other non-acoustic interference. All measurements will be taken during periods where wind speeds are less than 5 m/s; and • Compilating of an impact assessment report.
Biodiversity (Terrestrial)	Terrestrial Biodiversity Assessment	The surveys will include the following: • A survey for Red and Orange Data plant species; • A survey of fauna species occurring in the area; • Vegetation units will be identified, classified and delineated; and • Habitat types will be classified and delineated.

Aspect	Component	Scope of Work / Terms of Reference
		The floristic survey should be conducted during the growing season (the rainy season when most plants are in flower or seeding), over the project areas. These will give an indication of the actual species present on site and will be discussed in context of plant communities (should the area support distinct communities) within the ecosystem of the area. Protected, endemic, exotic, alien invasive and culturally significant species will also be discussed as separate issues and related back to relevant legal requirements. Furthermore, the identification of red data and protected species as listed according to the IUCN List, NEMBA and other Provincial and National legislation will be completed. Depending on the vegetation and terrain, the timed meander sampling could be used during vegetation assessments, however, should dominant vegetation types require other methods be used, then these shall be motivated. The surveys will include the following: • The identification of these features and delineation thereof; and • The location of any unique or protected habitat features. All sensitive areas, as described by the provincial and national legislation, will be identified. The locality and extent, as well as species composition of sensitive areas such as the wetlands or pans, streams, rivers and rocky outcrops will be conducted to identify and map all such sensitive areas present. Sensitive areas will be identified and delineated. A terrestrial ecology assessment report will be written. This report will be compiled according to the necessary requirements and standards.
Biodiversity (Aquatic) and wetlands	Aquatic and Wetland Biodiversity Assessment	The areas will be traversed on foot to identify local freshwater resources. The following will be achieved to supplement the approach: • A desktop assessment of all available datasets; • GIS processing to preliminary identify water accumulation areas; and • The delineation of water resources in accordance with the DWAF (2005) guidelines, whereby the outer edges will be identified; and • A functional and integrity assessment of the water resources. The “Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands and Estuaries” (Macfarlane, *et al*., 2014) will be used to determine the appropriate buffer zone for the proposed activity. The risk assessment will be completed in accordance with the requirements of the DWS General Authorisation (GA) in terms of Section 39 of the NWA for water uses as defined in Section 21(c) or Section 21(i) (GN 509 of 2016).

Aspect	Component	Scope of Work / Terms of Reference
		An aquatics and wetlands assessment report will be written. This report will be compiled according to the necessary requirements and standards.
Heritage	Heritage Impact Assessment	The following is included in the HIA for the EIA phase of the project: • Desktop Study An archaeological and historical desktop study will be undertaken by utilising the previous studies conducted. This will be augmented by an assessment of old topomaps and previous archaeological and heritage impact assessments undertaken for the study area and surroundings. • Fieldwork: An experienced fieldwork team from will undertake an archaeological and heritage site survey to identify the heritage resources within the study area. Tracklogs will be recorded and the locations of all heritage resources identified during the fieldwork will be documented using a hand-held GPS. Furthermore, the documentation will reflect a brief qualitative description and statement of significance for each site and includes a photographic record of all the sites. • Report: A Heritage Impact Assessment will be written. This report will be compiled according to the necessary requirements and standards.
Palaeontology	Palaeontology Impact Assessment	The following is included in the PIA for the EIA phase of the project: • A PIA desktop study will be undertaken by utilising available data. • A site survey will be undertaken. • A Palaeontological Impact Assessment will be compiled according to the necessary requirements and standards.
Hydrogeological	Hydrogeological Assessment	The aim of the geohydrological study is to assess the following: • Assessment of the hydrogeological environment in terms of aquifer development, aquifer hydraulics, groundwater flow and groundwater chemistry. • Assessment of a potential flow path for underground water in the Karoo aquifer which may seep into lower lying aquifers and increase the amount of fissure water in local mine shafts. • Assessment of the potential short and long-term impact from the production activities on the groundwater environment. • Recommended management measures to mitigate potential impacts. The study will include the following:

Aspect	Component	Scope of Work / Terms of Reference
		• Establish site baseline and background conditions and identify sensitive environmental receptors. This will entail a hydrocensus to cover a total buffer zone of 500m in the vicinity of each proposed drill site; • Determine the current status quo of the regional groundwater system including aquifer classification, aquifer unit delineation and vulnerability; • Development of a conceptual groundwater flow model; • Development of a numerical groundwater flow and mass transport model in order to quantify and qualify the potential impact of the gas extraction as well as simulate potential saline water migration towards the shallow aquifer; • Hydrogeological impact assessment and risk matrix; • Recommendations on best practise mitigation and management measures to be implemented; • Compilation of an integrated groundwater monitoring network and protocol.
Closure and Rehabilitation	Engineering Designs and Financial	A closure plan and closure cost estimate in support of the exploration right application will be undertaken. This report will address the closure measures that will be implemented and provides the cost of environmental rehabilitation at closure. The financial provisioning will be undertaken in accordance with the 2015 National Environmental Management Act: Regulations Pertaining to the Financial Provision for Prospecting, Exploration, Mining or Production Operations.

Social Assessment	Socio-Economic Impact Assessment	The following activities will form part of the process forward:
		• Fieldwork will be conducted to obtain additional information and communicate with key stakeholders. Key stakeholders are likely to include:
		  ○ Authorities: local municipalities that fall in the project area.
		  ○ Affected parties: communities and individuals that will be affected by the project.
		  ○ Interested parties: local business in the area, community-based organisations and non-governmental organisations within the affected communities, trade unions, and political groups.
		• Methodologies will include in-depth interviews, participatory rural appraisal, in-the-moment discussion groups, focus groups and immersions. Field notes will be kept of all interviews and focus groups. Initial meetings have been conducted.
		• An interview schedule might be utilised instead of formal questionnaires. An interview schedule consists of a list of topics to be covered, but it is not as structured as an interview. It provides respondents with more freedom to elaborate on their views.

Aspect	Component	Scope of Work / Terms of Reference
		• The final report will focus on current conditions, providing baseline data. Each category will discuss the current state of affairs but also investigate the possible impacts that might occur in future. The impacts identified in the scoping report will be revisited and rated accordingly. New impacts that have not been identified will be added to the report. Recommendations for mitigation will be made at the end of the report. • The SIA process will have a participatory focus. This implies that the SIA process will focus strongly on including the local community and key stakeholders. • The public consultation process needs to feed into the SIA. • Impacts will be rated according to significance (severity), probability, duration, spatial extent, and stakeholder sensitivity. • Information obtained through the public processes will inform the writing of the final SIA and associated documents

12.4 PROPOSED METHOD OF ASSESSING ENVIRONMENTAL ASPECTS

The same method of assessing impact significance as was used during the Scoping phase will be applied during the EIA phase. This methodology is described in detail in **Section 10.1** of this report.

12.5 PROPOSED METHOD FOR ASSESSING DURATION AND SIGNIFICANCE

The significance of environmental impacts will be rated before and after the implementation of mitigation measures. These mitigation measures may be existing measures or additional measures that may arise from the impact assessment and specialist input. The impact rating system considers the confidence level that can be placed on the successful implementation of the mitigation. The proposed method for the assessment of environmental issues is set out in **Section 10.1**. This assessment methodology enables the assessment of environmental issues including: the severity of impacts (including the nature of impacts and the degree to which impacts may cause irreplaceable loss of resources), the extent of the impacts, the duration and reversibility of impacts, the probability of the impact occurring, and the degree to which the impacts can be mitigated.

The specialist studies will recommend practicable mitigation measures or management actions that effectively minimise or eliminate negative impacts, enhance beneficial impacts, and assist project design. If appropriate, the studies will differentiate between essential mitigation measures, which must be implemented and optional mitigation measures, which are recommended.

12.6 STAGES AT WHICH COMPETENT AUTHORITIES WILL BE CONSULTED

Competent authorities have been and will be consulted during the initial notification period, the scoping phase as well as during the EIA phase.

12.7 PROPOSED METHOD OF EIA PHASE PUBLIC PARTICIPATION

The proposed public participation process to be followed for the EIA phase is provided below.

- The commenting periods that will be provided to the I&AP's (and the competent authorities) will be a minimum of 30 days as per the relevant legislative requirements.
- The dates of the review and commenting period for the draft EIA/EMPr will be determined later and communicated to all registered I&AP's through faxes, emails, SMS's and/or registered letters.
- The location at which the hard copy of the EIA Report will be made available is the same public places in the project area that the Scoping Report was made available (refer to **Section 8.3.4**), sent electronically to stakeholders who request a copy, and placed on the EIMS website: https://www.eims.co.za/public-participation/.
- The public participation will be undertaken in compliance with NEMA GNR 982 (Chapter 6).
- A public meeting will be held during the review period for the EIA report. Focus group meetings will also be held with key stakeholders as and when necessary.
- All comments and issues raised during the comment periods will be incorporated into the final EIA Report.

12.8 DESCRIPTION OF TASKS THAT WILL BE UNDERTAKEN DURING THE EIA PROCESS

The plan of study detailed in the above sections and is summarised below. The following tasks will be undertaken as part of the EIA phase of the project:

- EIA-phase specialist studies.
- Public consultation:

- Notification of the availability of the EIA Report for review and comment to all registered I&AP's;
- Public meeting;
- Focus group meetings (if necessary); and
- Site visit with PASA and/or DMPR Officials (if necessary).

- Authority consultation:
  - Consultation will be undertaken with administrative and competent authorities (PASA and DMPR) who will be provided with copies of the EIA Report for review and comment. The officials will also be invited to the public meeting and a site visit (if necessary); and
  - Commentary Authority consultation including Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs, Matjhabeng Local Municipality and Masilonyana Local Municipalities, Lejweleputswa District Municipality will be consulted further and provided with the EIA Reports to review and comment on. The officials will also be invited to the public meeting.
- Document compilation:
  - The EIA and EMPr will be compiled in line with the requirements of Appendix 3 and 4 of the NEMA EIA Regulations.
  - The EIA and EMPr will be made available for public comment for a period of 30 days.
  - The EIA and EMPr will be finalised and submitted to the competent authority for adjudication and decision making.

12.9 MEASURES TO AVOID, REVERSE, MITIGATE, OR MANAGE IMPACTS

All comments received from I&APs during the Scoping Report review will be taken into consideration and where applicable inform the high-level mitigation measures. Detailed mitigation measures will be further developed as part of the EIA phase. The potential impacts will further be assessed in terms of the mitigation potential, taking into consideration the following:

- Reversibility of impact:
  - Reversible;
  - Partially reversible.; and
  - Irreversible.
- Irreplaceable loss of resources:
  - Replaceable;'
  - Partially replaceable; and
  - Irreplaceable.
- Potential of impacts to be mitigated:
  - High;
  - Medium; and
  - Low.

More detailed findings for each identified impact taking the above into consideration will be provided in the EIA Report and associated EMPr.

13 ASSUMPTIONS AND LIMITATIONS

The following assumptions and limitations relating to this scoping phase assessment should be noted:

13.1 GENERAL

- The application is limited to the proposed Motuoane PR footprint and associated infrastructure within the Masilonyana and Matjhabeng Local Municipalities, Free State Province;
- The information provided by the applicant is considered accurate, adequate, unbiased, and no information that could change the outcome of the scoping process has been withheld;
- The preliminary site sensitivity verification and specialist desktop assessments are sufficient for the scoping phase and the site-specific information that will be obtained from the specialist studies for this project during the EIA Phase will be accurate, objective and sufficient for the level of assessment required;
- Detailed assessment of the positive and negative environmental impacts of the proposed project will be undertaken during the Environmental Impact Assessment phase;
- In determining the significance of impacts, with mitigation, it is assumed that mitigation measures proposed in the report are correctly and effectively implemented and managed throughout the life of the project;
- In accordance with the Protection of Personal Information Act (Act 4 of 2013), personal information (emails, contact numbers, address) are blanked out and/or excluded during the Public Participation and only provided to the competent authority officials;
- Personal information of I&APs made available to the competent authority will only be used by the authorities to confirm or obtain information regarding this specific project; and
- The information presented in this report was the most accurate and relevant at the time of compilation of the report.

13.2 AIR QUALITY

- No site inspections were conducted for the Air Quality Scoping Phase Assessment. Google EarthTM aerial imagery; along with ambient air quality concentration data were accessed for information to build the scoping phase assessment; and
- No publicly available ambient data was available for inclusion into the scoping report.

13.3 BIODIVERSITY

- The assessment area was based on the area provided by the client and any alterations to the footprint and/or missing GIS information pertaining to the assessment area would have affected the area surveyed;
- The species likelihood of occurrence is based on desktop information;
- The impact description included is preliminary and is solely based on the screening survey and desktop information; and
- All datasets accessed and utilised for this assessment are considered to be representative of the most recent and suitable data for the intended purposes.

13.4 GEOHYDROLOGY

- The scale of the investigation was set at 1:50 000 resolutions in terms of topographic and spatial data, a lower resolution of 1:250 000 scale for geological data and a 1: 500 000 scale resolution for hydrogeological information;

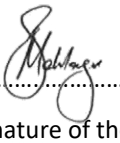
- The Digital Elevation Model (DEM) data was interpolated with a USGS grid spacing of 25.0m intervals;
- Rainfall data and other climatic data was sourced from the WR2012 database;
- Water management and catchment-based information was sourced from the GRDM and Aquiworx databases;
- The concept of representative elementary volumes (REV) has been applied i.e. a scale has been assumed so that heterogeneity within a system becomes negligible and thus can then be treated as a homogeneous system. The accuracy and scale of the assessment will result in deviations at point e.g. individual boreholes;
- The investigation relied on data collected as a snapshot of field surveys and existing data. Further trends should be verified by continued monitoring as set out in the monitoring program;
- Stratigraphical units, as delineated from surface geology within the model domain, are assumed to occur throughout the entire thickness of the model and were incorporated as such;
- The geological structures (fault zones and dyke contact zones) were modelled as permeable linear zones;
- Groundwater divides have been assumed to align with surface water divides, and it is assumed that groundwater cannot flow across this type of boundaries; and
- Where data was absent or insufficient, values were assumed based on literature studies and referenced accordingly.

13.5 PALAEONTOLOGY

- The geology of the area is the focal point of geological maps, and the sheet explanations of the Geological Maps were not intended to focus on palaeontological heritage. Many inaccessible areas of South Africa have never been examined by palaeontologists, and data is typically dependent solely on aerial pictures. Locality and geological information in museums and university databases is out of date, and data acquired in the past is not always adequately documented; and
- Comparable Assemblage Zones in other places are also used to provide information on the existence of fossils in areas that have not before been recorded. When similar Assemblage Zones and geological formations are used for Desktop studies, it is commonly assumed that exposed fossil exists within the footprint. Only a desktop assessment was conducted for this study, but a field assessment is planned for the EIA Phase.

14 UNDERTAKING REGARDING CORRECTNESS OF INFORMATION

I **Sikhumbuzo Mahlangu** herewith undertake that the information provided in the foregoing report is correct to the best of my knowledge, and that the comments and inputs from stakeholders and Interested and Affected Parties has been correctly recorded in the report where applicable.



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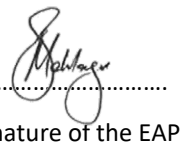
Signature of the EAP

Date: 2026/01/22

15 UNDERTAKING REGARDING LEVEL OF AGREEMENT

I **Sikhumbuzo Mahlangu** herewith undertake that the information provided in the foregoing report is correct, and that the level of agreement with Interested and Affected Parties and stakeholders has been correctly recorded and reported herein.



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Signature of the EAP

Date: 2026/01/22

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