Council for Geoscience

Carbon Capture Utilisation & Storage Project: 3D Seismic Survey & Drilling

ABBREVIATED ENVIRONMENTAL & SOCIAL IMPACT ASSESSMENT REPORT

DRAFT

June 2023

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A. Title & Approval Page

Project Name:	Carbon Capture Utilisation and Storage Project: 3D Seismic Survey and Drilling
Report Title:	Abbreviated Environmental and Social Impact Assessment Report
Report Status	Preliminary Draft

Client:	Council for Geoscience

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B. AMENDMENTS PAGE

Date	Nature of Amendment	Amendment No.
31/03/2023	Preliminary Draft for Client Review	0
01/05/2023	Draft for Client Review	1
04/07/2023	Draft for Review by Stakeholders	2

C. Executive Summary

1. INTRODUCTION

The Council for Geoscience (CGS) is undertaking a geoscientific research project for the piloting of Carbon Capture, Utilisation and Storage (CCUS) in Leandra in the Mpumalanga Province of South Africa (SA) (see Figure A below), where it is proposed to inject carbon dioxide (CO_2) into deep suitable geological formations, approximately 1km below the surface. The Government of South Africa (SA) has received funding from the World Bank (WB) to finance the CCUS Project and intends to apply part of the funding to conduct geological characterisation comprising of drilling a stratigraphic well and undertaking high-resolution 3D seismic survey at the proposed injection site, as well as supporting structures. This document only focuses on the geological characterisation component of the overall CCUS Project and not on the CO_2 injection phase, which is being assessed separately.

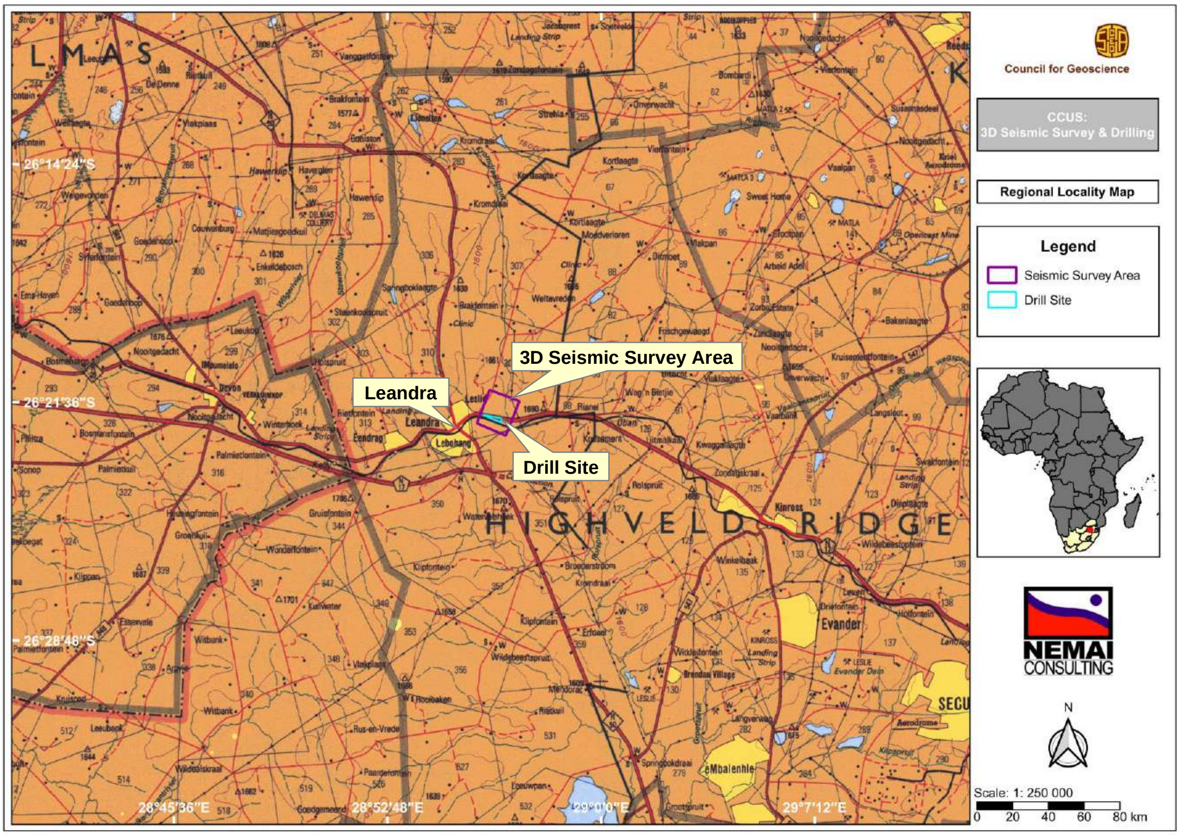

Figure A: CCUS locality map

Nemai Consulting (Pty) Ltd was appointed by the CGS to undertake an abbreviated Environmental and Social Impact Assessment (ESIA) for the 3D seismic survey and stratigraphic drilling required as part of the CCUS Project. The ESIA must satisfy the requirements of the WB Operational Policies (OPs) as well as the SA environmental legal requirements.

2. PROJECT DESCRIPTION

The project site falls the Gert Sibande District Municipality (GSDM) and is located within Wards 1, 2 and 6 of the Govan Mbeki Local Municipality (GMLM). The R29 runs through the central part of the overall project area. The GPS coordinates of the approximate centre of the proposed drill site are 26°22'4.84"S, 28°56'19.47"E.

The draft ESIA Report provides an overview of the following:

- The proposed drilling activities, which entail the drilling and associated borehole construction of a 2,000m deep slim hole for extracting drill core that can be analysed for geological characterisation, which will support the pilot CO_2 injection and monitoring; and
- The high resolution 3D seismic survey to map the structures, reservoir and seal rocks in detail over the identified potential injection site. The 3D seismic survey will be acquired by laying out energy source points (vibroseis) and receiver points (geophones) in a grid over the area to be surveyed. The total area of the survey is approximately 360 hectares in extent and the perimeter is close to 7.6km.

A site camp (including laydown area, site offices, materials storage area, workshop, basic services, waste management facilities, kitchen facilities and security) and parking area will be established in the fenced area of the drill site. Various temporary facilities will be required at the site camp to support the 3D seismic survey and drilling activities.

3. LEGISLATIVE AND INSTITUTIONAL FRAMEWORK

The draft ESIA Report presents the project's environmental and social governance framework by exploring the following:

- The environmental and social safeguard requirements of the WB, including the OPs and General Environmental, Health and Safety (EHS) Guidelines;
- International Agreements and Obligations formally adopted by SA; and
- SA's environmental regulatory framework, which includes the country's key environmental and social legislation and their possible relevance to the project.

A legislative gap analysis was undertaken by considering the key requirements of the WB's OPs and related provisions in SA legislation.

4. ENVIRONMENTAL & SOCIAL CONTEXT

The status quo of the project's physical, biological, and socio-economic environment is described. The baseline serves to provide the environmental and social context within which the ESIA was conducted.

The following features of the receiving environment are explained:

1. Climate
2. Geology
3. Topography
4. Soil
5. Groundwater
6. Surface water
7. Terrestrial Biodiversity
8. Land use
9. Air quality
10. Noise and vibration
11. Services
12. Heritage and palaeontology
13. Visual quality
14. Socio-economic environment
15. Transportation
16. Land capability

The evaluation of the environmental and social context allows for an appreciation of sensitive features that may be affected by the project. Some of these key receptors include the following:

- Groundwater resources, where potential receptors of impacts include groundwater users (domestic, livestock watering and irrigation) and the ecosystems reliant on groundwater.
- Surface water resources in the project area. The northern part of the project area drains towards tributaries of the Kromdraaispruit, which flows in a northern direction within the seismic survey area. The southern part of the project area drains towards tributaries of the Waterval River. One perennial river (Kromdraaispruit), various non-perennial rivers and wetlands are encountered in the seismic survey area. A drainage line flows across the property at the drill site and drains to the south-west.
- Terrestrial biodiversity in the project area. Parts of the seismic survey footprint fall within threatened ecosystems, which are listed as vulnerable. The drill site does not encroach into any threatened ecosystems. Two of the flora species found in the project area are protected in terms of the Mpumalanga Nature Conservation Act (Act No. 10 of 1998).
- Although the project area falls outside of the urban parts of Leandra, the neighbouring communities in the town and surrounding farms are potential sensitive receptors to noise, vibration, dust, and visual impacts.
- Heritage resources were identified in the project area, which includes graves, possible remains of structures and homesteads, and stone culverts under the railway line.

5. POTENTIAL ENVIRONMENTAL & SOCIAL IMPACTS & MITIGATION

The potential environmental and social risks and impacts associated with the proposed CCUS 3D seismic survey and drilling were identified during the abbreviated ESIA through an appraisal of the following:

- Legal context;
- Activities associated with the 3D seismic survey and drilling;
- Nature and profile of the receiving environment, including potential sensitive features and receptors;
- Findings of specialist studies;

- International and national case studies;
- Outcomes from stakeholder engagement; and
- Input received from authorities and the CGS.

The criteria used to assess the potential environmental and social risks and impacts associated with the CCUS 3D seismic survey and drilling activities included the extent, magnitude, duration, probability and significance. Suitable measures were identified to manage the identified environmental and social risks and impacts according to the mitigation hierarchy. The assessment considered the significance ratings before and after mitigation and also determined the residual impacts. Following the implementation/application of the suggested mitigation measures, the residual impacts to the environmental and social features ranged from minor to negligible.

The table to follow provides a summary of the potential environmental and social risks and impacts associated with the project, as identified during the ESIA, for which mitigation measures were proposed.

Table A: Summary of potential environmental & social impacts

Themes	Potential Significant Environmental & Social Risks & Impacts
Groundwater	• Contamination of groundwater by hazardous substances, waste and wastewater. • Mixing of aquifers may adversely affect groundwater resources. • Groundwater contamination from drilling fluid. • Water wastage. • Impact on groundwater resource volumes. • Compaction of near-surface springs. • Damage to boreholes and associated infrastructure. • Surface vibrations close to boreholes. • Drilling into high yielding confined aquifers. • Drilling into natural gas pockets.
Topography	• Damage to topographic features.
Surface Water	• Damage to structure and functioning of watercourses at vehicle crossings, including loss of vegetation, damage to channel morphology, compaction of wetland soils. • Loss of species that utilise watercourses. • Temporary increase in turbidity of watercourses from run-off over disturbed areas. • Reduction of water quality in watercourses that receive run-off from contaminated areas. • Livestock that drink surface water contaminated by the project's activities may be adversely affected. • Informal areas occur in certain parts of Leandra. People that do not have access to potable water and who use surface water contaminated by the project's activities may be adversely affected.
Soil	• Soil erosion may occur from disturbance caused by the movement of the vibroseis trucks and other vehicles. • Wheel ruts caused by equipment on wet/saturated soils may channel run-off and increase rill erosion. • Compaction of soils by heavy equipment and vehicles along survey transects, access roads and tracks. • Increase of sediment loads to watercourses from run-off over areas disturbed by the project's activities. • Ponding may impede certain activities to be carried out during rains. • Soil may be polluted by poor storage or handling of material, spillage and inadequate housekeeping practices.

Themes	Potential Significant Environmental & Social Risks & Impacts
	• Loss of topsoil in areas to be cleared (drill area, site camp and parking area).
Air Quality	• Adverse health effects to the surrounding community, sensitive animals and crews undertaking the survey and drilling activities. • Impacts of dust settling on crops.
Land Use	• Loss of crops. • Risks to livestock. • Disruption of traffic and human movement. • Disturbances (noise and vibration).
Terrestrial Biodiversity	• Loss, disturbance or displacement of flora and fauna species, including SCC. • Destruction, fragmentation and degradation of habitats and ecosystems. • Mortality/displacement of ground living mammals due to vibrations from seismic survey vehicles. • Human - animal conflicts. • Soil compaction and impacts on plant regrowth. • Soil erosion. • Disruption/alteration of species activities (breeding, migration, feeding) due to noise and vibration. • Influence on animal movement. • Nights lights may adversely affect nocturnal faunal species. • Illegal harvesting and poaching of faunal and floral species by survey and drilling crews. • Proliferation of invasive alien species in disturbed areas. • Pollution of the biophysical environment, with adverse effects to flora and fauna.
Noise & Vibration	• Disturbance to surrounding communities, fauna and livestock. • Occupational Health & Safety (OHS) risks. • Vibration may impact the stability of structures in proximity to the vibroseis trucks. • Underground services can be impacted by vibration caused by the vibroseis trucks.
Heritage & Palaeontology	• Damage to existing historical resources or remains. • Damage to unidentified graves. • Damage to fossils in the bedrock.
Visual Resources	• Scars in landscape caused by survey transects in natural areas and cleared areas. • Visual impacts caused by drill site and site camp. • Light pollution due to night lighting at drill site and site camp.
Socio-Economic Environment	• Noise, vibration and dust pollution. • Presence of construction workers. • Increased risk of HIV. • Quality of housing (risk of damage from vibroseis trucks). • Social and community infrastructure disruption. • Affects to daily life. • Employment opportunities. • Corruption. • Extortion. • Disparities in workforce.
Hazardous Materials & Waste	• Risk to human health (occupational and community health and safety). • Pollution of soil, groundwater and surface water. • Risk to plant life. • Risk to health and wildlife and livestock. • Malodours. • Compromised aesthetics (e.g., poor storage, windblown litter). • Vermin.
Transportation	• Disruptions to traffic. • Deterioration of roads used by vibroseis trucks and support vehicles. • Difficulty with using narrow gravel roads in certain parts of Leandra. • Damage to existing watercourse crossings that are unable to carry the weight of the vibroseis trucks. • Safety risk to vehicles travelling on R29 from drill rig, vibroseis trucks and support vehicles accessing and leaving the drill area and site camp. • Risks to road users, pedestrians and livestock from survey equipment and support vehicles.

Themes	Potential Significant Environmental & Social Risks & Impacts
Occupational Health & Safety	• Risk of work-related diseases, injuries or mortality.
Community Health & Safety	• Human health risks and degradation / loss of resources used by local communities caused by project-related pollution. • Accidents (e.g., traffic incidents) occurring during project that involve communities and their animals and livestock. • Impacts of project's security on local communities; • Spread of communicable diseases by project workers to the local communities. • Transfer of STIs from in-migrants and workforce to community. • Potential exposure to vector-related diseases. • Increased competition for the direct and indirect economic opportunities created by the project (labour Influx). • GBV and SEA/SH regarding community members. • Forced labour and child labour. • Risks to vulnerable and marginalised groups (including informal settlements in Leandra). • Community unrest.

6. ANALYSIS OF ALTERNATIVES

The following alternatives are discussed in this draft ESIA Report:

- Site alternatives (*preferred option = current site due to suitable geology for carbon capture and storage, land availability and landownership*);
- Technology alternatives –
  - Subsurface modelling (*preferred option = seismic survey*);
  - Acoustic source technologies (*preferred option = Vibroseis technology*);
  - Seismic data recording equipment (*preferred option = wireless seismic acquisition system*); and
  - Drilling fluid system alternatives:
    - Drilling fluid types (*preferred option = to be determined during the design phase*).
    - Management of drilling fluids and waste (*preferred option = storage tanks to separate cuttings from drilling fluids*).
- No-go / without project option. This option is not preferred, as the objectives of the CCUS pilot project will not be met and the associated benefits will not materialise. Although not proceeding with the activities associated with the geological characterisation would avoid the adverse environmental impacts, these impacts are considered to be manageable through the provisions contained in this ESIA Report.

7. STAKEHOLDER ENGAGEMENT

For the purposes of the ESIA, the key reasons for engaging with stakeholders include the following:

1. To provide stakeholders with an opportunity to obtain information about the project;
2. To allow stakeholders to express their views and concerns regarding the project;

3. To grant stakeholders an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
4. To enable the CGS to incorporate the needs, concerns, and recommendations of stakeholders into the project, where feasible.

This ESIA Report provides an overview of how stakeholders of the project were identified and analysed. It also provides an account of how stakeholders were notified and engaged with, and how their input was obtained.

A 30-day review period will be granted to stakeholders to review and comment on the draft abbreviated ESIA Report.

8. ENVIRONMENTAL AND SOCIAL MANAGEMENT PLAN

The abbreviated ESIA Report includes an Environmental and Social Management Plan (ESMP), which makes provision for the following (amongst others):

- Environmental and social management objectives of project;
- Roles and responsibilities of the CGS, Contractors and their Environmental and Social Officers, Environmental Control Officer and Community Liaison Officer;
- Grievance Redress Mechanism;
- General Management Plan;
- Thematic Management Plans covering the following topics –
  - Air Quality Management Plan;
  - Noise and Vibration Management Plan;
  - Groundwater Management Plan;
  - Surface Water Management Plan;
  - Waste Management Plan;
  - Erosion Control Management Plan;
  - Hazardous Materials Management Plan;
  - Community Health, Safety and Security Management Plan;
  - Traffic Management Plan;
  - Heritage Resources Management Plan;
  - Rehabilitation Plan; and
  - Emergency Response Plan.
- Training and awareness creation;
- Monitoring and Auditing Plan; and
- Preliminary Implementation Schedule and Cost Estimate.

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E. List of Acronyms

3D	Three Dimensional
AEL	Atmospheric Emission License
Al	Aluminium
AMD	Acid Mine Water
AOI	Area of Influence
AQI	Air Quality Index
As	Arsenic
B	Boron
Ba	Barium
BCEA	Basic Conditions of Employment Act (Act No. 75 of 1997)
BGG	Burial Grounds and Graves
BH	Borehole
C	Carbon
CBA	Critical Biodiversity Areas
CBD	Central Business District
CCPP	CO_2 Capture Pilot Project
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilisation and Storage
Cd	Cadmium
CEMP	Construction Environmental Management Plan
CGS	Council for Geoscience
CITES	Convention on the Illegal Trade in Endangered Species
Cl	Chloride
Cl_2	Chlorine
CLO	Community Liaison Officer
CN^-	Cyanide
CO	Carbon Monoxide
CO_2	Carbon Dioxide
COIDA	Compensation for Occupational Injuries and Diseases Act (Act No. 130 of 1993)
CR	Critically Endangered
Cr	Chromium
Cu	Copper
CVB	Channelled Valley Bottom
DARDLEA	Department of Agriculture, Rural Development, Land and Environmental Affairs
DEA	Department of Environmental Affairs
DEL	Department of Employment and Labour
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy

DPWRT	Department of Public Works, Roads and Transport
DWS	Department of Water and Sanitation
EC	Electrical Conductivity
E. coli	Escherichia coli
ECO	Environmental Control Officer
EIS	Ecological Importance and Sensitivity
EHS	Environmental, Health and Safety
EIA	Environmental Impact Assessment
EMPr	Environmental Management Programme
EN	Endangered
EO	Environmental Officer
ESA	Ecological Support Area
ESIA	Environmental and Social Impact Assessment
ESMP	Environmental and Social Management Plan
F	Fluoride
Fe	Iron
FEED	Front-End Engineering Design
FI	Financial Intermediary
GBV	Gender-Based Violence
GDPR	Gross Domestic Product Per Region
GIIP	Good International Industry Practice
GMLM	Govan Mbeki Local Municipality
GN	Government Notice
GRM	Grievance Redress Mechanism
GSDM	Gert Sibande District Municipality
Hg	Mercury
HGM	Hydrogeomorphic
HIV/AIDS	Human Immunodeficiency Virus, Acquired Immunodeficiency Syndrome
HPA	Highveld Airshed Priority Area
IDP	Integrated Development Plan
IFC	International Finance Corporation
ILO	International Labour Organization
IRP	Integrated Resources Plan
IUA	Integrated Unit of Analysis
LC	Leachable Concentrations
LIP	Large Igneous Province
LRA	Labour Relations Act (Act No.66 of 1995)
mamsl	meters above mean average sea level
MBSP	Mpumalanga Biodiversity Sector Plan
MPHRA	Mpumalanga Provincial Heritage Resource Authority
MPRDA	Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)
Mn	Manganese
MSDS	Material Safety Data Sheet

MTPA	Mpumalanga Tourism and Parks Agency
N	Nitrogen
Na	Sodium
NAMA	Nationally Appropriate Mitigation Actions
NBA	National Biodiversity Assessment
NDP	National Development Plan
NE-SW	North-East to South-West
NEMA	National Environmental Management Act (Act No. 107 of 1998)
NEM:AQA	National Environmental Management: Air Quality Act (Act No. 39 of 2004)
NEM:BA	National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
NEM:WA	National Environmental Management: Waste Act (Act No. 59 of 2008]
NFEPA	National Freshwater Ecosystem Priority Area
NGA	National Groundwater Archive
NGO	Non-Governmental Organisation
NHRA	National Heritage Resources Act (Act No. 25 of 1999)
Ni	Nickel
NO_2	Nitrogen Dioxide
NPAES	National Protected Area Expansion Strategy
NWA	National Water Act (Act No. 36 of 1998)
NWM	National Wetland Map
O_3	Ozone
OBM	Oil Based Mud
OHS	Occupational Health & Safety
OHSA	Occupational Health & Safety Act (Act No. 85 of 1993)
OP	Operational Policy
Pb	Lead
PCSP	Pilot CO_2 Storage Project
PES	Present Ecological State
PM2.5 % PM10	Particulate Matter
PM	Project Manager
PPE	Personal Protective Equipment
SA	South Africa
SAAQIS	South African Air Quality Information System
SACCCS	South African Centre for Carbon Capture and Storage
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
SANBI	South African National Biodiversity Institute
SANEDI	South African National Energy Development Institute
SANS	South African National Standard
SAPS	South African Police Service
Sb	Antimony
SBM	Synthetic Based Muds

SCC	Species of Conservation Concern
SDF	Spatial Development Framework
Se	Selenium
SEA/SH	Sexual Exploitation and Abuse and Sexual Harassment
SEP	Stakeholder Engagement Plan
S&EIR	Scoping and Environmental Impact Reporting
SO	Social Officer
SO_2	Sulphur Dioxide
SO_4	Sulphate
STDs	Sexually Transmitted Diseases
STIs	Sexually Transmitted Infections
SWSA	Strategic Water Source Area
TB	Tuberculosis
TDS	Total Dissolved Solids
U	Uranium
VU	Vulnerable
WB	World Bank
WBG	World Bank Group
WBM	Water Based Mud
WHO	World Health Organisation
WMA	Water Management Area
WML	Waste Management Licence
WUL	Water Use Licence
ZN	Zinc

F. UNITS OF MEASUREMENT

%	Percentage
°C	Degrees Celsius
h	Hour
ha	Hectare
Hz	Hertz
km	Kilometre
km/h	Kilometres per hour
l/s	Litres per second
m	Metre
m^2	Square metre
m^3	Cubic metre
mg/l	Milligrams per Litre
min	Minute
ml	Millilitre
mm	Millimetre
ms	Millisecond
NTU	Nephelometric Turbidity Units
ppb	Parts per billion
ppm	Parts per million
R	Rand
s	Second
µg/l	Micrograms per Litre
$\mu g/m^3$	Micrograms per cubic metre
µS/cm	Microsiemens per centimetre

CHAPTER 1: INTRODUCTION

1 INTRODUCTION

1.1 Project Background

According to Surridge *et al*. (2021), Carbon Capture and Storage (CCS) has been identified as one of the carbon dioxide (CO_2) emissions reduction mechanisms that could assist South Africa (SA) to meet its emissions reduction targets. The technology is part of SA's various emission reduction plans such as the Integrated Resources Plan (IRP) and National Development Plan (NDP). CCS is further identified as one of the National Flagship Priority Programme in the National Climate Change Response White Paper.

SA's Cabinet approved a CSS Roadmap for the storage of CO_2 in deep geological formations on 4 May 2012. The initial focus for CCS in SA was on geological storage. Without safe and permanent storage, CCS would not be a viable option to mitigate CO_2 emissions. Following the publication of the Atlas on Geological Storage of Carbon Dioxide in SA, the Government of SA through the South African National Energy Development Institute (SANEDI) initiated a Pilot CO_2 Storage Project (PCSP) in October 2009. In March 2020, the Minister of Mineral Resources and Energy authorised the transfer of the Carbon Capture, Utilisation and Storage (CCUS) programme from SANEDI to the Council for Geoscience (CGS).

The CGS is undertaking a geoscientific research project for the piloting of CCUS in Leandra in Mpumalanga, where it is proposed to inject CO_2 into deep suitable geological formations, approximately 1km below the surface. The Government of SA has received funding from the World Bank (WB) to finance the CCUS Project and intends to apply part of the funds for conducting geological characterisation comprising of drilling a stratigraphic well and undertaking high-resolution 3D seismic survey at the proposed injection site, as well as supporting infrastructure. This document only focuses on the geological characterisation component of the overall CCUS Project and not on the CO_2 injection phase, which is being assessed separately.

1.2 Implementing Agency

The CGS is a schedule 3A public entity organisation as defined by the Public Finance Management Act (Act No. 1 of 1999) of SA. The CGS derives its mandate from the Geoscience Act (Act No. 100 of 1993). The objective of the CGS under the Act, is to produce world-class geoscience knowledge products and to render geoscience-related services to SA public and industry. The strategic position of the CGS is to ensure that its activities contribute to the national imperatives, namely to free the potential of individuals by improving the quality of life of all citizens, assisting in the growth and wealth of the country and eradicating poverty especially in the rural areas of SA.

1.3 Project Rationale

SA has a coal based energy economy and hence emits CO_2 into the atmosphere at approximately 400 million tonnes per year. Recognising the anthropogenic forcing of global climate change, the country has committed itself to undertake steps to minimise such emissions in concert with other nations. Notwithstanding the recent advances made in the deployment of energy efficiency measures and renewable energies, it is envisaged that coal will remain a significant component of primary energy supply in SA.

CCUS has been acknowledged by SA as one of the technologies to minimise the emissions of carbon dioxide into the atmosphere and forms one of the Nationally Appropriate Mitigation Actions (NAMA). It is also one of the national flagship projects and forms part of a just transition to a future low-carbon energy economy.

The Mpumalanga Province area, where the piloting of CCUS is proposed, is home to mining and petrochemical industries and, as a result, the area is where the country's CO_2 emissions are most prevalent.

1.4 Scope of Work

Nemai Consulting (Pty) Ltd ("Nemai Consulting") was appointed by the CGS to undertake an abbreviated Environmental and Social Impact Assessment (ESIA) for the 3D seismic survey and stratigraphic drilling required as part of the CCUS Project. As mentioned, a separate ESIA will be undertaken for the CCUS injection phase by another Consultant appointed by the CGS.

The proposed Project will be supported by funding from the WB and therefore it is to be executed to meet all related requirements. In accordance with the WB's safeguard policies and procedures, namely Operational Policy (OP) 4.01, the proposed project qualifies for Category A. An abbreviated ESIA in terms of the WB OP and Environmental, Health and Safety (EHS) General Guidelines needs to be undertaken. In addition, the abbreviated ESIA must also satisfy SA's environmental legal requirements (refer to Section 3.4 below).

1.5 ESIA Methodology

According to the WB's OP 4.01, Environmental Assessment is a process whose breadth, depth, and type of analysis depend on the nature, scale, and potential environmental impact of the proposed project. An Environmental Assessment evaluates a project's potential environmental risks and impacts in its area of influence; examines project alternatives; identifies ways of improving project selection, siting, planning, design, and implementation by preventing, minimising, mitigating, or compensating for adverse environmental impacts and enhancing positive impacts, and includes the process of mitigating and managing adverse environmental impacts throughout project implementation.

The approach to undertaking the abbreviated ESIA for the CCUS 3D seismic survey and drilling included the key tasks shown in Figure 1 below.

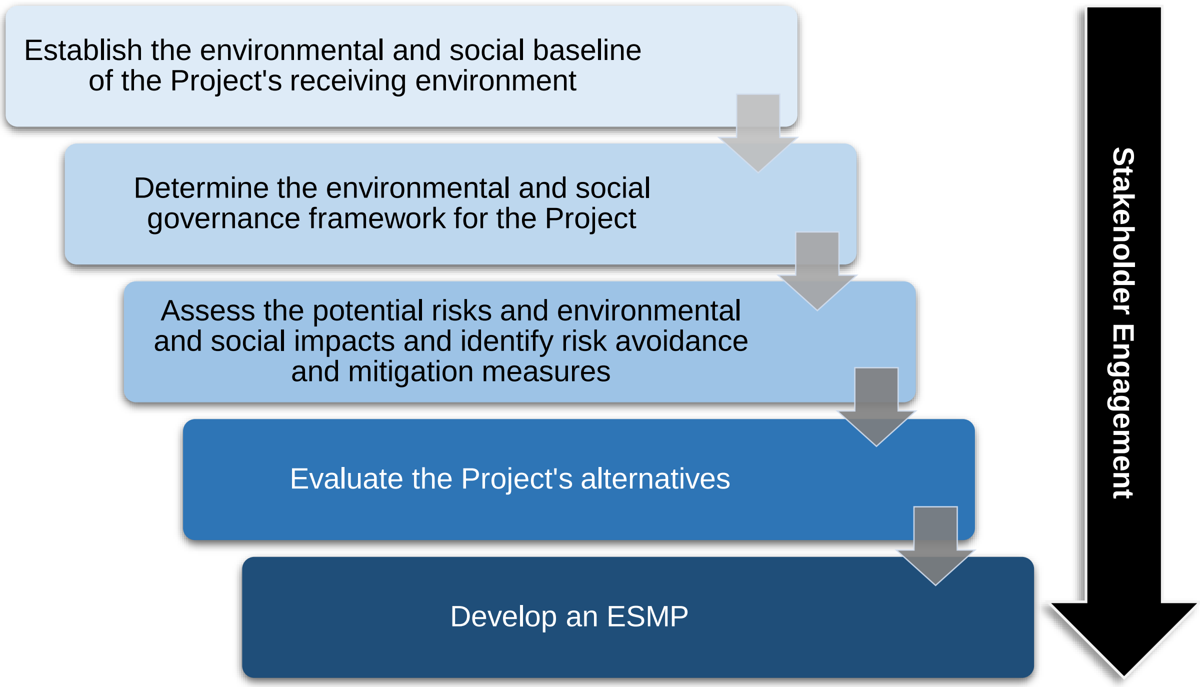


Figure 1: Approach to the Abbreviated ESIA

This abbreviated ESIA Report presents the outcomes and findings of the Environmental Assessment process for the CCUS 3D seismic survey and drilling activities.

1.6 Report Outline

An Environmental Assessment Report for a Category A project (refer to explanation in Section 3.2.2 below) focuses on the significant environmental issues that may be caused by the project. Accordingly, the abbreviated ESIA Report's scope and level of detail is commensurate with the potential impacts associated with the CCUS 3D seismic survey and drilling.

The alignment of the abbreviated ESIA Report with the WB's Environmental Assessment policy (OP 4.01) is presented in Table 1 below.

Table 1: Alignment of Abbreviated ESIA Report with OP 4.01

Sections in this ESIA Report	Correlation with OP 4.01 Annex B - Content of ESIA Report for a Category A Project
Section C Executive Summary	Executive Summary
Section 1 Introduction	Project Description
Section 2 Project Description	
Section 3	Policy, Legal, and Administrative Framework

Sections in this ESIA Report	Correlation with OP 4.01 Annex B - Content of ESIA Report for a Category A Project
Legislative and Institutional Framework	
Section 4 Description of the Environment	Baseline Data
Section 5 Determination of the Potential Impacts	Environmental Impacts
Section 6 Analysis of Alternatives	Analysis of Alternatives
Section 7 Stakeholder Engagement	-
Section 8 Environmental and Social Management Plan	Environmental Management Plan
Appendix A – J Thematic Management Plans	
Appendix K Specialist Studies	-
Appendix L Proof of Stakeholder Engagement	-

1.7 Limitations

The limitations associated with this abbreviated ESIA Report include the following:

- This ESIA was undertaken based on the project description provided by the CGS. Any future changes to the description of the 3D seismic survey and drilling, or additional relevant information that may come to light during the planning and design of these activities, may affect the findings of the ESIA. The implications of any significant changes should be evaluated against the ESIA to determine whether any additional mitigation, management or monitoring measures are required.
- The grid design of the 3D seismic survey will be prepared by the appointed Contractor. Hence, the ESIA did not assess specific transects but rather assessed the sensitivity of the entire survey area and any potential risks to the environmental and social features present. It is recommended as part of the mitigation measures that the seismic survey transects are planned and designed taking into account the environmental sensitivity determined as part of the ESIA.
- It is unknown whether underground services and utilities exist at the drill site or in the area where the 3D seismic survey will be undertaken. The vibration impacts from the seismic survey could also not be quantified. A precautionary approach was thus undertaken in the assessment of the associated risks.
- The following limitations were noted as part of the Specialist Studies –
  - Heritage Impact Assessment:
    - The extremely dense and long vegetation in several areas meant that archaeological and heritage visibility was low in those areas. Therefore, there is a possibility that some heritage resources were not identified, specifically, informal graves or burial sites and demolished building remains. A chance find procedure is included in the Environmental and Social Management Plan (ESMP) (refer to Heritage Resources Management Plan).

- Terrestrial Ecological Impact Assessment:
  - Inventory surveys of animal species occurring on a site are difficult to achieve within the time-frames associated with an ESIA. In order to compile a comprehensive site-specific list of the biota on site, studies would be required that would include different seasons and be undertaken over a much longer timeframe including extensive sampling. It is more important to know of fauna of value, as well as ecological processes. Therefore, the assessment attempted to identify threatened and other significant species, important habitats, and ecological processes. The study was based on an extensive site visit as well as a desktop study of the available information. The time spent on site was adequate for understanding general patterns across affected areas. The seasons in which the fieldwork (peak summer flowering period) was conducted was ideal for assessing the composition and condition of the vegetation, which is also suitable for assessing habitat condition and suitability for animals.
- Aquatic Ecological Impact Assessment:
  - The time of sampling could influence the delineation of wetlands. This can vary depending on the rainfall conditions and furthermore introduce a degree of variability in wetland boundaries.
  - The assessment of wetlands was limited to the proposed development footprint and does not include the 500m regulated area in terms of the National Water Act (Act No. 36 of 1998) (NWA).

Chapter 3: Project Description

2 PROJECT DESCRIPTION

2.1 Introduction

This section provides a detailed description of the situational setting of the site and an overview of the CCUS 3D seismic survey and drilling activities.

2.2 Study Area

2.2.1 Geographical Context

The project site is situated near the town of Leandra in the Mpumalanga Province of SA. The R29 runs through the central part of the overall project area. The project site falls the Gert Sibande District Municipality (GSDM) and is located within Wards 1, 2 and 6 of the Govan Mbeki Local Municipality (GMLM). The GPS coordinates of the approximate centre of the proposed drill site are 26°22'4.84"S, 28°56'19.47"E. The locality maps are presented below.

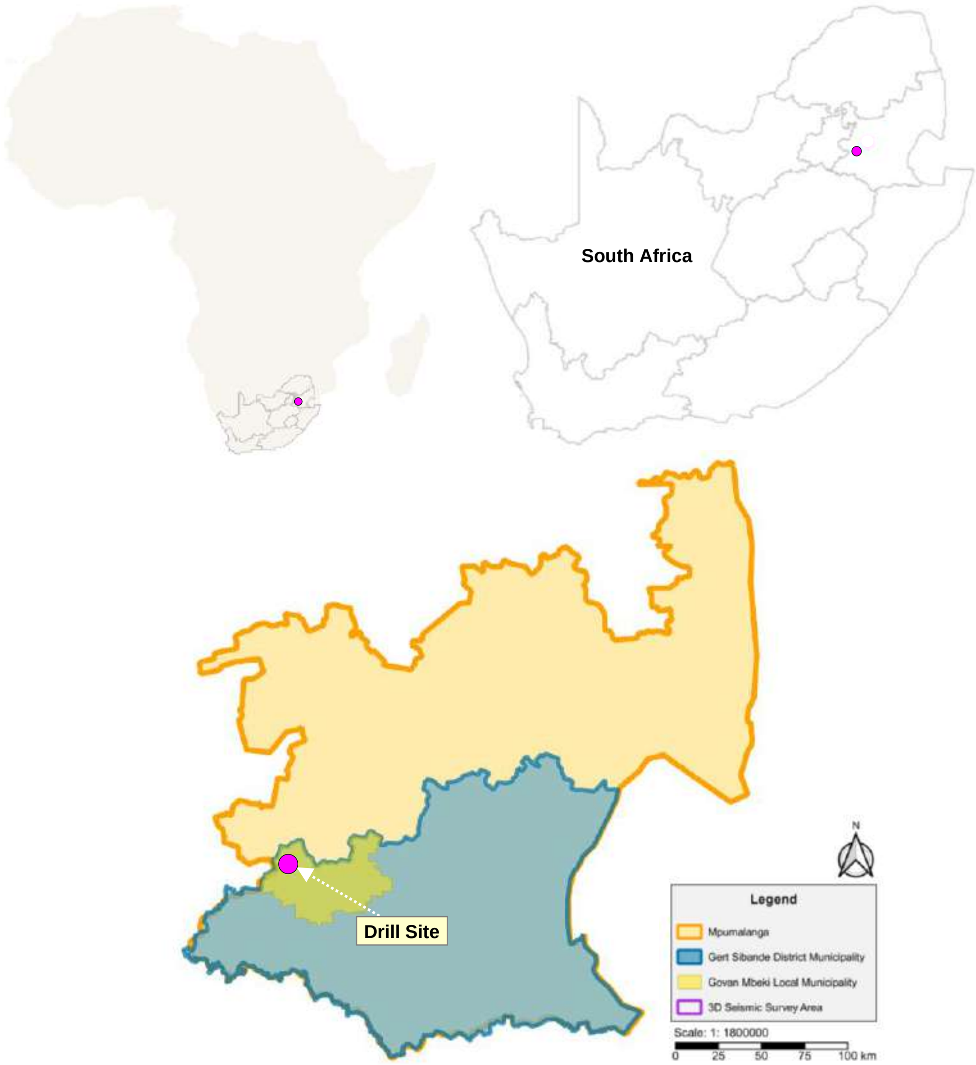


Figure 2: National, provincial and local geographical context

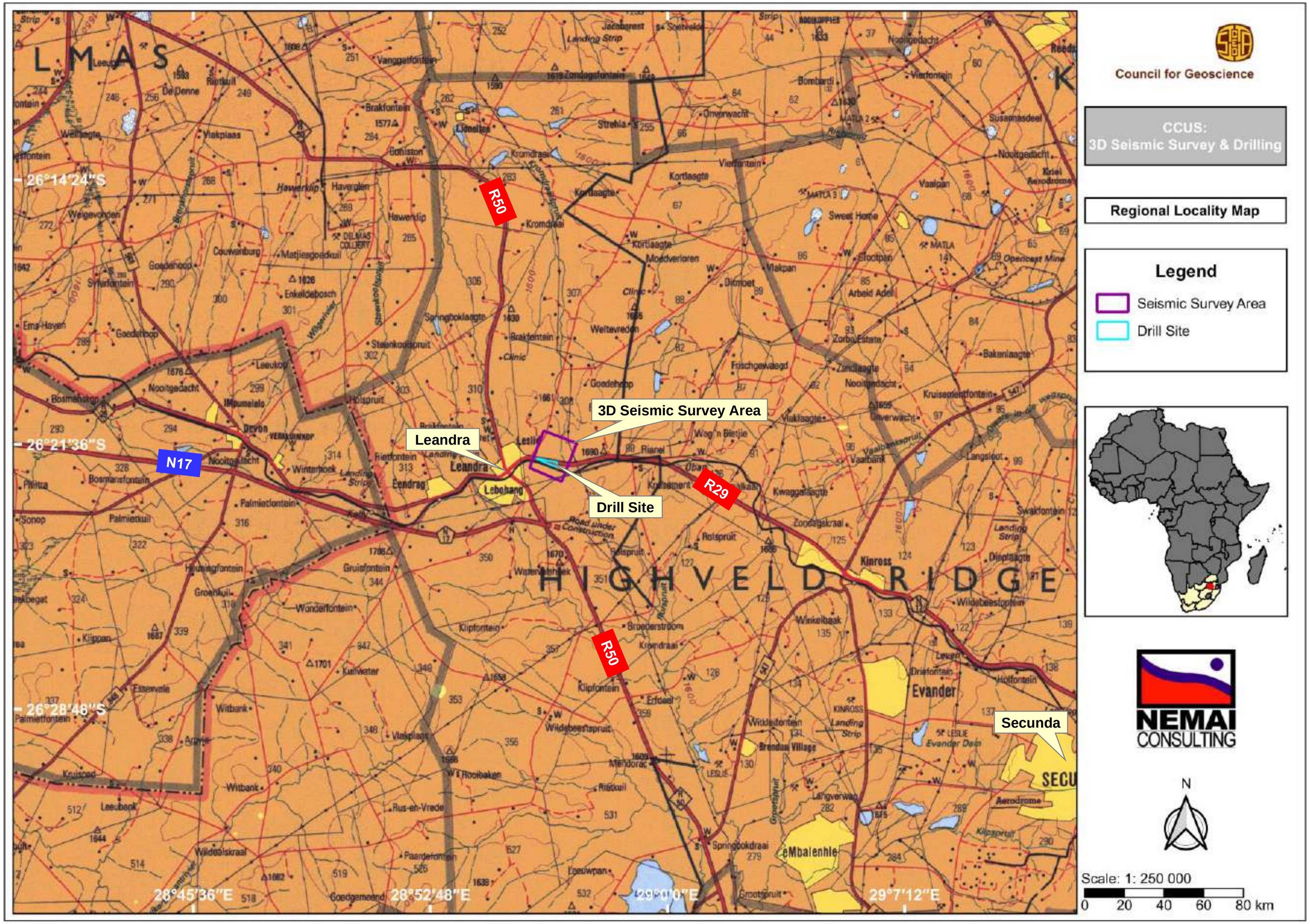


Figure 3: Regional locality map

2.2.2 Property Details & Ownership

The cadastral boundaries of the properties in the project area are shown in Figure 4 below. The properties that are directly affected by the proposed CCUS 3D seismic survey and drilling activities and their ownership, apart from the properties (erven) within the town of Leandra in the south-western part of the seismic survey area, are listed in Table 2 below. All properties that are directly affected by the Project were accessed during the specialists' fieldwork.

The property earmarked for the drilling activities belongs to the GMLM, who has entered into a lease agreement with the CGS in 2021 as a research site for the investigation into the viability of CCUS. As shown in Figure 5 below, there is a combination of government, municipal and privately owned properties in the project area.

Table 2: List of properties directly affected by the proposed Project (excluding the town of Leandra)

Farm Details	21-digit Surveyor General No.	Landowner
Farm Goedehoop 308 Portion 2*	T0IR00000000030800002	GMLM
Farm Goedehoop 308 Portion 2	T0IR00000000030800002	GMLM
Farm Goedehoop 308 Portion 6	T0IR00000000030800006	BART HARMSE / BARWOU BOERDERY TRUST
Farm Goedehoop 308 RE of Portion 9	T0IR00000000030800009	NU-WAY HOUSING DEVELOPMENTS PTY LTD
Farm Goedehoop 308 Portion11	T0IR00000000030800011	PAYNE CHARLES WILLIAM
Farm Goedehoop 308 Portion12	T0IR00000000030800012	GMLM
Farm Goedehoop 308 Portion13	T0IR00000000030800013	SWIEGERS LOUISA ANTOINETTA SUSANNA MAGDELENA
Farm Goedehoop 308 Portion 25	T0IR00000000030800025	GMLM
Farm Goedehoop 308 Portion 29	T0IR00000000030800029	JABULA PLANT HIRE PTY LTD

* According to lease agreement between GMLM and the CGS

The 3D seismic survey is planned within rural areas that are vacant or used for agricultural purposes. The drill site is also vacant and used for informal grazing. The town of Leandra is located to the south and south-east of the project area. Lebohang, which forms the southern part of Leandra, is located to the south of the project area. It is a residential area with smaller stands, where the dwellings are characterised by clustered government houses and informal dwellings are also encountered in this area.

Even though the direct footprint of the project area is located on individual farm portions, the ESIA also assessed the indirect impacts to the surrounding urban and rural land uses. In addition, the ESIA also considered the intended future land use within the project area, based on the municipal Spatial Development Framework (SDF) (see Section 4.9 below).

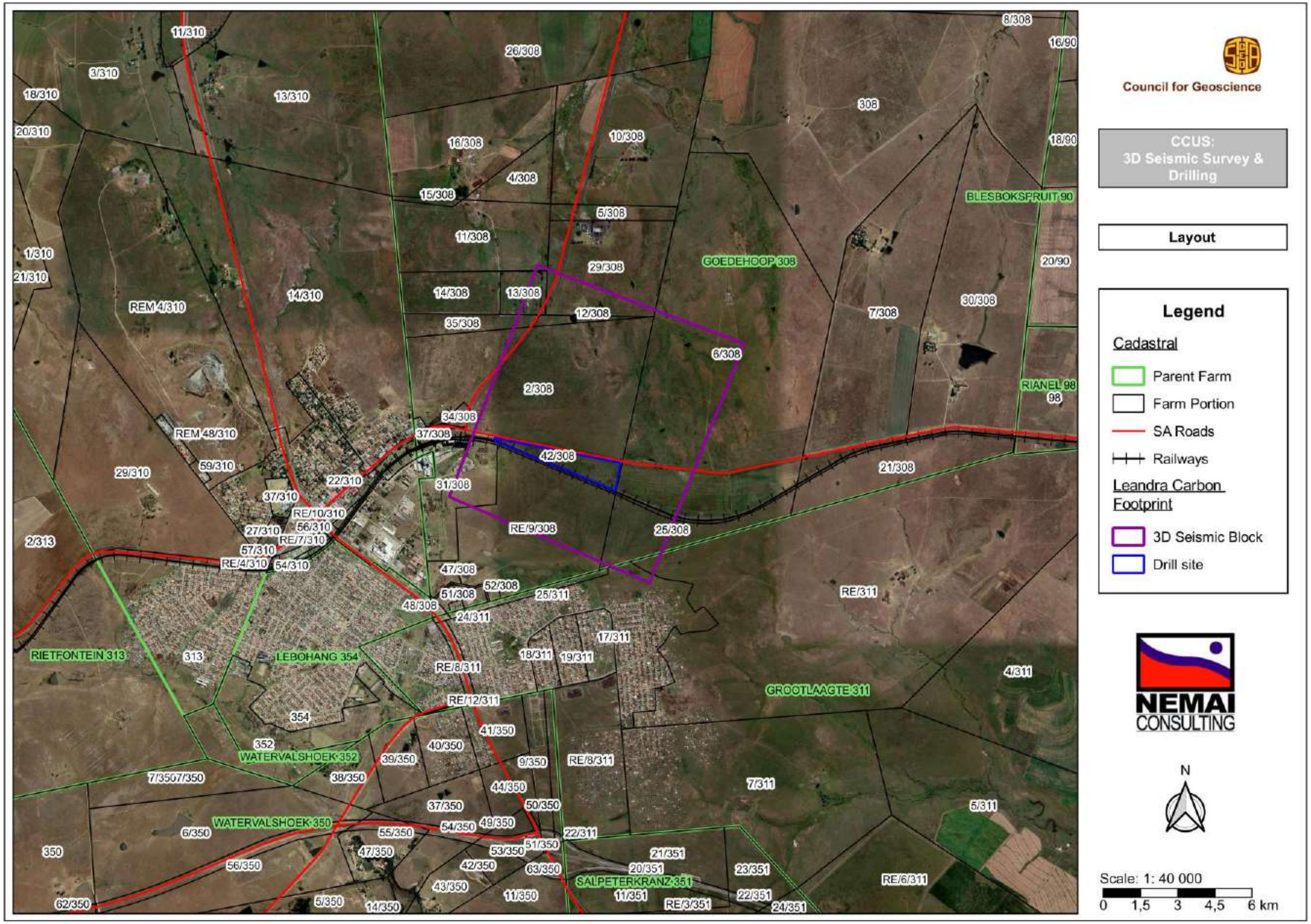


Figure 4: Map showing cadastral boundaries

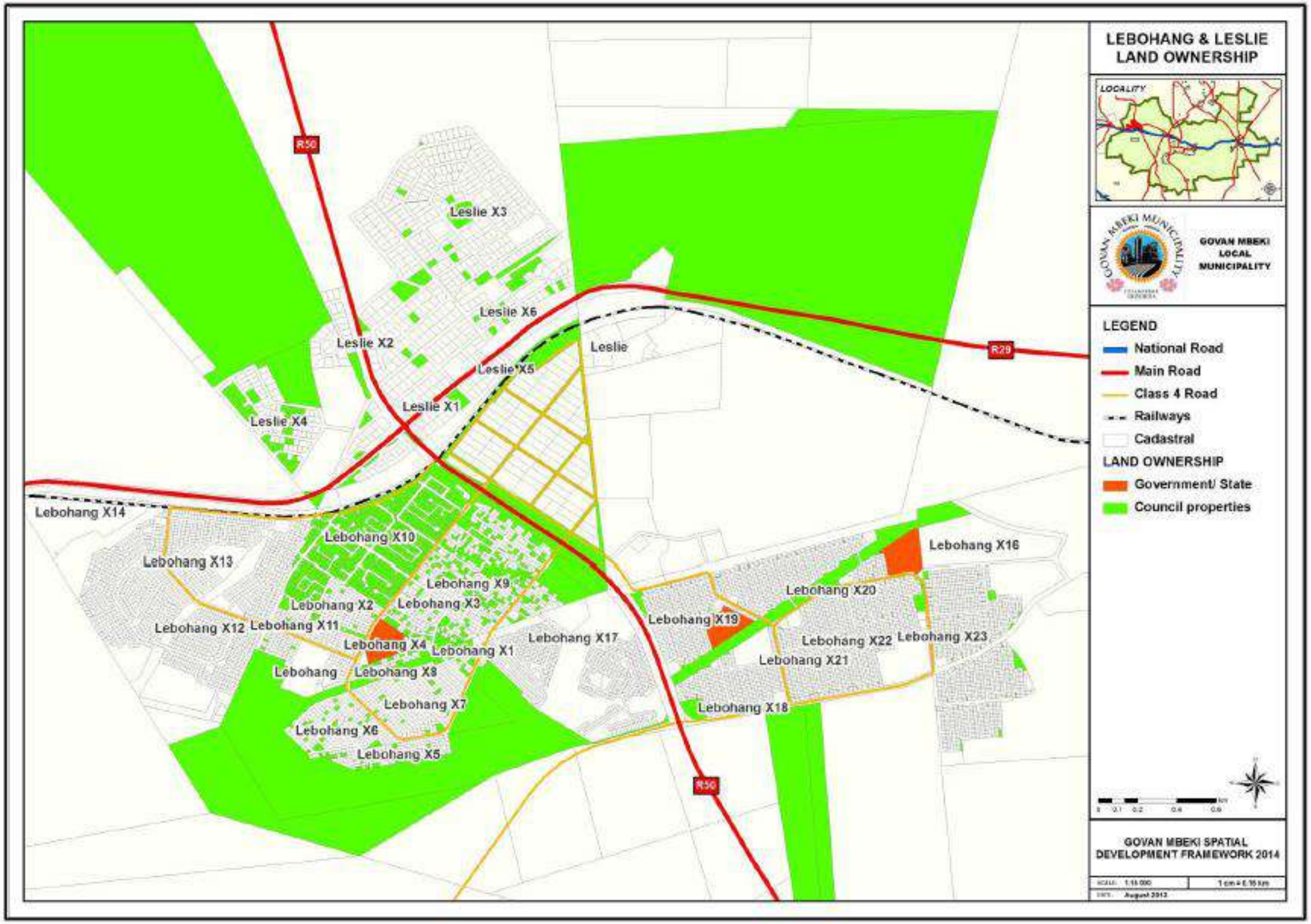


Figure 5: Land Ownership in Leslie & Lebohang (GMLM, 2014)

2.3 Proposed Project

2.3.1 CCUS

CCUS reduces the release of anthropogenic CO_2 emissions into the atmosphere by capturing CO_2 at the source (e.g., point-source emitters such as coal-fired plants) and transporting and storing the captured CO_2 in suitable deep geological formations. Some of the captured CO_2 may then be used in additional downstream industries.

According to Dhansay *et al*. (2022), SA is the highest CO_2 emitter on the African continent and has one of the largest rates of CO_2 emissions in the world. In general, SA's coal reserves, current coal utilisation and subsequently most CO_2 emissions occur in the north-eastern part of the country.

Basaltic rocks, which are rocks rich in iron, calcium, magnesium, and aluminium silicate minerals, are regarded as very promising CO_2 storage reservoirs. This is largely because basaltic rocks are globally voluminous, have unique trapping mechanisms linked to their multi-phase geodynamic emplacement; and have a chemical composition that is highly susceptible for mineral carbonation on a large scale and which is several orders of magnitude faster than in classical siliciclastic reservoirs (Dhansay *et al*., 2022). SA has extensive basaltic occurrences across the country. Figure 6 below provides an overview of the surface expression of significant basaltic sequences across SA together with coalfields and coal-fired energy generation plants.

An assessment of available geological data undertaken by the CGS identified the availability of deep coal seams and potential CO_2 storage reservoirs that can support CCUS development in the Mpumalanga Province (see Figure 7 below).

The purpose of the Project is to demonstrate the application of CCUS technology to SA conditions. The overall Project comprises the following two components:

- **Component 1:** PCSP for the investigation and characterization of a suitable CO_2 storage site and the subsequent injection, storage and monitoring of between 10,000 and 50,000 tonnes of CO_2 into deep suitable geological formations.
- **Component 2:** A CO_2 Capture Pilot Project (CCPP) Front-End Engineering Design (FEED) for the preparation of a FEED study for a capture pilot plant at the Eskom Kusile Power Station.

The scope of this ESIA is the geological characterisation under the PCSP (part of component 1 above) comprising of drilling a stratigraphic borehole and undertaking high-resolution 3D seismic survey at the proposed injection site, and associated supporting infrastructure.

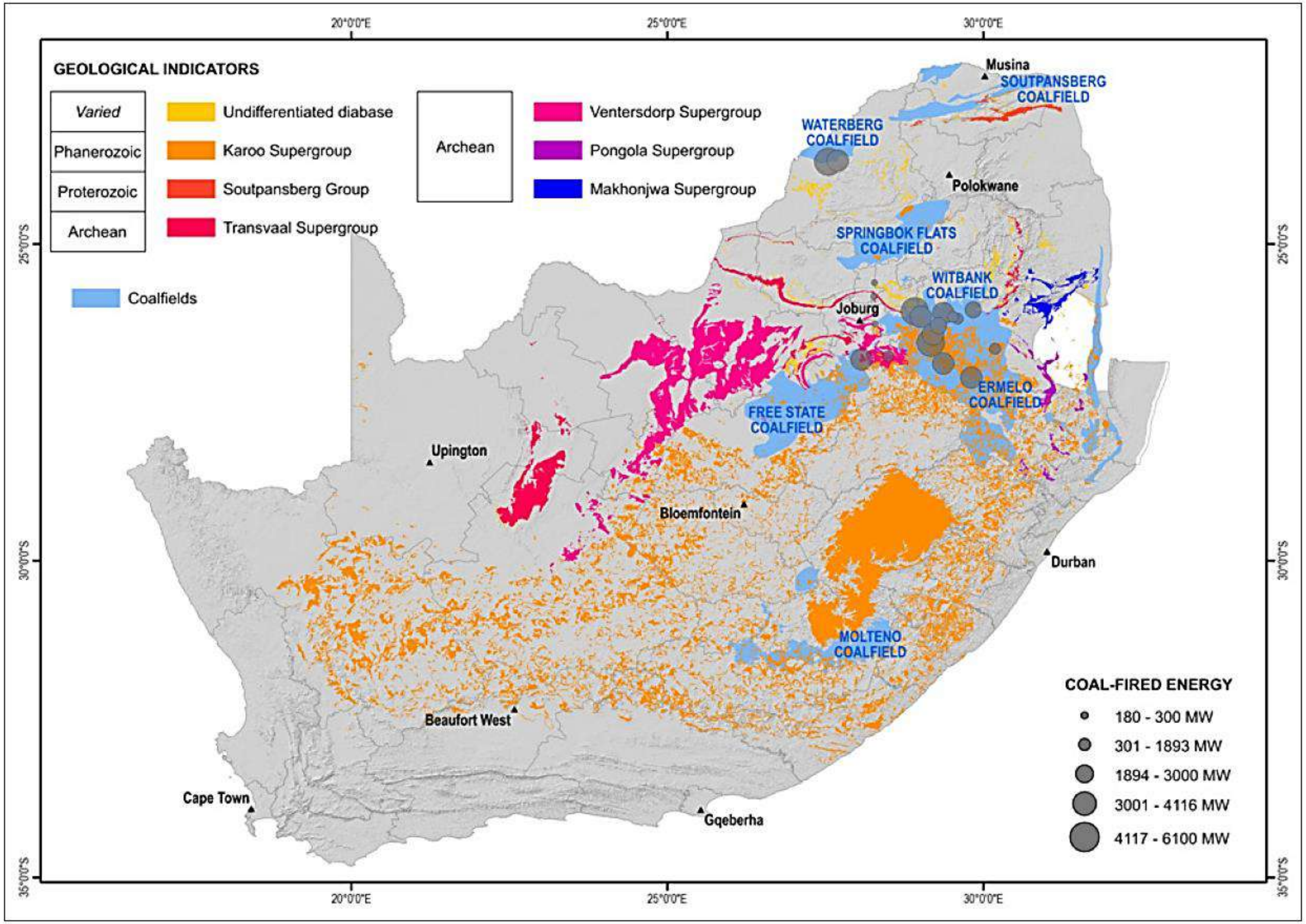


Figure 6: Significant basaltic sequences across SA together with coalfields and coal-fired energy generation plants (Dhansay *et al*., 2022)

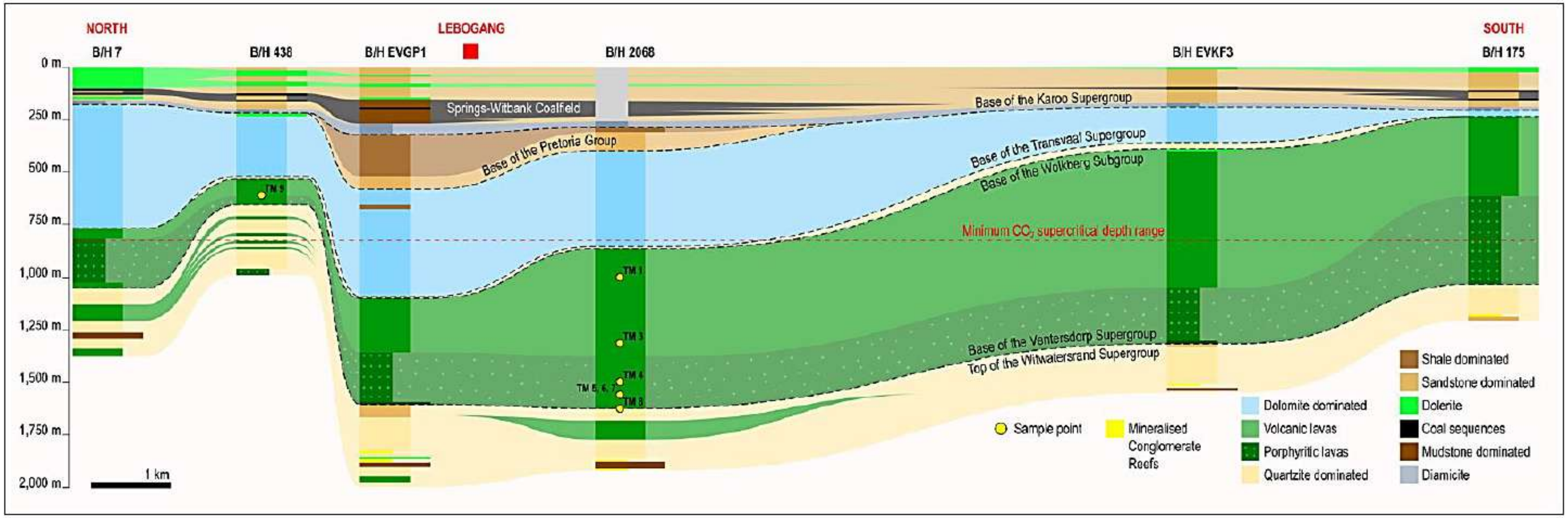


Figure 7: Schematic geological profile developed proximal to SA's significant point-source CO_2 emitters (Dhansay *et al*., 2022)

2.3.2 Proposed Drilling Activities

2.3.2.1 Overview

The drilling and associated borehole construction of a 2,000m deep slim hole for extracting drill core that can be analysed for geological characterisation, which will support the pilot CO_2 injection and monitoring. The proposed drill site is located along the R29 from Leandra to Kinross and is bounded to the south by a railway line from Secunda to Springs.

The dimensions of the proposed drill area will be approximately 50m x 30m. A well pad will be constructed at the location to accommodate a drilling rig, associated equipment and support services. The drilling rig and support services are transported to site, typically in modules and assembled. A typical drill site is shown in Figure 8 below. A schematic of the proposed drill site is provided in Figure 9 below.

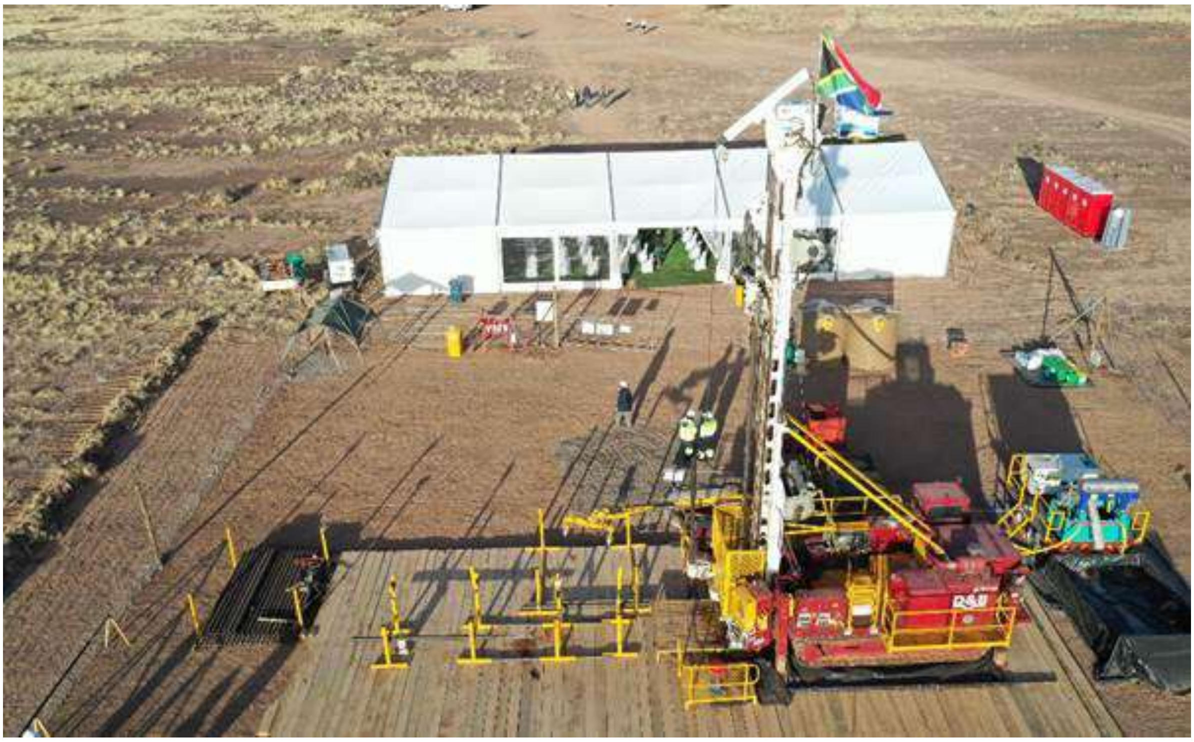


Figure 8: Photograph of a typical drill site (KDD-01 site)

The borehole will be cored from the top of the bedrock to total depth. The minimum hole diameter in the upper 12 m is 152mm. The remainder of the hole to target depth is 95mm diameter. At various intervals during the drilling, suites of geophysical instruments will be installed in the borehole to obtain geophysical information. In addition, tests to determine the presence and quantity of gasses, e.g., hydrocarbons/light gasses, and tests to determine hydrological information will be conducted at systematic horizons, e.g., where water strikes are intersected, in the borehole. The drilling of the slim hole will be to acquire core and wireline logs to assist in undertaking high-resolution geological characterisation.

Figure 9: Schematic of proposed drill site

It is proposed that the boreholes will be engineered as follows:

- Drill 152 mm to approximately 12 metres;
- Install PW casing and grout to the surface;
- Drill PQ to approximately 150 metres;
- Run HW casing c/w casing shoe and seat casing; and
- Drill HQ to TD.

2.3.2.2 Drilling Fluid System

Drilling fluids will be circulated through the drill string and pumped through the drill bit. The fluid assists the drill bit cutting action and cools the bit, removes cuttings rock from the borehole and protects the borehole against formation pressures. When each borehole section has been drilled, steel casing will be run into the hole and cemented into place to prevent collapse.

According to the International Finance Corporation (IFC) (2007a), drilling fluids are circulated downhole and routed to a solids control system at the surface facilities where fluids can be separated from the cuttings. The drilling fluids are then recirculated downhole leaving the cuttings behind for disposal.

Requirements for the drilling fluid system for the CCUS Project include the following:

- The Contractor shall be responsible for the design, supply, mixing and maintenance of a fresh-water-based drilling fluid system that will maintain borehole stability and improve drilling efficiency;
- Only non-toxic and environmentally-friendly drilling fluid additives shall be used;
- A list of all drilling fluid additives that are proposed to be used, with their Material Safety Data Sheets (MSDS), shall be available;
- Circulation losses shall be remedied;
- Suitable storage and mixing facilities shall be provided;
- Responsible crew members shall be fully trained in the design, mixing and testing procedures of the drilling fluid system;
- A detailed fresh water-based drilling fluid programme shall be prepared, which will ensure the integrity of the borehole during the drilling and logging operations; and
- A programme for the disposal of drilled cuttings from the active circulating system will be prepared.

2.3.2.3 Plant, Equipment and Goods

Plant, equipment and goods associated with the CCUS drilling shall include (amongst others):

- Drill rigs including masts or derricks;
- Drilling fluid mixing, pumping and recycling equipment;
- Grouting pumps, mixers and all other equipment necessary for grout casing of the borehole, when necessary;

- Lighting plants and other equipment necessary to allow safe and efficient 24-hour operation;
- Adequate power supply unit for the drilling operation and the staff camp;
- Water supply for drilling and potable water for project workers;
- Shared facilities between drilling activities and seismic survey –
  - Site office, accommodation for security personnel, stores, workshops and kitchen facilities at the site, which will be fenced off;
  - Office for CGS representatives;
  - Adequate vehicles to allow completion of the work, including suitable transport to safely transport contractor personnel to and from the drill site;
  - Adequate, approved temporary ablution and latrine facilities;
  - A reliable communication system; and
  - All spare parts and back-up plant and equipment to ensure safe and efficient completion of the work.

2.3.2.4 Borehole Completion

On completion, the borehole will be securely capped with a concrete sanitation block and a lockable metal cap with a clear sign to avoid potential hazards to people and animals. The drill site will also be suitably rehabilitated. New facilities will be created for the injection phase.

2.3.3 3D Seismic Survey

2.3.3.1 Overview

The area earmarked for the 3D seismic survey encompasses rural areas to the east and north-east of the town of Leandra. The total area of the survey is approximately 360 hectares in extent and the perimeter is close to 7.6km.

A seismic survey is a method of investigating subterranean structure. The technique is based on determining the time interval that elapses between the initiation of a seismic wave at a selected shot point (i.e., location where the seismic wave is generated) and the arrival of reflected or refracted impulses at one or more seismic detectors (https://www.britannica.com/science/seismic-survey). The purpose of the high resolution 3D seismic survey for the CCUS Project is to map the structures, reservoir and seal rocks in detail over the identified potential injection site. The 3D seismic survey will also establish the baseline for future time-lapse CO_2 monitoring activities. 3D seismic surveys must be conducted over a large area in order to provide sufficient data for accurate interpretation of the subsurface geology.

For the Project, the seismic waves will be induced by vibrating truck-mounted heavy plates on the ground. These specialised trucks are known as “Vibroseis” (see example in Figure 10 below). By analysing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped. 3D seismic surveys are acquired by laying out energy source points (vibroseis) and receiver points (geophones) in a grid over the area to be surveyed (see Figure 11 below).

Figure 10: Example of a vibroseis truck

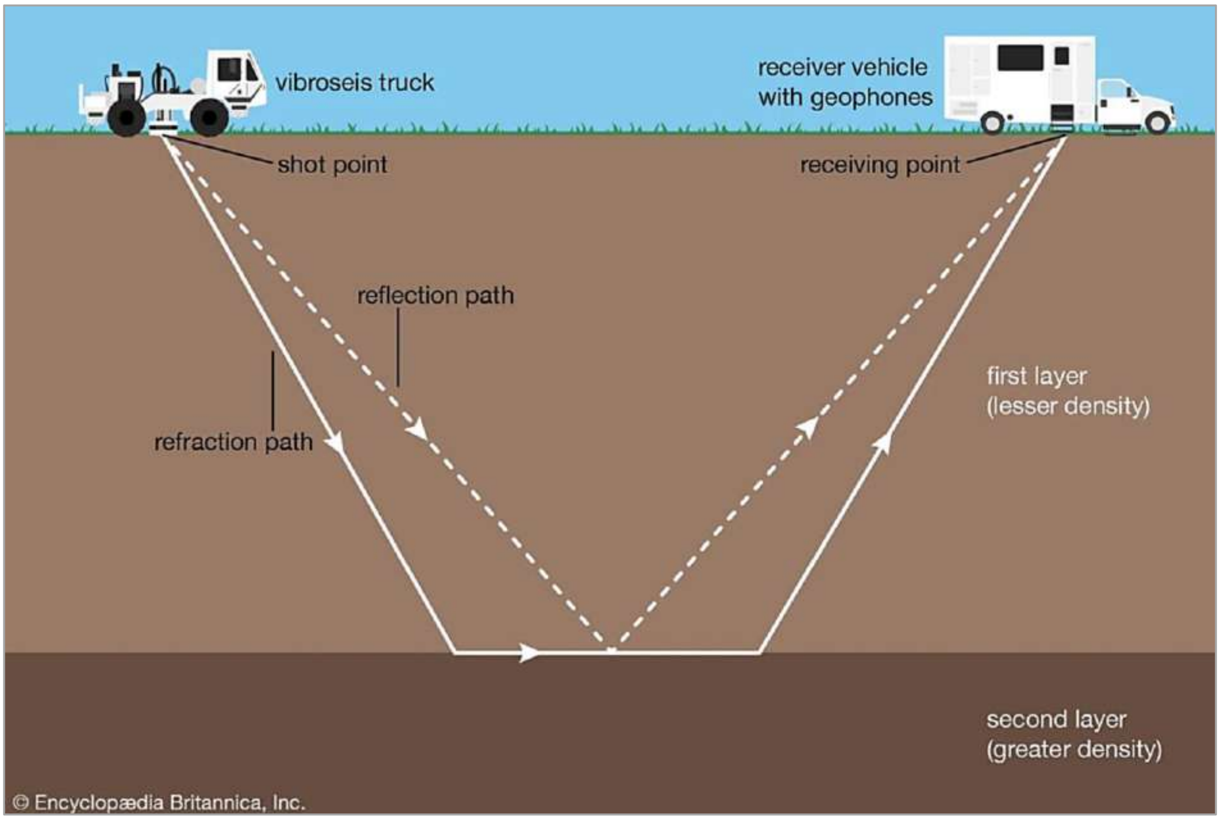


Figure 11: Simplified diagram of seismic data acquisition (https://www.britannica.com/science/seismic-survey#/media/1/532921/61754)

The 3D seismic data for the Project will be processed using pre-stack time/depth migration and post-stack time migration approaches for comparison purposes. The information from the existing legacy and borehole data will be utilised to provide constraints on the designs of the seismic surveys and processing of the seismic data.

The wireless geophones will be deployed on foot by the survey crew and from support vehicles at pre-determined locations, based on the final grid design. At the end of each day the geophones will be recovered and returned to the camp site to allow the collected data to be downloaded and the batteries to be recharged. The source and receiver lines will be deployed perpendicular to each other according to predefined survey parameters, as shown in Figure 12 below. Geophones will be placed at regular intervals along the receiver line. The source line consists of shot points marked at regular intervals along which the vibroseis trucks will travel.

The 3D seismic survey over the identified injection area will be undertaken at 20m receiver and source line spacing and 5m receiver and source spacing. The survey needs to provide high resolution from shallower depth of 100m to a maximum depth of 2km.

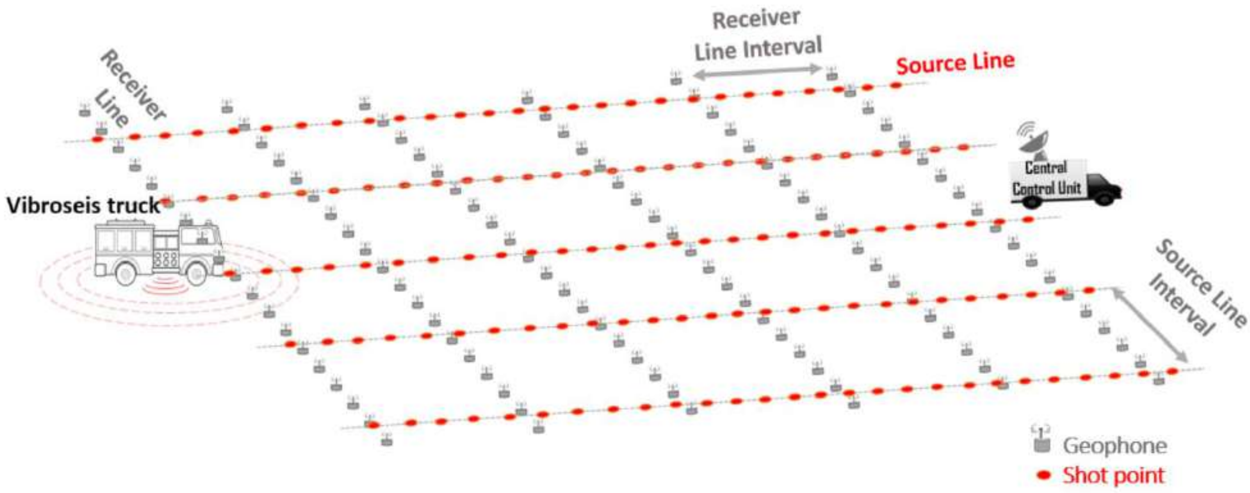


Figure 12: Wireless geophone network orthogonal geometry (Makama *et al*., 2021)

The proposed CCUS seismic survey will comprise the following key activities:

- Determine seismic line coordinates and conduct survey to develop 3D seismic survey grid;
- Prepare vehicle access routes;
- Lay receiver nodes along access routes;
- Undertake seismic acquisition (generation of an acoustic signal) using two vibroseis trucks; and
- Demobilise, rehabilitate and close vehicular access to seismic lines, and undertake monitoring as required of rehabilitation works.

2.3.3.2 Survey Parameters

Additional parameters for the CCUS 3D seismic survey are provided in Table 3 below.

Table 3: Seismic survey parameters for the 3D survey (subject to wave testing of applicable parameters)

Survey area	360 hectares
Receiver line separation	20m
Source line separation	20m
Minimum depth of investigation	100m
Maximum depth of investigation	2km (below ground surface)
Receiver spacing	5m
Source	Vibroseis (x 2) (28-ton vehicles)
Source spacing	5m
Geophone type	Wireless
Sampling rate	0.5 ms (depending on field tests)
Sweep	16-24 s, + 4s listen (final decision will depend on soil response and site tests)
Sweep Frequency	Up to 200 Hz

2.3.3.3 Survey Design

The survey design will be developed by the Contractor appointed to undertake this work. This will include determining the seismic line transects. In addition, the Contractor will need to provide the following information:

- Project plan;
- Logistical plan;
- List of equipment that will be used to carry out the survey;
- Estimated time required to mobilise to the site from the time the contract has been awarded;
- Estimated time for survey set up (i.e., geophone set up);
- Estimated length time of data acquisition; and
- Project Safety, Health and Environment Plan.

2.3.3.4 Plant, Equipment and Goods

Equipment and goods required for the survey shall include (amongst others):

- Two vibroseis trucks;
- Geophones;
- Other equipment necessary to allow safe and efficient 24-hour operation; and
- Shared facilities between drilling activities and seismic survey (see Section 2.3.2.3 above).

2.3.4 Access Considerations and Constraints for 3D Seismic Survey

The overall road network around the project area is discussed in Section 4.16.1 below.

Environmental and social restrictions, such as accessibility, sensitive ecosystems, sensitive fauna and flora species, topography, cultivation, and demographic restrictions are factors that can affect survey design and acquisition. Because of these restrictions, careful planning and some adjustment of nominal shooting geometry will be required for the project to achieve acceptable data from the survey.

Fortunately, the terrain outside the urban area is relatively flat and the survey area occurs in grassland with very few trees (see Figure 13 below)

Figure 13: Typical site conditions encountered in natural areas of survey area

The following characteristics and constraints of the seismic survey area are noted in terms of access and vehicle movement –

- The drill site is bounded to the south by a railway line (see Figure 14 below), which will pose a significant physical barrier to the movement of the vibroseis trucks. The trucks and support vehicles will need to access the southern part of the survey area by using the surrounding road network (refer to Section 4.16.1 below), as opposed to travelling over land.
- Wetlands and non-perennial rivers are encountered in parts of the survey area (see Figure 15 below).
- Anthropogenic landforms, such as quarries, borrow pits (see Figure 16 below) and diggings, pose obstructions to the movement of the vibroseis trucks.

- There were certain urbanised parts within the initial survey area that was proposed which pose restrictions to vehicle movement and the overall survey (see Figure 17 below). The roads in parts of the town are narrow and in a poor condition. This area was subsequently removed from the survey area.
- Farming-related structures and infrastructure are encountered in the survey area.
- Fences are in place on privately-owned farms, which pose barriers.
- The open spaces around the town of Leandra are used for livestock grazing. This includes the areas earmarked for the drilling and seismic survey. Considering the large alternative areas available surrounding the town of Leandra for livestock grazing, as well as the temporary nature of the seismic survey and the movement of the vibroseis trucks along the source lines (only small areas affected where trucks are operating), there should not be significant livelihood restrictions of the cattle owners. The project workers will maintain a safe distance between the vibroseis trucks and people and livestock moving in the vacant areas where the seismic survey is planned.
- The drill site is located more than 800m from any dwelling and will be fenced off to prevent unauthorised access. The seismic survey footprint excludes the surrounding built-up areas inhabited by people, with the nearest dwelling in Lebohang located approximately 80m south-east from the survey area. Although a farmhouse is located within the northern part of the survey area, the vibroseis trucks will avoid any structures associated with this dwelling.
- Protected plants and heritage resources are encountered in certain parts of the site, which need to be safeguarded.

Figure 14: Railway line along the southern boundary of the drill site

Figure 15: Wetland in north-eastern part of seismic survey area

Figure 16: Water-filled borrow pit in north-western part of seismic survey area

Figure 17: View of urbanised parts of seismic survey area (subsequently discarded)

Sensitive environmental features in the project area are further discussed in Section 4 below.

2.3.5 Temporary Facilities

A site camp (approximately 50m x 50m) and parking area (approximately 60m x 10m) (see Figure 9 above) will be established in the fenced area of the drill site. The following temporary facilities will be required at the site camp to support the 3D seismic survey and drilling activities:

- Site offices;
- Materials storage area (including oils and chemicals);
- Workshop;
- Basic services, including water, sanitation, electricity, and health care;
- Waste management facilities (non-hazardous and hazardous waste storage areas);
- Kitchen facilities; and
- Security.

The site camp will comply with industry best practices and will adhere to municipal bylaws. All environmental and social impacts associated with the temporary facilities will be managed through control measures contained in the ESMP.

The vibroseis trucks and support vehicles will depart from and return daily to the site camp.

At this stage, it is assumed that onsite accommodation will not be provided to the project workers, apart from site security personnel (1 - 2 people).

Following the completion of the 3D seismic survey and drilling activities, the temporary facilities will be dismantled and removed. The waste generated from the dismantling of these facilities will be reuses, recycled, or disposed of as general or hazardous waste at licenced disposal facilities. Certain temporary facilities may be retained for use during the injection phase of the overall project.

2.4 Resources and Services Required

This section briefly outlines the resources that will be required to execute the CCUS 3D seismic survey and drilling activities. Provision is made in the ESMP to manage impacts associated with aspects listed below, as relevant.

2.4.1 Water

Water will be required for various purposes, such as drilling, washing of plant and equipment in dedicated areas, dust suppression (if required), potable use by project workers, etc. It is anticipated that 3,000 litres of water will be required for the CCUS Project on a monthly basis.

The Contractor will supply the necessary equipment for the pumping and cartage of drilling water from the source to the drill site. Sources of water may include municipal supply or registered boreholes that are owned by the municipality. Water tankers may also supply water to the site, if necessary.

All water uses triggered in terms of Section 21 of the National Water Act (Act No. 36 of 1998) (NWA) will comply with DWS' requirements.

2.4.2 Sanitation

Sanitation services will be required for the drilling and survey crews in the form of chemical toilets, which will be serviced at regular intervals by the supplier.

2.4.3 Solid Waste and Wastewater

Table 4 below lists the types of waste expected for the 3D seismic survey and drilling.

Solid waste generated during the project will be temporarily stored at the site camp and will be removed at regular intervals and disposed of at an appropriately licenced waste disposal site. The municipality has three (3) licensed operational waste disposal sites, which are the Bethal, Secunda and Leandra landfill sites. It is noted that according to the GMLM's Integrated Development Plan (IDP) (GMLM, 2022), the infrastructure and maintenance at all these waste disposal sites do not meet the minimum requirements for waste disposal by landfill and regulations in terms of the National Environmental Management: Waste Act (Act No. 59 of 2008) (NEM:WA). All the waste generated by the project will be disposed of at licenced waste disposal site with proper record keeping. Alternative landfills will need to be identified if the status of the abovementioned municipal sites remains unchanged.

The waste generated during the drilling operations will predominantly consist of drilling mud and cuttings. Drill cuttings are transported out of the borehole with the drilling mud. At the surface the solids will be separated from the fluid. The drilling fluid will be returned to the recirculating system. The drilling fluid and cuttings will be disposed of, based on their chemical properties and classification.

Wastewater refers to any water adversely affected in quality through the 3D seismic survey and drilling activities and human influence.

Specific measures for the management of solid waste and wastewater are included in the Waste Management Plan (Appendix E).

Table 4: Types of waste expected for the 3D seismic survey and drilling

Waste Type	Source
Non-Hazardous / General Waste	• Food waste, litter, paper, cardboards • Metallic drums • Drill cuttings (water-based muds) • Construction debris – inert waste
Hazardous Waste	• Chemicals (solvents, others) • Batteries (dry and acid-based) • Aerosol cans • Contaminated soil from accidental spills on site • Electrical and electronic equipment • Used oil • Oil filters • Oily rags • Cement slurries • Medical waste • Liquid waste (fluids, lubricating oils, chemical substances, fuel)
Hazardous Wastewater	• Drilling fluids • Gray and black water from showers, toilets and kitchen facilities • Water used for washing purposes (e.g., equipment, staff) • Drainage over contaminated areas (e.g., workshop, equipment storage areas, etc.) • General oily water (e.g., from drip trays)

2.4.4 Roads

The drill site is accessible from the tarred R29 from Leandra to Kinross. A gravel access road leading to the site is available for use by the Contractor.

It is not anticipated that additional access roads will be constructed for the 3D seismic survey as all vehicles will have off-road capabilities. Access considerations and constraints for the seismic survey are discussed in Section 2.3.4 above.

The areas affected by temporary roads will be reinstated.

2.4.5 Electricity

Electricity will be obtained from diesel generators during the 3D seismic survey and drilling.

2.4.6 Refuelling

The vibroseis trucks will be refuelled at the site camp in a dedicated area. The fuel tank will be located on an impermeable surface and will include a bund wall capable of holding the content of the fuel tank. The refuelling area will be located away from watercourses and will be protected from weather conditions. It will also be a safe distance from any accommodation and offices.

Light vehicles will be refuelled at public fuel stations, which are available in the town of Leandra (see Figure 18 below).

Figure 18: Fuel station in Leandra (approximately 1.5km from the drill site)

2.5 Project Timeframes

The following durations of the Project activities are anticipated:

- Seismic survey - approximately 1 month; and
- Drilling - approximately 6 months.

Chapter 2: Legislative and Institutional Framework

3 Legislative and Institutional Framework

3.1 Introduction

This chapter presents the environmental and social governance framework for the 3D seismic survey and drilling activities proposed as part of the CCUS. The WB requirements are discussed, followed by a list of SA's international agreements and obligations. Thereafter, an explanation is provided of the national environmental regulatory framework that the project needs to adhere to. Finally, a gap analysis between the WB and SA's requirements is presented.

3.2 WB Policies & Environmental, Health and Safety Guidelines

3.2.1 Introduction

The WB Group's OPs and EHS Guidelines were put in place to prevent or mitigate adverse impacts of its projects on people and the environment. This section provides an overview of the WB Policies and EHS Guidelines in the context of the CCUS 3D seismic survey and drilling activities.

3.2.2 Environmental Screening

The WB undertakes environmental screening of each proposed project to determine the appropriate extent and type of Environmental Assessment required. The WB classifies a proposed project into one of four categories, depending on the type, location, sensitivity, and scale of the project and the nature and magnitude of its potential environmental impacts. These categories include the following:

1. **Category A**: A proposed project is classified as Category A if it is likely to have significant adverse environmental impacts that are sensitive, diverse, or unprecedented. These impacts may affect an area broader than the sites or facilities subject to physical works. Environmental Assessment for a Category A project examines the project's potential negative and positive environmental impacts, compares them with those of feasible alternatives (including the "without project" situation), and recommends any measures needed to prevent, minimize, mitigate, or compensate for adverse impacts and improve environmental performance. For a Category A project, the borrower is responsible for preparing a report, normally an Environmental and Social Impact Assessment (ESIA) (or a suitably comprehensive regional or sectoral Environmental Assessment).
2. **Category B**: A proposed project is classified as Category B if its potential adverse environmental impacts on human populations or environmentally important areas (including wetlands, forests, grasslands, and other natural habitats) are less adverse

than those of Category A projects. These impacts are site-specific and few if any of them are irreversible. In most cases mitigatory measures can be designed more readily than for Category A projects.

3. **Category C**: A proposed project is classified as Category C if it is likely to have minimal or no adverse environmental impacts. Beyond screening, no further EA action is required for a Category C project.
4. **Category FI**: A proposed project is classified as Category FI if it involves investment of Bank funds through a financial intermediary, in subprojects that may result in adverse environmental impacts.

As mentioned, the overall CCUS Project is considered a Category A, however the activities for which this abbreviated ESIA have been prepared is considered Category B.

3.2.3 Gap Analysis of WB Safeguard Polities

Table 5 below presents the relevance of the WB's OPs to the CCUS 3D seismic survey and drilling.

Table 5: Relevance of WB's OPs to the Project

WB OP	Relevant to Project	Explanation
OP 4.01 Environmental Assessment	**Yes**	The abbreviated ESIA that is being undertaken for the Project will evaluate and manage the environment and social risks and impacts in a manner consistent with the OP 4.01.
OP 4.04 Natural Habitats	**Yes**	Natural habitats are land and water areas where (i) the ecosystems' biological communities are formed largely by native plant and animal species, and (ii) human activity has not essentially modified the area's primary ecological functions (OP 4.04 - Annex A). Large parts of the areas earmarked for the proposed CCUS 3D seismic survey and drilling occur in natural habitats, which may be adversely affected by the proposed activities. Suitable management measures are thus required to safeguard the natural habitat and to mitigate the potential impacts.
OP 4.09 Pest Management	**No**	The project will not involve or support the purchase, manufacture or use of pesticides.
OP 4.10 Indigenous Peoples	**No**	The project will not impact distinct, vulnerable, social and cultural groups possessing the characteristics listed in OP 4.10.
OP 4.11 Physical Cultural Resources	**Yes**	Physical cultural resources occur in the project area, as identified by a Heritage Specialists. Suitable management measures are thus required to safeguard physical cultural resources and to mitigate potential impacts to these features.
OP 4.12 Involuntary Resettlement	**No**	The 3D seismic survey area excludes inhabited parts of the town of Leandra. For this reason, as well as the non-invasive nature of the seismic survey, it is not anticipated that OP 4.12 will be triggered. Mitigation measures to safeguard humans from the 3D seismic survey and drilling activities are included in the ESIA Report. The open spaces around the town of Leandra are used for livestock grazing. This includes the areas earmarked for the drilling and seismic survey. Considering the large alternative areas available surrounding the town of Leandra for livestock grazing, as well as the temporary nature of the seismic survey and the movement of the

WB OP	Relevant to Project	Explanation
		vibroseis trucks along the source lines (only small areas affected where trucks are operating), there should not be significant livelihood restrictions of the cattle owners. The project workers will maintain a safe distance between the vibroseis trucks and people and livestock moving in the vacant areas where the seismic survey is planned.
OP 4.36 Forestry	**No**	Forests do not occur in the project area.
OP 4.37 Safety of Dams	**No**	Small dams are encountered in the 3D seismic survey area. These dams will be avoided during the survey.
OP 7.50 Projects on International Waterways	**No**	No international waterways exist in the project area.
OP 7.60 Projects in Disputed Areas	**No**	There are no known disputed areas in the project area. It is noted that it was not confirmed during the ESIA whether any areas earmarked for the CCUS 3D seismic survey and drilling are subject to land claims in terms of SA’s Restitution of Land Rights Act (Act No. 22 of 1994). A query in this regard was forwarded to the Land Claims Commissioner at the Department of Agriculture, Land Reform and Rural Development and feedback is awaited.

3.2.4 Environmental, Health and Safety Guidelines

Borrowers and projects are required to apply the relevant requirements of the WB Group’s EHS Guidelines. These are technical reference documents, with general and industry specific examples of Good International Industry Practice (GIIP). The General EHS Guidelines are designed to be used together with the relevant Industry Sector EHS Guidelines which provide guidance to users on EHS issues in specific industry sectors.

The General EHS Guidelines consists of the following primary sections, which were considered for the CCUS 3D seismic survey and drilling activities:

- Environmental;
- Occupational Health and Safety (OHS);
- Community health and safety; and
- Construction and decommissioning.

Based on the nature of the CCUS 3D seismic survey and drilling activities, the industry specific examples of GIIP were not considered to be relevant.

The EHS Guidelines for Onshore Oil and Gas Development include information relevant to seismic exploration, exploration and production drilling, development and production activities, transportation activities including pipelines, other facilities (including pump stations, metering stations, pigging stations, compressor stations and storage facilities), ancillary and support operations, and decommissioning. Although the CCUS Project is not regarded as exploration for mining purposes, the EHS Guidelines for Onshore Oil and Gas Development provide valuable guidance to manage certain impacts associated with the 3D seismic survey and drilling activities.

3.3 International Agreements and Obligations

SA is a signatory to several conventions on sustainable development and is a member of various bilateral and multilateral organisations.

Some of the key conventions and protocols that are relevant to SA include, but are not limited to, the following:

- African Convention on Nature and Natural Resources, 1968;
- Man and Biosphere Programme, 1971;
- Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention), 1971;
- Convention Concerning the Protection of the World Cultural and Natural Heritage, 1972;
- Convention on the Illegal Trade in Endangered Species (CITES), 1973;
- Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention), 1979;
- Montreal Protocol, 1987;
- Basel Convention, 1989;
- Convention on Biological Diversity, 1992;
- United Nations Framework Convention on Climate Change, 1992;
- Convention to Combat Desertification, 1995;
- Southern African Development Community (SADC) Protocol on Wildlife and Law Enforcement, 1999;
- Protocol on Shared Water Courses, 2002;
- United Nations Framework Convention on Climate Change, 2002;
- Stockholm Convention, 2004;
- SADC Regional Biodiversity Strategy, 2006;
- Paris agreement on Climate Change, 2015; and
- International Labour Organization (ILO) Conventions (including 9 Fundamental Conventions, 2 Governance Conventions, and 17 Technical Conventions).

SA's legislative framework often takes cognisance of these conventions and protocols through discussion papers, white papers, legislation, regulations and by-laws.

3.4 SA's Environmental Regulatory Framework

3.4.1 Introduction

SA has a strong and diverse environmental governance framework with mandated authorities within the various spheres of government regulating impacting activities and elements of the environment.

According to Strydom and King (2009), SA has three legislative mechanisms that exist at a national level to afford protection to the environment. The first mechanism is the constitutional entrenchment of environmental protection through either a rights-based or regulatory approach. The second is environmental protection through framework legislation, namely the National Environmental Management Act (Act No. 107 of 1998) (NEMA). Lastly, the third mechanism is to adopt specific environmental legislation that covers a range of environmental topics and media such as waste, biodiversity, air quality, water resources, heritage resources, protected areas, oceans and coasts, and hazardous substances.

The CGS undertook an ESIA in 2016 for a seismic reflection survey and well drilling in the uMkhanyakude District Municipality, northern KwaZulu-Natal (KZN). The work was undertaken for the South African Centre for Carbon Capture and Storage (SACCCS), a unit of SANEDI. As part of this ESIA, it was concluded that none of the applicable national legislation in SA caters specifically for CCS activities, nor associated investigations. This ESIA was undertaken in accordance with OP 4.01. As part of the current ESIA for the CCUS 3D seismic survey and drilling, a new review of SA's prevailing environmental legislation was conducted to confirm whether the conclusion from the previous CGS project still applies. The findings from this legal review follow in Section 3.4.4 below.

3.4.2 Environmental Legislation

Key environmental legislation in SA and their possible relevance to the Project is shown in Table 6 below. Note that this list does not attempt to provide an exhaustive explanation, but rather represents an identification of some of the most appropriate sections from pertinent pieces of legislation.

Table 6: SA's Environmental Regulatory Framework

Legislation	Description and Relevance
The Constitution of the Republic of South Africa (Act 108 of 1996)	▪ Chapter 2 – Bill of Rights. ▪ Section 24 – Environmental Rights.
National Environmental Management Act (Act No. 107 of 1998)	▪ Key sections (amongst others): ○ Section 24 – Environmental Authorisation (control of activities which may have a detrimental effect on the environment). ○ Section 28 – Duty of care and remediation of environmental damage. ▪ Environmental management principles. ▪ Authorisation type – Environmental Authorisation, which is not deemed to be required for the CCUS 3D seismic survey and drilling activities. ▪ Authorities – Department of Forestry, Fisheries and the Environment (DFFE) (national) (competent authority for the Project) and the Mpumalanga Department of Agriculture, Rural Development, Land and Environmental Affairs (DARDLEA) (provincial).
EIA Regulations of 2014 (as amended)	▪ Purpose – regulate the procedure and criteria as contemplated in Chapter 5 of NEMA relating to the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities, subjected to EIA, in order to avoid or mitigate detrimental impacts on the environment, and to optimise positive environmental impacts, and for matters pertaining thereto.
National Water Act (Act No. 36 of 1998)	▪ Sustainable and equitable management of water resources. ▪ Key sections (amongst others):

Legislation	Description and Relevance
	○ Chapter 3 – Protection of water resources. ○ Section 19 – Prevention and remedying effects of pollution. ○ Section 20 – Control of emergency incidents. ○ Chapter 4 – Water use. ▪ Authorisation type – General Authorisation (GA) or Water Use Licence (WUL. It is not anticipated that authorisation under this Act will be required for the CCUS 3D seismic survey and drilling activities. ▪ Authority – Department of Water and Sanitation (DWS).
National Environmental Management: Waste Act (Act No. 59 of 2008)	▪ Management of waste. ▪ Key sections (amongst others): ○ Section 16 – General duty in respect of waste management. ○ Chapter 5 – licensing of waste management activities listed in Government Notice (GN) No. R. 921 of 29 November 2013 (as amended). ▪ Authorisation type – Waste Management Licence (WML). A WML is not required for the CCUS 3D seismic survey and drilling activities. ▪ Authority – DFFE (national) and DARDLEA (provincial).
National Environmental Management Air Quality Act (Act No. 39 of 2004)	▪ Air quality management. ▪ Key sections (amongst others): ○ Section 32 – Dust control. ○ Section 34 – Noise control. ▪ Authorisation type – Atmospheric Emission License (AEL). An AEL is not required for the CCUS 3D seismic survey and drilling activities. ▪ Authority – DFFE (national), DARDLEA (provincial) and GSDM (local).
National Environmental Management: Biodiversity Act (Act No. 10 of 2004)	▪ Management and conservation of the country's biodiversity. ▪ Protection of species and ecosystems. ▪ Authorisation type – Permit. It is not anticipated that a permit under this Act will be required for the CCUS 3D seismic survey and drilling activities. The current mitigation measures in the ESMP propose the avoidance of all protected species. ▪ Authority – DFFE (national) and Mpumalanga Tourism and Parks Agency (MTPA) (provincial).
National Forests Act (Act No. 84 of 1998)	▪ Supports sustainable forest management and the restructuring of the forestry sector, as well as protection of indigenous trees in general. ▪ Section 15 – Authorisation required for impacts to protected trees. ▪ Authorisation type – Licence. It is not anticipated that a licence under this Act will be required for the CCUS 3D seismic survey and drilling activities. ▪ Authority – DFFE.
National Environmental Management: Protected Areas Act (Act No. 57 of 2003)	▪ Protection and conservation of ecologically viable areas representative of SA's biological diversity and natural landscapes. ▪ There are no formally protected areas in proximity to the project area.
Mineral and Petroleum Resources Development Act (Act No. 28 of 2002)	▪ Equitable access to and sustainable development of the nation's mineral and petroleum resources and to provide for matters related thereto. ▪ Key sections (amongst others): ○ Section 22 – Application for mining right. ○ Section 27 – Application for, issuing and duration of mining permit. ○ Section 53 – Use of land surface rights contrary to objects of Act. ▪ Authorisation type – Mining Permit / Mining Right. It is not anticipated that authorisation under this Act will be required for the CCUS 3D seismic survey and drilling activities. ▪ Authority – Department of Mineral Resources and Energy (DMRE).
National Heritage Resources Act (Act No. 25 of 1999)	▪ Key sections: ○ Section 34 – protection of structure older than 60 years. ○ Section 35 – protection of heritage resources. ○ Section 36 – protection of graves and burial grounds. ○ Section 38 – Heritage Impact Assessment for linear development exceeding 300m in length; development exceeding 5 000m^2 in extent, etc. ▪ Authorisation type – Permit. A permit will be required if heritage resources are to be affected by the CCUS 3D seismic survey and drilling activities. The current mitigation measures propose the avoidance of all heritage resources. ▪ Authority – South African Heritage Resources Agency (SAHRA) (national) and Mpumalanga Provincial Heritage Resource Authority (MPHRA) (provincial).

Legislation	Description and Relevance
Conservation of Agricultural Resources Act (Act No. 43 of 1983)	▪ Control measures for erosion. ▪ Control measures for alien and invasive plant species. ▪ Authority – DARDLEA.
Mpumalanga Nature Conservation Act (Act No. 10 of 1998)	▪ Deals with matters related to nature conservation in Mpumalanga. ▪ Authority – MTPA.
Occupational Health & Safety Act (Act No. 85 of 1993)	▪ Provisions for Occupational Health & Safety (OHS). ▪ Authority – Department of Employment and Labour (DEL). ▪ Relevant regulations, such as Construction Regulations, etc.
Hazardous Substances Act (No 15 of 1973) and Regulations	▪ Provides for the control of substances which may cause injury or ill-health to or death of human beings by reason of their toxic, corrosive, irritant, strongly sensitising or flammable nature or the generation of pressure thereby in certain circumstances, and for the control of certain electronic products. ▪ Provides for the division of such substances or products into groups in relation to the degree of danger. ▪ Provides for the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of such substances and products.
Regulations for Hazardous Chemical Agents (GN No. R.280 of 29 March 2021)	▪ Requirements for protecting employees who work with hazardous chemical substances in the workplace.

3.4.3 Social Legislation

Key pieces of social-related legislation in SA that the project will need to adhere to include the following (amongst others):

- The Constitution of the Republic of South Africa (Act 108 of 1996);
- Basic Conditions of Employment Act (Act No. 75 of 1997) (BCEA);
- Employment Equity Act (Act No. 55 of 1998);
- Labour Relations Act (Act No.66 of 1995) (LRA);
- Occupational Health and Safety Act (Act No. 85 of 1993) (OHSA);
- Compensation for Occupational Injuries and Diseases Act (Act No. 130 of 1993) (COIDA);
- Skills Development Act (Act No. 37 of 2008); and
- Unemployment Insurance Fund Act (Act No. 63 of 1993).

3.4.4 Key Pieces of SA Environmental Legislation Governing the Project

3.4.4.1 National Environmental Management Act

NEMA is the framework legislation regulating the environment in SA and it provides for cooperative governance and establishes principles for decision-making on matters affecting the environment, such as:

- People and their needs must be placed at the forefront of environment management;
- Development must be sustainable and therefore requires avoidances of pollution and degradation of the environment, disturbances of landscapes and sites of cultural heritage;

- The integrated nature of the environment and that responsibility for environmental management exists throughout the life cycle of an activity (from cradle to grave);
- Public Participation;
- Transparent decision making; and
- Intergovernmental co-ordination and harmonization of policies, legislation and actions.

Section 2(4)(p) of NEMA requires that 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 are paid for by those responsible for harming the environment.

Section 28(1) of NEMA imposes a duty of care and remediation for environmental damage and requires that "every person who causes, has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing or recurring, or, in so far as such harm to the environment is authorised by law or cannot reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment".

Section 24 of NEMA provides for the consideration, investigation, assessment and reporting of the potential consequences for, or impacts on, the environment of listed activities (or specified activities) to the competent authority. The Environmental Impact Assessment (EIA) Regulations were promulgated to regulate the procedure and criteria as contemplated in Section 24 of NEMA relating to the preparation, evaluation, submission, processing and consideration of, and decision on, applications for environmental authorisations for the commencement of activities, subjected to an EIA, in order to mitigate detrimental impacts on the environment, and to optimise positive environmental impacts. The EIA Regulations were published under GN No. 982 in Gazette No. 38282 of 4 December 2014 and amended by GN 326 of 7 April 2017 published in Gazette No. 40772 (the "EIA Regulations").

The EIA Regulations consist of the following:

- GN No. 326 of 7 April 2017 – EIA procedure;
- GN No. 327 of 7 April 2017 (Listing Notice 1) – activities that need to be subjected to a Basic Assessment process, as prescribed in Regulations 19 and 20 of the EIA Regulations;
- GN No. 325 of 7 April 2017 (Listing Notice 2) – activities that need to be subjected to a Scoping and Environmental Impact Reporting (S&EIR) Process, as prescribed in Regulations 21 - 24 of the EIA Regulations; and
- GN No. 324 of 7 April 2017 (Listing Notice 3) – activities in specific identified geographical areas that need to be subjected to a Basic Assessment process, as prescribed in Regulations 19 and 20 of the EIA Regulations.

Table 7 below lists key activities from the EIA Listing Notices that could potentially have been triggered by a 3D seismic survey and drilling project, but which are not regarded as relevant to the CCUS Project's geological investigations covered in this report. It shows that the proposed activities were screened against the EIA Regulations and that it was confirmed that Environmental Authorisation will not be required, based on the current project description. A pre-application meeting was held with DFFE on 22 March 2022, during which the relevance of the EIA Listing Notices to the project were discussed with this Department. This abbreviated ESIA Report was thus compiled to only comply with the WB's Environmental Assessment policy (OP 4.01) and not the EIA Regulations. Following the design of the drilling and seismic survey, the relevance of the EIA Listing Notices to the project will need to be re-evaluated.

Table 7: Listed Activities possibly triggered by the Project in terms of the EIA Listing Notices

Activity	Wording of Listed Activity	Reasons why these activities are not relevant to the Project
	Listing Notice 1	
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.	*The drilling will not take place within a watercourse.* *The ESMP recommends the avoidance of all watercourses identified in the project area.*
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 aerial 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 geological investigations that form part of the proposed CCUS 3D seismic survey and drilling activities do not relate to exploration for mineral and petroleum resources in terms of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA).*
24	The development of a road - (i) for which an environmental authorisation was obtained for the route determination in terms of activity 5 in GN 387 of 2006 or activity 18 in GN 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.	*Although a temporary gravel road will be created to access the drill site, the roads will not be wider than 8m.* *No new access roads will be constructed for the seismic survey, as all vehicles will have off-road capabilities.*
27	The 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 total footprint of the drill site (including drill pad, site camp and parking area shown in Figure 9) is less than 1 hectare.*

Activity	Wording of Listed Activity	Reasons why these activities are not relevant to the Project
		It is not anticipated that vegetation will need to be cleared to allow for the 3D seismic survey to be undertaken.
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.	*It is not anticipated that existing roads will need to be widened or lengthened to allow for the CCUS 3D seismic survey and drilling activities to be undertaken.*
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. Certain exclusions apply. (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.	*It is not anticipated that phased activities, where the combination of the phases will exceed a specified threshold, apply.*
	Listing Notice 2	
18	Any activity including the operation of that activity 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, in Listing Notice 1 of 2014 or in Listing Notice 3 of 2014, required to exercise the exploration right, excluding- (a) any desktop study; (b) any aerial survey; (c) any onshore seismic survey which is included in activity 21C in Listing Notice 1 of 2014, in which case that activity applies; (d) a hydraulic fracturing activity which is included in activity 20A, in which case activity 20A of this Notice applies; and (e) the processing of a petroleum resource, including the beneficiation or refining of gas, oil or petroleum products, in which case activity 5 of this Notice applies.	*The geological investigations that form part of the proposed CCUS 3D seismic survey and drilling activities do not relate to exploration for mineral and petroleum resources in terms of the MPRDA.*
	Listing Notice 3	
4	The development of a road wider than 4 metres with a reserve less than 13,5 metres.	*The access road that will be created from the R29 to the drill site, camp site and parking areas are not located within sensitive geographical areas.* *No new access roads will be constructed for the seismic survey, as all vehicles will have off-road capabilities.*
10	The development and related operation of facilities or infrastructure for the storage, or storage and handling of a dangerous good, where such storage occurs in containers with a combined capacity of 30 but not exceeding 80 cubic metres.	*It is not anticipated that bulk fuel storage at the camp site will exceed the threshold of 30m^3.* *In addition, the camp site does not occur in sensitive geographical areas.*
12	The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is	*The areas where indigenous vegetation will be cleared*

Activity	Wording of Listed Activity	Reasons why these activities are not relevant to the Project
	required for maintenance purposes undertaken in accordance with a maintenance management plan.	*(including the drill area, site camp and parking area) are not located in sensitive geographical areas.*
18	The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.	*It is not anticipated that existing roads will need to be widened or lengthened to allow for the CCUS 3D seismic survey and drilling activities to be undertaken.*

3.4.4.2 Mineral and Petroleum Resources Development Act

The purpose of the Mineral and Petroleum Resources Development Act (Act No. 28 of 2002) (MPRDA) is to make provision for equitable access to and sustainable development of the nation's mineral and petroleum resources and to provide for matters related thereto. This Act defines mining as "any operation or activity for the purposes of winning any mineral on, in or under the earth, water or any residue deposit, whether by underground or open working or otherwise and includes any operation or activity incidental thereto".

The geological investigations that form part of the proposed CCUS 3D seismic survey and drilling activities do not relate to exploration for mineral and petroleum resources. In this regard, the following definitions contained in the Mineral and Petroleum Resources Development Regulations (Published under GN R527 in Government Gazette 26275 dated 23 April 2004, as amended) are noted:

- "Exploration well" means "a well drilled for the purpose of obtaining specific geological and geophysical information to prove, define and assess the existence and commerciality of petroleum by conducting any type of pressure tests". From this definition, the borehole proposed for the CCUS drilling is not regarded as an exploration well.
- "Stratigraphic well" means "a well or hole drilled only for the purpose of obtaining information pertaining to specific geological, structural and stratigraphic information that might lead towards the discovery of petroleum with no intent to produce from such a well". This definition is linked to the borehole proposed for the CCUS drilling.

In terms of Section 53 of the MPRDA, any person who intends to use the surface of any land in any way which may be contrary to any object of this Act or which is likely to impede any such object must apply to the Minister for approval in the prescribed manner. CGS needs to confirm whether Section 53 of the MPRDA applies to the proposed drill site.

3.4.4.3 National Environmental Management: Waste Act

Amongst others, the purpose of NEM:WA includes the following:

1. To reform the law regulating waste management in the country by providing reasonable measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development;

2. To provide for institutional arrangements and planning matters;
3. To provide for specific waste management measures;
4. To provide for the licensing and control of waste management activities;
5. To provide for the remediation of contaminated land; and
6. To provide for compliance and enforcement.

"Waste" is defined in NEM:WA as "any substance, material or object, that is unwanted, rejected, abandoned, discarded or disposed of, or that is intended or required to be discarded or disposed of, by the holder of that substance, material or object, whether or not such substance, material or object can be re-used, recycled or recovered and includes all wastes as defined in Schedule 3 to this Act".

Schedule 3 of the NEM:WA groups waste into two categories, namely hazardous waste and general waste. The classification of waste determines the associated management and licencing requirements. ''Hazardous waste'' is defined as "any waste that contains organic or inorganic elements or compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment and includes hazardous substances, materials or objects within business waste, residue deposits and residue stockpiles".

GN No. R. 921 of 29 November 2013 (as amended) contains a list of waste management activities that have, or are likely to have, a detrimental impact on the environment. If any of the waste management activities are triggered in Category A and Category B, a WML is required. It is not anticipated that the CCUS 3D seismic survey and drilling activities will trigger a WML.

In terms of Category C of GN No. R. 921 of 29 November 2013 (as amended), the following activities will need to comply with the National Norms and Standards for the Storage of Waste (GN R. 926 of 29 November 2013):

- The storage of general waste at a facility that has the capacity to store in excess of $100m^3$ of general waste at any one time, excluding the storage of waste in lagoons or temporary storage of such waste; and
- The storage of hazardous waste at a facility that has the capacity to store in excess of $80m^3$ of hazardous waste at any one time, excluding the storage of hazardous waste in lagoons or temporary storage of such waste.

Where relevant, waste generated during the drilling will need to be classified in terms of the Waste Classification and Management Regulations (GN R. 634 of 23 August 2013) ("Waste Classification and Management Regulations") (except if it is listed in Annexure 1) and analysed in terms the National Norms and Standards for the Assessment of Waste for Landfill Disposal (GN R. 635 of 23 August 2013).

The following principles will apply to the project's waste management strategy:

- The project will aim to adhere to the waste management hierarchy, which promotes the following order of priority: waste avoidance / reduction, re-use, recycling, recovery and disposal (last option).
- Waste must be separated at source, in accordance with the requirements of the NEM:WA, to maximise opportunities for re-use and recycling, and treatment efficiencies.
- The management and disposal of waste drilling fluids and cuttings shall comply with the NEM:WA.
- *Duty of Care Principle* – The industry that generates a waste is responsible for the fate of the generated waste in all circumstances. The generator of the waste is ultimately responsible for ensuring that the waste is handled, stored, transported and disposed of according to the legislation and in an environmentally sound and responsible manner; and
- *Polluter Pays Principle* – The person or organisation causing pollution is liable for any costs involved in cleaning-up or rehabilitating its effects. The generator of the waste is thus liable unless able to prove that the transferal of management of the waste was a responsible action.

3.4.4.4 National Water Act

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

- Meeting the basic human needs of present and future generations;
- Promoting equitable access to water;
- Redressing the results of past racial and gender discrimination;
- Promoting the efficient, sustainable and beneficial use of water in the public interest;
- Facilitating social and economic development;
- Providing for growing demand for water use; protecting aquatic and associated ecosystems and their biological diversity;
- Reducing and preventing pollution and degradation of water resources;
- Meeting international obligations;
- Promoting dam safety; and
- Managing floods and droughts.

Some key definitions from the NWA include:

- "Pollution" means the direct or indirect alteration of the physical, chemical or biological properties of a water resource so as to make it (a) less fit for any beneficial purpose for which it may reasonably be expected to be used; or (b) harmful or potentially harmful;

- "Waste" includes any solid material or material that is suspended, dissolved or transported in water (including sediment) and which is spilled or deposited on land or into a water resource in such volume, composition or manner as to cause, or to be reasonably likely to cause, the water resource to be polluted; and
- A "water resource" includes a watercourse, surface water, estuary, or aquifer.

Table 8 below lists water uses, in terms of Section 21 of the NWA, that could potentially have been triggered by a 3D seismic survey and drilling activities, but which are not regarded as relevant to the CCUS Project's geological investigations at this stage. A meeting was held with DWS, who is the custodian of SA's water resources, on 24 March 2023 to discuss the possible water uses that may be associated with the project. Following the design of the drilling and seismic survey, the relevance of the water uses listed in Section 21 of the NWA to the project will need to be re-evaluated.

Table 8: Water uses possibly associated with the Project in terms of Section 21 of the NWA

<table>
<tr><th colspan="2">Water Use Type</th><th>Project-related Activities</th></tr>
<tr><td>Section 21(g)</td><td>Disposing of waste in a manner which may detrimentally impact on a water resource.</td><td>It is not deemed that the structures to be used to manage drilling fluids, as well as the management of the associated waste (drilling mud and cuttings), will trigger this water use.</td></tr>
<tr><td>Section 21(c)</td><td>Impeding or diverting the flow of water in a watercourse.</td><td rowspan="2">The regulated area of a watercourse for Section 21(c) and (i) water uses is defined as follows in Government Gazette No. 40229 of 26 August 2016:
• The outer edge of the 1 in 100 year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
• In the absence of a determined 1 in 100 year flood line or riparian area the area within 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 NWA); or
• A 500 m radius from the delineated boundary (extent) of any wetland or pan.

The CCUS drill site is not located within the regulated area of a watercourse.

The seismic survey area falls within the regulated area of various watercourses. However, due to the non-invasive nature of the survey and mitigation measures proposed in this ESIA Report, it is deemed that Section 21(c) and (i) water uses are not triggered by this project.</td></tr>
<tr><td>Section 21(i)</td><td>Altering the bed, banks, course or characteristics of a watercourse.</td></tr>
</table>

3.4.4.5 National Environmental Management: Air Quality Act

The purpose of the National Environmental Management: Air Quality Act (Act No. 39 of 2004) (NEM:AQA) is to reform the law regulating air quality by providing measures for the prevention of pollution and ecological degradation and for securing ecologically sustainable development. This Act aims to promote justifiable economic and social development; to provide for national norms and standards regulating air quality monitoring, management and control by all spheres of government, and for specific air quality measures.

Some key definitions from this Act include:

- "Air pollution" means any change in the composition of the air caused by smoke, soot, dust (including fly ash), cinders, solid particles of any kind, gases, fumes, aerosols and odorous substances;
- "Atmospheric emission" or "emission" means any emission or entrainment process emanating from a point, non-point or mobile source that results in air pollution;
- A "non-point source" is a source of atmospheric emissions which cannot be identified as having emanated from a single identifiable source or fixed location, and includes veld, forest and open fires, mining activities, agricultural activities and stockpiles; and
- A "Point source" is a single identifiable source and fixed location of atmospheric emission, and includes smoke stacks and residential chimneys.

The NEM:AQA provides for the listing of activities which result in atmospheric emissions that pose a threat to health or the environment. No person may conduct any such listed activity without an AEL. It is not anticipated that the CCUS 3D seismic survey and drilling activities will trigger a AEL.

National Dust Control Regulations (GN No. R. 827 of 1 November 2013), as amended, were gazetted in terms of NEM:AQA. The purpose of the regulations is to prescribe general measures for the control of dust in all areas. There Regulations prescribe acceptable dust fallout rates.

Provision is made in the Air Quality Management Plan (Appendix A) to manage impacts to air quality as a result of the CCUS 3D seismic survey and drilling activities.

3.4.4.6 National Environmental Management: Biodiversity Act

The purpose of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) (NEM:BA) is to provide for the management and conservation of SA's biodiversity within the framework of NEMA.

The Act allows for the publication of provincial and national lists of ecosystems that are threatened and in need of protection. The list should include:

- Critically Endangered Ecosystems, which are ecosystems that have undergone severe ecological degradation as a result of human activity and are at extremely high risk of irreversible transformation.
- Endangered Ecosystems, which are ecosystems that, although they are not critically endangered, have undergone ecological degradation due to human activity.

- Vulnerable Ecosystems, which are ecosystems that have a high risk of undergoing significant ecological degradation.
- Protected Ecosystems, which are ecosystems that are of a high conservation value or contain indigenous species at high risk of extinction in the wild in the near future.

Similarly, the Act allows for the listing of endangered species, including critically endangered species, endangered species, vulnerable species and protected species. A person may not carry out a restricted activity (including trade) involving listed threatened or protected species without a permit.

The Regulations on the management of Listed Alien and Invasive Species were promulgated on 1 August 2014. The Listed Invasive Species were also published on this date and were subsequently amended.

Some key definitions from this Act include:

- "Alien species" –
  - A species that is not an indigenous species; or
  - An indigenous species translocated or intended to be translocated to a place outside its natural distribution range in nature, but not an indigenous species that has extended its natural distribution range by natural means of migration or dispersal without human intervention.
- "Biological diversity" or "biodiversity" – the variability among living organisms from all sources including, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part and also includes diversity within species, between species, and of ecosystems.
- "Indigenous species" – a species that occurs, or has historically occurred, naturally in a free state in nature within the borders of the Republic, but excludes a species that has been introduced in the Republic as a result of human activity.
- "Invasive species" – any species whose establishment and spread outside of its natural distribution range -
  - Threaten ecosystems, habitats or other species or have demonstrable potential; and
  - May result in economic or environmental harm or harm to human health.
- "Species" – a kind of animal, plant or other organism that does not normally interbreed with individuals of another kind, and includes any sub-species, cultivar, variety, geographic race, strain, hybrid or geographically separate population.

The implications of NEM:BA for the Project include *inter alia* the requirements for managing invasive and alien species, protecting threatened ecosystems and species, as well as for rehabilitating the areas affected by the CCUS 3D seismic survey and drilling activities.

The findings of the Terrestrial and Aquatic Ecological Impact Assessments that were undertaken for the CCUS 3D seismic survey and drilling are contained in this ESIA Report.

3.4.4.7 National Heritage Resources Act

The purpose of the National Heritage Resources Act (Act No. 25 of 1999) (NHRA) is to protect and promote good management of SA's heritage resources, and to encourage and enable communities to nurture and conserve their legacy so it is available to future generations.

In terms of Section 34(1) of the NHRA, 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 defines a "structure'' as meaning "any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith". The heritage authorities, which include SAHRA (national) and MPHRA (provincial), will be engaged with during the course of the ESIA. An application will also be made to MPHRA to demolish structures older than 60 years. The ESMP also includes a chance find procedure (refer to Heritage Resources Management Plan).

In terms of Section 38 of the NHRA, certain listed activities require authorisation from provincial agencies, which include:

- The construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- The construction of a bridge or similar structure exceeding 50m in length;
- Any development or other activity which will change the character of a site -
  - Exceeding 5 000m^2 in extent; or
  - Involving three or more existing erven or subdivisions thereof; and
- The re-zoning of a site exceeding 10 000m^2 in extent.

The findings of the Heritage Impact Assessment that was undertaken for the CCUS 3D seismic survey and drilling are contained in this ESIA Report.

3.5 Legislative Gap Analysis

The key requirements of the WB's OPs and related provisions in SA legislation are captured in Table 9 below. Also refer to Table 5 above regarding the relevance of the WB's OPs to the Project.

Table 9: Key requirements of WB's OPs and related provisions in national legislation

Key Requirements of WBG ESS	Related Provisions in SA Legislation	Gaps
OP 4.01 Environmental Assessment: • An Environmental Assessment report for a Category A project focuses on the significant	Chapter 24 of NEMA caters for the procedures for the investigation, assessment and communication of the potential consequences or impacts of activities on the environment. Related provisions in the EIA Regulations:	No significant gaps identified between the referenced SA legislation and the requirements of OP 4.01. It is noted that

Key Requirements of WBG ESS	Related Provisions in SA Legislation	Gaps
environmental issues of a project. The report's scope and level of detail should be commensurate with the project's potential impacts. • Depending on the project, a range of instruments can be used to satisfy the WB's Environmental Assessment requirement, such as an EIA (amongst others).	• Prescribe the regulatory process necessary to apply for environmental authorisation in terms of NEMA and a WML in terms of NEM:WA. • Provide the requirements of the EIA process, which include the assessment and mitigation of detrimental impacts on the environment. • Prescribe the content of the following – o Basic Assessment Report / Scoping and EIA Reports; o Environmental Management Programme (EMPr); o Closure Plan; and o Environmental Audit Report.	the proposed CCUS 3D seismic survey and drilling activities do not trigger the need for Environmental Authorisation in terms of NEMA, and an EIA was thus not undertaken.
OP 4.04 **Natural Habitats**	The following SA legislation directly deals with conserving biodiversity: • NEMA; • NWA; • NEM:BA and Regulations; • National Environmental Management: Protected Areas Act (Act No. 57 of 2003); and • National Forests Act (Act No. 84 of 1998).	No significant gaps identified between the referenced SA legislation and the requirements of OP 4.04.
OP 4.09 **Pest Management**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 4.10 **Indigenous Peoples**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 4.11 **Physical Cultural Resources**	The NHRA serves to protect and promote good management of SA's heritage resources.	No significant gaps identified between the referenced SA legislation and the requirements of OP 4.11.
OP 4.12 **Involuntary Resettlement**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 4.36 **Forestry**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 4.37 **Safety of Dams**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 7.50 **Projects on International Waterways**	Not applicable to the CCUS 3D seismic survey and drilling activities.	
OP 7.60 **Projects in Disputed Areas**	Not applicable to the CCUS 3D seismic survey and drilling activities.	

As seen in the above table, the objectives and requirements of the WB's OPs are primarily included in provisions of the full suite of SA legislation governing the environmental sector. The most stringent thresholds/measures will apply to the Project, whether it's the WB's requirements or the national legislation.

Chapter 4: Description of the Environment

4 DESCRIPTION OF THE ENVIRONMENT

4.1 Introduction

This section describes the status quo of the project's physical, biological, and socio-economic environment. The baseline serves to provide the environmental context within which the abbreviated ESIA was conducted. It also allows for an appreciation of sensitive environmental and social features and possible receptors of the effects of the proposed Project. The baseline provides the standard against which impacts can be benchmarked.

4.2 Climate

Mpumalanga Province is characterised by a subtropical climate. Climatic conditions in Leandra are presented below. It is noted that a weather station is located in Leandra (station id: 1182).

4.2.1 Temperature

The warmest month with the highest average high temperature is February (26.5°C). The month with the lowest average high temperature is June (17.4°C) (see Figure 19 below).

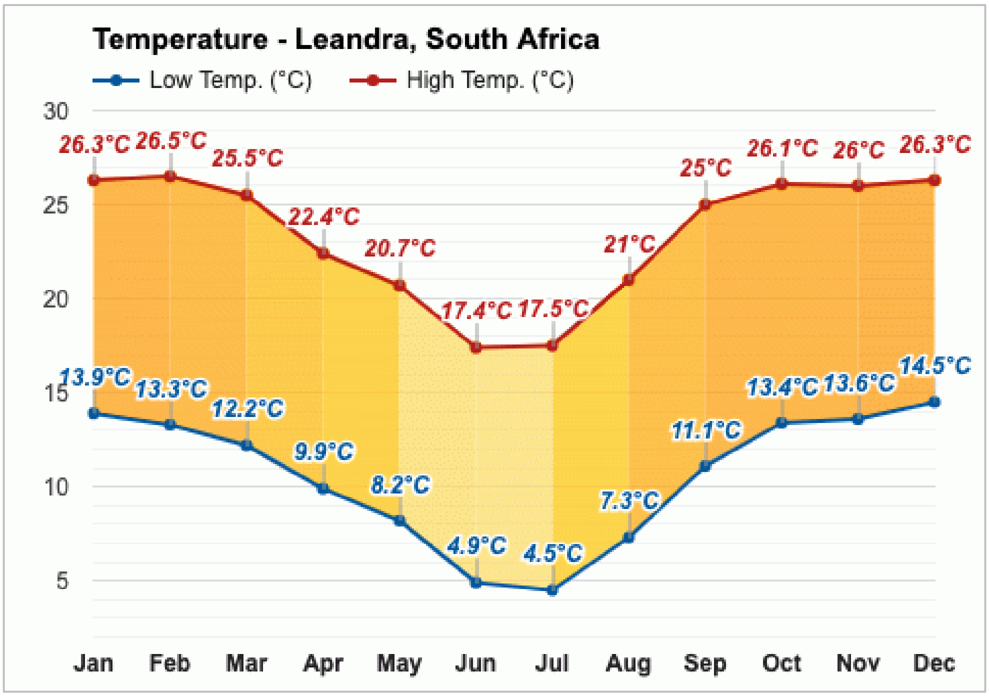


Figure 19: Average temperature Leandra
(https://www.weather-atlas.com/en/south-africa/leandra-climate#temperature)

4.2.2 Wind

The windiest month with the highest average wind speed is September (12.5km/h). The calmest month with the lowest average wind speed is March (8.9km/h) (see Figure 20 below).

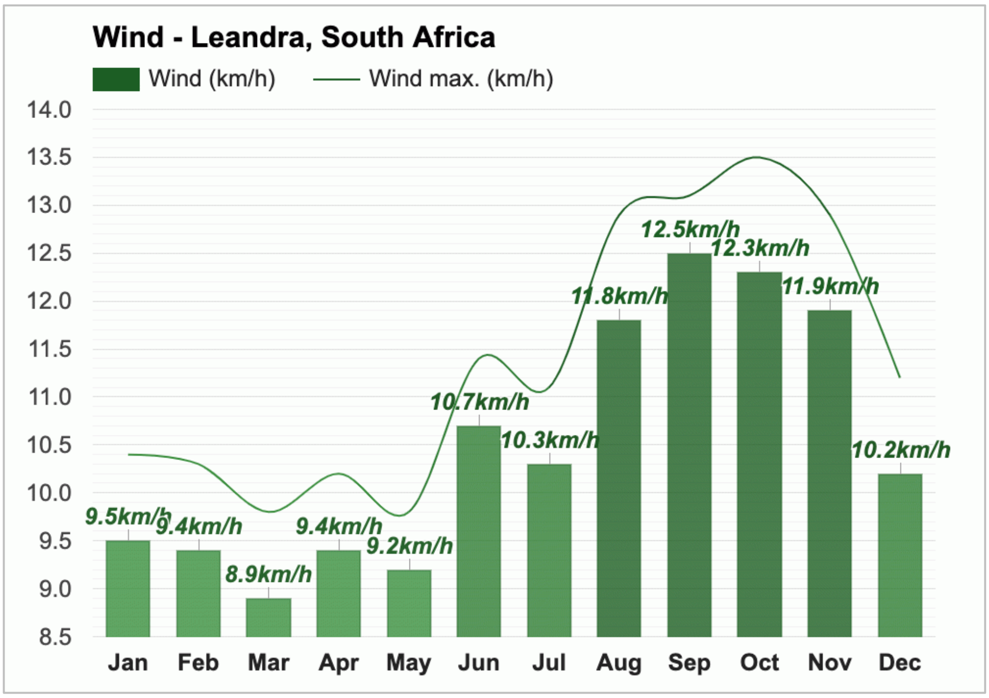


Figure 20: Average wind speed Leandra
(https://www.weather-atlas.com/en/south-africa/leandra-climate#temperature)

4.2.3 Rainfall

The wettest month with the highest rainfall is December (109mm). The driest month with the least rainfall is July (0mm) (see Figure 21 below).

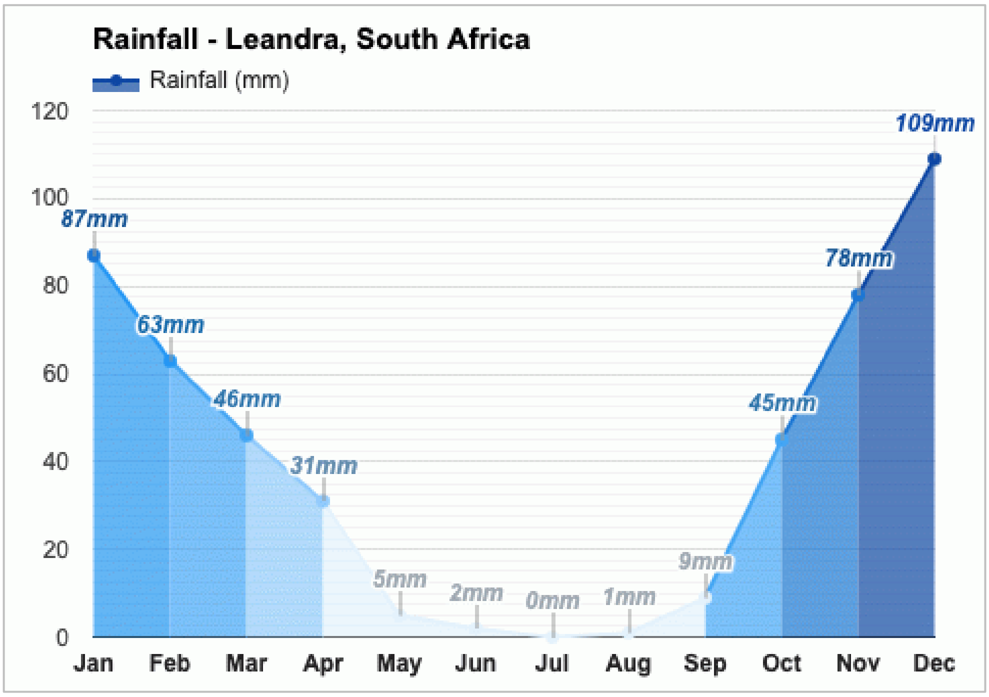


Figure 21: Average rainfall Leandra
(https://www.weather-atlas.com/en/south-africa/leandra-climate#temperature)

4.2.4 Daylight

The month with the most sunshine is October (Average sunshine: 11h and 30min) and the month with the least sunshine is April (Average sunshine: 7h and 18min) (see Figure 22 below).

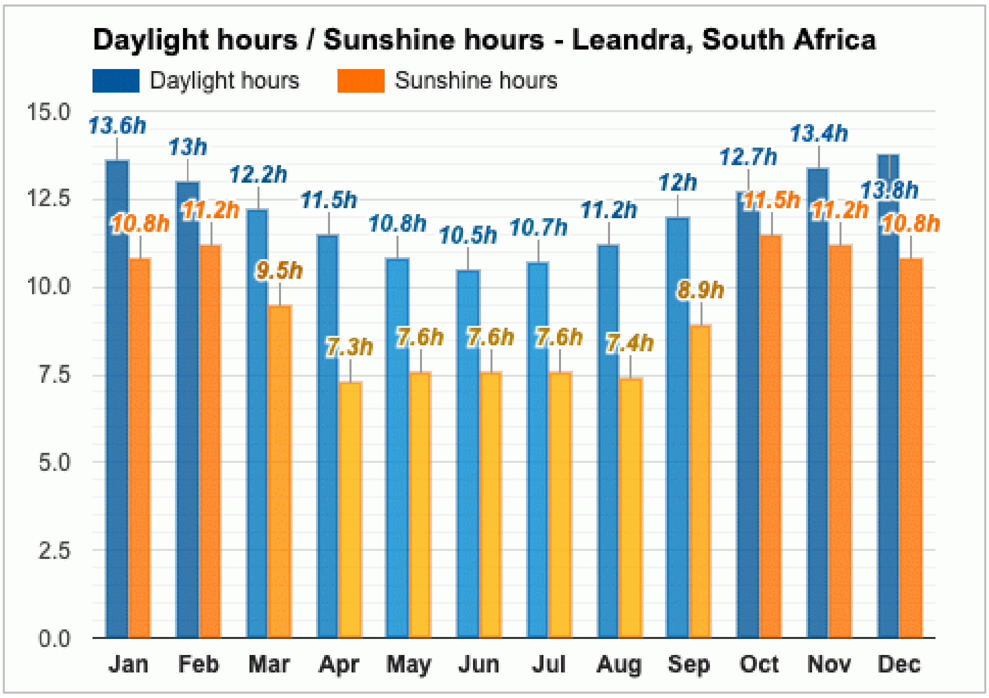


Figure 22: Average daylight / Average sunshine Leandra
(https://www.weather-atlas.com/en/south-africa/leandra-climate#temperature)

4.3 Geology

4.3.1 General Geology of the Area

The surface geology of the region and of the project area is shown in Figure 23 and Figure 24 below, respectively.

The northern portion of the Highveld coalfields presents unique geology, which affords the potential storage of CO_2. Generally, several sedimentary and volcanic basins are found in the region, labelled from the oldest as the Basement granite, the Archean Witwatersrand (Wits) Basin, Neo-Archaean Ventersdorp Basin, Paleoproterozoic Transvaal Basin, Mesozoic Karoo Basin and various post-Karoo dolerite intrusions.

A description of the general geology follows in the sub-sections below. A geological profile of the drill site is shown in Figure 25 below.

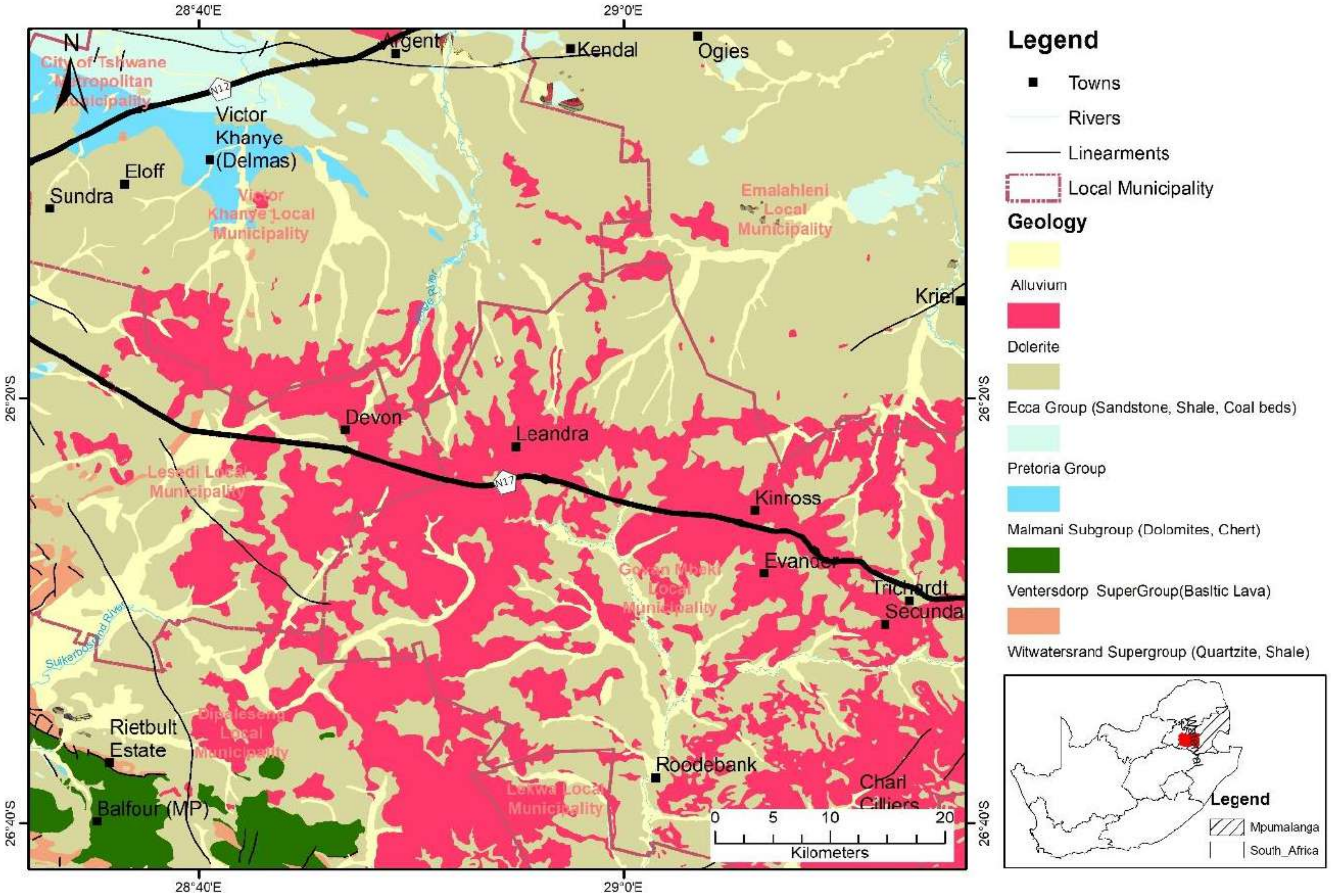


Figure 23:Surface geology of the region (CGS, 2022)

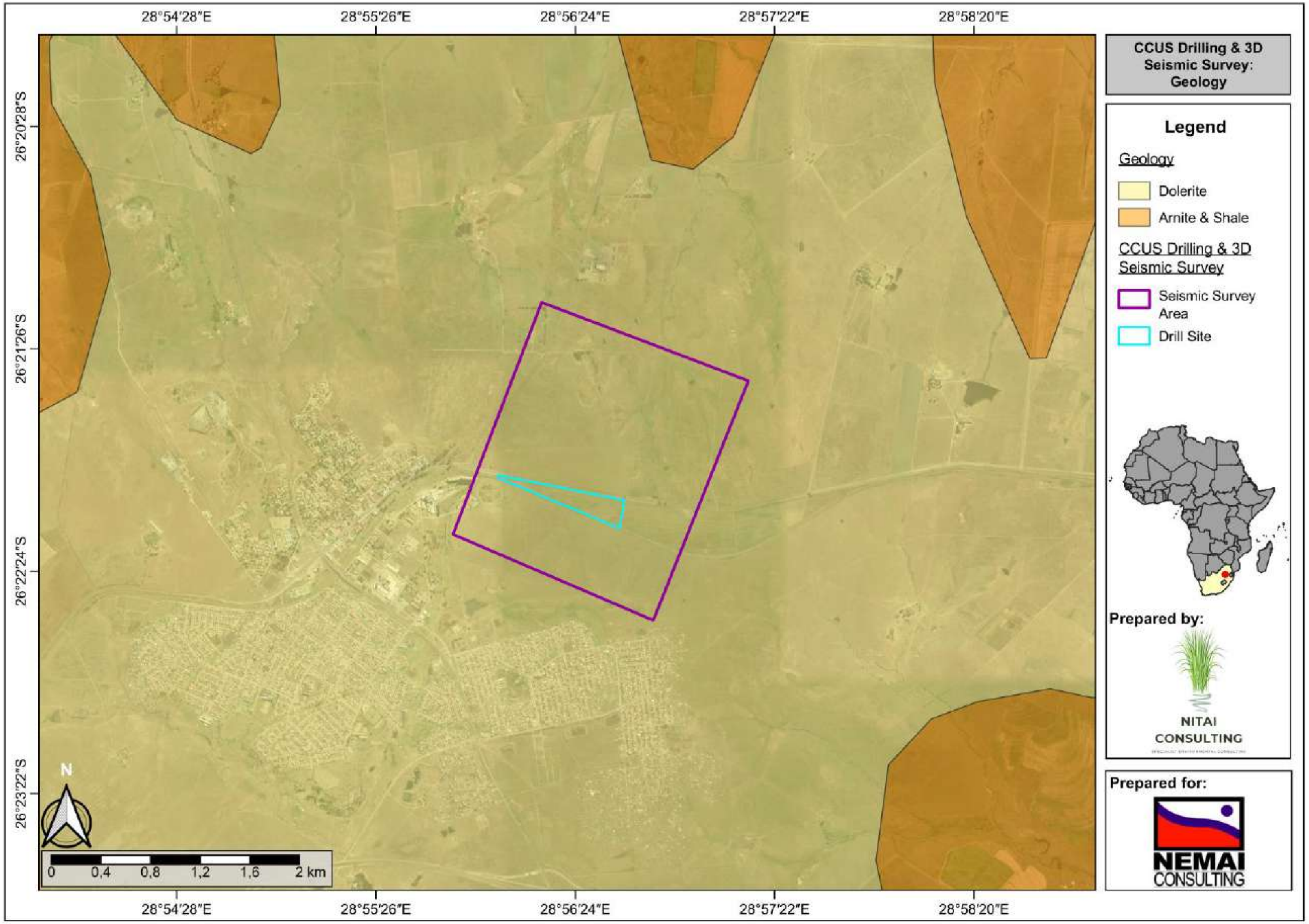


Figure 24: Map indicating the geology of the project area

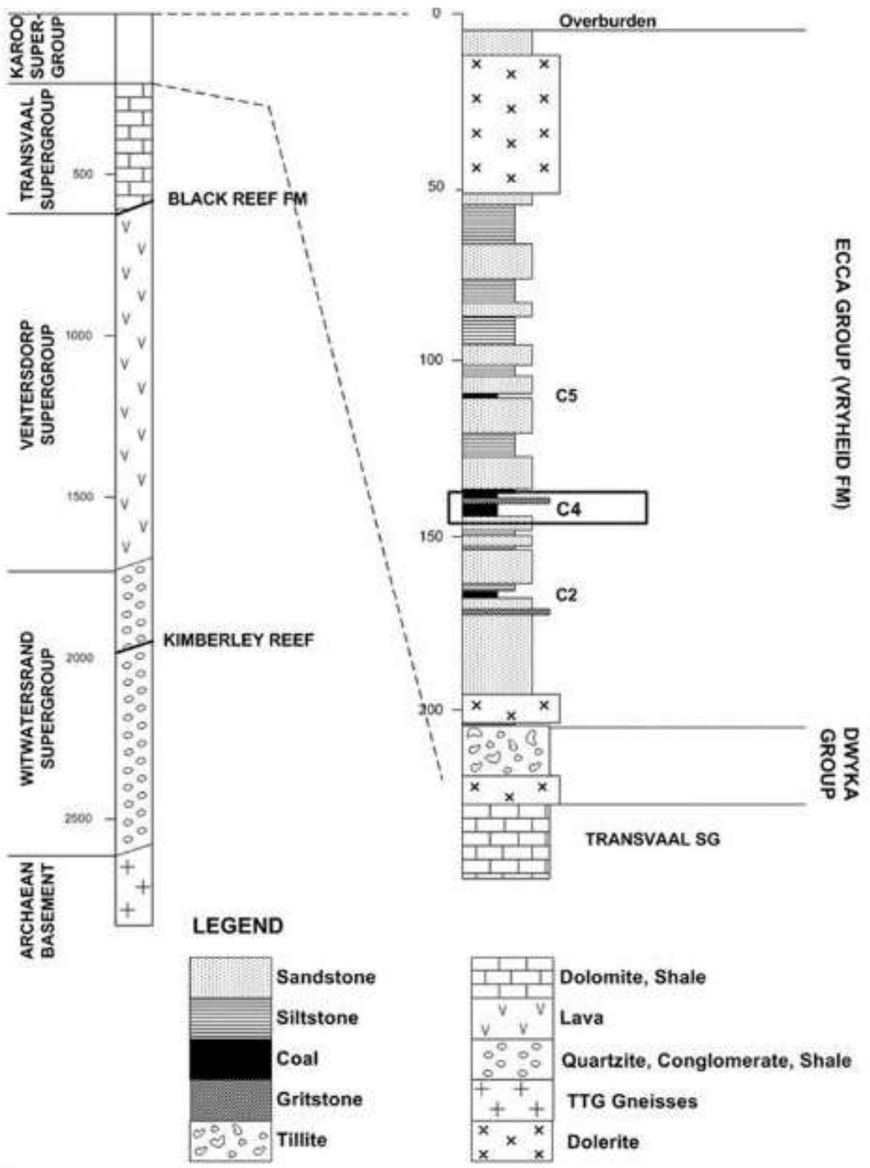


Figure 25: Simplified geological log of the subsurface geology expected at the drill site

4.3.1.1 Witwatersrand Supergroup

The lowermost portion of the study is the Witwatersrand Basin. The study area is located in the Evander Goldfield, ~650km thick, and the rock strata from the Witwatersrand Supergroup belong to the Central Rand Group. The Witwatersrand strata in the area are partly overlain by the Ventersdorp and Transvaal Supergroup strata and are all overlaid by Karoo Supergroup rocks. At the base is the Johannesburg Subgroup consisting of quartzite that fines upward into the Booysens Formation, where most boreholes observed are stopped. The borehole logs revealed Leandra quartzite Formation, Zandfontein quartzite Formation, Evander quartzite Formation and Kinross Quartzite Formation rocks are encountered in the area. Overlaying the Booysens Formation is the Kimberly Formation, which has (as a conglomerate) a Kimberley Reef that lies in a major disconformity of the Winkelhaak Member. The Kimberley Reef, locally known as the Winkelhaak Conglomerate Formation, was initially targeted during geological exploration for gold mineralisation. The conglomerate bands mainly consist of sparsely distributed small to medium chert and quartzite pebbles in a greenish-grey medium-grained quartz matrix with visible detrital sulphide mineralization. The units overlying the Kimberley Reef occur as upward-coarsening units, which culminate in scattered conglomerates of the Mondeor Formation. The Witwatersrand sequence is conformably overlain by lavas of the Ventersdorp Supergroup and the contact encountered is a minor conglomerate, the “speckled contact zone”, called the Ventersdorp Contact Reef.

4.3.1.2 Ventersdorp Supergroup

Overlying the Witwatersrand Supergroup with an unconformable contact is the Ventersdorp Supergroup. The Ventersdorp Supergroup provides a unique volcano-sedimentary supracrustal record and contains the largest and most widespread sequence of volcanic rocks with a lithostratigraphic thickness range of 500m to 1000m in the Leandra area. From the base to the top, the Ventersdorp Supergroup consists of the Klipriviersberg, Platberg, and Pniel Groups. It is important to note that in the Evander area, only the Klipriviersberg Group is present. Four distinct units have been observed on the borehole cores, from bottom to top, ultramafic lava, the amygdaloidal mafic zone, the porphyritic zone with needle-like porphyries, and the felsic fine-grained unit on top. The bottom-most ultramafic unit is coarser-grained, is relatively thin with a thickness of >20m in observed boreholes, is more consistent throughout the observed data points in the Evander basin and is used as a marker horizon for the lithological correlation.

4.3.1.3 The Transvaal Supergroup

The Transvaal Supergroup overlies the Ventersdorp Supergroup unconformably and attains a maximum thickness in the region of 1100m. The base of the Transvaal basin is the Black Reef formation, consisting of mature quartz arenites with lesser conglomerates and subordinate mudrocks. It forms a thin veneer of arenaceous rocks unconformably overlying the Ventersdorp Supergroup. The Malmani Subgroup, Chuniespoort Group, is the uppermost sequence of the Transvaal Supergroup observed in the Evander area. The subgroup is a dolomitic series, ~650m thick, with laminated with cherty bands, in some areas it is vesicular and has thin shale beds.

4.3.1.4 The Karoo Supergroup

The Karoo Supergroup in the northern parts of the main Karoo Basin in SA was deposited during the late Carboniferous to early Permian. The Dolomite series of the Transvaal Supergroup is overlain unconformably by the Dwyka Group of the Karoo Supergroup which predominantly consists of the basal glaciogenic tillite. Above the Dwyka sequence is the siliciclastic Ecca Group which consists of sandstone, siltstone, coal seams and gritstone. The coal is largely confined to the Vryheid Formation of the Ecca Group. The Dwyka on the surface in the region is brown and highly weathered.

4.3.1.5 Post-Karoo Deposits

Dolerites in the Karoo Basin commonly represent kilometre-scale interconnected saucer-shaped structures that consist of inner sills, bounded by inclined sheets connected to stratigraphically higher outer sills. The Evander basin has undergone extensive faulting and reef duplication. Three types of intrusions, which often occupy the major faults are linked to the following regional events: dolerite dykes related to the outpouring of lavas of the Ventersdorp, medium to fine-grained ophitic diabase dykes and sills related to the Bushveld event and the dolerite dykes related to the Karoo event.

4.3.2 Geotechnical Investigation

The CGS compiled a Geotechnical Report for the CCUS Project (Bunk, 2023). An extract from this report follows in the sub-sections below.

4.3.2.1 Geology of the Targeted Storage Zone

The Ventersdorp Supergroup is targeted as the storage zone and occurs as a volcano-sedimentary succession that represents three separate Large Igneous Province (LIP) events, the Klipriviersberg, Platteberg and Allanridge LIPs (Gumsley *et al*., 2020). Of these only the Klipriviersberg occurs within the study area, but the rocks have been affected by extensional tectonics related to both the Platteberg and Allanridge events. The supergroup is developed in extensional block-faulted basins associated with the close of deposition of the Central Rand Group of the underlying Witwatersrand Supergroup (Stanistreet *et al*., 1986; McCarthy *et al*., 1986). The Klipriviersberg Group is the only unit preserved in the Evander area. The Plateberg Group is mostly absent from the north-eastern part of the Ventersdorp depository (van der Westhuizen *et al*., 2005), thus leaving only the lower Klipriviersberg Group in the area of interest.

Three distinct units have been observed on the borehole cores, these are the bottom ultramafic, the mafic zone with olivine-rich amygdales and needle-like plagioclase porphyries, and the non-amygdaloidal and non-porphyritic units. The bottom-most ultramafic unit, although relatively thin at not more than 20m in observed boreholes, is more consistent throughout the observed data points in the Evander basin and is a useful marker horizon for lithological correlation. It is generally dark-greenish to sometimes black with a coarse-grained matrix and no visible porphyries, and sometimes with chlorite-filled veins. This unit is consistent with the Westonaria Formation komatiites extruded during the basin tension to facilitate the ascent of magma directly from depth (van der Westhuizen *et al*., 2005).

The unit immediately above, the basal porphyritic Alberton Formation, consists of lath-like plagioclase phenocrysts and a medium-grained upper unit with olivine-rich amygdales. The Loraine and Edenville formations make up the top of the lavas and consist of fine-grained crystalline non-porphyritic and porphyritic units with milky quartz porphyries, sometimes with alteration around amygdales. The Alberton, Loraine and Edenville formations seem more consistent with the cyclic lava flows and form the thickest successions of the lavas; the total thickness observed on borehole BH2188 is about 800m.

The lavas were deposited as a flood basalt sequence which erupted over a relatively short period (van der Westhuizen *et al*., 2005). Although not observed on any of the logged boreholes, the Klipriviersberg lavas have been recognised elsewhere to have flow top brecciation (van der Westhuizen *et al*., 1991) indicative of rapid cooling and degassing.

4.3.2.2 3.2 Structural geology

Faulting within the Evander basin is common, with multiple tectonic episodes identified (see Figure 26 below). Minor faulting occurs on the 0.5-1km scale, whilst major basement faults occur on a ~5km scale. Faulting within the study area is commonly pre-Transvaal in age with faults displacing geological units of both the Ventersdorp and Witwatersrand supergroups but terminating at the unconformity with the Transvaal Supergroup (Witthüser *et al*., 2015; Coetzee & Kisters, 2016).

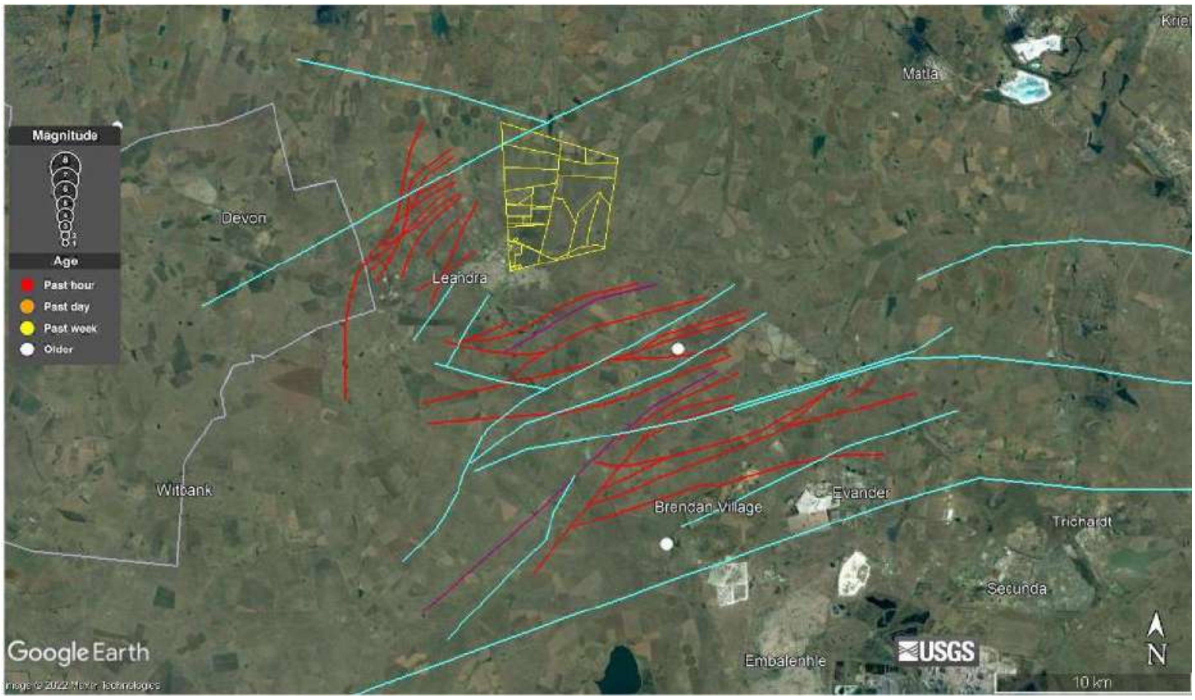


Figure 26: Structural data obtained from 1:50 000 map sheets and Tweedie (1986) overlain with the USGS seismic database (Bunk, 2023)

Major fault systems are generally northeast-southwest striking in the west and change towards a north-south strike direction in the eastern region (Witthüser *et al*., 2015). The south-eastern margin of the Evander sub-basin is truncated by a major east-northeast-striking fault with a down-throw to the north (Witthüser *et al*., 2015). The Sugarbush Fault, which represents a major tectonic boundary within the Kaapvaal Craton, is essentially east-west-trending and represents a left-lateral strike-slip (wrench) fault system (Myers *et al*., 1987. The northern margin of the Evander sub-basin is defined by a normal fault, here termed the Leandra Fault, which has a similar NE-SW trend to the Sugarbush Fault, however, unlike the latter, the Leandra Fault appears to have offset all lithologies in the region including units of the Bushveld Complex (Pretorius *et al*., 1986).

Most of the faulting in the project area is of Ventersdorp age (Tweedie, 1986; McCarthy, 2005; van der Westhuizen *et al*, 2005), and it is quite evident from the cross section in Figure 27 below that almost all fault structures are oriented in the east-west direction. The orientation of the faults, mainly normal and reverse faults as observed from the 'loss and gain' zones in the Kimberley reef of the Evander gold mines, can be associated with the Sugerbush fault to the south. It is also apparent looking at the north-south cross-sections that there is also major strike-slip faulting impacting the area.

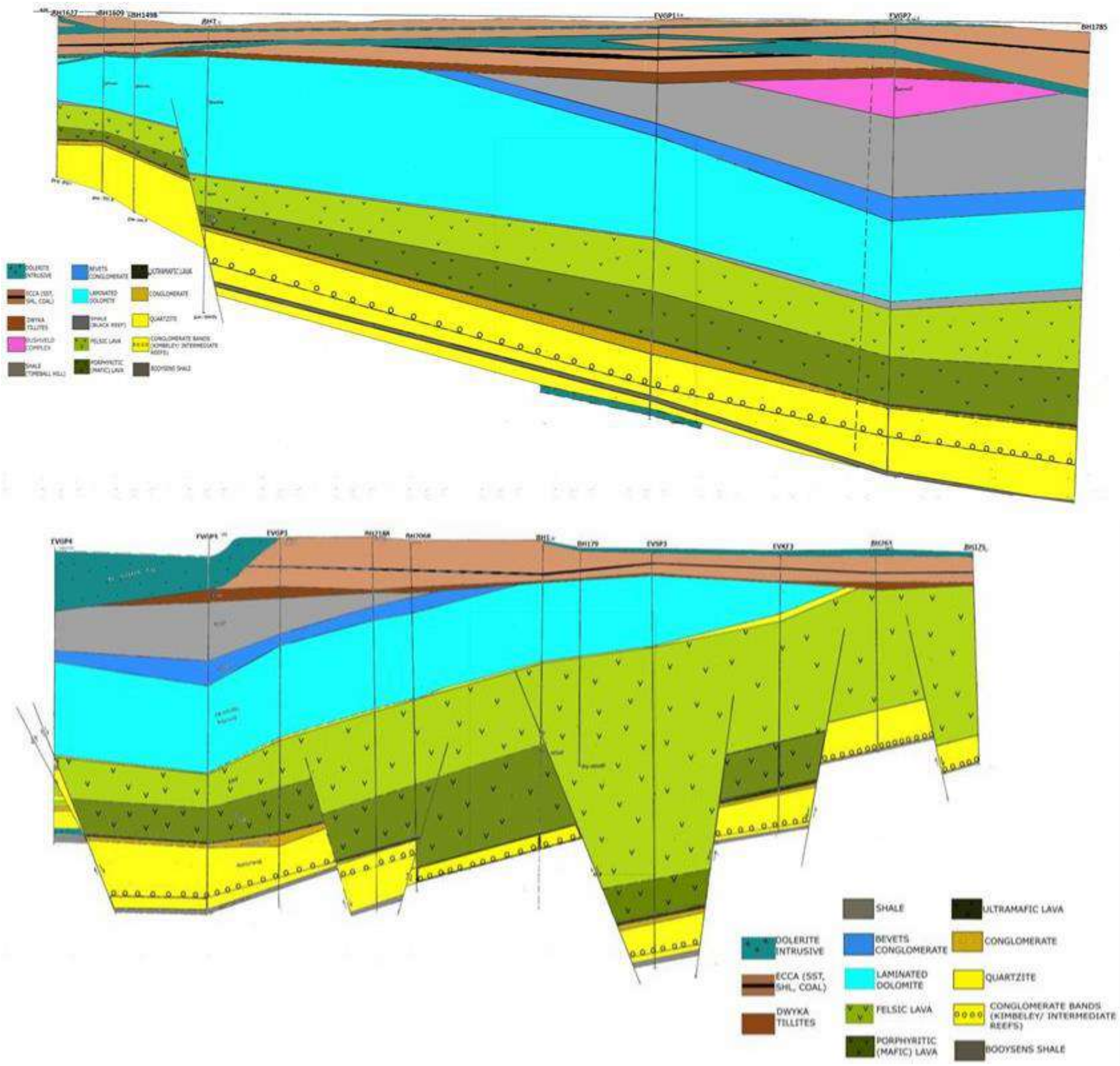


Figure 27: a) A schematic West-East Section line through project area indicating depth of lower Porphyritic zone of Ventersdorp lavas (Vertical scale 1:5 000, horizontal scale 1:10 000). b) A schematic North-South Section line (Vertical scale 1:5 000, horizontal scale 1:20 000) (Bunk, 2023)

4.4 Topography

Anthropogenic landforms that are observable in the greater area surrounding Leandra include land-fill sites, mine tailing dumps, and mining excavations.

The surface topography of the area is typical of the Mpumalanga Highveld, with the terrain morphology classified as “plains and hills”. In terms of the Soil and Terrain Digital Database (SOTER), the landform encountered in the project area is described as a “plain at high level” (shown in Figure 28 below).

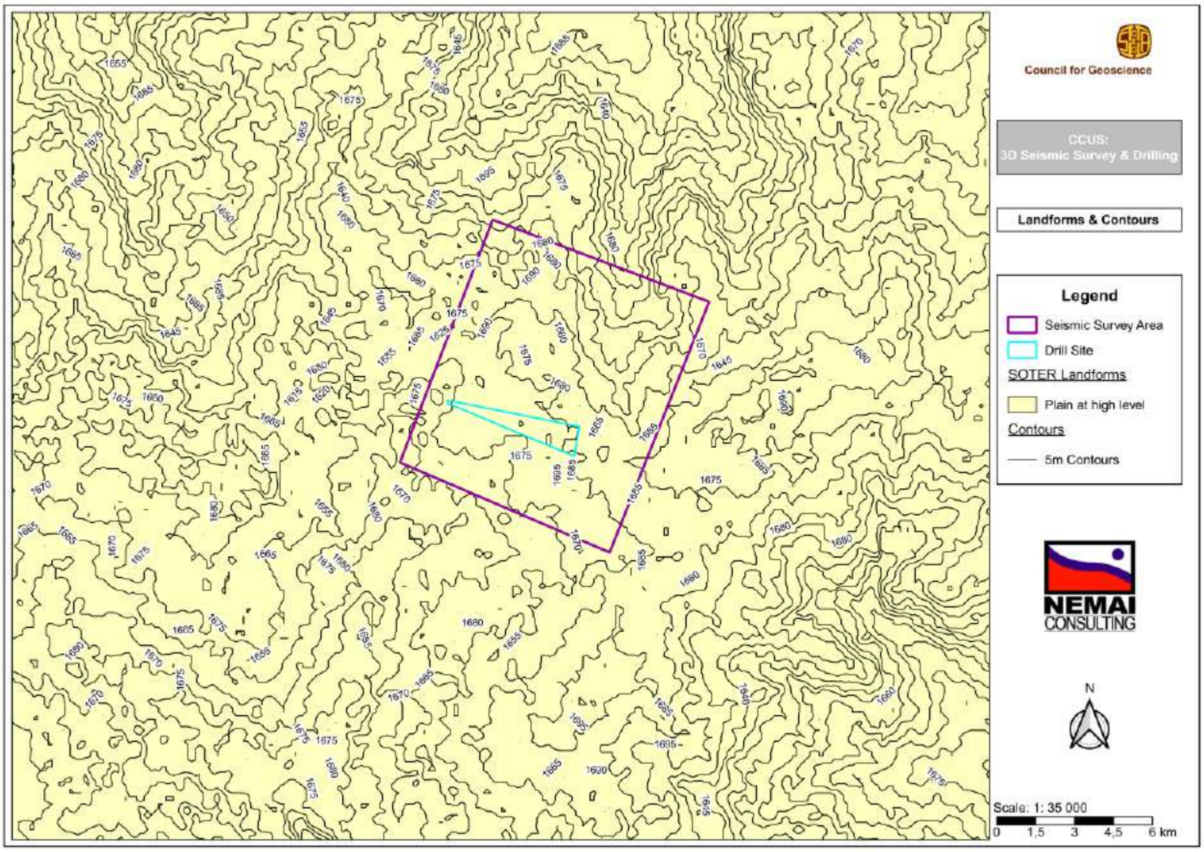


Figure 28: SOTER Landforms and 5m contours

The drill site is predominantly flat. There is a gentle slope from south-east to north-west, with the elevation ranging from 1675 meters above mean sea level (mamsl) to 1672 mamsl. The Digital Elevation Model for the entire 3D seismic survey area is shown in Figure 29 below.

The terrain in the seismic survey area is relatively flat and the area occurs in grassland. Distinctive topographical features in the survey area include watercourses that traverse the survey area and anthropogenic landforms (including quarries, borrow pits and diggings).

It is not anticipated that the seismic survey will cause significant impacts to the terrain due to the non-invasive seismic profiling technology and the specialist all-terrain vibroseis vehicles that will be used.

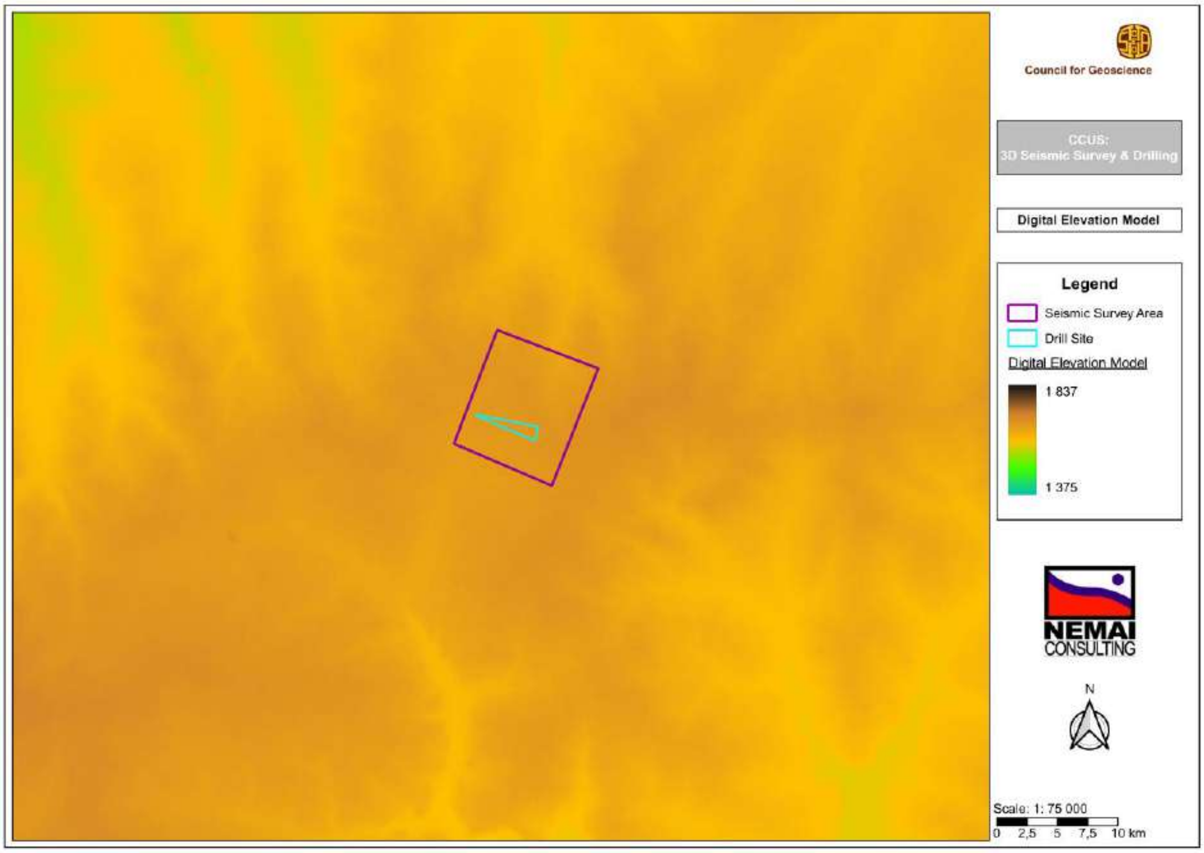


Figure 29: Digital Elevation Model for project area

4.5 Soil

The geology mostly supports shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the intrusive Karoo Suite dolerites which feature prominently in the area. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb land types (Mucina & Rutherford, 2006). Furthermore, the proposed survey area is categorised with swelling clay soils such as Arcadia and Mayo soils (see Figure 30 below). These soil types occur in basic igneous geology such as dolerite (van der Waals *et al*., 2019).

Photographs of typical soil conditions in the northern and southern parts of the project area are shown in Figure 31 and Figure 32 below, respectively.

It is not anticipated that the seismic survey will cause significant impacts to soil due to the non-invasive seismic profiling technology and the specialist all-terrain vibroseis vehicles that will be used. In addition, the vibroseis trucks and support vehicles will attempt to use existing access roads and tracks as far as possible. It is noted that due to the clayey nature of the soils that rutting can be caused by the movement of the vibroseis trucks during saturated ground conditions.

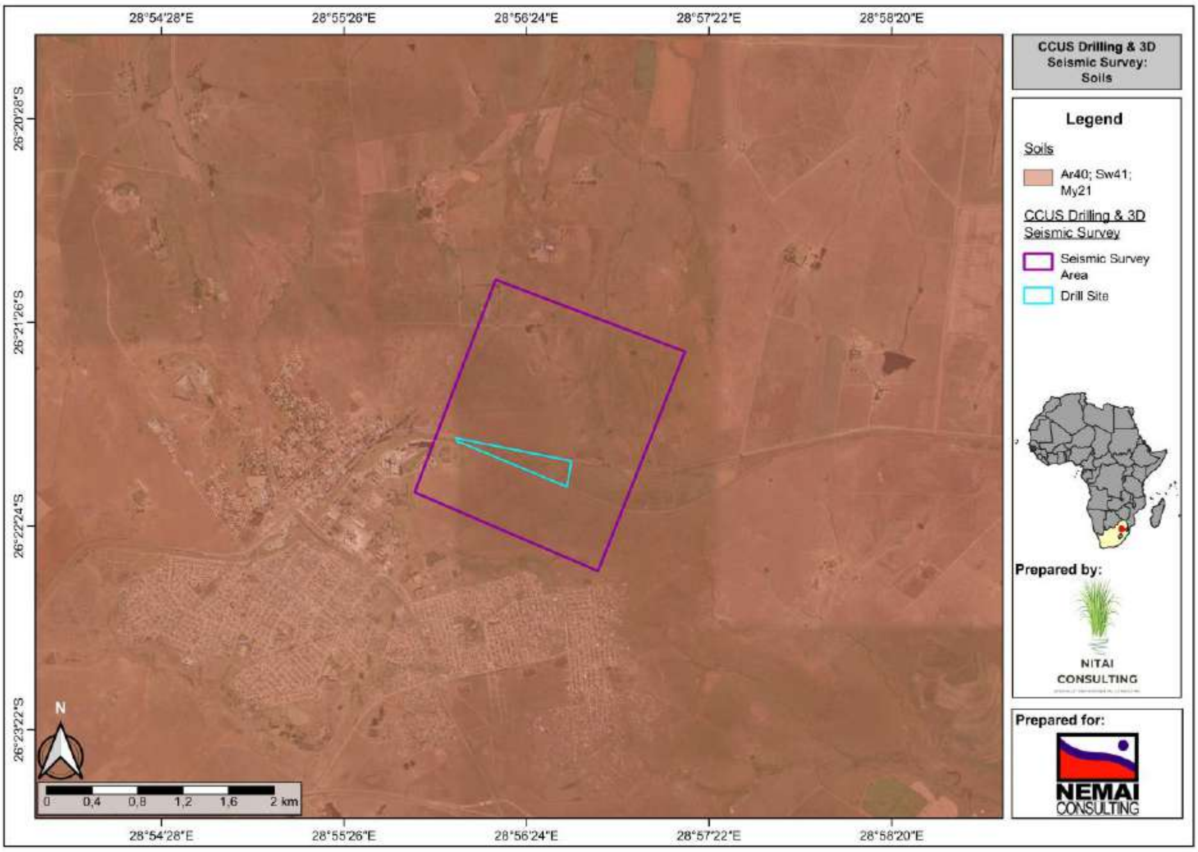


Figure 30: Soil forms encountered in the project area

Figure 31: Soil conditions in northern part of project area

Figure 32: Soil conditions in southern part of project area

4.6 Groundwater

4.6.1 Hydrogeological Mapping

4.6.1.1 Introduction

The CGS undertook 1:50 000 Hydrogeological mapping of the 2628BD Leandra map sheet in 2022. An extract from this study, as well as the Geotechnical Report (Bunk, 2023), follows.

The study area is shown in Figure 33 below and the 2628 BD Leandra Hydrogeological Map is shown in Figure 34 below. It is noted that the study area extended beyond the project area for the CCUS 3D seismic survey and drilling.

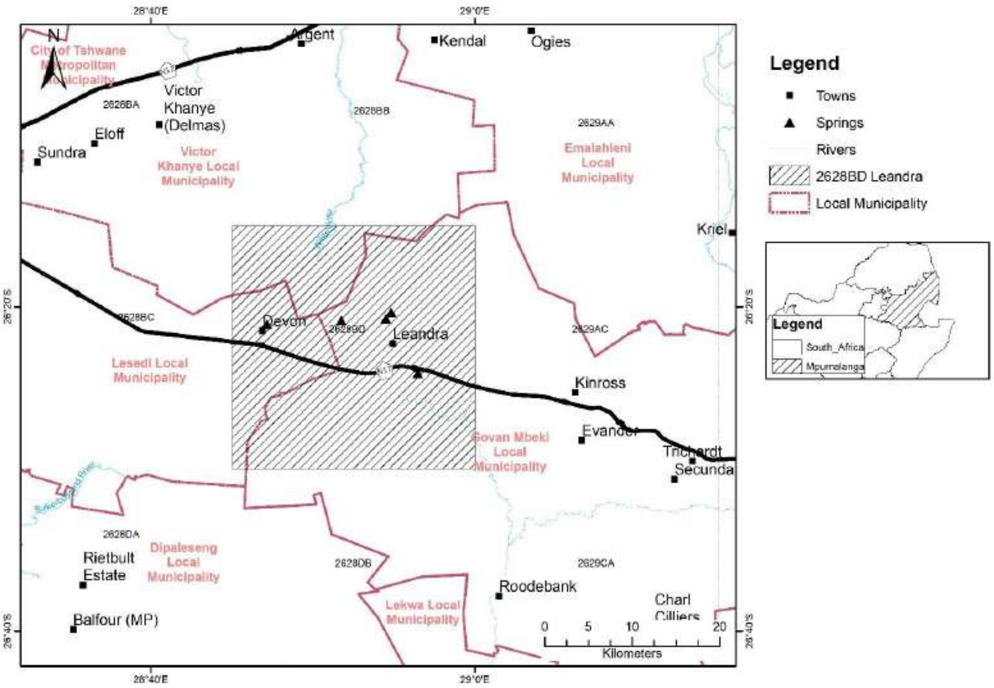


Figure 33: Study area for hydrogeological mapping of map sheet 2628BD Leandra (CGS, 2022)

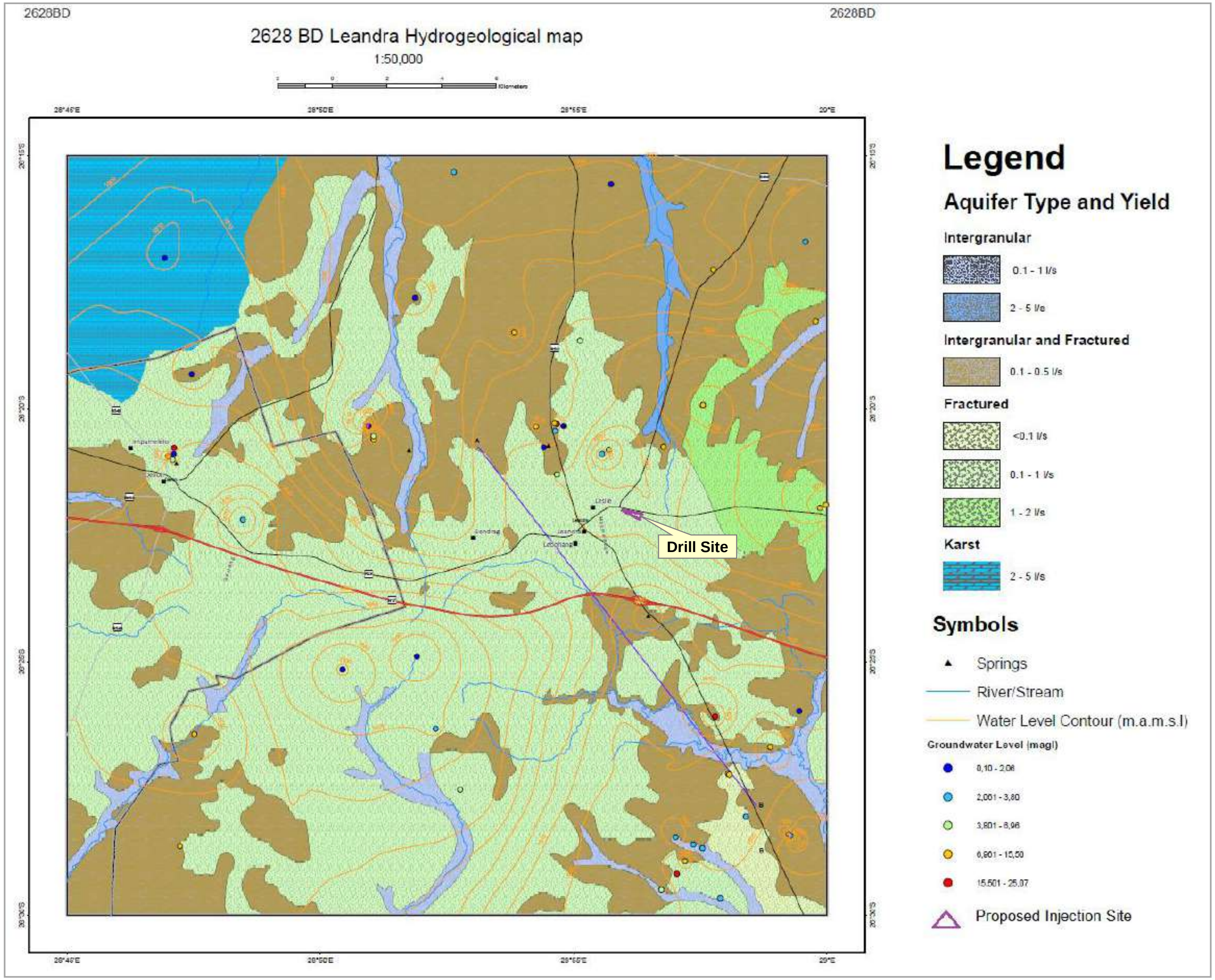


Figure 34: 2628 BD Leandra Hydrogeological Map (Bunk, 2023)

As part of hydrocensus undertaken by the CGS, groundwater samples were collected and sent to the laboratory for analysis. The data results therefore form past of baseline water quality data in addition to literature data available. The literature data was collected from the National Groundwater Archive (NGA) database hosted by the DWS. According to the NGA, 11 boreholes with groundwater information are recorded within the Leandra sheet and the surrounding 5 km radius. Additional information was collected from mining houses in the Leandra sheet. Hydrocensus results show data from boreholes verifiable during site visits. A total of 80 boreholes were verified within the Leandra sheet although NGA boreholes were not found. Groundwater levels were measured from 62 accessible boreholes, borehole depths were measured for 40 boreholes, 70 boreholes were sampled and measured for physical paraments. Only 10 boreholes were not accessible or dry.

The proposed drill site is located within the quaternary catchment B20E but in close proximity to catchment to B11E and C24D. The site is therefore expected to be on the groundwater divide. According to Bunk (2023), comparing topography to groundwater levels provides a correlation of just above 40% (see Figure 35 below). The low correlation could be an indication of localised confining conditions within the mapping sheet. The existing shallow dolerite sills are known to play a role in confining aquifers and producing perched water tables. The groundwater levels were recorded with no knowledge of lithology, water strikes, and borehole construction and the correlation does not consider groundwater levels from different aquifers.

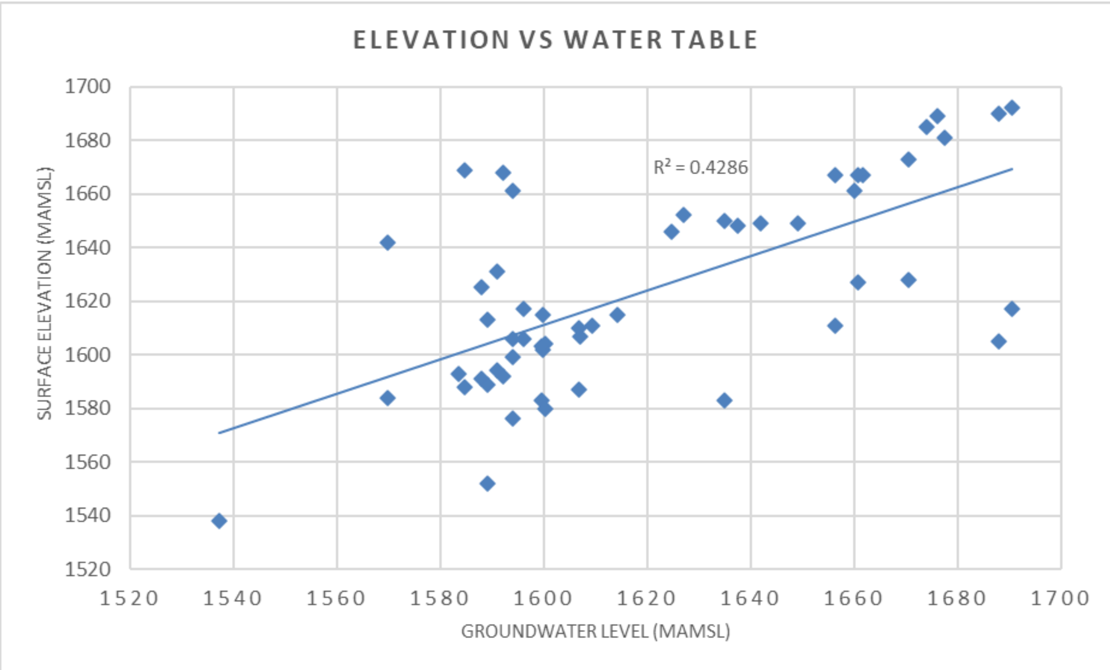


Figure 35: Topography vs Groundwater Level (Bunk, 2023)

4.6.1.2 Stratigraphy of the Study Area

Table 10 below shows a simplified stratigraphy of the geology of the study area for the hydrogeological mapping. This table assists in distinguishing distinct groundwater occurrences at a regional scale. The procedure used to simplify the geology of the 2628BD Sheet was firstly to identify and evaluate the lithologies or rock types of similar origin and their hydraulic properties ("hydrogeological domains") and to correlate these with the stratigraphy of the local geology. Therefore, the "hydrogeological domains" are described in terms of lithology and stratigraphy.

Thus, volcanic rocks regardless of their age were grouped together to form Fractured and intergranular /weathered and sedimentary rocks of Permian and Triassic were combined to form fractured aquifers. Where these sedimentary rock were weathered they may present also intergranular aquifers.

Table 10: Simplified stratigraphy of the study area (CGS, 2022)

		Rock Type		
ERA	**PERIOD**	**Metamorphic**	**Volcanic**	**Sedimentary**
	Quaternary			
Cenozoic	Neogene			
	Palaeogene			
	Cretaceous			
Mesozoic	Jurassic			
	Triassic			
	Permian			
	Carboniferous			
Palaeozoic	Devonian			
	Silurian			
	Ordovician			
	Cambrian			
Proterozoic				
Archean				

Sedimentary rocks of Cenozoic age, particularly alluvium deposits were combined and classified as Intergranular Aquifers.

Based on the above approach, the following groundwater regime occurrences were determined:

1. Porous media, symbolizes aquifers in which groundwater mainly circulates through intergranular pores.

2. Cavities flow. Represents aquifers where groundwater moves through dissolution canals, particularly in dolomitic, limestone rocks.
3. Fracture and porous flow. Igneous rocks have a tendency of developing weathered profile overlying a fractured zone. Depending on particular situations, these two zones may be interconnected. To highlight the importance of groundwater flow, this aquifer type was subdivided into two classes: Intergranular/weathered Aquifers and Fractured Aquifers.
4. The type 3 groundwater regime is also represented in consolidated sediments. In the 2628BD sheet, these sediments are represented by arenaceous sediments of Karoo.

Through the above process, an aquifer map was produced. In general, the preparation of the aquifer map followed the criteria presented in Table 11 below.

Table 11: Aquifer types and yield classes adopted for the hydrogeological mapping (CGS, 2022)

Aquifer Types	Aquifer Subclasses	Aquifer Potential (l/s)		
		>2.5	0.5–2.5	<0.5
Intergranular		A3	A2	A1
Karst		B3	B2	B1
Intergranular and Fractured (Sedimentary Rocks)	Intergranular	$C_1$3	$C_1$2	$C_1$1
	Fractured	$C_2$3	$C_2$2	$C_2$1
Intergranular and Fractured (Igneous Rocks)	Intergranular	$D_1$3	$D_1$2	$D_1$1
	Fractured	$D_2$3	$D_2$2	$D_2$1

Figure 36 below depicts the lithology and aquifer system, showing different potential aquifers present in the area.

The groundwater potential in the Leandra map sheet (see Figure 34 above) shows most intergranular aquifers in the form of alluvium have the potential to produce between 0.1 to 1 l/s and only one particular alluvium has the potential to produce between 2 to 5 l/s. The intergranular and fractured have low potential of 0.1 to 0.5 l/s while the three types of fractured aquifers are expected to produce less than 0.5 l/s, between 0.1 to 1 l/s and between 1 to 2 l/s. The study area is located within the fractured aquifers that are expected to produce between 0.1 to 1 l/s. The karst aquifer with this anticipated at depth, is expected to produce boreholes yielding between 2 to 5 l/s.

Groundwater level contours (see Figure 34 above) show the water is generally flowing towards the major drainage channels particularly towards the Waterval River in the south-east. Closer to the drill site, the groundwater levels confirm the groundwater divide with relatively flat contours with flows going in different directions (Bunk, 2023).

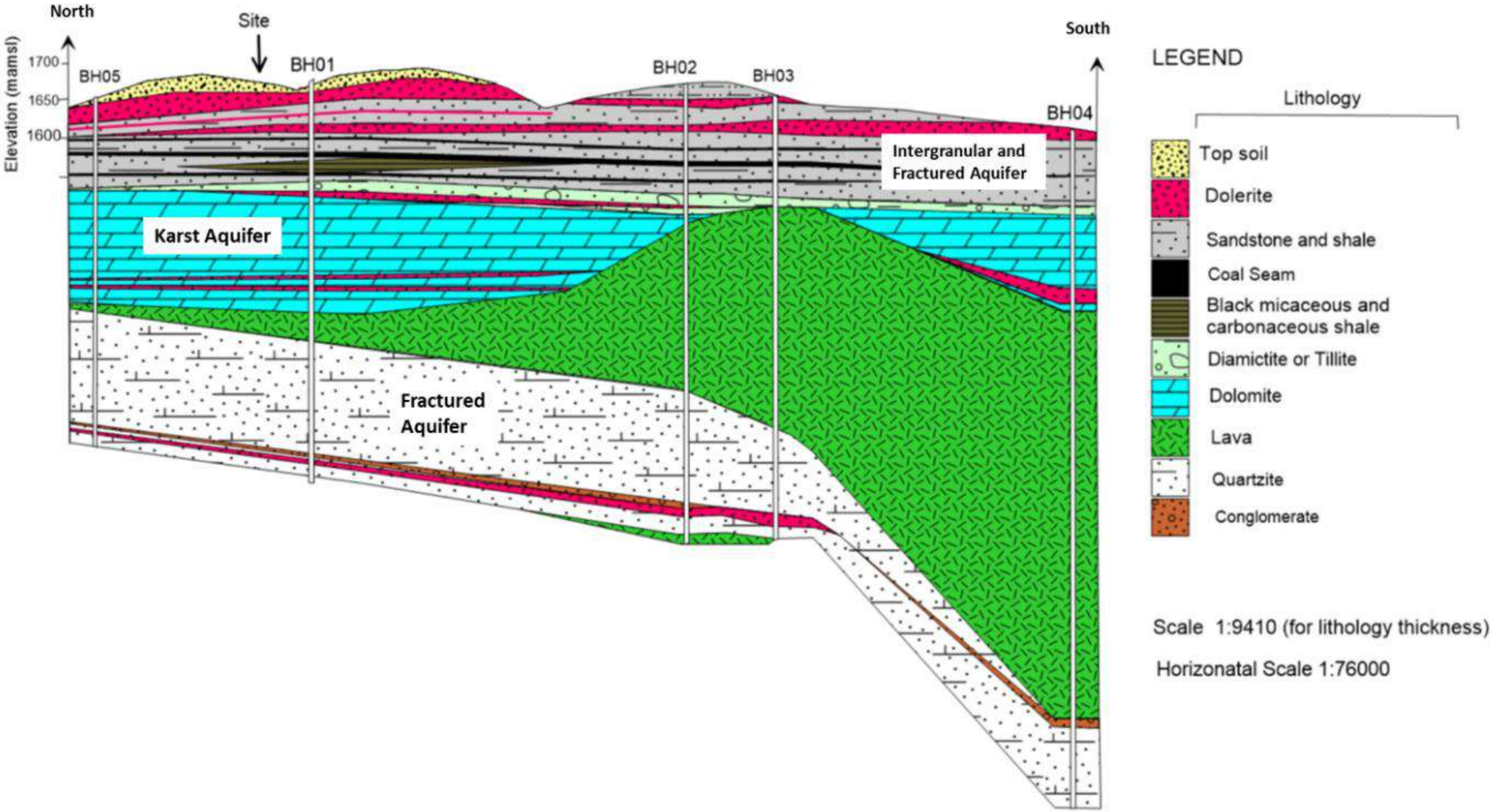


Figure 36: Geological Cross-Section showing lithology and potential aquifers in the Evander region (Bunk, 2023)

4.6.1.3 Regional Groundwater Levels

Groundwater is relatively shallow in the mapped area (see Figure 37 below). According to CGS (2022), the water levels recorded during the hydrocensus indicated that groundwater is often observed on the surface as natural springs and in boreholes. Although dolomites which typical have high yield are sitting deeper than 500m below ground level in Leandra but appear to be shallow in the north-west portion of the mapped area, as per borehole lithology log data, even water levels are shallow in this karst aquifer. Despite the substantial use of groundwater in mapped area, water levels remain shallow.

4.6.1.4 Key Observations

The following key observations were made from the hydrogeological mapping exercise (CGS, 2022):

- The main aquifers in the area are intergranular, fractured, intergranular and fractured, and Karst aquifers with a low to medium development potential;
- Intergranular aquifers (tertiary and quaternary alluvial deposits) generally have a low yield of less than 1 l/s, and in some areas producing yield of 2-5 l/s, with pH range of 6 – 9, and Electrical Conductivity (EC) of less than 500 µS/cm;
- Groundwater development potential in fractured aquifers is generally low to medium, with borehole yield of 0.1 - 1 L/s, with PH range of 6 – 9, and EC mostly falls below 1000 µS/cm. The dolerite sills are associated with coal seams which gives the water bad odour and black colour;
- Intergranular and fractured aquifers (particularly the Ecca group sediments) in this area typically yield water in the range of 0.1-0.5 L/s, with PH range of 6 – 9, and EC mostly falls below 1000 µS/cm, reaching 1700 µS/cm in some places;
- Malmani dolomites are characterised as karst aquifers in this region, and often times fractured as well, yielding groundwater in excess of 2 - 5 L/s, with less than 900 µS/cm in EC, and PH range of 7.5 – 8.5; and
- Farms in the mapped area rely on groundwater for domestic, livestock and agricultural purpose, using windmill, solar, electric and diesel engine powered pumps to fills tanks and dams.

The following is noted in the geotechnical investigation (Bunk, 2023):

- The proposed drill site lies above the low yield fractured aquifer that is dominated by a dolerite sill.
- The recharge is located on the groundwater divide where three quaternary catchments border. Catchment divides generally have a low surface area for rainfall collection. In addition, the dolerite rock is known to have low permeability. The proposed drill site is therefore expected to be a low recharge zone. The faults in the project area are potential natural pathways for groundwater movement between aquifers, however, this fault does not seem to extent on the proposed drill site.
- Potential receptors of impacts include groundwater users (domestic, livestock watering and irrigation) and the ecosystems reliant of groundwater. Currently, the nearest recorded groundwater users are located 2km from the drill site.

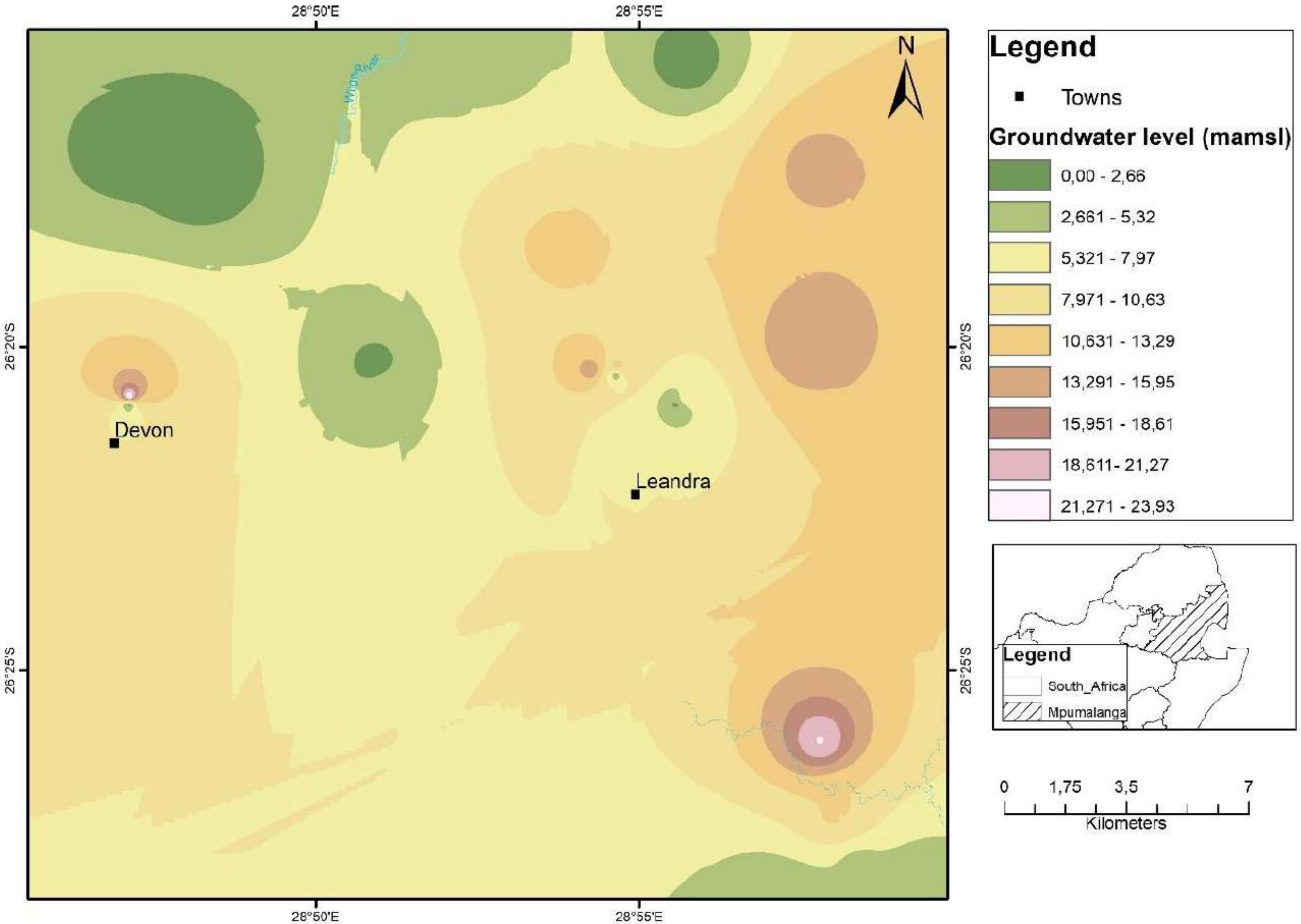


Figure 37: Local groundwater levels in the mapped area (CGS, 2022)

4.6.2 Groundwater Monitoring

The following potential sources of contamination of surface and groundwater are known to exist in the region (CGS, 2022):

- Surface coal mines - Acid Mine Water (AMD);
- Present and historical gold mining, in the Evander Goldfield in particular – AMD; and
- Agricultural activities - nutrients, such as nitrogen and phosphorus, and pesticides, including herbicides, insecticides, and fungicides (among others).

The CGS have been analysing groundwater samples for the CCUS Project in the Leandra area. The details of the sampled boreholes and monitoring results are provided in Table 12 below. The sampling points are shown in Figure 38 below. The nearest boreholes to the seismic survey area are GHBH003 and GHBH002 (located to the north-west), which are used for livestock watering.

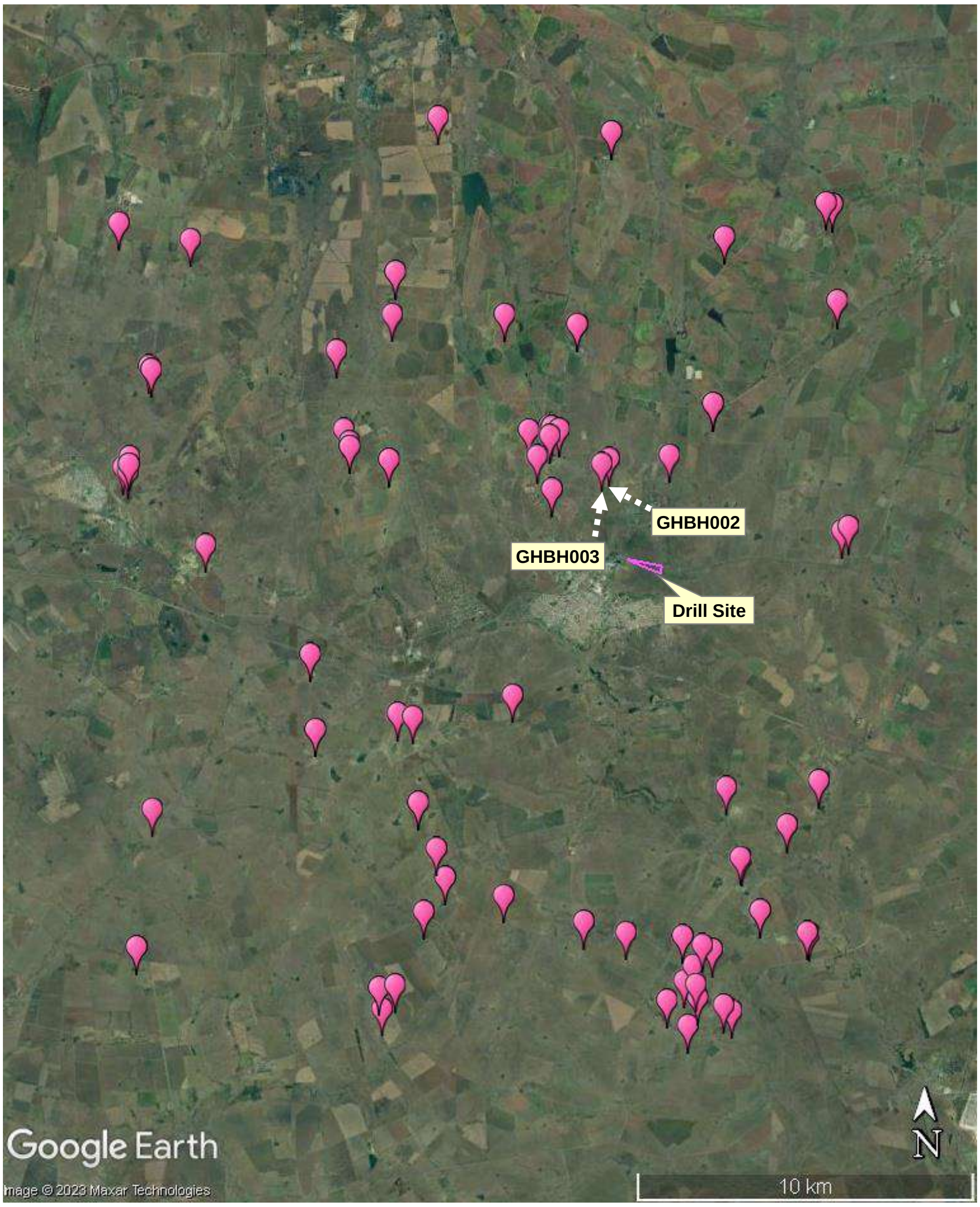


Figure 38: Locations of CCUS Project groundwater sampling points (Google Earth™)

Table 12: CGS sampled boreholes and monitoring results

Site ID	Measurement Date	Location	Lat (Dec. Deg)	Long (Dec. Deg)	Elevation (mamsl)	Water Level (m above ground level)	PH	EC (microS/cm)	Temperature (°C)	Water use type
WBH001A	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.50872	29.09636	1477	0.93	7.08	2328	20.8	Monitoring Borehole
WBH001B	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.50872	29.09636	1477		7.85	576.5	18.4	Monitoring Borehole
WBH003A	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51715	29.10031	1603	0.66	7.6	2994	21	Monitoring Borehole
WBH003B	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51715	29.10031	1603	0.38	7.5	736.7	21.2	Monitoring Borehole
WBH002A	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.5046	29.10387	1589	0	7.06	2373	20.3	Monitoring Borehole
WBH002B	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.5046	29.10387	1589	1.6	7.06	2523	21.2	Monitoring Borehole
WBH004A	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51882	29.11438	1605	0.12	6.77	10810	21.3	Monitoring Borehole
WBH004B	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51882	29.11438	1605	11.53	7.38	2020	24.1	Monitoring Borehole
WBH005A	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51163	29.11681	1622	9.55	7.29	3088	23.4	Monitoring Borehole
WBH005B	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.51163	29.11681	1622	19.82	7.71	1370	20.2	Monitoring Borehole
WBH006	2022-02-01	Evander Gold Mines, Winkelhaak Mines	-26.49897	29.10911	1595		7.82	4665	23	Monitoring Borehole
LBH002	2022-02-01	Evander Gold Mines, Leslie	-26.51332	29.03346	1594	1.45	7.23	1088	21.7	Monitoring Borehole
LBH003	2022-02-01	Evander Gold Mines, Leslie	-26.52346	29.03788	1588	2.43	6.82	2312	21.9	Monitoring Borehole
LBH004	2022-02-01	Evander Gold Mines, Leslie	-26.52476	29.0554	1574	4.41	7.34	495.5	21.3	Monitoring Borehole
LBH005	2022-02-01	Evander Gold Mines, Leslie	-26.51224	29.0548	1575	1.48	6.89	2691	24	Monitoring Borehole
8SBH011	2022-02-02	Evander Gold Mines, 8 Shaft	-26.46005	29.05999	1610	1.88	702	3718	21	Monitoring Borehole
8SBH012	2022-02-02	Evander Gold Mines, 8 Shaft	-26.46051	29.0629	1606	1.67	7.26	2222	20.2	Monitoring Borehole
KDBH017	2022-02-02	Evander Gold Mines, Karibo Dam	-26.48258	29.07401	1596	5.27	7.02	1104	20.5	Monitoring Borehole
KBH002A	2022-02-02	Evander Gold Mines, Kinros	-26.48481	29.078	1598	0.33	7.76	1716	23.2	Monitoring Borehole
KBH002B	2022-02-02	Evander Gold Mines, Kinros	-26.48481	29.078	1598	0.36	7.78	774.7	22.1	Monitoring Borehole
MB017	2022-02-03	Matla Power Station	-26.27633	29.15513	1612	1.89	6.97	766.5	22.9	Monitoring Borehole
MB001	2022-02-03	Matla Power Station	-26.2782	29.15709	1617	1.55	7.36	388	20.7	Monitoring Borehole
MB021	2022-02-03	Matla Power Station	-26.26118	29.15346	1597	0.023	7.03	158.1	18.1	Monitoring Borehole
MB004	2022-02-03	Matla Power Station	-26.26197	29.15334	1597	0.6	7.21	716.5	22.6	Monitoring Borehole
MB003	2022-02-03	Matla Power Station	-26.26522	29.15347	1601	1.87	7.21	194.3	22.6	Monitoring Borehole

Site ID	Measurement Date	Location	Lat (Dec. Deg)	Long (Dec. Deg)	Elevation (mamsl)	Water Level (m above ground level)	PH	EC (microS/cm)	Temperature (°C)	Water use type
MB002	2022-02-03	Matla Power Station	-26.27261	29.15324	1608	1.06	6.72	1110	22.2	Monitoring Borehole
MB049	2022-02-03	Matla Power Station	-26.29527	29.19735	1574	1.47	9.82	362.2	23.3	Monitoring Borehole
MB050	2022-02-03	Matla Power Station	-26.29523	29.19739	1572	6.46	9.91	270.3	20.1	Monitoring Borehole
MB033	2022-02-03	Matla Power Station	-26.29729	29.18469	1574	0	7.17	287.1	21.1	Monitoring Borehole
MB031	2022-02-03	Matla Power Station	-26.29431	29.1688	1574		7.31	518.1	20.9	Monitoring Borehole
MB037	2022-02-03	Matla Power Station	-26.29422	29.16503	1575	10.49	7.87	588.3	18.9	Monitoring Borehole
MB038	2022-02-03	Matla Power Station	-26.29423	29.16507	1573		7.35	348.3	21.5	Monitoring Borehole
MB047	2022-02-03	Matla Power Station	-26.2946	29.16508	1603	1.79	7.07	195.8	24.6	Monitoring Borehole
MB053	2022-02-03	Matla Power Station	-26.28056	29.18845	1578	0	8.5	1141	23.3	Monitoring Borehole
MB048	2022-02-03	Matla Power Station	-26.28351	29.19884	1567	3.83	9.27	151.1	22	Monitoring Borehole
MB042A	2022-02-03	Matla Power Station	-26.28377	29.19923	1566	0.49	8.53	1222	21.2	Monitoring Borehole
MB042B	2022-02-03	Matla Power Station	-26.28377	29.19923	1566	1.3	8.06	926.6	19.6	Monitoring Borehole
MB030	2022-02-03	Matla Power Station	-26.2863	29.20113	1569	0	8.27	798	26.3	Monitoring Borehole
MB057	2022-02-03	Matla Power Station	-26.29131	29.20086	1577	4.2	9.31	233.1	22.2	Monitoring Borehole
MB043	2022-02-03	Matla Power Station	-26.29371	29.19795	1574		6.87	1467	19.7	Monitoring Borehole
MB035	2022-02-03	Matla Power Station	-26.27966	29.12719	1624	0.48	7.47	162.3	20.9	Monitoring Borehole
MB034	2022-02-03	Matla Power Station	-26.27944	29.12566	1621	0	6.96	744.5	22.9	Monitoring Borehole
MCBH006M	2022-02-08	Manungu Colliery	-26.21691	28.68391	1578	4	7.86	209.4	20.7	Monitoring Borehole
MCBH006D	2022-02-08	Manungu Colliery	-26.21688	28.68393	1577	23.98	7.85	213.9	18.4	Monitoring Borehole
MCBH009S	2022-02-08	Manungu Colliery	-26.24837	28.69805	1599	3.79	9.21	157.1	19.1	Monitoring Borehole
MCBH009M	2022-02-08	Manungu Colliery	-26.24835	28.24835	1599	4.06	9.14	106.5	18.6	Monitoring Borehole
MCBH009	2022-02-08	Manungu Colliery	-26.24832	28.69806	1597	5.16				Monitoring Borehole
MCBH009D	2022-02-08	Manungu Colliery	-26.2484	28.69803	1598	42.62	9.41	137.1	19.7	Monitoring Borehole
MCBH004S	2022-02-08	Manungu Colliery	-26.23963	28.69451	1602	4.21	9.02	206.6	19.3	Monitoring Borehole
MCBH004M	2022-02-08	Manungu Colliery	-26.23963	28.69447	1601	6.83	9.31	84.59	18.5	Monitoring Borehole
MCBH004D	2022-02-08	Manungu Colliery	-26.23963	28.69447	1602	26.36	8.85	139.1	18.8	Monitoring Borehole
GHBH006	2022-02-15	Goedehoop	-26.33229	28.9592	1669	15.37	7.79	853.7	24.1	Livestock
GHBH005	2022-02-15	Goedehoop	-26.33206	28.95923	1668	15.25				Not In Use

Site ID	Measurement Date	Location	Lat (Dec. Deg)	Long (Dec. Deg)	Elevation (mamsl)	Water Level (m above ground level)	PH	EC (microS/cm)	Temperature (°C)	Water use type
GHBH004	2022-02-15	Goedehoop	-26.34589	28.9462	1642	12	7.24	440.1	20.3	Domestic, Livestock
GHBH003	2022-02-15	Goedehoop	-26.34819	28.92604	1670	2.24	7.22	602.5	21.2	Livestock
GHBH002	2022-02-15	Goedehoop	-26.34685	28.92827	1661	6.5	7.49	507.1	18.5	Livestock
GHBH001	2022-02-15	Goedehoop	-26.51546	29.17572	1552	1.83	7.59	142.6	22.4	Domestic, Livestock
MVBH007	2022-02-15	Moedverloren	-26.30456	28.99626	1625	12.98	8.12	420.6	26.4	Domestic
CRBH008	2022-02-15	Weltevreden	-26.28751	28.96263	1605	14.34	7.8	409.1	21.2	Not In Use
CRBH009	2022-02-15	Weltevreden	-26.27837	28.99292	1631	3.32	7.19	498.4	25.3	Not In Use
CRBH011	2022-02-15	Weltevreden	-26.27876	28.99484	1625	0	7.23	455	17.4	Not In Use
BKBH012	2022-02-16	Brakfontein	-26.35497	28.91119	1638	6.33	7.22	1098	18.1	Domestic, Livestock
BKBH013	2022-02-16	Brakfontein	-26.33832	28.91117	1620	2.06	7.47	833.2	22.4	Domestic, Livestock
BKBH014	2022-02-16	Brakfontein	-26.33832	28.91116	1620	20.16	7.39	487.7	21	Domestic, Livestock
BKBH015	2022-02-16	Brakfontein	-26.33807	28.91036	1617	10.82	7.31	511.5	21.7	Domestic, Livestock
BKBH016	2022-02-16	Brakfontein	-26.33899	28.91335	1628	1.5	7.33	625	23.6	Domestic, Livestock
BKBH017	2022-02-16	Brakfontein	-26.34067	28.91056	1627	3	7.33	852.8	27	Domestic
BKBH018	2022-02-16	Brakfontein	-26.33915	28.90427	1623	15.5	8.14	473.4	24.1	Domestic
BKBH019	2022-02-16	Brakfontein	-26.34612	28.90682	1632	1.3	6.67	960.6	20.9	Monitoring Borehole
BKBH020	2022-02-16	Brakfontein	-26.31095	28.91874	1631	6.96	7.76	576.9	23.6	Domestic, Livestock
SBLBH021	2022-02-17	Springboklaagte	-26.30825	28.89709	1601	12.08	7.57	597.1	25.3	Domestic
KDBH022	2022-02-17	Kromdraai	-26.25942	28.92898	1588	1.2	7.41	376.1	21.1	Domestic
KDBH023	2022-02-17	Kromdraai	-26.23328	28.93625	1583	66.57	7.47	352.5	22.3	Domestic, Livestock
KDBH024	2022-02-17	Kromdraai	-26.23328	28.93625	1583		6.83	1578	24.7	Livestock
HSBH024	2022-02-17	Holspruit	-26.34351	28.85093	1611	10.59	8.41	347.4	22	Livestock
HSBH025	2022-02-17	Holspruit	-26.34234	28.85083	1615	5.1				Domestic, Livestock
SSBH026	2022-02-17	Steinkonspruit	-26.31789	28.84699	1587		7.74	437.3	22.5	Livestock
SSBH027	2022-02-17	Steinkonspruit	-26.30824	28.8636	1583		7.82	338.5	25.1	Livestock
SSBH028	2022-02-17	Steinkonspruit	-26.29685	28.86456	1580	1.58				Not In Use
HKBH029	2022-02-18	Haverklip	-26.25543	28.87729	1576	3.6	7.14	187.4	22.4	Domestic, Livestock
LKBH030	2022-02-18	Leeukop	-26.34904	28.78331	1617	11.8	8.82	397.8	21.4	Domestic, Livestock

Site ID	Measurement Date	Location	Lat (Dec. Deg)	Long (Dec. Deg)	Elevation (mamsl)	Water Level (m above ground level)	PH	EC (microS/cm)	Temperature (°C)	Water use type
LKBH031	2022-02-18	Leeukop	-26.34624	28.78525	1652	25.07	9.22	517	22.4	Domestic, Livestock
LKBH032	2022-02-18	Leeukop	-26.34822	28.78509	1661	0.9	7.71	452.4	19.6	Monitoring Borehole
LKBH033	2022-02-18	Leeukop	-26.35014	28.7848	1667	5.4	7.39	502.8	20.7	Domestic, Livestock
EBBH034	2022-02-18	Enkeldebosch	-26.28813	28.80346	1620		8.22	433.2	21.4	Domestic, Livestock
ECBBH035	2022-02-18	Couwenburg	-26.28367	28.78213	1611	1.75	7.58	698	25.5	Domestic, Livestock
HSBH036	2022-02-22	Holspruit	-26.33898	28.84916	1538	0.82	7.5	484.8	24.5	Domestic, Livestock
LKBH038	2022-02-22	Leeukop	-26.32291	28.79178	1620		8.55	846.1	24.6	Domestic, Livestock
WHBH039	2022-02-22	Winterhoek	-26.36985	28.80792	1681	3.57	7.35	1045	21.9	Domestic, Livestock
WHBH040	2022-02-22	Winterhoek	-26.39907	28.83912	1679		7.55	733.2	27	Domestic, Livestock
WHBH041	2022-02-22	Winterhoek	-26.37594	28.4229	1649	0	7.54	421.7	23.2	Domestic
RFBH042	2022-02-22	Rietfontein	-26.34705	28.86263	1589	0	7.61	554.6	20	Domestic
RFBH043	2022-02-22	Leeukop	-26.322	28.79108	1615	0.85	8.92	474	23.5	Not In Use
BSBH045	2022-02-23	Broederstroom	-26.4447	28.98133	1593	9.6	7.3	461.9	19.1	Domestic
BSBH046	2022-02-23	Broederstroom	-26.4329	28.99082	1607	0.1	7.45	232.4	19.5	Domestic
BKBH047	2022-02-24	Salpeterkrans	-26.43469	28.96319	1646	21.42	7.7	142.3	23.2	Domestic
UMKBH048	2022-02-24	Uitmaalkaar	-26.3754	29.0014	1648	10.6	7.88	571.8	28.1	Domestic, Livestock
UMKBH049	2022-02-24	Uitmaalkaar	-26.37539	28.0014	1649	7.05	7.36	497.5	18	Domestic, Livestock
RBH050	2022-02-24	Rianell	-26.36494	28.99961	1685	10.99	7.34	643.1	23.1	Not In Use
RBH051	2022-02-24	Rianell	-26.36602	28.99765	1689	12.9	7.73	1180	20.1	Domestic, Livestock
BSBH052	2022-02-24	Brakspruit	-26.49088	28.95469	1598		8.85	351.7	24.7	Domestic, Livestock
BSBH053	2022-02-24	Brakspruit	-26.48739	28.95415	1605		7.71	380	25.9	Domestic, Livestock
BSBH054	2022-02-24	Brakspruit	-26.49449	28.96486	1588	3.4	7.72	511.6	24.2	Domestic, Livestock
BSBH055	2022-02-24	Brakspruit	-26.49293	28.96245	1592		7.53	579.2	18.4	Domestic, Livestock
WSBH057	2022-02-25	Wildebeestspruit	-26.48228	28.95328	1584	14.3				Domestic, Livestock
WSBH058	2022-02-25	Wildebeestspruit	-26.49836	28.95177	1604		9.44	521.5	20.2	Domestic, Livestock
WSBH059	2022-02-25	Wildebeestspruit	-26.49165	28.94553	1599	5	7.38	482.8	19	Livestock
WSBH060	2022-02-25	Wildebeestspruit	-26.48643	28.95067	1613	24	7.98	428	22	Livestock
GFBH061	2022-02-25	Gruisfontein	-26.41579	28.86969	1695		7.67	455.9	22.9	Domestic

Site ID	Measurement Date	Location	Lat (Dec. Deg)	Long (Dec. Deg)	Elevation (mamsl)	Water Level (m above ground level)	PH	EC (microS/cm)	Temperature (°C)	Water use type
GFBH062	2022-02-25	Gruisfontein	-26.41489	28.86514	1690	1.97				Domestic
BSBH063	2022-03-01	Brakspruit	-26.473445	28.9874113		3.1	7.5	380.1	19.1	Livestock
BSBH064	2022-03-01	Brakspruit	-26.47388	28.98796	1491	3	7.76	371	20.8	Livestock
WSBH065	2022-03-01	Wildebeestspruit	-26.473507	28.9332834			7.62	445.3	21.7	Livestock
WSBH066	2022-03-01	Wildebeestspruit	-26.470517	28.92068			8.23	611.2	22.4	Livestock
GFBH067	2022-03-01	Gruisfontein	-26.463610	28.896779			7.44	212.9	23.8	Not In Use
GFBH068	2022-03-01	Gruisfontein	-26.41918	28.84065		1.4	7.64	349.1	25	Not In Use
VPBH069	2022-03-01	Vlakplaats	-26.438700	28.87131		2.4	7.49	456.5	19.3	Not In Use
VPBH070	2022-03-01	Vlakplaats	-26.458731	28.8793314		6.34	7.89	465.8	18.9	Not In Use
VPBH071	2022-03-01	Vlakplaats	-26.467885	28.8729159			7.37	355.2	17.4	Domestic, Livestock
VPBH072	2022-03-01	Vlakplaats	-26.451005	28.87672			8.03	386.1	21	Domestic, Livestock
WSBH073	2022-03-01	Wintervalshoek	-26.410028	28.899473			7.7	688.6	21.1	Domestic, Livestock
VPBH074	2022-03-02	Vlakplaats	-26.493885	28.86045	1605		7.42	660.4		Domestic, Livestock, Irrigation
VPBH075	2022-03-02	Vlakplaats	-26.48825	28.85955	1678		7.41	717.1		Domestic, Livestock, Irrigation
VPBH076	2022-03-02	Vlakplaats	-26.48751	28.86434	1666		8.27	830.9	22.3	Domestic, Livestock, Irrigation
WFBH077	2022-03-02	Wonderfontein	-26.440456	28.79193	1650	15				Domestic, Livestock, Irrigation
WBBH078	2022-03-02	Witbank	-26.47732	28.78715	1667	10.76	7.68	600.1	20.9	Domestic, Livestock
KFBH079	2022-03-02	Klipfontein	-26.478039	28.959041	1602	2.3				Domestic, Livestock
KFBH080	2022-03-02	Klipfontein	-26.474411	28.950202	1610	3.2				Domestic, Livestock
KFBH081	2022-03-02	Klipfontein	-26.467588	28.973327	1603	3.5				Domestic
KFBH082	2022-03-02	Klipfontein	-26.476835	28.956044	1604	3.8				Domestic, Livestock
KFBH083	2022-03-02	Klipfontein	-26.453436	28.96742	1606	12				Domestic, Livestock
KFBH084	2022-03-02	Klipfontein	-26.453771	28.967816	1606	10				Domestic, Livestock

The CGS normally compares monitoring results to the drinking water quality standard (SANS 241:2015), which are listed in Table 13 below.

Table 13: Drinking water quality standard (SANS 241:2015)

		RISK	STANDARD LIMITS
Physical and Aesthetic Determinands			
Colour (mg/l as Pt-Co)		Aesthetic	≤15
Conductivity (at 25 ºC)		Aesthetic	≤170
Total Dissolved Solids (mg/l)		Aesthetic	≤1200
Turbidity (NTU)		Operational	≤1
		Aesthetic	≤5
pH (at 25 ºC)		Operational	≥5 to ≤9.7
Chemical Determinands – Macro Determinands			
Free Chlorine (mg/l as Cl_2)		Chronic Health	≤5
Monochloromine (mg/l)		Chronic Health	≤3
Nitrate (mg/l as N)		Acute Health	≤11
Nitrite (mg/l as N)		Acute Health	≤0.9
Combined Nitrate plus Nitrite (mg/l)		Acute Health	≤1
Sulphate (mg/l as SO_4^{2-})		Acute Health	≤500
		Aesthetic	≤250
Fluoride (mg/l as F-)		Chronic Health	≤1.5
Ammonia (mg/l as N)		Aesthetic	≤1.5
Chloride (mg/l as Cl-)		Aesthetic	≤300
Sodium (mg/l as Na)		Aesthetic	≤200
Zinc (mg/l as Zn)		Aesthetic	≤5
Chemical Determinands – Micro Determinands			
Antimony (µg/l as Sb)		Chronic Health	≤20
Arsenic (µg/l as As)		Chronic Health	≤10
Barium (µg/l as Ba)		Chronic Health	≤700
Boron (µg/l as B)		Chronic Health	≤2400
Cadmium (µg/l as Cd)		Chronic Health	≤3
Total Chromium (µg/l as Cr)		Chronic Health	≤50
Copper (µg/l as Cu)		Chronic Health	≤2000
Cyanide (recoverable) (µg/l as CN-)		Acute Health	≤200
Iron (µg/l as Fe)		Chronic Health	≤2000
		Aesthetic	≤300
Lead (µg/l as Pb)		Chronic Health	≤10
Manganese (µg/l as Mn)		Chronic Health	≤400
		Aesthetic	≤100
Mercury (µg/l as Hg)		Chronic Health	≤6
Nickel (µg/l as Ni)		Chronic Health	≤70
Selenium (µg/l as Se)		Chronic Health	≤40
Uranium (µg/l as U)		Chronic Health	≤30
Aluminium (µg/l as Al)		Operational	≤300
Chemical Determinands – Organic Determinands			
Total Organic Carbon (mg/l as C)		Chronic Health	≤10
Trihalo-methanes	Chloroform (µg/l)	Chronic Health	≤300
	Bromoform (µg/l)	Chronic Health	≤100
	Dibromochloromethane (µg/l)	Chronic Health	≤100
	Bromodichloromethane (µg/l)	Chronic Health	≤60
Combined Trihalomethane		Chronic Health	≤1

		RISK	STANDARD LIMITS
Total Microcystin (µg/l) j		Chronic Health	≤1
Phenols (µg/l)		Aesthetic	≤10
Microbiological Determinands			
E.coli or Faecal Coliforms (Count per 100 ml)		Acute Health	Not Detected
Protozoan Parasites			
Cryptosporidium Species (Count per 10 litres)		Acute Health	Not Detected
Giardia Species (Count per 10 litres)		Acute Health	Not Detected
Total Coliforms (Count per 100 ml)		Operational	≤10
Heterotrophic Plate Count (Count per ml)		Operational	≤1000
Somatic Coliphages (Count per ml)		Operational	Not Detected

4.7 Surface Water

4.7.1 Hydrological Setting

The project area falls within two Water Management Areas (WMA), namely the upper part of the Vaal WMA and southern part of the Olifants WMA (see Figure 39 below). On a smaller scale, the project area is located within the B20E and C12D Quaternary Catchments (see Figure 40 below).

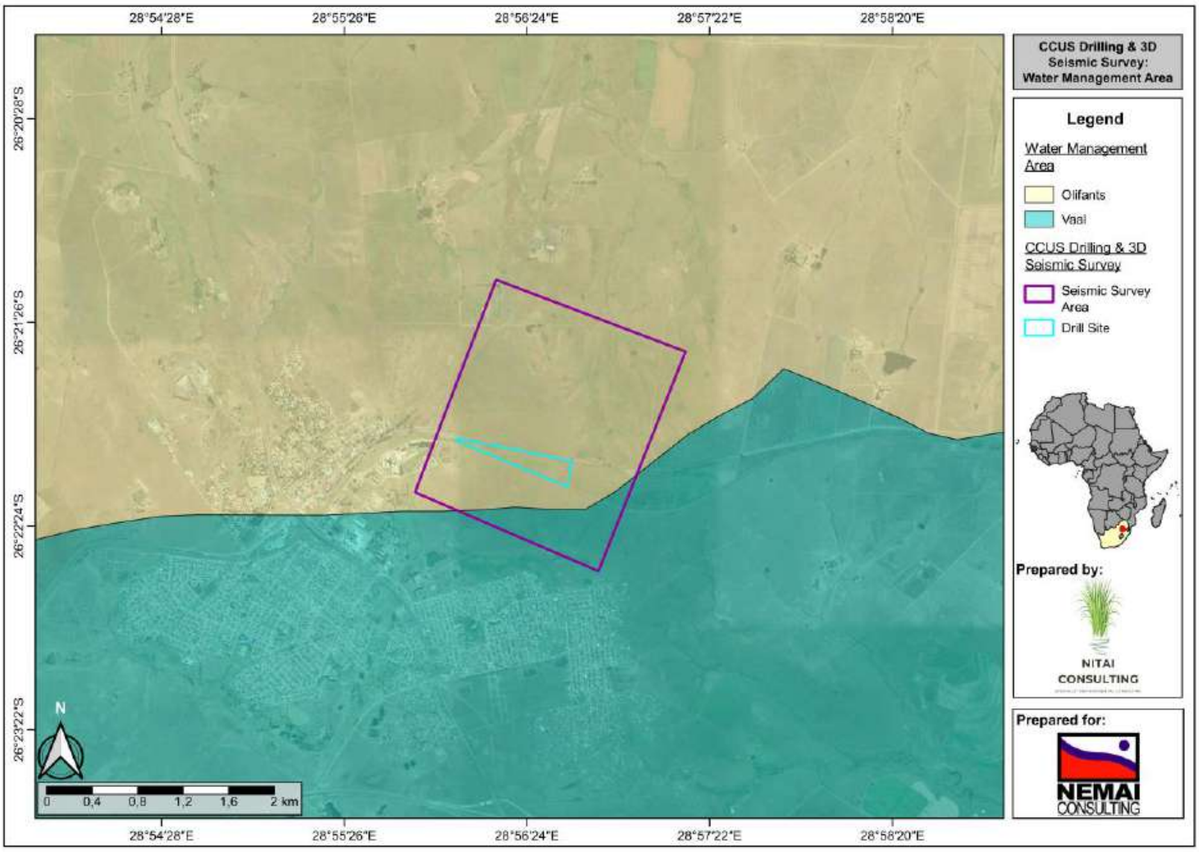


Figure 39: Water Management Area associated with the proposed study area

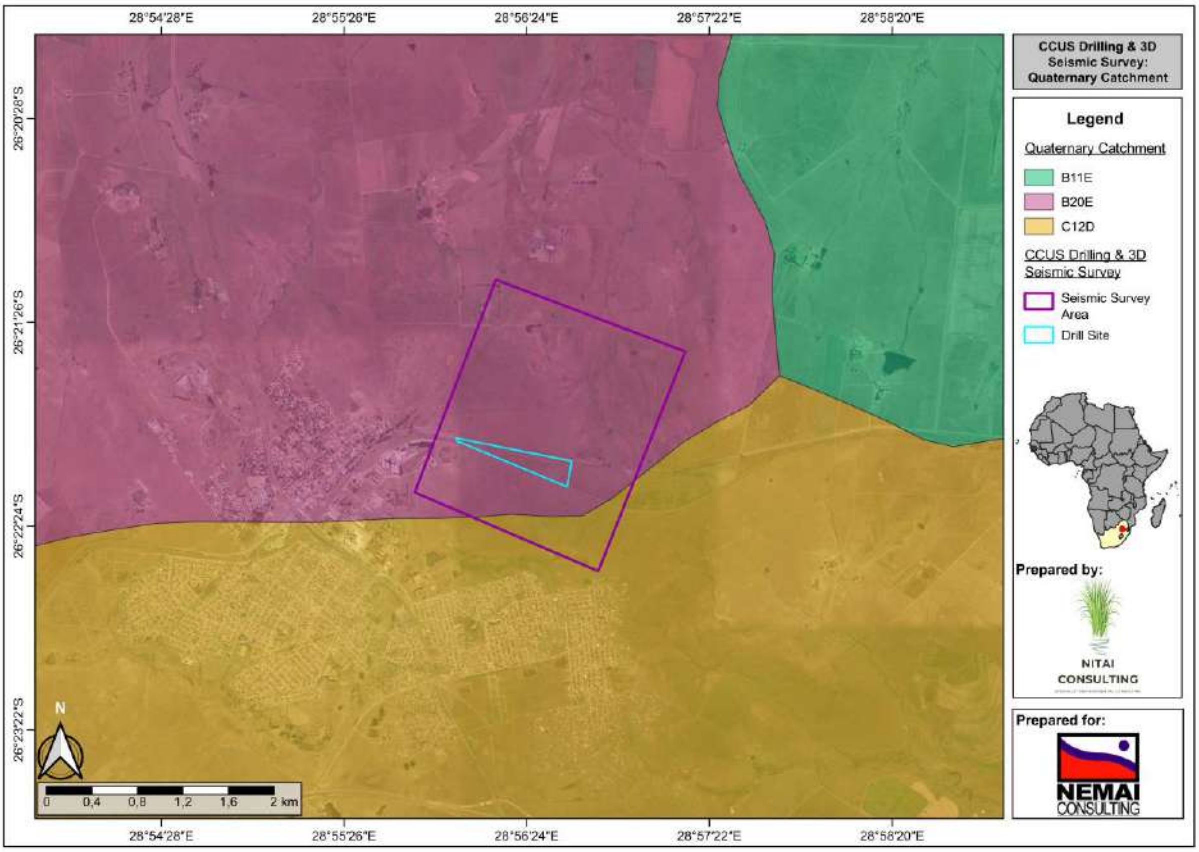


Figure 40: Quaternary Catchments associated with the proposed study area

The ecological categories for the Integrated Unit of Analysis (IUA) that cover the project area are as follows (DWA, 2013; DWS, 2014):

- B20E:
  - PES = C (moderate); and
  - EIS = high.
- C12D:
  - PES = D (Largely modified); and
  - EIS = moderate.

The project area is further located within the Highveld ecoregion. This high lying region is described as plains with a moderate to low relief, as well as various grassland vegetation types.

The northern part of the project area drains towards tributaries of the Kromdraaispruit, which flows in a northern direction within the seismic survey area. The Kromdraaispruit is a tributary of the Wilge River. The southern part of the project area drains towards tributaries of the Waterval River.

Impacts to water resources in these sub-catchments are associated with agriculture, mining, industries and urban areas. The region is characterised by intensive coal mining and associated energy and manufacturing economy.

4.7.2 National Freshwater Ecosystem Priority Areas

Figure 41 below shows the National Freshwater Ecosystem Priority Area (NFEPA) rivers, non-perennial rivers and dams within the project area. The NPEFA rivers include the tributaries of the Kromdraaispruit and Waterval River in the northern and southern parts of the project area, respectively.

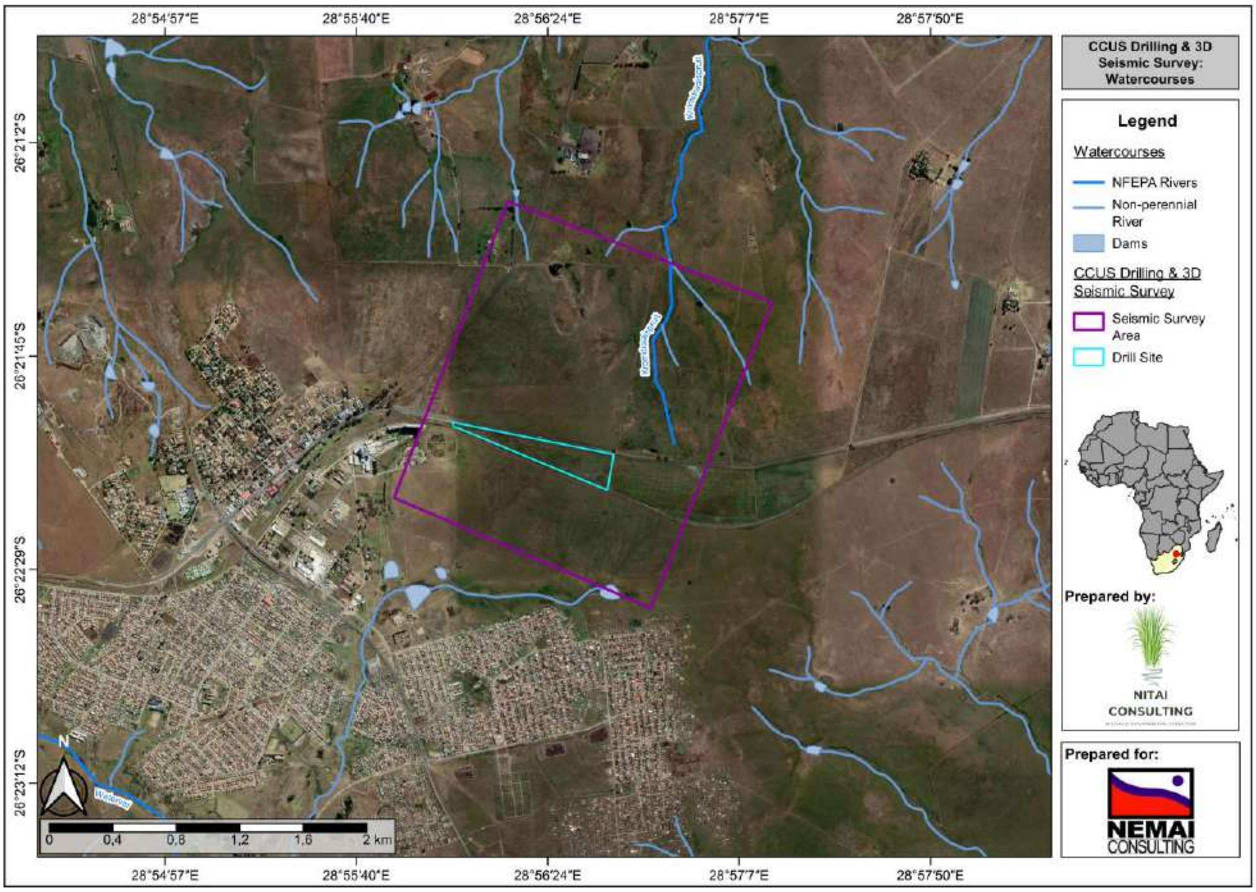


Figure 41: NFEPA rivers, non-perennial rivers and dams in the project area

4.7.3 National Biodiversity Assessment (NBA) 2018

According to the National Biodiversity Assessment (NBA) 2018 National Wetland Map (NWM) 5 spatial data, there is only one hydrogeomorphic (HGM) unit within the footprint of the project area, which is a seep (see Figure 42 below).

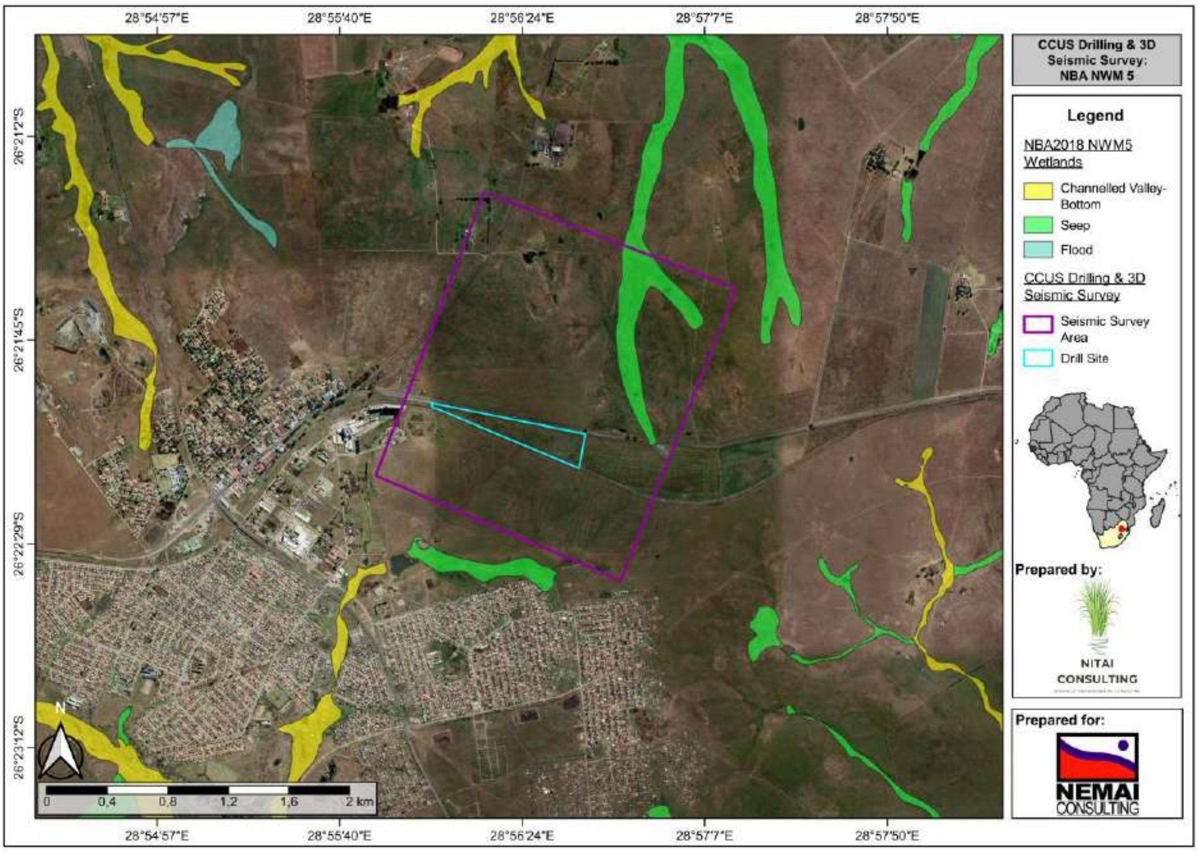


Figure 42: Wetland HGM units encountered in the project area

4.7.4 Mpumalanga Biodiversity Sector Plan

On a regional scale, terrestrial and aquatic biodiversity conservation priorities are highlighted in the Mpumalanga Biodiversity Sector Plan (MBSP) (Lotter *et al*., 2014). A Biodiversity Sector Plan provides a map of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological process – these are called Critical Biodiversity Areas (CBAs) and Ecological Support Areas (ESAs) (Lotter *et al*., 2014).

CBAs are areas that are required to meet each ecosystem's biodiversity target while being maintained in an appropriate ecological condition for their category, referred to as the land management objective. These include all areas required to meet biodiversity pattern targets and to ensure continued existence and functioning of species and ecosystems, special habitats and species of conservation concern. In addition, these areas also include critical endangered ecosystems and critical linkages to maintain connectivity. The CBA map of the Mpumalanga relies on the NFEPA project and includes three sub-categories of CBAs (i.e., CBA Aquatic species, CBA Rivers and CBA Wetlands).

ESAs are terrestrial and freshwater areas that are not essential for meeting biodiversity representation targets, but which nevertheless play an important role in supporting the ecological functioning of CBAs (Lotter *et al*., 2014). Furthermore, ESA's need to be maintained in a functional or near natural state, supporting the purpose for which they are identified. These include natural features such as riparian habitat surrounding rivers or wetlands, corridors, over-wintering sites for Blue Cranes (Lotter *et al*., 2014).

According to the aquatic biodiversity component of the MBSP, the project area does not fall within any aquatic CBAs or ESAs (see Figure 43 below). The project area is situated in heavily modified areas as well as "other natural areas" (Lotter *et al*., 2015).

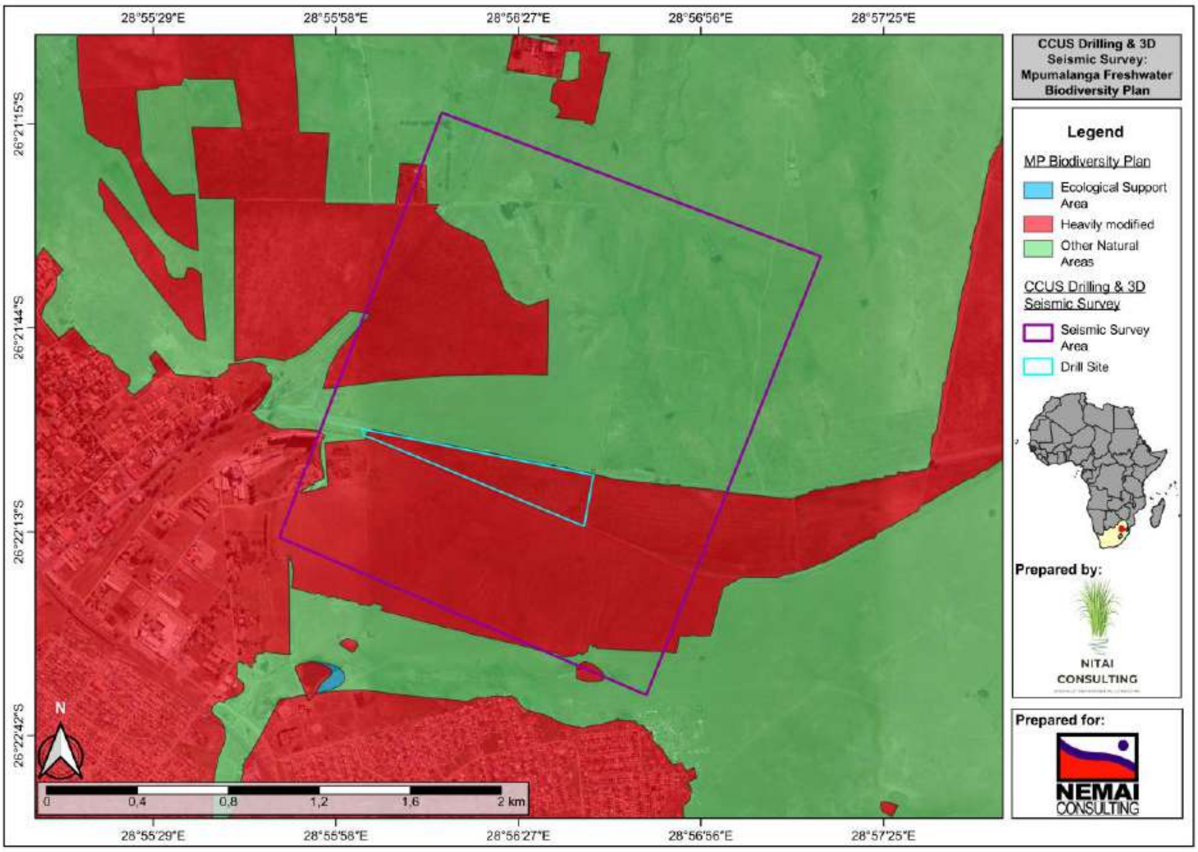


Figure 43: Aquatic CBAs in relation to the project area

4.7.5 Strategic Water Source Area

A Strategic Water Source Area (SWSA) refer to either (a) areas that supply an uneven (large quantity) amount of mean annual surface water runoff in relation to their size and are therefore considered to be nationally important or (b) have high groundwater recharge and where the groundwater forms nationally important resource or (c) areas that meat both criteria (a) and (b) (Nel *et al*., 2013; Le Maitre *et al*., 2018). Areas that supply these disproportionate amounts of water can be because of climatic conditions such as high rainfall, or physical properties (ability of the soils and underlying weathered material and rocks to store water as groundwater) (Le Maitre *et al*., 2018). In South Africa, 22 SWSA surface water and 37 SWSA groundwater areas has been identified to be strategically important at national level for water and economic security (Le Maitre *et al*., 2018).

The project area is situated to the north of a surface water SWSA (see Figure 44 below). Based on the non-invasive nature of the seismic survey activities, the project is not anticipated to impact the status of this SWSA.

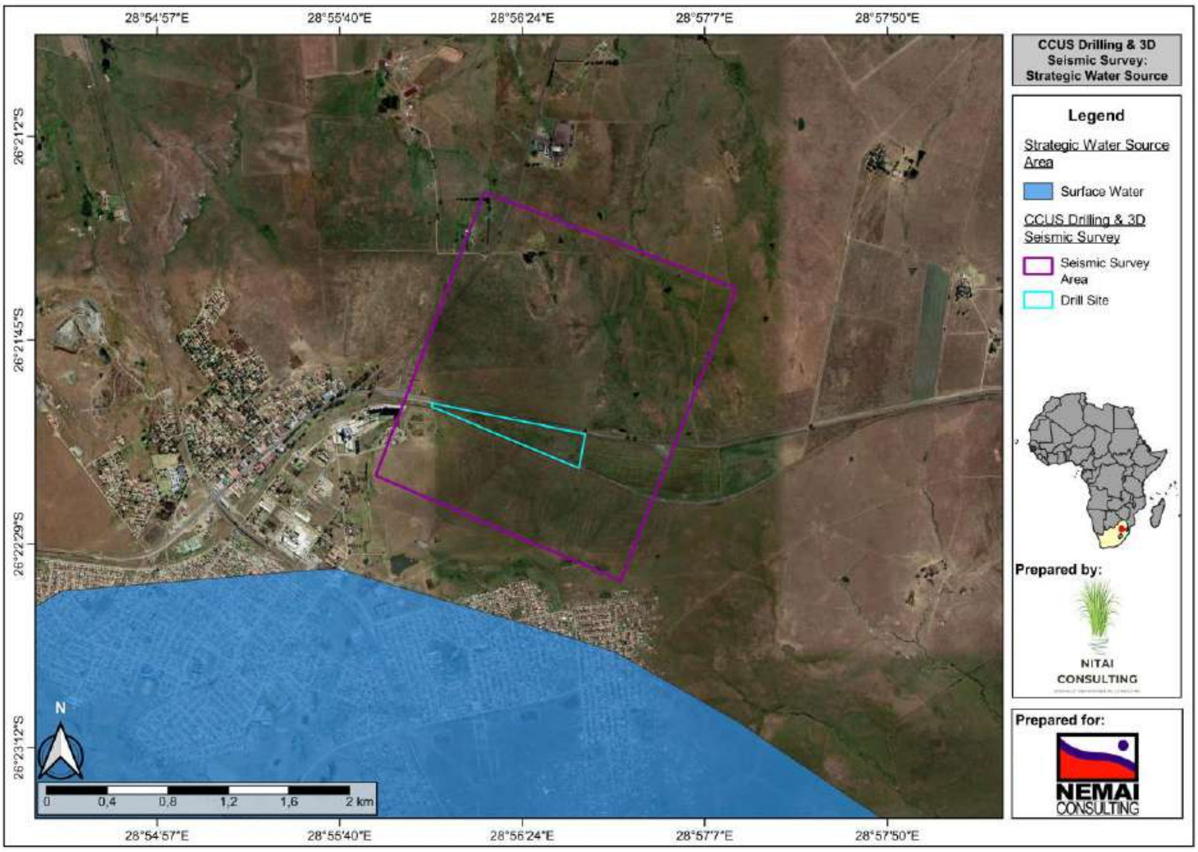


Figure 44: Surface water SWSA in relation to the project area

4.7.6 Findings of the Aquatic Assessment

4.7.6.1 Watercourses in the Project Area

The watercourses identified in the project area are shown in Figure 45 below. One perennial river, namely the Kromdraaispruit, and various non-perennial rivers are encountered in the seismic survey area. A drainage line flows across the property at the drill site and drains to the south-west.

The 500m regulated area of wetlands that surround the drill site is also shown in Figure 45 below.

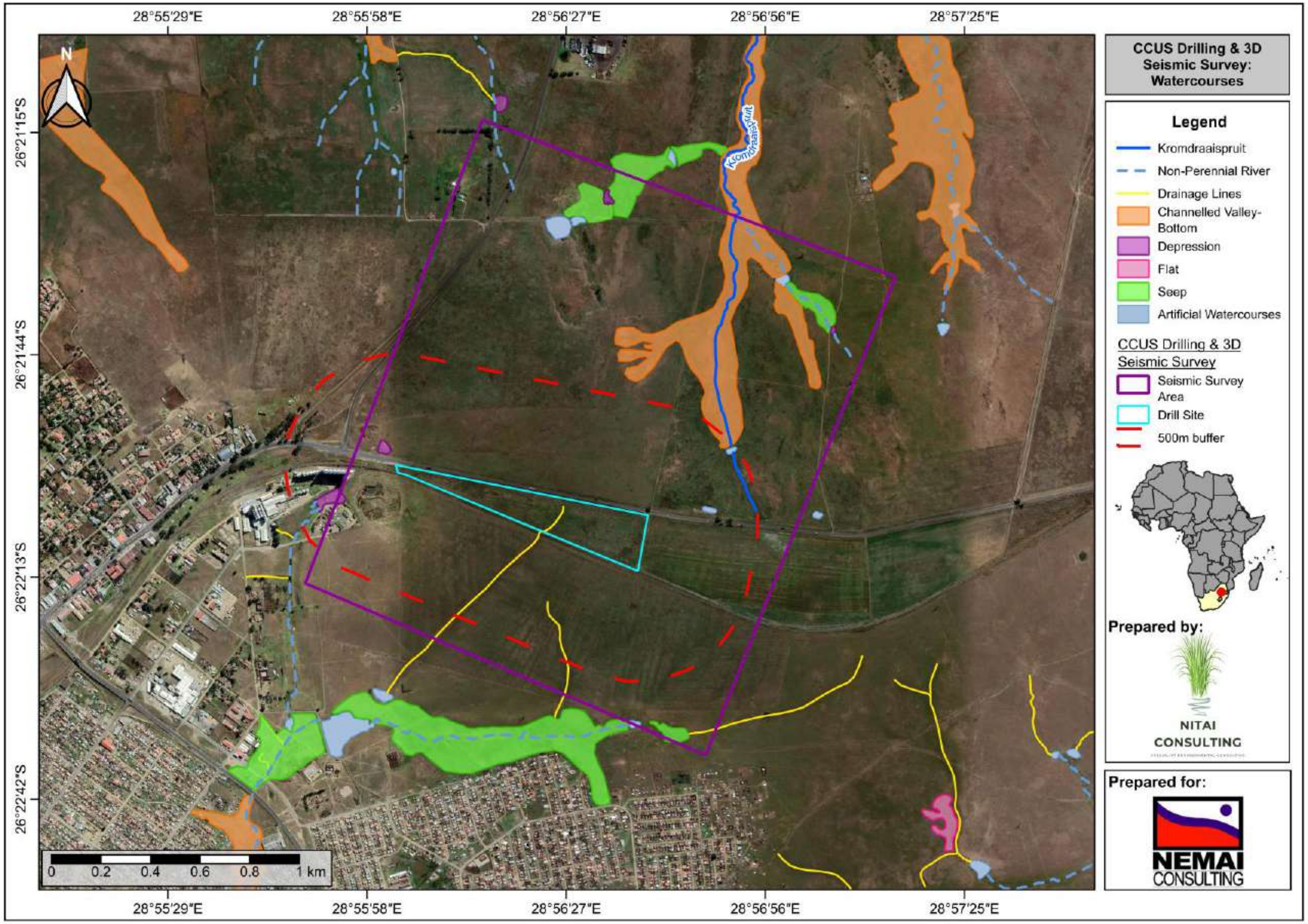


Figure 45: Watercourses identified within the project area

The following wetlands were delineated in the project area (see Figure 45 above):

- A channelled valley bottom wetland (CVB) is located along the main stem of the Kromdraaispruit in the north-western part of the survey area;
- A seep wetland is located along a tributary of the Kromdraaispruit in the north-western part of the survey area;
- Depressions are encountered in parts of the project area; and
- A seep wetland occurs along the tributary of the Waterval River near Lebohang and is on the southern perimeter of the 3D seismic survey area.

Buffer zones of 32m (shown in Figure 46 below) were determined for all watercourses in the project area, based on the current condition of these systems. These buffer zones do not necessarily indicate no-go areas/exclusion zones, since the proposed seismic survey will be non-invasive. However, it is recommended that certain activities, such as the stopping of the vibroseis trucks or refuelling/maintenance of the trucks and support vehicles do not take place within these buffer zones. The activities at the drill site and camp site also need to remain outside of the buffer zone of the drainage line that flows through the property.

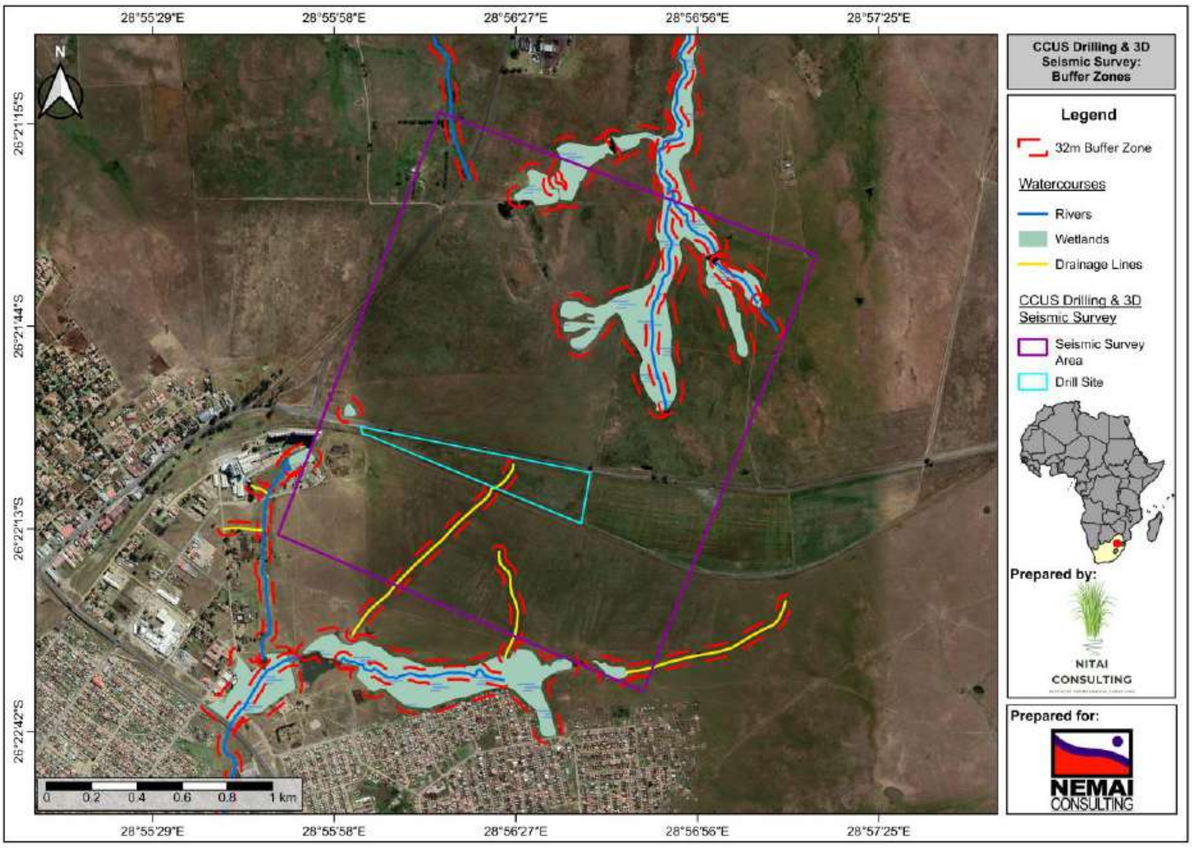


Figure 46: Buffer zones for watercourses in project area

Several dams are encountered in the seismic survey area and surrounding region (see examples of these dams in Figure 47 below). A cattle trough is also located just north of Lebohang, south of the seismic survey area.

Figure 47: Examples of dams in project area

Figure 48 below provides views of the general environment around points where watercourses were delineated for the project.

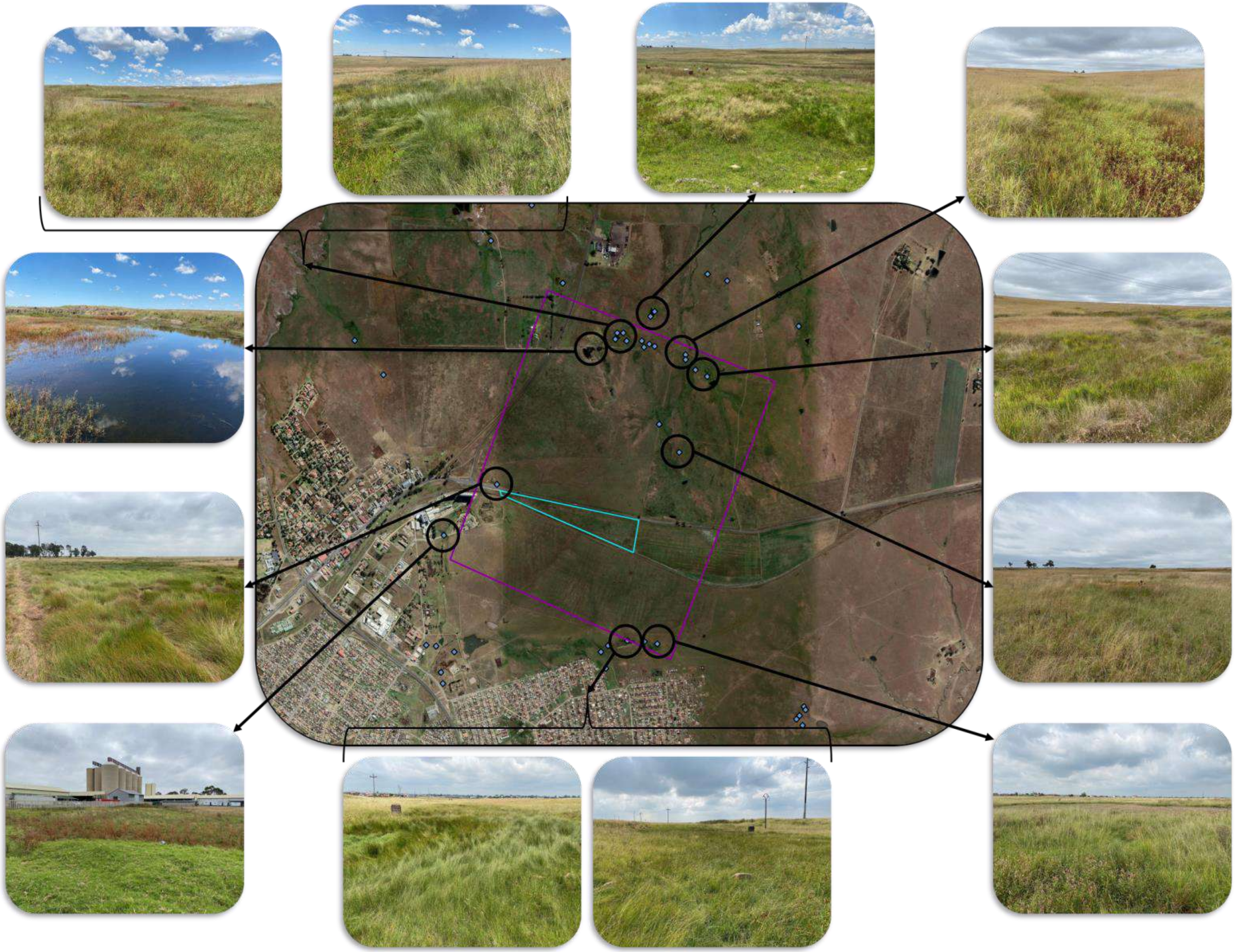


Figure 48: Photographs indicating the general environment around points where watercourses were delineated

4.7.6.2 Vegetation Characteristics

During the site visit, vegetation characteristics indicative of wetland habitats were observed within the project area (refer to photographs shown in Figure 49 below).

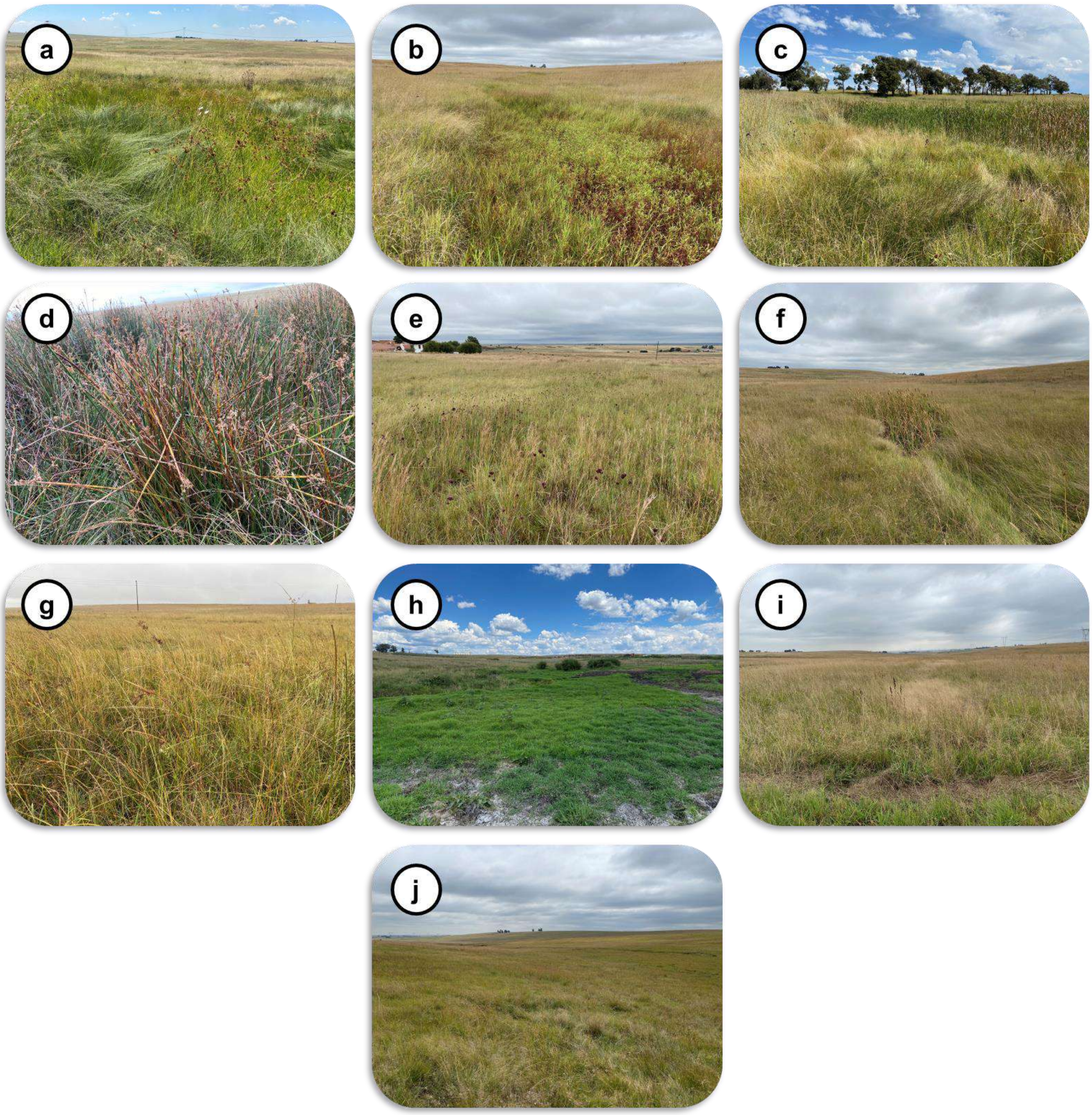


Figure 49: Vegetation characteristics associated with the project area

(*Photos highlight the different species (a) Juncus punctorius, (b) Persicaria lapathifolia, (c) Phragmites australis, (d) Schoenoplectus brachyceras, (e) Verbena bonariensis, (f) Typha capensis, (g) Cyperus fastigiatus, (h) Paspalum dilatatum, (i) Imperata cylindrica, and (j) Sporobolus africanus*)

4.7.6.3 Ecological Status of Wetlands in Project Area

The PES and EIS were determined for the wetlands delineated for the project in the Kromdraaispruit Catchments (north) and Waterval Catchment (south). The PES and EIS scores are presented in Table 14 and Table 15 below, respectively.

Table 14: PES scores calculated for wetlands within the project area

HGM Unit	Hydrology	Geomorphology	Vegetation	Overall
Kromdraaispruit Catchment				
Channelled Valley-Bottom	C (Moderately modified) Impact score: 3.1	C (Moderately modified) Impact Score: 2.8	C (Moderately modified) Impact Score: 3.0	C (Moderately modified) Impact score: 3.4
Depression	B (Largely natural) Impact Score: 1.0	C (Moderately modified) Impact Score: 2.5	C (Moderately modified) Impact Score: 3.5	C (Moderately modified) Impact Score: 2.3
Seep	C (Moderately modified) Impact Score: 2.4	C (Moderately modified) Impact Score: 3.1	D (Largely modified) Impact Score: 5.0	C (Moderately modified) Impact Score: 3.3
Waterval Catchment				
Seep	C (Moderately modified) Impact Score: 2.8	C (Moderately modified) Impact Score: 3.1	D (Largely modified) Impact Score: 5.0	C (Moderately modified) Impact Score: 3.4
Depression	C (Moderately modified) Impact Score: 3.7	C (Moderately modified) Impact Score: 3.2	C (Moderately modified) Impact Score: 3.5	C (Moderately modified) Impact Score: 3.5

Table 15: EIS scores calculated for wetlands within the project area

HGM Unit	Ecological Importance and Sensitivity
Kromdraaispruit Catchment	
Channelled Valley-Bottoms	Moderate (1.34)
Seeps	Moderate (1.29)
Depressions	Moderate (1.51)
Waterval Catchment	
Seeps	Moderate (1.29)
Depressions	Moderate (1.64)

4.7.7 DFFE Screening Tool

According to DFFE's National Web Based Environmental Screening Tool (the "Screening Tool"), the Aquatic Biodiversity Theme shows very high sensitivity in certain parts of the project area (see Figure 50 below). This relates to the watercourses encountered within the proposed seismic survey area (see Section 4.7.5 above). Due to the non-invasive nature of the seismic survey, it is not anticipated that the associated activities pose significant risks to aquatic biodiversity if the proposed mitigation measures are implemented.

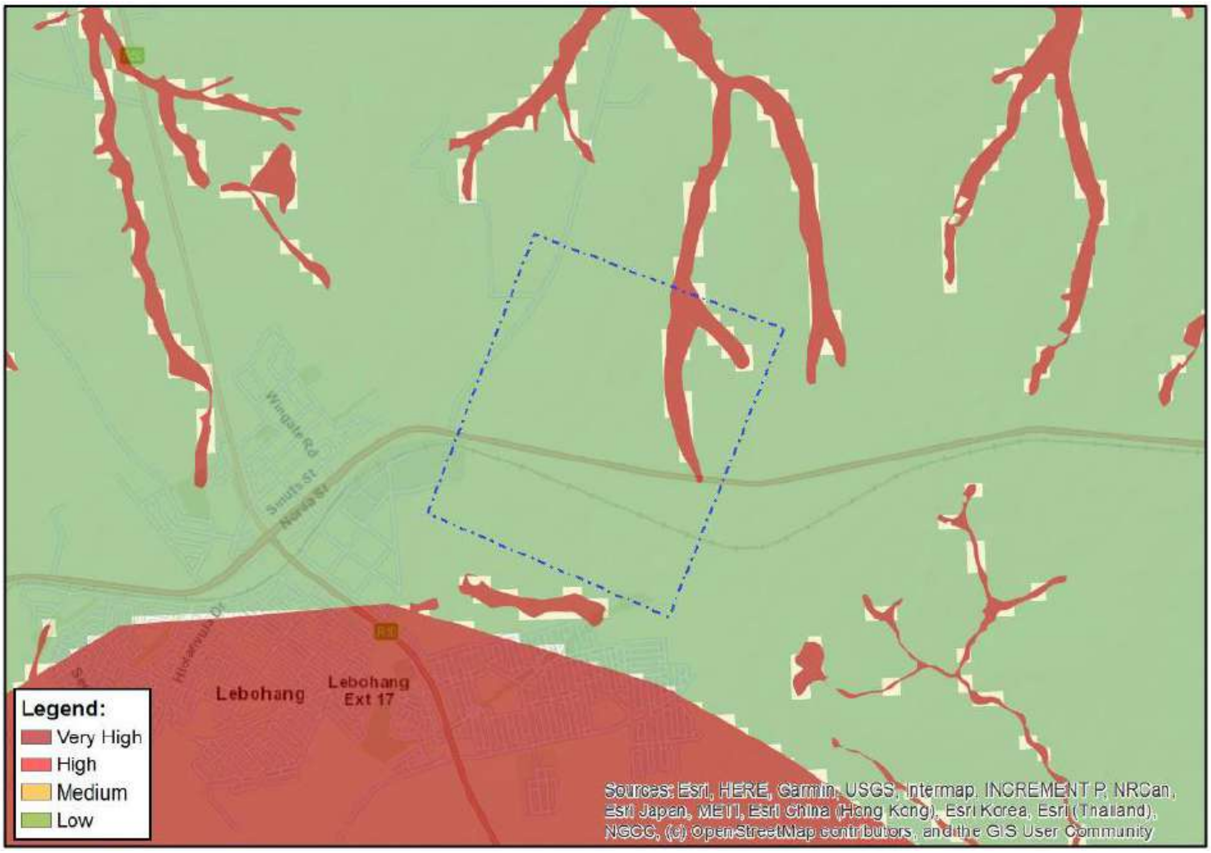


Figure 50: Map of relative Aquatic Biodiversity Theme Sensitivity (DFFE Screening Tool, 2023)

4.7.8 Surface Water Monitoring

The CGS have been analysing surface water samples for the CCUS Project in the Leandra area. The details of the sampling points are listed in Table 16 and shown in Figure 51 below. The results of the analyses are presented in Table 17 below.

Table 16: CGS surface water sampling points

Site Name	Waterbody type	Coordinates	
		Latitude	Longitude
GM1	Quarry	26.357472°S	28.939984°E
GM2	Dam	26.375559°S	28.931416°E
GM3	Stream	26.375416°S	28.929485°E
GM4	Dam	26.385432°S	28.889435°E
GM5	Stream	26.355830°S	28.910280°E
GM6	Stream	26.351940°S	28.916110°E
GM7	Marsh	26.376110°S	28.945280°E
GM8	Quarry	26.395560°S	28.918060°E
GM9	Quarry	26.381250°S	28.811900°E

Site Name	Waterbody type	Coordinates	
		Latitude	Longitude
GM10	Dam	26.373760°S	28.823150°E
GM11	Stream	26.388890°S	28.858330°E

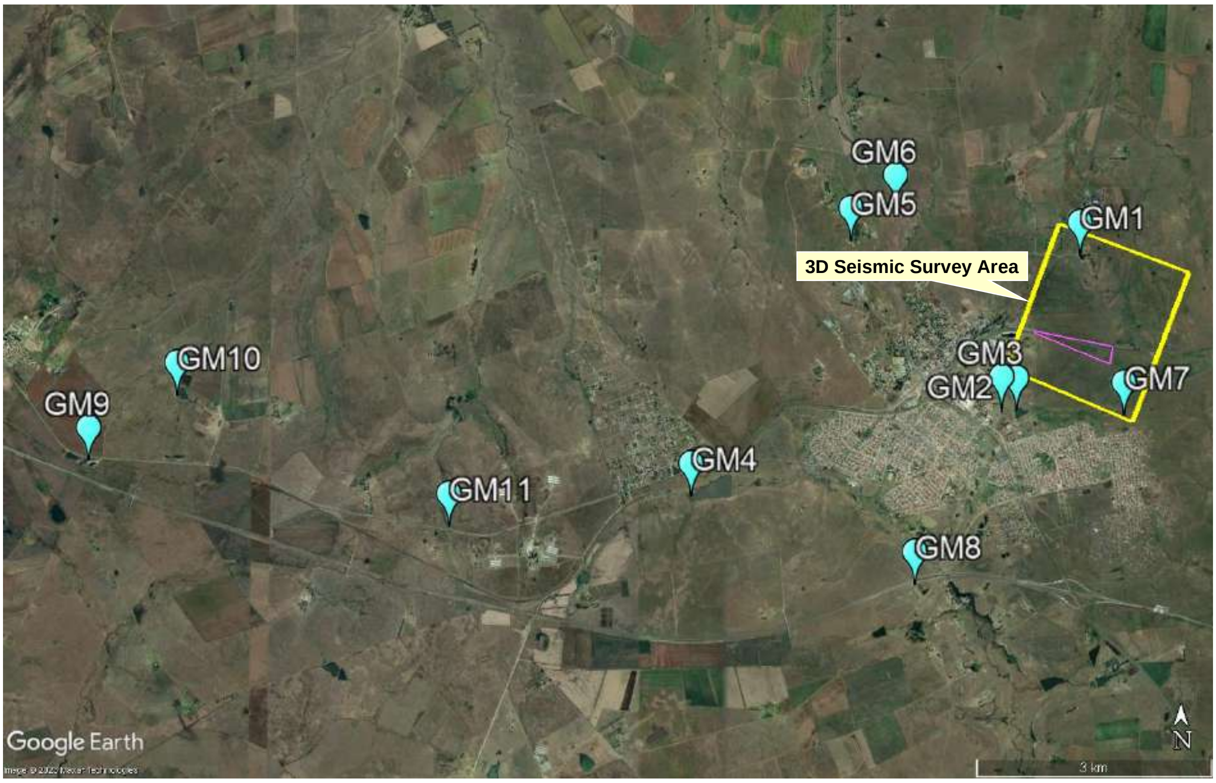


Figure 51: Locations of CCUS Project surface water sampling points (Google Earth™)

The levels of EC and Total Dissolved Solids (TDS), which are directly proportional to one another, were elevated at monitoring points GM2, GM3 and GM7, which are located within the 3D seismic survey area. It is assumed that the factors that contribute towards reduced water quality at these monitoring points include runoff from agricultural lands and residential areas. There are no surface water quality monitoring points in proximity to the drill site, as the area is not traversed by any watercourses.

Table 17: Results of CGS surface water analyses

Date: July 2022								
Site Name	**Temperature (°C)**	**pH**	**EC (µS)**	**TDS (ppm)**	**ORP (mV)**	**RDO (mg/l)**	**Salinity (ppm)**	**Resist (Ohm-cm)**
GM1	8.8	8.76	488.7	234.4	-171.6	7.89	218.5	815.3
GM2	9	7.01	1704	831.6	-35.7	2.32	825.4	610.2
GM3	10	7.61	2575	832	-62	0.08	939.4	406.4
GM4	11.1	7.1	427.6	208.6	-32.3	5.27	139.6	239.1
GM5	10.8	7.38	1309	637.7	-50.3	5.76	625.7	748.5
GM6	11.8	7.48	2696	396.7	-57.5	6.87	536.4	379.1
GM7	9.7	7.19	1539	750.6	-37	1.34	749.5	665.4
GM8	18.3	7.65	850.1	416.4	-61.4	5.55	402.3	495.3
GM9	18	8.31	1159	567.3	-125.7	6.01	553.7	865.5
GM11	14.9	8.15	1916	935.3	-95.9	8.22	938.3	534.5
Date: August 2022								
Site Name	**Temperature (°C)**	**pH**	**EC (µS)**	**TDS (ppm)**	**ORP (mV)**	**RDO (mg/l)**	**Salinity (ppm)**	**Resist (Ohm-cm)**
GM1	17.3	7.63	1347	637.5	-89.9	5.17	678.4	743.1
GM2	22.6	8.3	2062	1013	-106.1	6.59	1066	483
GM3	19.3	8.39	2400	1200	-108.3	11.39	1232	415.6
GM4	19.5	7.35	445	221	-42.5	4.99	215.9	649
GM5	21.7	8.2	1053	533	-96.7	6.22	522.4	957.1
GM6	24.2	8.38	2913	1456	-109.4	6.65	1056	342.4
GM7	21.6	6.8	1458	729	872.6	4.17	739.9	685.2
GM8	16	8.11	914	475.1	-93.5	5.19	444.5	1093
GM9	26.6	3.69	513	255.7	342.6	5.31	249.6	893.5
GM11	19.2	7.44	788	893.9	-81.6	7.44	907.6	559.4

Date: November 2022								
Site Name	Temperature (°C)	pH	EC (µS)	TDS (ppm)	ORP (mV)	RDO (mg/l)	Salinity (ppm)	Resist (Ohm-cm)
GM1	24.2	8.1	706.2	365.2	-92.9	7.46	346.6	1399
GM2	23.5	7.62	1093	546.5	-83.8	3.82	542.4	916.3
GM3	21	8.01	739.5	976.9	-103.4	0.13	999.7	510.6
GM4	20.6	6.9	444.9	222.2	-67.3	4.97	212.5	225.5
GM5	22.5	7.45	1291	643.1	-92.5	6.18	647.8	775.7
GM6	26.8	8.01	1269	633.4	-106.2	7.55	624.1	729.9
GM7	22	7.23	803.7	368.2	-53.8	2.78	353.5	1369
GM8	21.7	7.9	721.1	361.2	-97.33	6.79	356.2	1387
GM9	20.8	6.56	1582.7	286.2	259.2	6.49	281.9	1727
GM11	21	7.93	1367	681.7	-67.8	6.6	692.9	733.9

4.8 Terrestrial Biodiversity

4.8.1 Threatened Ecosystems

In terms of Section 52(1)(a) of NEM:BA, a national list of ecosystems that are threatened and in need of protection was gazetted on 9 December 2011. The list classified all threatened or protected ecosystems in SA in terms of four categories, namely Critically Endangered (CR), Endangered (EN), Vulnerable (VU), or Protected. The purpose of categorising these ecosystems is to prioritise conservation areas in order to reduce the rates of ecosystem and species extinction, as well as preventing further degradation and loss of structure, function, and composition of these ecosystems.

According to the South African National Biodiversity Institute (SANBI) (2011), parts of the seismic survey footprint fall within threatened ecosystems, which are listed as VU (see Figure 52 below). The drill site does not encroach into any threatened ecosystems.

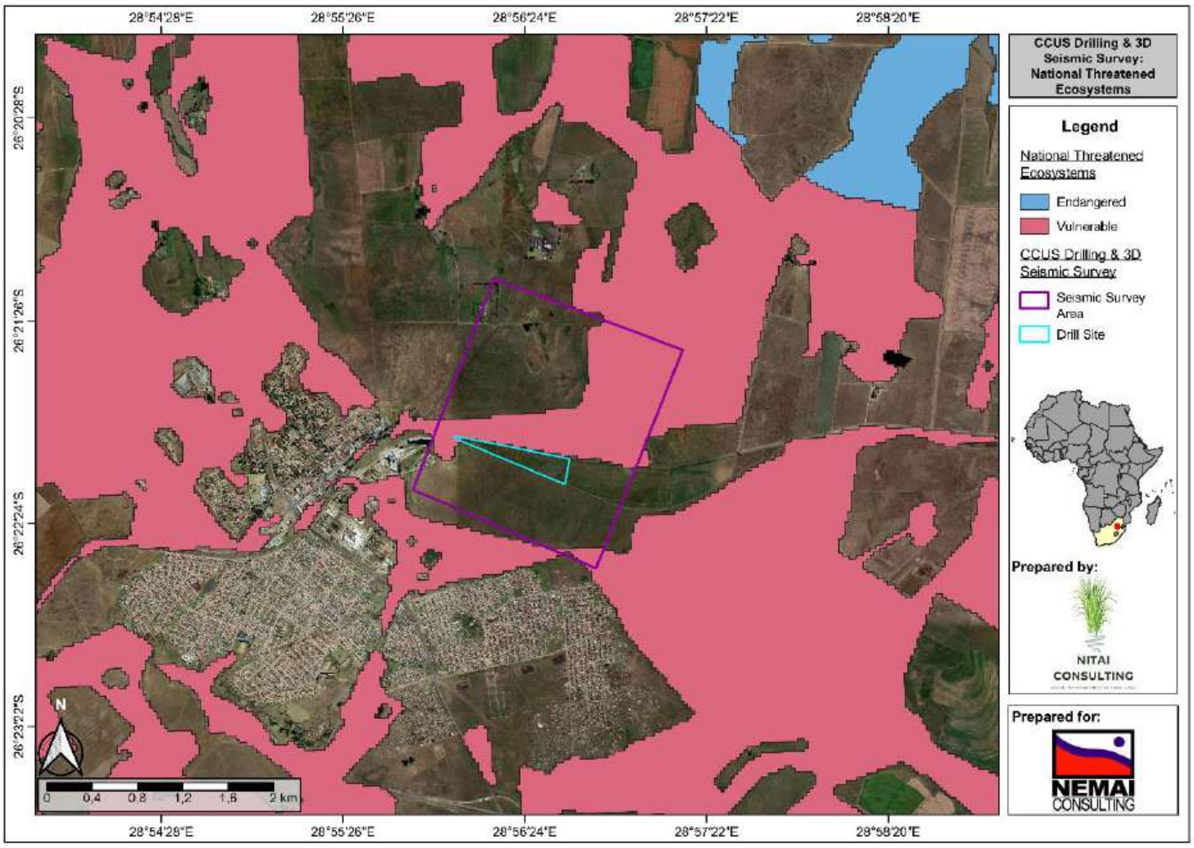


Figure 52: Project area in relation to Threatened Ecosystems

4.8.2 National Protected Area Expansion Strategy

The National Protected Area Expansion Strategy (NPAES) presents the best opportunities in SA for meeting the ecosystem-specific protected area targets and were designed with strong emphasis on climate change resilience and requirements for protecting freshwater ecosystems.

As shown in Figure 53 below, the project area falls outside of the NPAES.

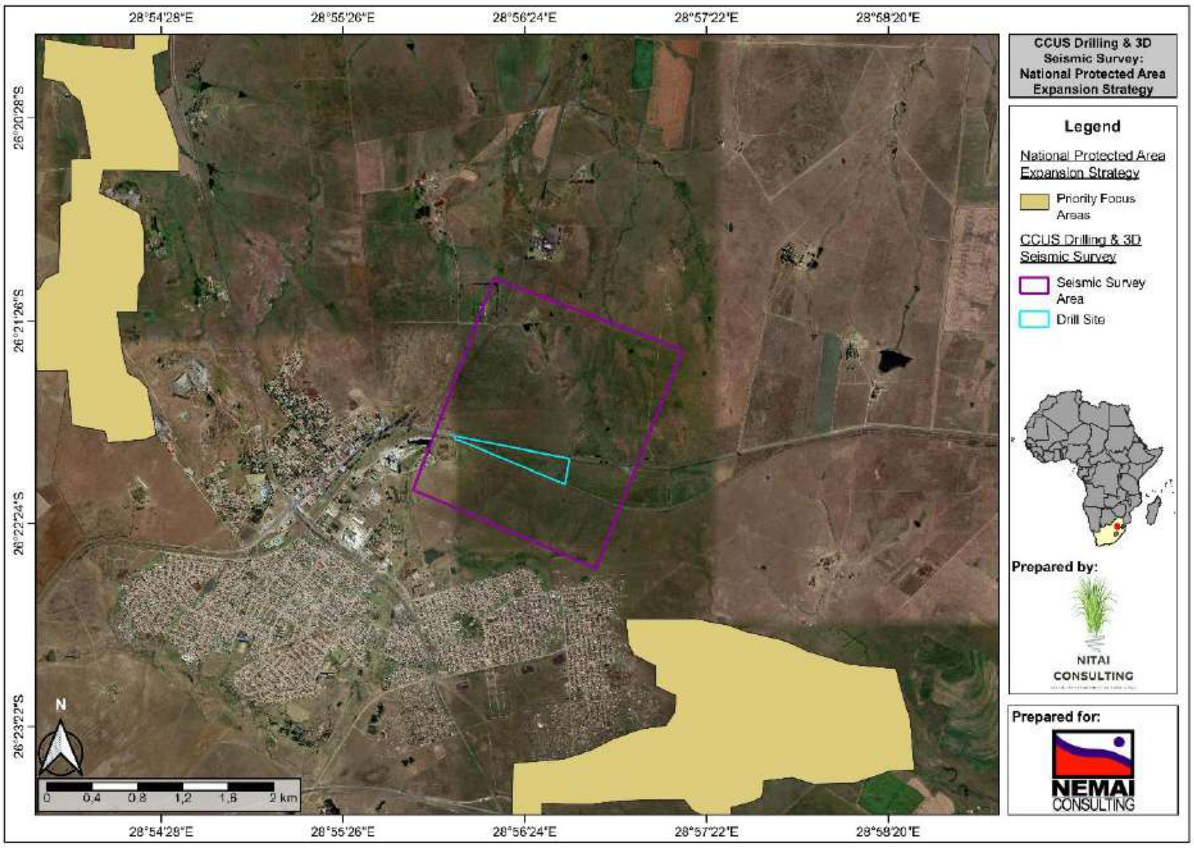


Figure 53: Project area in relation to Priority Focus Area in terms of the NPAES

4.8.3 Biome and Vegetation Type

The project area is situated within the Grassland Biome. There is only one regional vegetation pattern encountered in the project area, which is the Soweto Highveld Grassland (Mucina & Rutherford, 2006) (see Figure 54 below. The natural parts of the project area support short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*.

In places not disturbed, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover.

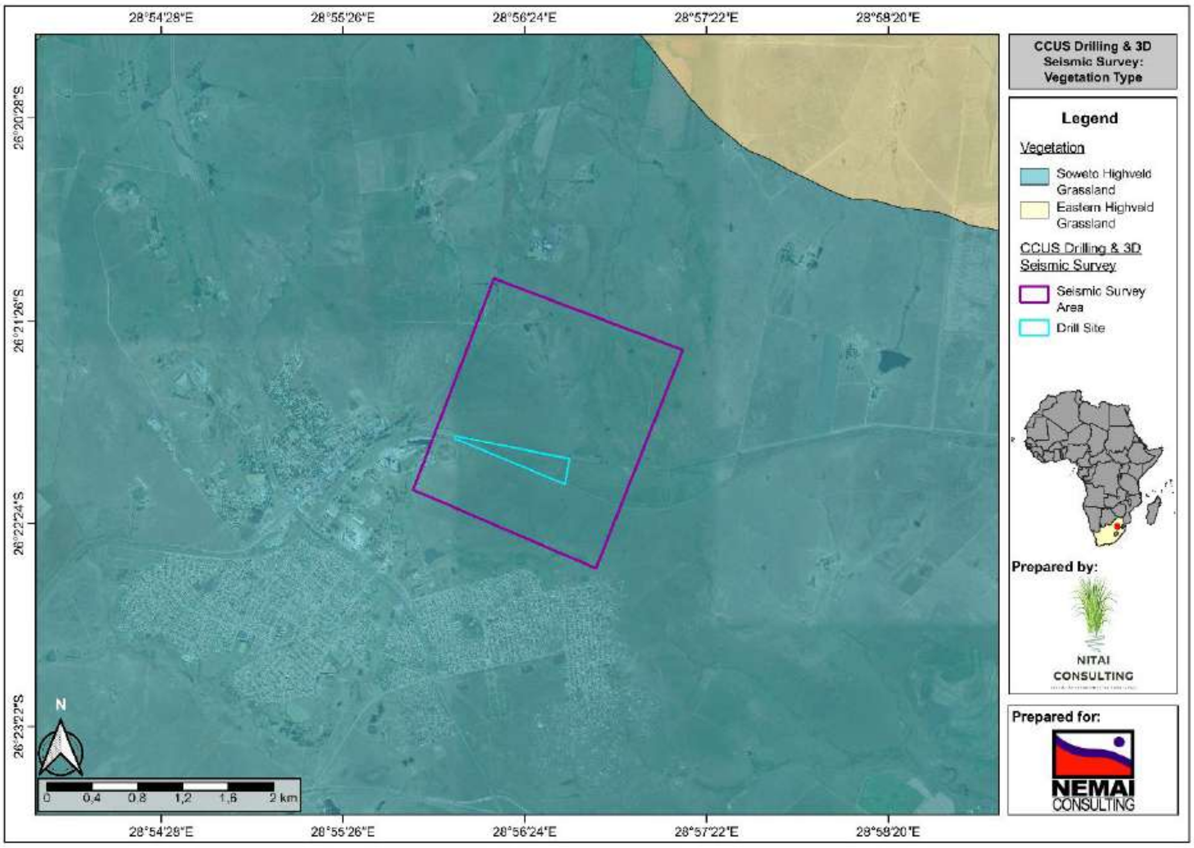


Figure 54: Project area in relation to Regional Vegetation Types

4.8.4 Mpumalanga Biodiversity Sector Plan

According to the terrestrial biodiversity component of the MBSP, the project area falls within the following areas (see Figure 55 below):

- Other Natural Areas – Encountered in the northern and north-eastern parts of the project area. These areas retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions.
- Moderately and Heavily Modified – Encountered in the remainder of the project area (including the drill site), including the old cultivated lands.

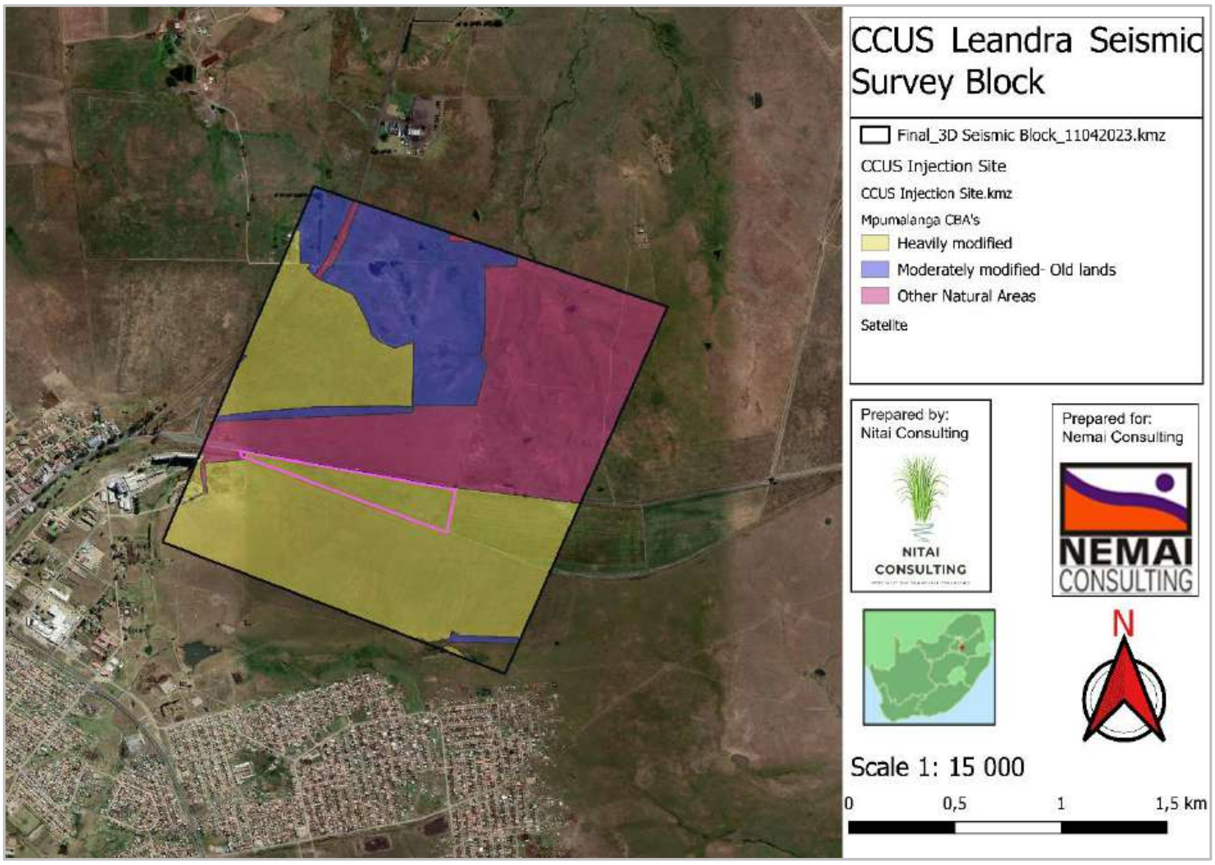


Figure 55: Terrestrial CBAs in relation to the project area

4.8.5 Findings from Terrestrial Ecologist's Fieldwork

4.8.5.1 Habitat Types

A map of the habitats identified within the project area is provided in Figure 56 below. The area is located within typical mesic grassland with turf soil. Descriptions of these habitat types are provided in the sub-sections to follow.

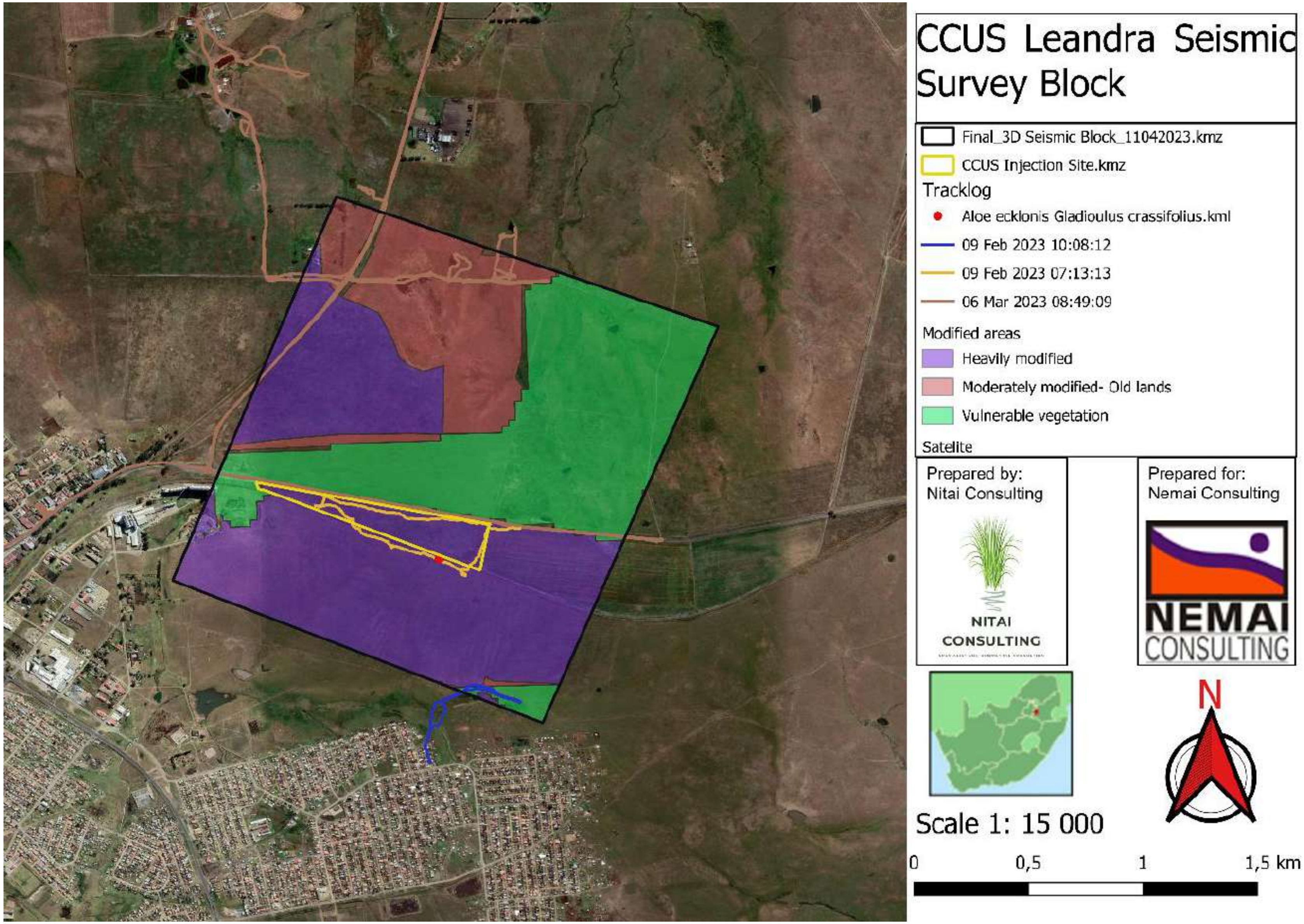


Figure 56: Habitat units identified in the project area

Vulnerable Habitats

This habitat type is characterised by natural vegetation with little disturbances. The vegetation structure ranges from short grassland vegetation on shallower soils to very tall grassland on deeper Arcadia soils (see Figure 57 below).

Figure 57:General view of vegetation in Vulnerable Habitat

The floristic composition of this habitat is dominated by true grassland species with virtually no trees or shrubs. Two of the species found in this habitat are protected in terms of the Mpumalanga Nature Conservation Act (Act No. 10 of 1998), namely *Gladiolus crassifolius* and *Aloe ecklonis.*

Various exotic species were identified in this habitat. Of these, the following species are listed as declared invasives under the Alien and Invasive Species Lists (published in GNR 1003 of 18 September 2020): *Verbena bonariensis* and *Cirsium vulgare.*

Aquatic Habitats

This habitat consists of wetlands in the project area, which were delineated by the Aquatic Ecologist. These wetlands are discussed in Section 4.7.6 above.

Two of the species found in this habitat are protected in terms of the Mpumalanga Nature Conservation Act (Act No. 10 of 1998), namely *Gladiolus crassifolius,* and *Aloe ecklonis.*

Various exotic species were identified in this habitat. Of these, *Verbena bonariensis* is listed as a declared invasive under the Alien and Invasive Species Lists (published in GNR 1003 of 18 September 2020).

Modified Habitats (Moderate and Heavy)

These are areas that were cultivated but have been left for an extended period without ploughing. Through natural succession processes, they generally develop a perennial cover of grasses (see Figure 58 below), but these secondary grasslands are species poor and the original diversity of resprouting species is usually entirely absent. Non-grass species diversity usually consists of re-seeding and weedy species, and sometimes animal- and/or bird-dispersed woody species. On aerial photographs and satellite images with adequate resolution, these areas are often recognisable by the presence of residual plough lines and other structural features often present in cultivated fields.

Generally, this area consists of medium species richness and is dominated by medium to short graminoid species with herbaceous vegetation dispersed in between. The area has a high cover of plant species. There are clear indicators that this system is undergoing old land succession and has several pioneer plant species, although the perennial species are well established and seem to propagate well.

Figure 58: General view of Old Land Habitat

Two of the species found in this habitat are protected in terms of the Mpumalanga Nature Conservation Act (Act No. 10 of 1998), namely *Gladiolus crassifolius* and *Aloe ecklonis.*

Various exotic species were identified in this habitat. Of these, *Verbena bonariensis* is listed as a declared invasive under the Alien and Invasive Species Lists (published in GNR 1003 of 18 September 2020).

4.8.5.2 Current Impacts on Biodiversity

The following impacts to biodiversity were identified in the project area:

- Agricultural practises;
- Farm roads and main roads (and associated traffic and wildlife road mortalities);
- Grazing and trampling of natural vegetation by livestock;
- Invasive species;
- Fences and associated maintenance; and
- Urban development.

Anthropogenic activities drive habitat destruction causing displacement of fauna and flora and possibly direct mortality. Land clearing destroys local wildlife habitat and can lead to the loss of local breeding grounds, nesting/burrowing sites and wildlife movement corridors such as rivers, streams and drainage lines, or other locally important features. The removal of natural vegetation may reduce the habitat available for fauna species and may reduce animal populations and species compositions within the area.

4.8.5.3 Protected Plant Species Found on Site

The following protected plant species were identified by the Terrestrial Ecologist in the seismic survey area (not within the drill site): *Gladiolus crassifolius* and *Aloe ecklonis* (see Figure 59 below). These species can be transplanted or rescued.

Figure 59: Photographs of protected plant species identified in the project area
(*left = Gladiolus crassifolius; right = Aloe ecklonis*)

4.8.5.4 Protected Animal Species Found on Site

Two species protected under the Threatened or Protected Species Regulations (published in GN No. 152 of 23 February 2007) has current distribution records for the project area, namely the Cape porcupine (*Hystrix africaeaustralis*) and the South African hedgehog (*Atelerix frontalis*).

4.8.5.5 Biodiversity Importance & Site Ecological Importance

Table 18 below presents the Biodiversity Importance as well as the Site Ecological Importance, for the delineated habitat types in the project area, as determined by the Terrestrial Ecologist.

Table 18: Biodiversity Importance & Site Ecological Importance

Habitat Type	Conservation Importance	Functional Integrity	Biodiversity Importance	Receptor resilience	Biodiversity Importance	Site Ecological Importance
Vulnerable Habitat	High	High	High	Medium	High	Medium
Aquatic Habitats	High	High	High	Medium	High	High
Modified Habitats	Medium	Medium	Medium	Medium	Medium	Medium

4.8.6 DFFE Screening Tool

The Screening Tool shows the sensitivity of the project area to be as follows:

- **Plant Species Theme** – medium to low sensitivity (see Figure 60 below). The medium sensitivity is linked to the presence of three sensitive plant species that could potentially occur in the project area, which were identified in the Screening Tool as species 691, 1252 and *Pachycarpus suaveolens*. Although the Terrestrial Ecologist did not find these species on site, two other protected plant species was found (namely *Gladiolus crassifolius* and *Aloe ecklonis*), which can be transplanted or rescued if necessary.
- **Animal Species Theme** – medium sensitivity (see Figure 61 below). The medium sensitivity is linked to the presence of certain bird, mammal and insect species. According to the findings of the Terrestrial Ecologist, these animals may make use of various habitats available in the project area.
- **Terrestrial Biodiversity Theme** – very high sensitivity (see Figure 62 below). This is as a result of the project area falling within Vulnerable Ecosystem (see Section 4.8.1). The Terrestrial Ecologist noted that there are significant areas that have been affected by cultivated lands (current and historically) and impacted by heavy grazing that do not support the very high sensitivity classification.

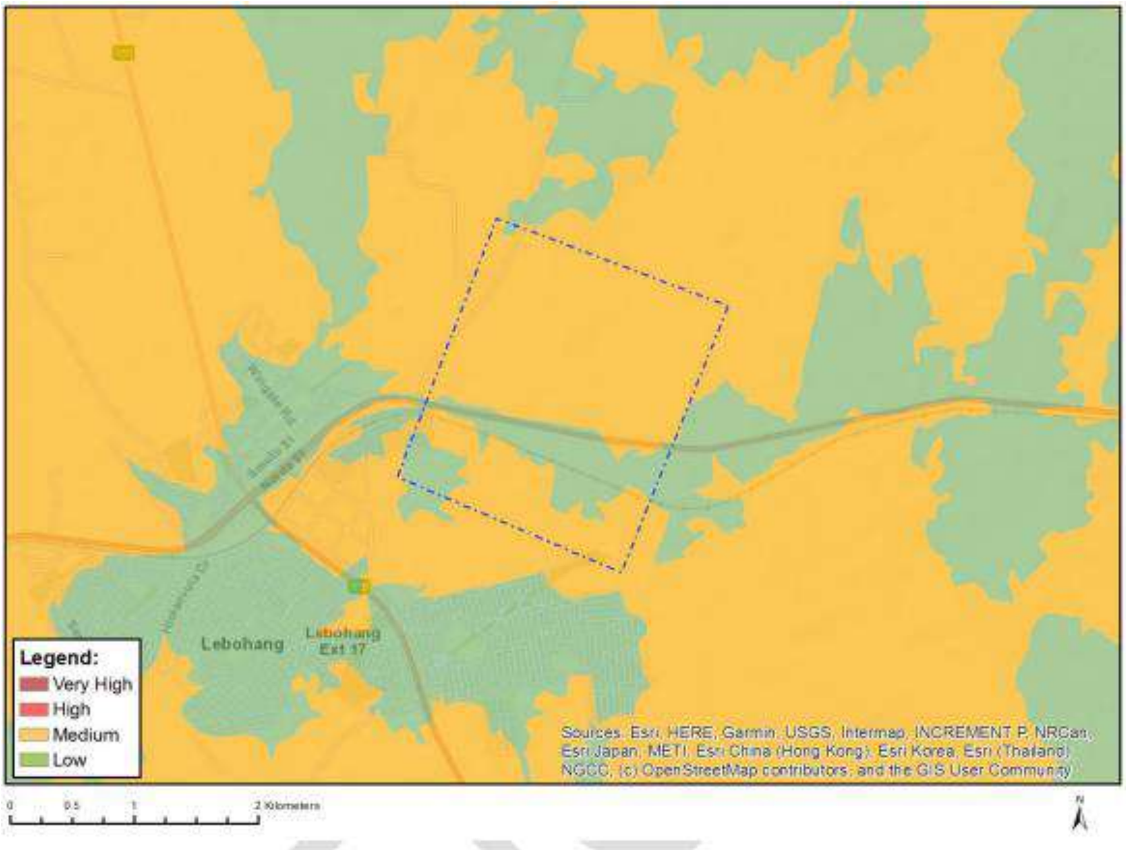


Figure 60: Map of relative Plant Species Theme Sensitivity (DFFE Screening Tool, 2023)

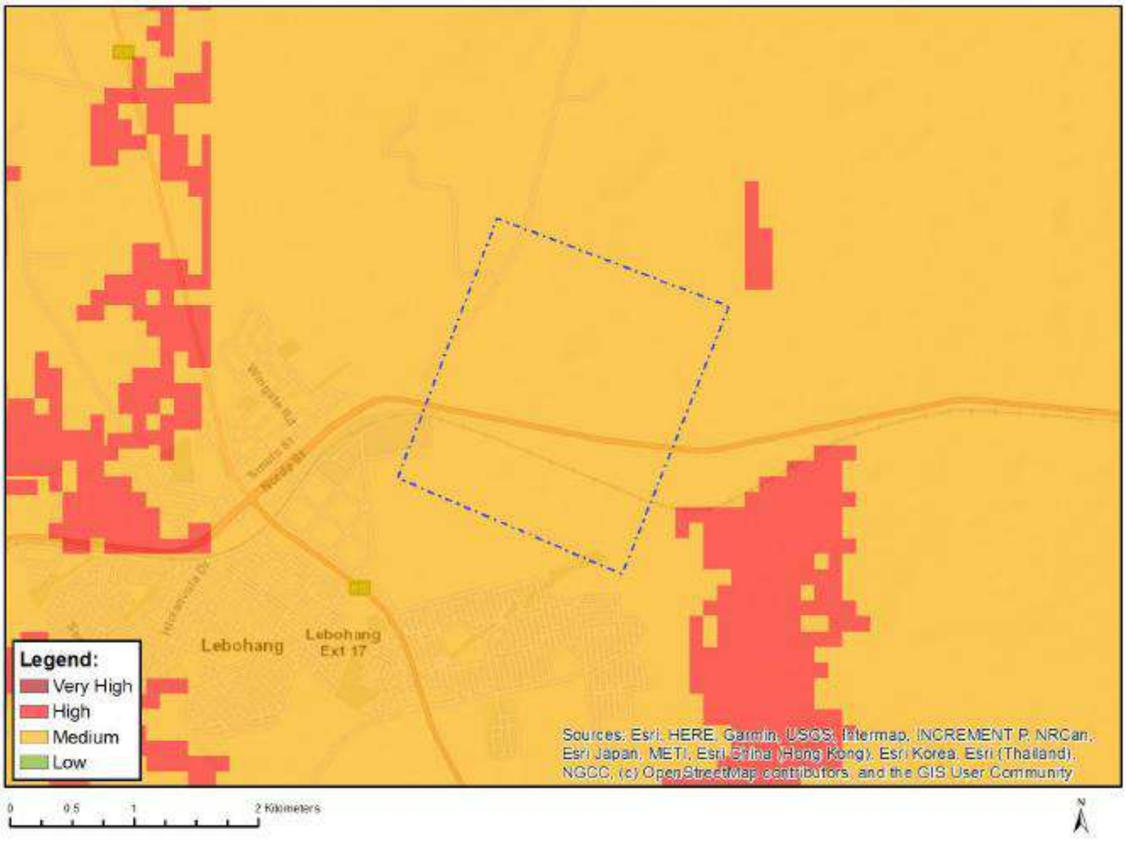


Figure 61: Map of relative Animal Species Theme Sensitivity (DFFE Screening Tool, 2023)

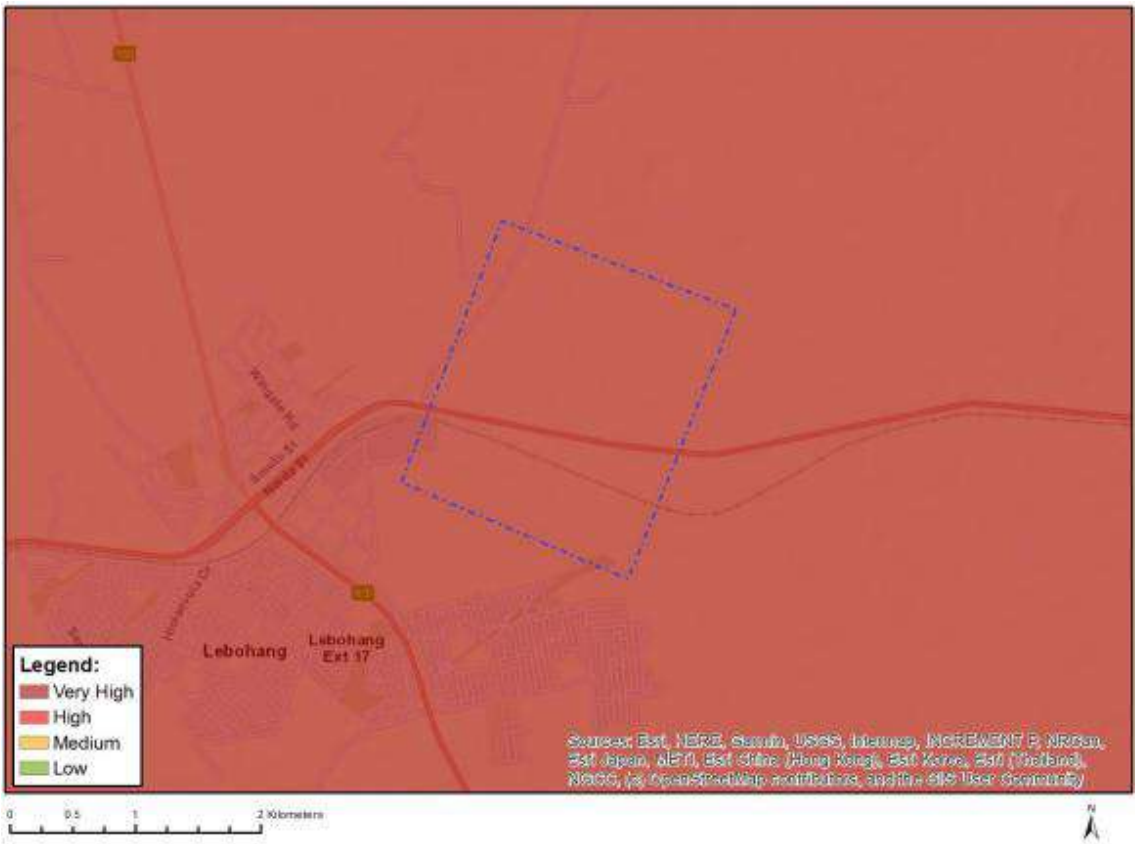


Figure 62: Map of relative Terrestrial Biodiversity Theme Sensitivity (DFFE Screening Tool, 2023)

4.9 Land Use & Land Cover

4.9.1 Spatial Elements

The town of Leandra, which consists of Leslie (north), Lebohang (south) and Eendracht (west), was established to fulfil a service centre role for either the mining and or agricultural sectors in the district (GMLM, 2014). The Local Spatial Framework for Leslie and Lebohang is shown in Figure 63 below. The town is fragmented, with Lebohang being separated from Leslie by the R29 and a railway line.

Some key features of Leandra, based on the municipal SDF, include the following (GMLM, 2014):

- Leslie is characterised by large stands, many vacant serviced stands and proclaimed undeveloped residential areas.
- Lebohang, which has smaller stands, was identified as a service upgrading priority area as it has a low level of infrastructure and social services.
- A mixed use development corridor is proposed along Provincial Routes R29 and R50, wherein high and medium density residential, business and light industrial/commercial development is promoted.

- The central business district (CBD) has an elongated shape, stretching along the R29 through the town of Leandra.
- The open space system is based on the various watercourses that traverse Leandra.
- The urban edge includes the following –
  - On the northern side the proposed urban edge follows the northern boundaries of Eendracht and Leandra and encloses some vacant land north of Provincial Road R29 between these two areas;
  - On the eastern side the proposed urban edge encloses some vacant land east of Leslie industrial area and Lebohang which can be used for future extensions to Lebohang; and
  - On the southern side the proposed urban edge roughly follows the southern and western boundaries of Lebohang and the railway line.

The majority of the project area is located inside the urban edge, with part of the area also extending into rural areas to the north-east.

In terms of the SDF, the drill site and seismic survey area are located within an area designated for future residential development. The seismic survey area also includes an area designated in the SDF as commercial / light industrial. Due to the temporary nature of the Project and the restoration of the site following the drilling and seismic survey, there are no anticipated impacts to the future development of the area affected by the Project activities. The GMLM was informed of the Project to ensure that the proposed timing of the drilling and seismic survey activities does not influence municipal projects.

The open spaces around the town of Leandra are used for livestock grazing. This includes the areas earmarked for the drilling and seismic survey. Considering the large alternative areas available surrounding the town of Leandra for livestock grazing, as well as the temporary nature of the seismic survey and the movement of the vibroseis trucks along the source lines (only small areas affected where trucks are operating), there should not be significant livelihood restrictions of the cattle owners. The project workers will maintain a safe distance between the vibroseis trucks and people and livestock moving in the vacant areas where the seismic survey is planned.

The drill site is located more than 800m from any dwelling and will be fenced off to prevent unauthorised access. The seismic survey footprint excludes the surrounding built-up areas inhabited by people, with the nearest dwelling in Lebohang located approximately 80m south-east from the survey area. Although a farmhouse is located within the northern part of the survey area, the vibroseis trucks will avoid any structures associated with this dwelling.

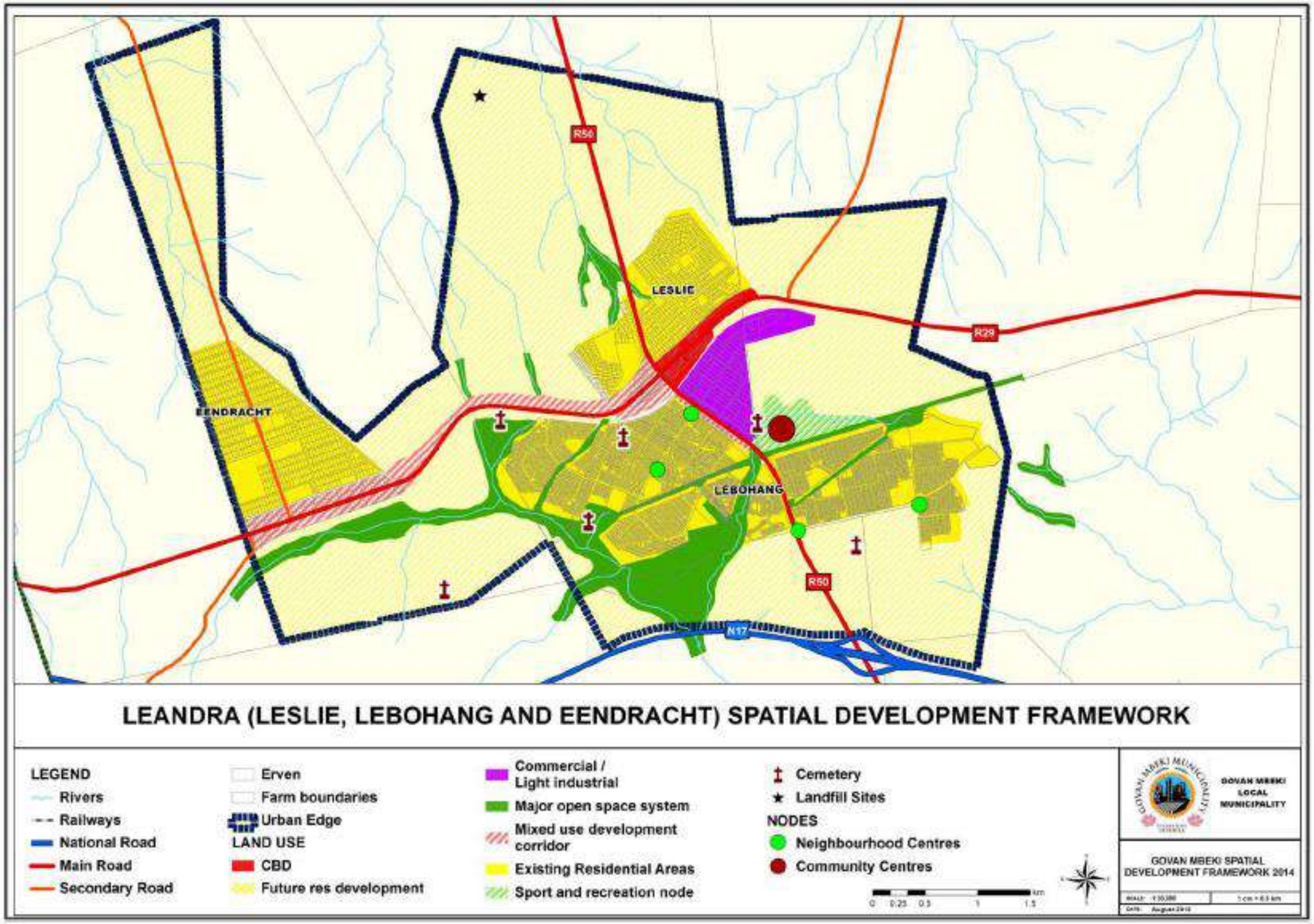


Figure 63: Leandra SDF (Leslie, Lebohang, Eendracht) (GMLM, 2014)

4.9.2 Land Cover

The dominant land uses in the region include mining and agriculture, with scattered towns.

The 3D seismic survey is planned within rural areas that are vacant or used for agricultural purposes.

The area where the 3D seismic survey is planned consists of the following dominant land cover features (see Figure 65 below):

- ❑ Commercial croplands (non-pivot / non-irrigated);
- ❑ Fallow lands and old fields;
- ❑ Natural grassland; and
- ❑ Wetlands.

It is noted that the although the map in Figure 65 below shows that an industrial area occurs in the south-western part of the seismic survey site, this area will be avoided due to access constraints.

The drill site is vacant (see Figure 64 below). Although the land cover in Figure 65 below shows the site to consist of commercial croplands, from historical aerial imagery it appears that the site has not been cultivated in at least the last 20 years. The drill site will be fenced for safety and security purposes.

Figure 64: View of drill site looking westwards towards the town of Leandra

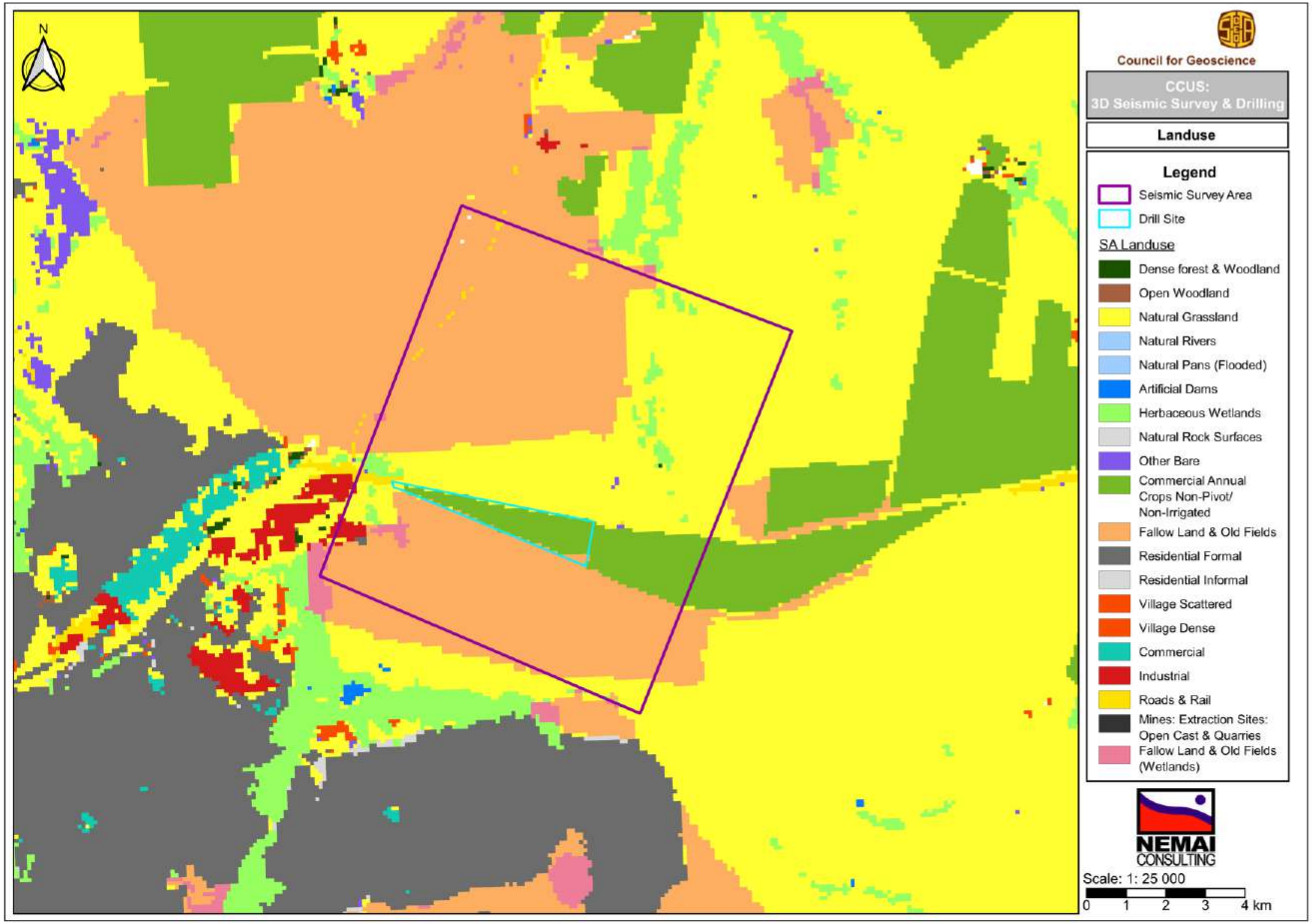


Figure 65: Land cover in project area

4.10 Air Quality

4.10.1 General Description

The Highveld area in SA is associated with poor air quality, and elevated concentrations of criteria pollutants occur due to the concentration of industrial and nonindustrial sources (DEA, 2011). The Highveld Airshed Priority Area (HPA) was declared by the Minister of Environmental Affairs at the end of 2007, requiring the development of an Air Quality Management Plan for the area. The plan includes the establishment of emissions reduction strategies and intervention programs based on the findings of a baseline characterisation of the area.

Potential sources of air pollution in the region include the following:

- Power stations;
- Mining operations;
- Industrial operations;
- Fugitive dust emissions from agricultural activities;
- Exhaust emissions from vehicles traveling on paved and unpaved roads;
- Biomass burning (veld fires);
- Domestic fuel burning;
- Waste treatment and disposal; and
- Other fugitive dust sources such as wind erosion from exposed areas.

A key factor in identifying a suitable location for the pilot CCUS Project, apart from suitable geological conditions, was the proximity to large-scale industrial emitters.

While the seismic survey footprint is relatively large (approximately 360 hectares), each source line as an individual works process will be undertaken within a period of a few days. The seismic survey operations proceed at a rate of approximately 3 to 5km per day. Therefore, it is not anticipated that the seismic survey will cause significant impacts in terms of dust. The vibroseis trucks also move at a slow rate, which minimises dust generation.

4.10.2 Atmospheric Data

Figure 66 below shows the concentration levels of the air pollutants within the Lebohang region, as sourced by CGS from the South African Air Quality Information System (SAAQIS) for the station in Lebohang. It depicts that Ozone (O_3) is most prevalent in the air compared to the concentration of Sulfur dioxide (SO_2) and Nitrogen Dioxide (NO_2). The concentration of O_3 peaked in the spring season of 2021 at a mean of 36.3 ppb. This may have been the result of pollutants from automobiles, power plants, industrial boilers, refineries, chemical plants, and other sources where the O_3 undergoes chemical reactions in the presence of sunlight. The concentration of SO_2 peaked in the winter season of 2022 at 12.65 ppb, which can be attributed to the combustion of fossil fuels. The concentration of Nitrogen Dioxide (NO_2) was highest in the winter season of 2021 at 7.98 ppb.

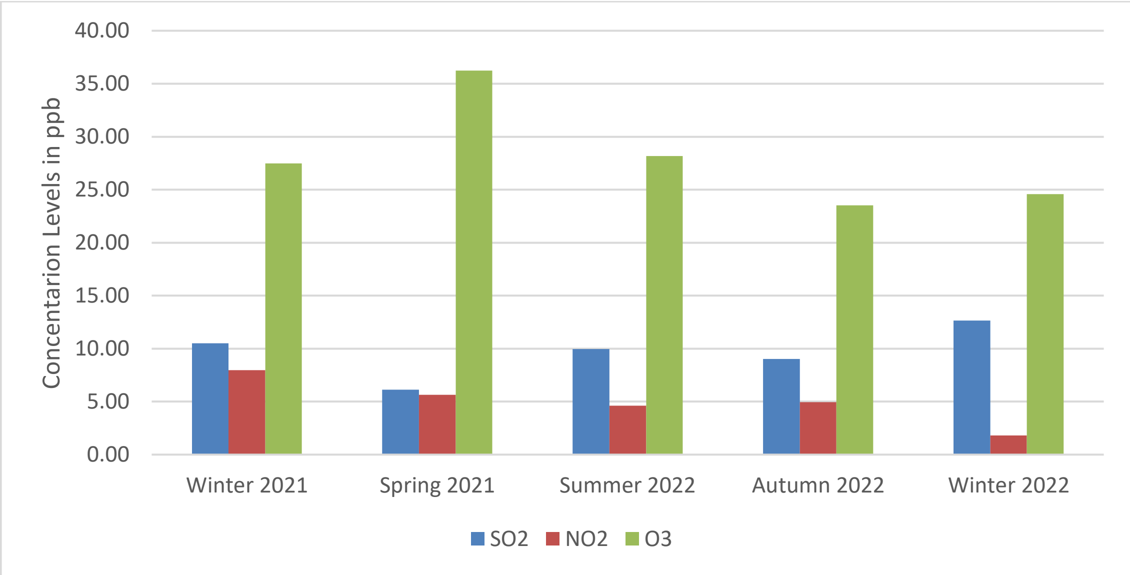


Figure 66: Seasonal trends yearly of air gas pollutants concentrations levels in ppb

Figure 67 below shows the distribution of particulate matter ($PM_{2.5}$ and PM_{10}) levels over a yearly period. Particulate matter levels for both $PM_{2.5}$ and PM_{10} peaked in the winter season of 2022, with $PM_{2.5}$ peaking at a mean of 32.51 µg/m^3 and PM_{10} at 53.55 µg/m^3.

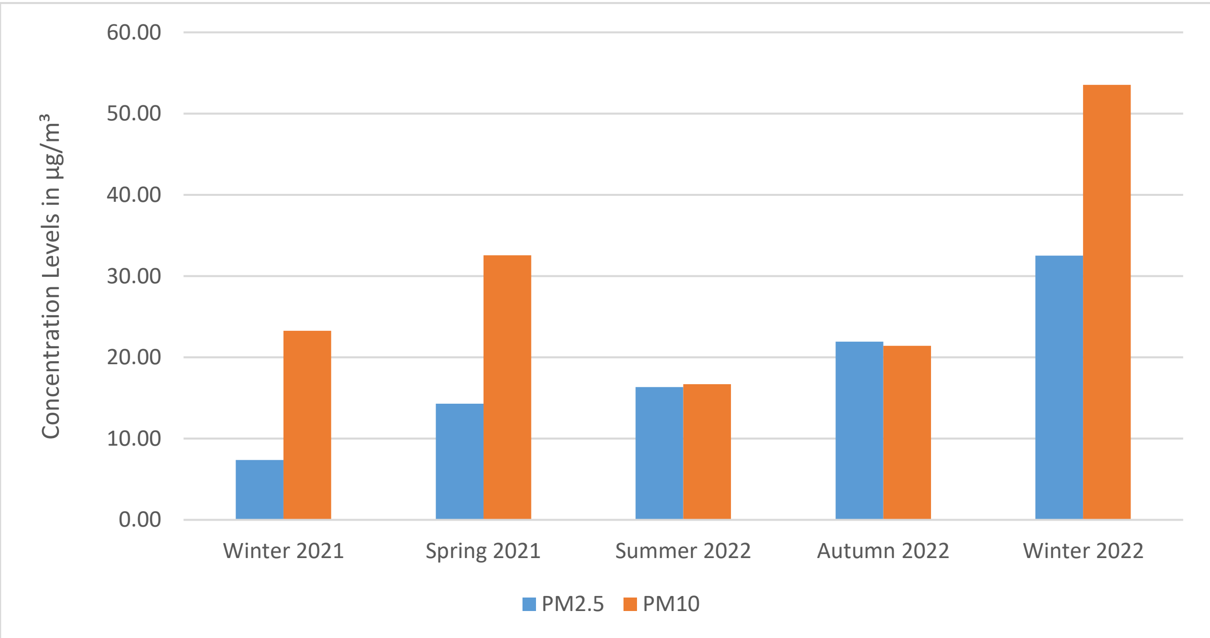


Figure 67: Seasonal yearly particulate matter concentration levels in µg/m^3

The SA government has developed a country-specific Air Quality Index (AQI) (shown in Table 19 below), which is a simplified tool for reporting air quality to the general public. The AQI is derived from six criteria pollutants (both gases and particulates), which include PM_{10}, $PM_{2.5}$, CO, O_3, SO_2, and NO_2) on a scale of one (1) for good air quality to a scale of ten (10) for hazardous air quality. The index has five bands indicating ‘Low’, ‘Moderate’, ‘High’, ‘Very High’ and ‘Hazardous’ levels of air pollution.

Table 19: SA AQI bands

Colours	AQ Level	Levels of Health Concerns	Bands	NO_2 (ppb)	O_3 (ppb)	SO_2 (ppb)	$PM_{2.5}$ (µg/m^3)	PM_{10} (µg/m^3)
Green	Low	Good	1	0 –66	0 –26	0 –115	0 –22	0 –40
			2	67 –133	27 –53	116 –231	23 –43	41 –80
			3	133 –200	54 –80	232 –350	44 –65	81 –120
Yellow	Moderate	Moderate	4	201 –267	81 –107	351 –400	66 –75	121 –130
			5	268 –334	108 –134	401 –450	76 –85	131 –140
Orange	Unhealthy	Unhealthy	6	335 –400	135 –160	451 –500	86 –95	141 –150
			7	401 –467	161 –187	551 –550	96 –105	151 –160
Red	Very Unhealthy	Very unhealthy	8	468 –534	188 –213	551 –600	106 – 115	161 –170
			9	535 –601	214 –240	601 –650	116 – 125	171 –180
Hazardous	Hazardous	Hazardous	10	>602	>241	>651	>126	>181

The data obtained for the yearly period of winter 2021 until winter 2022 suggest that the air quality within the Lebohang area is good when compared to the AQI. All AQI values for the project area range between 0 and 50, indicating air quality that is satisfactory and poses little or no health risk to humans. According to the standard procedure regarding the reporting of AQI, values between 0 and 50 can be reported at discretion. Nevertheless, this does not suggest air quality could not deteriorate, but the results paint a picture of good air quality and should be monitored for any change.

4.11 Noise & Vibration

In terms of the local acoustical environment, the background noise levels are expected to be typical of urban (town of Leandra), semi-rural and rural areas. Noise in the greater area emanates primarily from anthropogenic sources in town, farming operations (e.g., use of farming equipment), vehicles on the surrounding road network, human activities in surrounding settlements and trains passing on the railway.

Sensitive receptors to noise and vibration include surrounding communities, sensitive faunal species, and livestock. There are also noise sensitive areas such as schools, places of worship, clinics and residences in the town of Leandra.

Certain structures in residential areas in parts of Leandra consist of makeshift shacks of corrugated tin, sheet metal and scrap wood. Other brick structures are also dilapidated and could be at risk from vibrations. The seismic survey area excludes the areas where these structures occur.

4.12 Services

The drill site is bordered by the road reserve of the R29 to the north and the railway servitude to the south. There is no known underground infrastructure located on the property where the drilling is proposed, which will need to be confirmed by CGS during the design phase.

Many services exist within the urban part of the seismic survey area, which typically include below-ground water, sewer and stormwater pipelines, as well as overhead power lines and telephone lines (see Figure 68 below). Overhead power lines also traverse the rural parts of the survey area (see Figure 68 below). A survey will need to be undertaken to ensure that the project will not affect services and utilities. All necessary wayleaves will need to be obtained from the custodians of the infrastructure, as required.

Figure 68: View of overhead services in Leandra (top) and surrounding rural areas (bottom)

The SA government has identified nine Strategic Gas Pipeline Corridors that would be suitable for the development of gas pipeline networks in the country. The project area falls within the Phase 8: Rompco Pipeline Corridor in terms of GN No. 143 of 26 February 2021.

4.13 Palaeontology & Heritage

4.13.1 Palaeontological Sensitivity

A basic palaeontological sensitivity was determined using the South African Heritage Resources Information System (SAHRIS) database for South African Fossil Sensitivity Map (http://www.sahra.org.za/sahris/map/palaeo). This map indicates that the project footprint falls within an area where the underlying geology has “insignificant to zero” fossil sensitivity (grey) (see Figure 69 and Table 20 below).

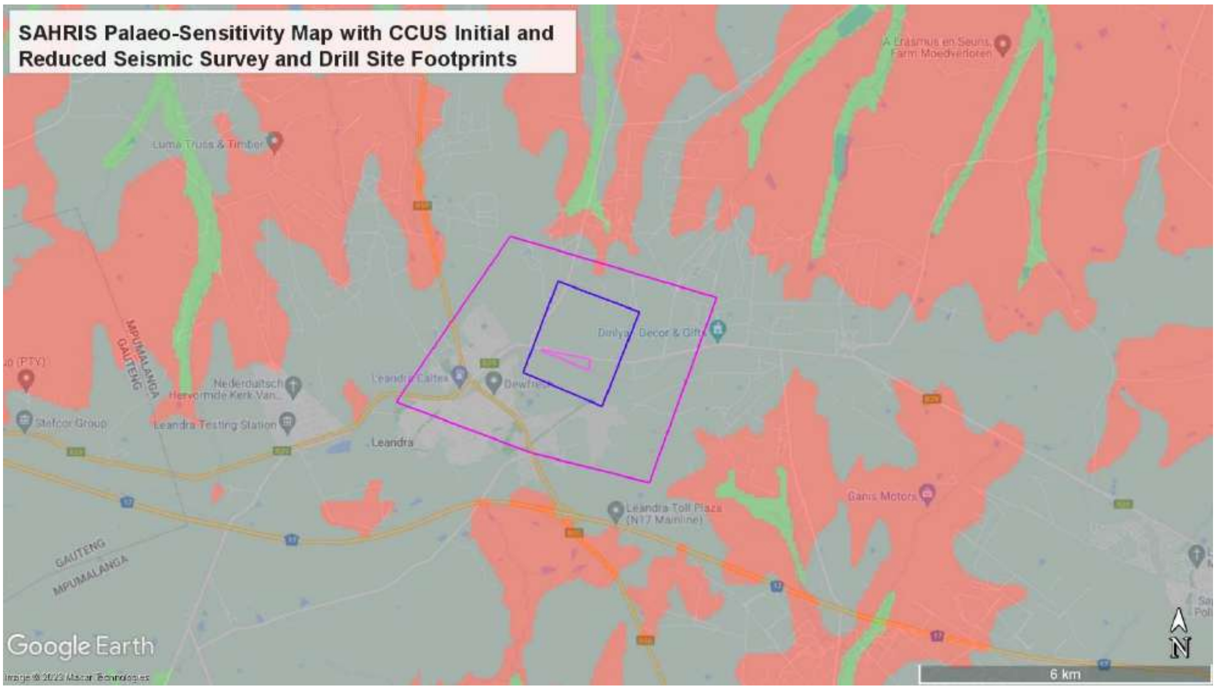


Figure 69: SAHRIS Palaeo sensitivity map overlain on the project footprint (blue polygon)

Table 20: SAHRIS Fossil Map Palaeontological Sensitivity Ratings and Required Actions

Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required.
ORANGE/ YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely to be requested.
GREEN	MODERATE	Desktop study is required.
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required.
GREY	INSIGNIFICANT /ZERO	No palaeontological studies are required.
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information becomes known, SAHRA will continue to populate the map.

4.13.2 Cartographic Findings

An assessment of available historical topographical maps was undertaken to establish a historic layering for the project area. It should be noted that the earliest edition of the map sheets for this area dates to the 1960s (see Figure 70 below). As the first edition of this sheet dates to 1965, it was not considered necessary to examine the later edition map sheets as any heritage resources that are 60 years or older would be depicted on the 1965 edition sheet.

The following 1:50 000 map sheet was assessed for the CCUS footprint: 2628BD Leslie Edition 1 1965. The map was surveyed in 1965 and drawn in 1966 by the Trigonometrical Survey Office of the Republic of SA from aerial photographs taken in 1948.

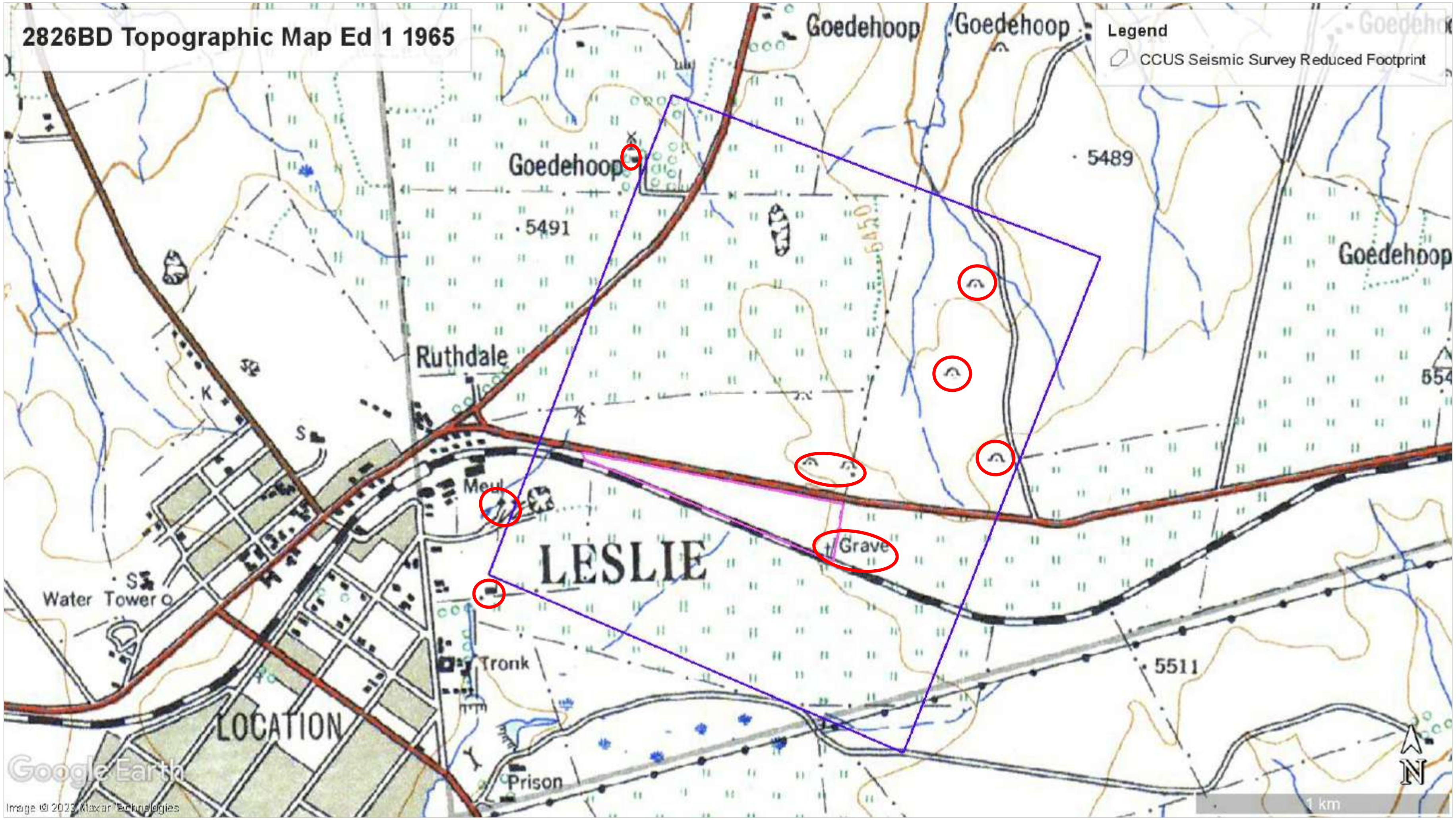


Figure 70: Enlarged view of topographic map 2628BD Ed 1 1965, depicting heritage features (red circles) within the CCUS seismic survey footprint (blue polygon)

As can be seen in Figure 70 above, the 2628BD Ed 1 1965 map sheet depicts many heritage features within the larger CCUS seismic survey footprint. Most of these features are homestead clusters or single homesteads, as well as two grave sites.

4.13.3 Findings from Heritage Specialist's Fieldwork

A survey of the project area was undertaken by a Heritage Specialist which aimed to find and identify archaeological and other heritage resources such as burial grounds and graves (BGG), archaeological material or sites, historic built environment and landscape features of cultural heritage significance.

A total of nine heritage resources (see map in Figure 71 and photographs in Figure 72 below) was identified in the project area, which included the following:

- Drill site –
  - CCUS-01 (possible homestead; low significance);
  - CCUS-02 (grave depicted on 1965 map just north of the railway line; high significance);
  - CCUS-03 (stone culvert under railway line; high significance); and
  - CCUS-04 (possible remains of structure; low significance).
- 3D seismic survey area –
  - CCUS-33 (stone culvert under railway line; high significance);
  - CCUS-06, CCUS-07 and CCUS-30 (structure or homestead remains; low significance); and
  - CCUS-08 (possible structure or homestead remains; low significance).

Further details of each of the above heritage resources are included in the Heritage Impact Assessment Report contained in Appendix M).

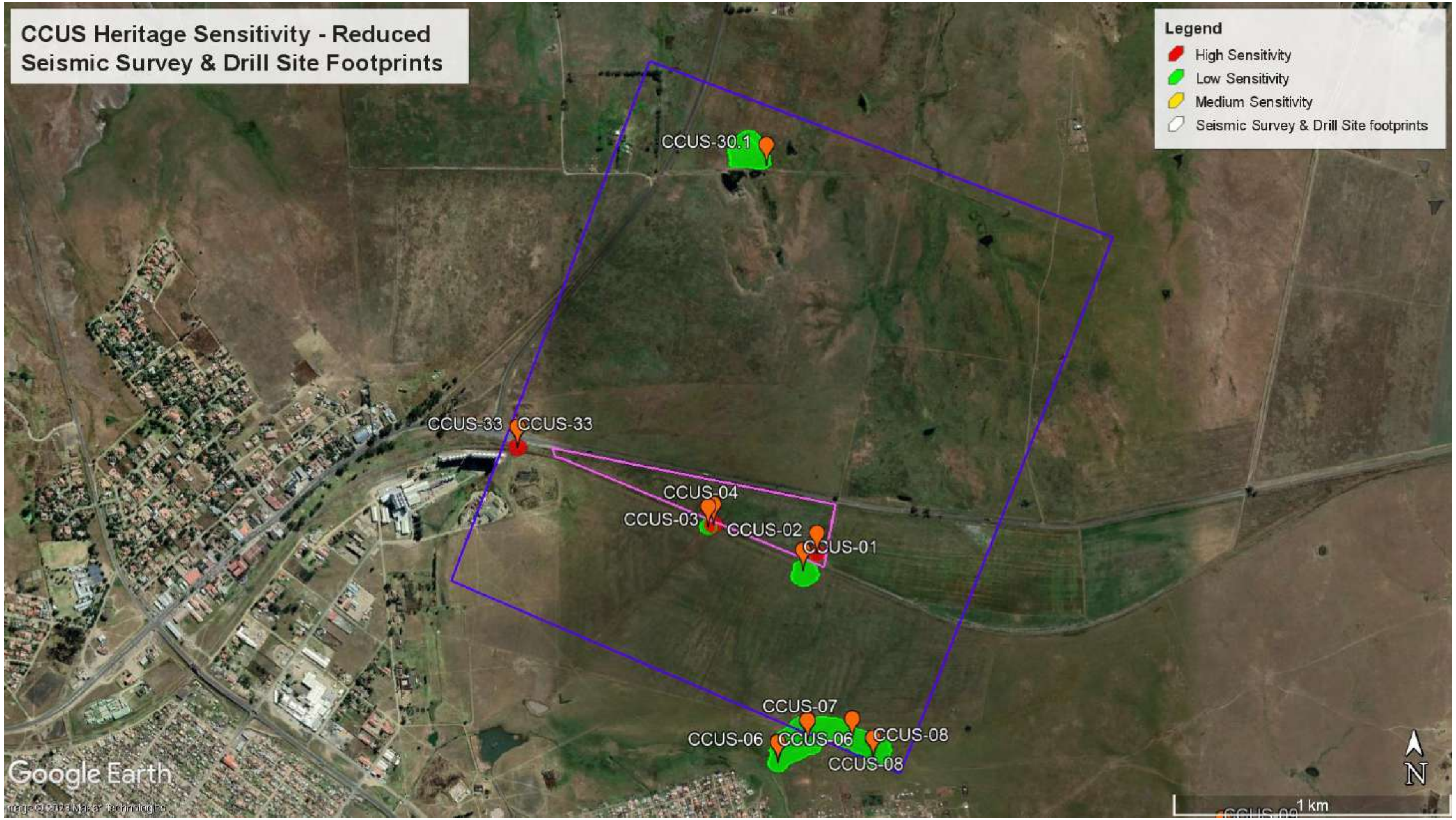


Figure 71: Heritage sensitivity map for the overall project area

Figure 72: Examples of heritage resources identified in the project area
(*top left = CCUS-03: stone culvert under the railway line; top centre = CCUS-07: circular shaped stone pillar; top right = CCUS-08: possible rubble from demolished structure; bottom left = CCUS-30: one of the lower grindstones of possible demolished structure; bottom right = CCUS-33: stone culvert under the railway line*)

4.14 Visual Resources

The town of Leandra dominates the visual environment in the otherwise rural setting of the project area. The broader surroundings consist of undulating landscapes.

Potential sensitive receptors to visual impacts in the area include residents in Leandra and the surrounding farms, as well as motorists using the road network.

Visual impacts that may be caused by the Project include scarring of the landscape caused by survey transects in natural areas and cleared areas, visually obtrusive activities related to drilling and site camp; and light pollution due to night lighting at drill site and site camp. Mitigation measures to manage potential visual impacts are provided in the ESMP.

4.15 Socio-Economic Environment

4.15.1 Key Statistics

Table 21 below lists key statistics for Leandra and Lebohang, based on Census 2011 data. The higher population numbers and density in Leandra are evident.

Table 21: Key statistics for Leandra and Lebohang (Statistics SA: Census 2011)

	Leandra	Lebohang
Total population	2,023	31,553
Young (0-14)	25,1%	31%
Working Age (15-64)	67,2%	65,1%
Elderly (65+)	7,7%	3,9%
Dependency ratio	48,9	53,6
Sex ratio	110,3	97,5
Population density	210 persons/km^2	6519 persons/km^2
No schooling aged 20+	3,4%	13,1%
Higher education aged 20+	18,3%	3,3%
Matric aged 20+	37,5%	23,7%
Number of households	508	8,908
Average household size	3,8	3,5
Female headed households	26,4%	40,2%
Formal dwellings	98,6%	76,5%
Housing owned/paying off	57,7%	56%
Flush toilet connected to sewerage	90,4%	96,5%
Weekly refuse removal	90,7%	97,9%
Piped water inside dwelling	89,2%	73%
Electricity for lighting	96,9%	96,5%

4.15.2 Economy

Table 22 below presents the Gross Domestic Product Per Region (GDPR) for GMLM. As shown, the mining and manufacturing industries contribute significantly to the economy in the municipality. The official unemployment rate for the GMLM, based on Census 2011 data, is 26.2%

Table 22: GMLM sector GDPR contributions (Regional Economic Indicators, 2011)

Economic Activity	% Share
Mining	39%
Manufacturing	24%
Wholesale and trade	15%
Government and community service	9%
Business services	5%
Transport	4%
Agriculture	1%
Construction	1%
Electricity and water	1%

The average household income for Leandra and Lebohang, based on Census 2011 data, is presented in below.

Table 23: Average household income for Leandra and Lebohang (Statistics SA: Census 2011)

Income	Percentage	
	Leandra	Lebohang
No income	10,8%	18,2%
R1 - R4,800	0,8%	6,3%
R4,801 - R9,600	1,8%	8,5%
R9,601 - R19,600	4,7%	19%
R19,601 - R38,200	10,8%	20,3%
R38,201 - R76,400	16%	14%
R76,401 - R153,800	20,1%	8,8%
R153,801 - R307,600	23,1%	3,5%
R307,601 - R614,400	8,9%	1,1%
R614,001 - R1,228,800	2,8%	0,1%
R1,228,801 - R2,457,600	0,2%	0,1%
R2,457,601+	0%	0%

4.15.3 Local Communities

4.15.3.1 Leslie Community

Leslie forms the northern and central parts of Leandra and comprises of residential areas, the town's CBD along the R29 and an industrial area (see Figure 5 and Figure 63 above). It is located approximately 1km to the west of the drill site. Table 24 below shows some images of the Leslie community.

Table 24: Leslie community

Agri-Silo Leandra

Dewfresh Factory Outlet

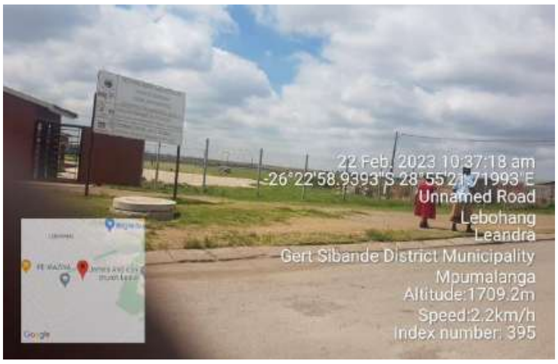
4.15.3.2 Lebohang Community

Lebohang forms the southern part of Leandra (see Figure 5 and Figure 63 above). The dwellings in the area are characterised by clustered government/RDP houses and informal dwellings. There are schools, worship centres, a cemetery, clinics, community facilities and community businesses such as spaza shops, car wash places, informal street traders, etc. The seismic survey footprint does not encroach into the Lebohang area. Table 25 below shows some images of the Lebohang community.

Table 25: Lebohang community

Isolomuzi Day Care

Leandra Car Wash



Lebohang Stadium

Lebohang Community Facilities

4.15.3.3 Eendracht Community

Eendracht forms the western part of Leandra (see Figure 63 above and Figure 73 below). The area primarily consist of businesses along the R29 and medium density residential area, with some institutional land use. The seismic survey footprint does not include the Eendracht community.

Figure 73: Eendracht community

4.15.3.4 Marikana and Ekuthuleni Informal Settlements

The Ekuthuleni and Marikana informal settlements are located in the south-eastern part of Lebohang (see Figure 75 below). According to feedback received during stakeholder engagement, these settlements are continuously expanding and their occupancy is illegal.

Figure 74: Marikana and Ekuthuleni informal settlements

Figure 75: Structures in informal settlement in Leandra

The proposed 3D seismic survey footprint does not encroach into any informal settlements.

4.15.3.5 Health

Healthcare facilities in the GMLM are listed in Table 26 below.

Table 26: Healthcare facilities in the GMLM (GMLM, 2014)

Type	Facility
Clinic	Bethal Town Clinic
Clinic	Emzinoni Clinic
Clinic	Evander Clinic
Clinic	Kinross/Thistle Grove Clinic
Clinic	Langverwacht Clinic
Clinic	Langverwacht Ext 14 Clinic
Clinic	Sead Clinic Bethal
Clinic	Secunda Clinic
Community Health Centre	Embalenhle CHC
Community Health Centre	Lebohang CHC
Community Health Centre	Paulina Morapeli CHC
District Hospital	Bethal Hospital
District Hospital	Evander Hospital
Mobile Service	Bethal Mobile 1
Mobile Service	Embalenhle Mobile 1
Mobile Service	Highveld Ridge Mobile 1
Mobile Service	Langverwacht Mobile 1
Mobile Service	Leandra Mobile 1
Correctional Centre	Bethal Correctional Centre

Type	Facility
Correctional Centre	Geluk Correctional Centre
EMS Station	Bethal EMS Station
EMS Station	Evander EMS Station
EMS Station	Secunda EMS Station
EMS Station	Trichardt EMS Station

Common health-related problems in the municipality include tuberculosis (TB), sexual transmitted infections (STIs) and human immunodeficiency virus (HIV) (GMLM, 2022). Health risks associated with illegal dumping, inadequate waste management and environmental pollution were also highlighted in the municipal IDP (GMLM, 2022).

4.15.3.6 Safety & Security

The Leslie Police Station is located at 23 Norda Street in the town of Leandra (location: 26°22'11.06"S, 28°55'19.07"E) (see Figure 76 below). Crime statistics for this station for 2017/2018 to 2021/2022 are presented in Table 27 below.

Table 27: Crime statistics for Leslie Police Station for 2017/2018 to 2021/2022 (https://www.saps.gov.za/services/crimestats.php)

Crime Category	2017/2018	2018/2019	2019/2020	2020/2021	2021/2022
Total Contact Crimes (crimes against the person)	339	366	356	298	273
Total Sexual Offences	40	36	34	27	31
Total Contact-Related Crimes	62	58	57	47	63
Total Property-Related Crimes	398	375	263	214	209
Total Other Serious Crimes	142	144	150	137	122
Total Crime Detected as a Result of Police Action	301	127	93	53	39

Figure 76: Leslie Police Station (Google Earth™)

4.15.3.7 Education

The following schools are located in Leandra:

- Vukuqhakaze Secondary School;
- Chief Ampie Mayisa Secondary School;
- Leandra Secondary School;
- Sidingulwazi Primary school;
- SS Mshayisa Primary School;
- Mpumelelo Primary School;
- PE Maziya Primary School;
- Wildebeesspruit Primary School;
- Hoeveld Primary School;
- Zithobe Primary School; and
- Osizweni Special School.

4.15.4 Rapid Rural Assessment Process.

Primary data on the receiving social environment was gathered as part of the Social Impact Assessment (contained in Appendix M). This served to understand the expectation of the local people with reference to the proposed project. The key socio-economic needs that were observed during the fieldwork are captured in Table 28 below.

Table 28: Summary of the Community's Needs

Key needs / Issues Identified	Mitigation methods
Livelihood economic opportunities	• There is a need to create more economic opportunities that will benefit marginalised communities with special emphasis on the empowerment of women and the youth with special skills. • There is a need to implement diverse economic activities and radically drive communities to be fully involved. • Create broad based economic activities.
Development of skills for the youth.	• Introduce skills development programmes that will target matriculants, school leavers and the unemployed as this will curb the rate of employment expectations from the seasonal jobs available in this area. • Create technology and sustainable innovations that will further develop skills for the youth. • Implement training programmes that will maximise employment opportunities for the local community.
Roads Development	• There is a need to improve and implementing maintenance services of the inner roads and major routes. In addition, solar powered traffic control lights can be implemented to help in managing the influx of vehicle traffic in the area.
Land Pollution Mitigation Measures	• The municipality can partner up with local cleaning companies to mitigate the challenges of illegal dumping on open-access land and within local areas in local communities.
Drugs / Substance Abuse amongst the youth.	• Rehabilitation centres are necessary to mitigate the challenge of drug and substance abuse.
Public health facilities	• There is a need for an additional public health facility that will service the growing population. Health challenges such as asthma

Key needs / Issues Identified	Mitigation methods
	due to high pollution levels are dominant especially amongst the infants and the old.

4.16 Transportation

4.16.1 Roads

The overall road network around the project area is shown in Figure 77 below. The drill site is situated alongside the Provincial Route R29, which runs west to east from Leandra to Kinross (see Figure 78 and Figure 79 below). The Provincial Route R50 runs from north to south through Leandra, to the west of the project area. The National Route N17 runs to the south of Leandra, outside of the seismic survey area.

Public and private roads are available in the seismic survey area for the vibroseis trucks. A combination of tarred and gravel roads occur in Leandra (see Figure 80 below), with gravel roads and tracks in the rural areas (see Figure 81 below).

The are large open tracts of land north and south of the drill site, which consist of relatively flat terrain in grassland (see Figure 82 below). It is not anticipated that additional access roads will be constructed for the 3D seismic survey in these areas as all vehicles will have off-road capabilities (see examples of vibroseis trucks travelling through grassland in Figure 83 below).

There are various characteristics and constraints of the survey area that are noted in Section 2.3.4 above, which will influence access and vehicle movement.

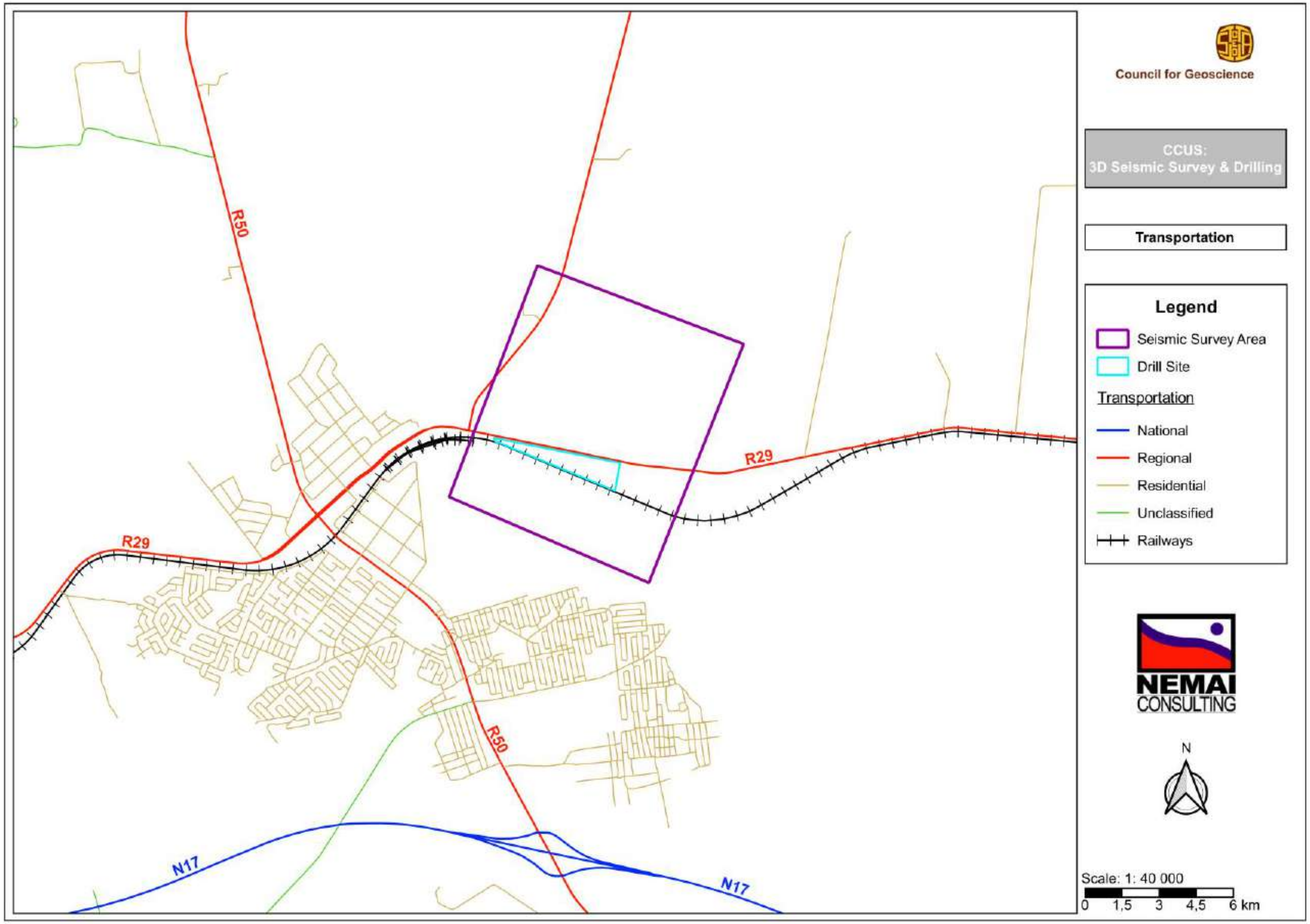


Figure 77: Transportation network in project area

Figure 78: View along the R29 near the drill site

Figure 79: View along the R29 through the Leandra CBD (approximately 1.5km west of drill site)

Figure 80: Public roads in Lebohang (south of seismic survey area)

Figure 81: Access to farm outside seismic survey area

Figure 82: Open tracts of land north (top) and south (bottom) of the drill site

Figure 83: Examples of vibroseis truck travelling though grassland

4.16.2 Rail

The drill site is bounded to the south by a railway line from Secunda to Springs (see Figure 77 above). This is the Johannesburg–Richards Bay freight rail line, which runs through the GMLM in an east-west direction. Bulk freight such as coal, timber, fuel, maize, etc. is transported on this rail line between the coast and Gauteng (GMLM, 2014).

Figure 84: Railway line along southern boundary of the drill site

This railway line will pose a significant physical hindrance to the movement of the vibroseis trucks. It also assumed that approval will not be granted by Transnet for the vehicles to cross over the railway line. The trucks and support vehicles will need to access the southern part of the survey area by using the surrounding road network (refer to Section 4.16.1 above), as opposed to travelling over land.

4.17 Land Capability

4.17.1 General Description

Cultivated areas are encountered to the north and east of the project area, outside the seismic survey footprint. Fallow lands and old fields occur within the project area.

Informal grazing takes place on vacant and unfenced areas in Leandra and the surrounding rural areas (see below).

Figure 85: Informal grazing in Leandra

4.17.2 DFFE Screening Tool

The following is noted in terms of the relative agriculture theme in the project area, according to the National Web Based Environmental Screening Tool (see Figure 86 below):

- Drill site –
  - The screening tool shows that field crops occur on the site. It is noted that from historical aerial imagery it appears that the site has not been cultivated in at least the last 20 years.
- Seismic survey area –
  - The majority of the area has medium agricultural sensitivity, which relates to the moderate land capability. Field crops occur to the north and east, and are not directly

affected by the seismic survey area. Cattle pastures occur on the large farm on Portion 6 of the Farm Goedehoop 308 in the north-eastern part of the seismic survey area, which is privately owned land and is also fenced off. Informal grazing occurs throughout the remaining unfenced parts of the seismic survey area.

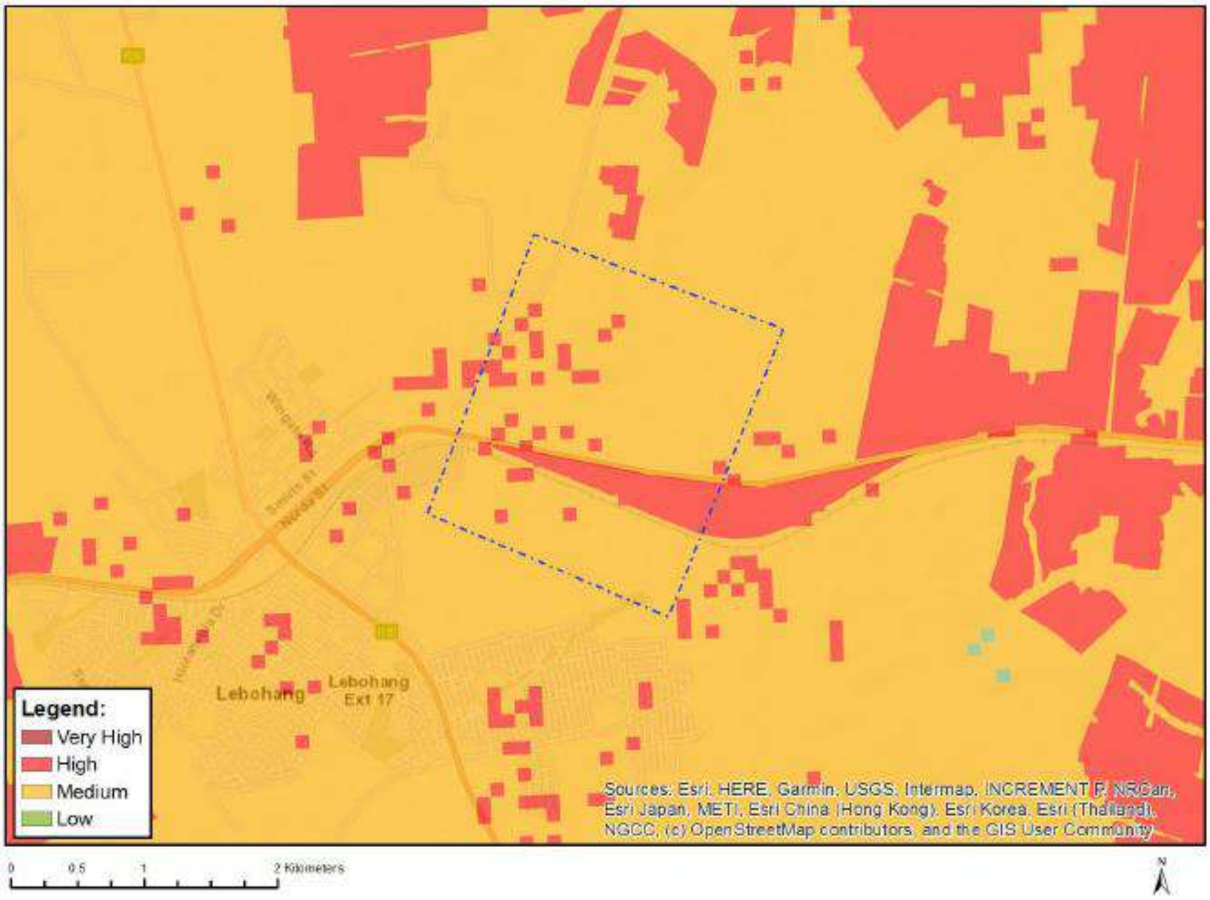


Figure 86: Map of relative agriculture theme sensitivity (DFFE Screening Tool, 2023)

Chapter 5: Determination of Potential Impacts

5 DETERMINATION OF THE POTENTIAL IMPACTS

5.1 Introduction

According to OP 4.01 (Annex B - Content of an Environmental Assessment Report for a Category A Project), a project's likely positive and negative impacts are predicted and assessed in quantitative terms to the extent possible. In addition, mitigation measures are established and residual negative impacts that cannot be mitigated are identified.

The abbreviated ESIA Report's scope and level of detail is commensurate with the potential impacts associated with the CCUS 3D seismic survey and drilling.

The following definitions apply to the impact assessment:

- 'Environmental and social aspects' are regarded as those activities related to the Project that are likely to interact with environmental and social features and cause an impact; and
- 'Impact' refers to the change to the environmental and social features resulting from an environmental and social aspect (or activity), whether desirable or undesirable. An impact may be the direct or indirect consequence of an activity.

5.2 Predicting Potential Environmental and Social Impacts

The potential environmental and social risks and impacts associated with the proposed CCUS 3D seismic survey and drilling were identified during the abbreviated ESIA through an appraisal of the following:

- Legal context;
- Activities associated with the 3D seismic survey and drilling;
- Nature and profile of the receiving environment, including potential sensitive features and receptors;
- Findings of specialist studies;
- International and national case studies;
- Outcomes from stakeholder engagement; and
- Input received from authorities and the CGS.

5.3 Mitigation of Impacts

As part of the ESIA, suitable measures were identified to manage the identified environmental and social risks and impacts according to the following mitigation hierarchy:

1. Initial efforts strive to avoid the risk and resultant occurrence of the impact;
2. If this is not possible, mitigation includes measures that reduce or minimise the risk and the resultant significance of the impact to an acceptable level;

3. Remediation or restoration will take place if measures cannot suitably prevent or reduce the risks and resultant impacts, or to address the residual impacts; and
4. As a last measure, where significant residual impacts remain, compensation or offsets (where technically and financially feasible) will be employed as a form of mitigating the impacts associated with the Project.

The ESMP is included in Section 8 below.

5.4 Impact Assessment Methodology

The following criteria were used to determine the significance of the environmental and social impacts associated with the CCUS 3D seismic survey and drilling activities:

Nature (/Status)
The project could have a **positive**, **negative**, or **neutral** impact on the environment.

Extent
- **Local** - extend to the site and its immediate surroundings.
- **Regional** - impact on the region but within the province.
- **National** - impact on an interprovincial scale.
- **International** - impact outside of SA.

Magnitude
Degree to which impact may cause irreplaceable loss of resources.
- **Low** - natural and social functions and processes are not affected or minimally affected.
- **Medium** - affected environment is notably altered; natural and social functions and processes continue albeit in a modified way.
- **High** - natural or social functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.

Duration
- **Short term** - 0-5 years.
- **Medium term** - 5-11 years.
- **Long term** - impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.
- **Permanent** - mitigation either by natural process or by human intervention will not occur in such a way or in such a time span that the impact can be considered transient.

Probability
- **Almost certain** - the event is expected to occur in most circumstances.
- **Likely** - the event will probably occur in most circumstances.
- **Moderate** - the event should occur at some time.
- **Unlikely** - the event could occur at some time.
- **Rare/Remote** - the event may occur only in exceptional circumstances.

Significance
Provides an overall impression of an impact's importance and the change brought about to the receptors in the receiving environment. The range for significance ratings is as follows:
- **Negligible** - Insignificant change to baseline conditions of the environment. No mitigation necessary.
- **Minor** - Minimal change to baseline conditions of the environment. Low to moderate receptor sensitivity. Mitigation to be considered.
- **Moderate** - Moderate change to baseline conditions of the environment. Moderate to high receptor sensitivity. Mitigation necessary.
- **Major** - Significant change to baseline conditions of the environment. Moderate to high receptor sensitivity. Mitigation necessary.

5.5 Positive Impacts

This section focuses on the positive impacts of the proposed CCUS 3D seismic survey and drilling in order to provide a balanced appraisal of the potential environmental and social consequences of these planned activities. The positive impacts are listed in Table 29 below.

Table 29: Positive impacts associated with the seismic survey and drilling

Receptor	Positive Impacts	Measures for Enhancing Positive Impacts
Socio-Economic Environment	The most common queries raised during stakeholder engagement to date, related to potential employment opportunities and use of local businesses during the project. Unemployment levels are high in Leandra and there are expectations from stakeholders that the local community will benefit from the project.	• The CGS is to be open and honest about the nature of possible job opportunities that are not long-term or permanent in nature. It is anticipated that 26 temporary job opportunities will be created. • Where possible the CGS can explore social investment opportunities in the project area. • The CGS is to promote the use of local labour and support of local businesses in the sourcing of goods and services from the local area where possible and within the local statutes. • Employment targets can be considered as part of the Contractors' contractual obligations. • Continue the stakeholder engagement programme with the relevant stakeholders to inform, consult, and involve them on the CCUS Project. • Identify opportunities to involve local graduates in the CCUS Project. • The CGS to explore technological interventions that will preserve jobs in the energy nexus.
Air Quality	The seismic survey and drilling activities are required for the geological characterisation of the study area to support the pilot CCUS project.	Integration between the seismic survey and drilling phase and the subsequent injection phase.
Geology & Hydrogeology	• The seismic survey will provide a high level of detail of the geology in the study area. • The knowledge gained from the project will benefit regional groundwater use planning and monitoring programmes in the future. • The 3D seismic survey images will help further research and study.	• Publish the findings from the project. • Collaborate with DWS on groundwater resources and share information produced as part of the exploratory work for the project.

5.6 Negative Impacts

The potential adverse impacts associated with the CCUS 3D seismic survey and drilling are assessed in the sub-sections to follow. Mitigation measures are also proposed to manage the impacts to receptors in the receiving environment. The assessment shows the significance ratings before and after mitigation and also considers any residual impacts.

5.6.1 Groundwater

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Groundwater	• Imprudent use of groundwater from local boreholes by the Contractor to execute the project's activities.	• Groundwater reserve. • Groundwater users. (groundwater is the primary water source used by local farmers). • Ecosystems reliant on groundwater.	• Water wastage. • Impact on groundwater resource volumes.	• Refer to the provisions in the following thematic management plans: ○ Groundwater Management Plan (Appendix C); ○ Waste Management Plan (Appendix E); and ○ Hazardous Materials Management Plan (Appendix G).
	• Indiscriminate movement of vibroseis trucks and other vehicles in natural areas.		• Compaction of near-surface springs. • Damage to boreholes and associated infrastructure.	
	• Inadequate management of wastewater. • Improper storage of hazardous substances • Spillages of fuel, oil and other dangerous goods.		• Contamination of groundwater.	
	• Surface vibrations close to boreholes.		• Surface vibrations close to boreholes may disturb borehole construction which may affect the apertures which groundwater pathways and thus affect the borehole yield.	
	<u>Drilling:</u> • Drilling into high yielding confined aquifers. • Drilling into natural gas pockets. • Groundwater pollution from inadequate drilling practices and poor management of drilling fluid.		• Groundwater contamination from drilling fluid. • Drilling into high yielding confined aquifers is identified as possible risk due to the expected karst aquifer located approximately 500m below surface. If the aquifer is confined, artesian condition will result in groundwater flow above the groundwater surface. The loss of artesian water will have to be managed as this is a possible risk of water loss. Drilling into this aquifer may also result in groundwater interaction between two aquifers. • Natural gas such as methane is common with the underlying Karoo coal deposits. Drilling into natural gas pockets may results in contamination of overlying aquifers and/or explosions.	

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local to Regional	High	Long-Term to Permanent	Likely	Major	With the successful implementation of stipulated mitigation measures in the relevant thematic management plans, and the provisions of the ESMP, it is anticipated that the residual impacts to groundwater would be minor to negligible.
After Mitigation:	Local	Low	Short-Term	Unlikely	Minor	

5.6.2 Topography

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Topography	• Indiscriminate movement of vibroseis trucks, drill rig and other vehicles over terrain.	• Topographic features (natural and man-made).	• The non-invasive nature of the vibroseis survey technique limits the potential for terrain related environmental impacts. Nonetheless, damage to topographic features may occur.	• Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible. • Plan and design seismic survey transects to avoid sensitive topographic features, including sensitive watercourses and anthropogenic landforms.

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium	Long-Term	Moderate	Minor to Moderate	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to topographical features would be negligible. The insignificance of residual impacts to topography is further supported by the non-invasive nature of the seismic survey and the flat terrain outside the urban area of Leandra.
After Mitigation:	Local	Low	Short-Term	Rare	Negligible	

5.6.3 Surface Water

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Surface Water	• Clearing of land to make way for drilling, site camp and parking area. • Movement of vibroseis trucks and support vehicles through riparian or wetland areas. • Improper rehabilitation.	• Surface water - resource quality (i.e., flow, in-stream and riparian habitat, aquatic biota and water quality).	• Damage to structure and functioning of watercourses at vehicle crossings, including loss of vegetation, damage to channel morphology, compaction of wetland soils, and erosion. • Loss of species that utilise watercourses. • Temporary increase in turbidity of watercourses from run-off over disturbed areas.	• Refer to the provisions in the following thematic management plans: ○ Surface Water Management Plan (Appendix D); ○ Waste Management Plan (Appendix E); and ○ Hazardous Materials Management Plan (Appendix G).
	• Inadequate management of waste and wastewater. • Improper storage of hazardous substances. • Spillages of fuel, oil and other dangerous goods.	• Surface water - aquatic biota and water quality.	• Reduction of water quality in watercourses that receive run-off from contaminated areas. This may result in the loss of aquatic biota and impact on terrestrial fauna that utilise the affected watercourses.	

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
			• Livestock that drink surface water contaminated by the project's activities may be adversely affected. • Informal areas occur in certain parts of Leandra. People that do not have access to potable water and who use surface water contaminated by the project's activities may be adversely affected.	

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local to Regional	High	Long-Term to Permanent	Likely	Major	With the successful implementation of stipulated mitigation measures in the relevant thematic management plans, and the provisions of the ESMP, it is anticipated that the residual impacts to surface water would be minor.
After Mitigation:	Local	Low	Short-Term	Unlikely	Minor	

5.6.4 Soil

Themes	Project Activities & Environmental Aspects	Receptors	Potential Negative Impacts	Mitigation
Soil	• Indiscriminate movement of vibroseis trucks, drill rig and other vehicles over untransformed terrain, as well as trampling by survey and drilling crews. • Disturbance of vegetative cover and soil structure. • Improper rehabilitation. • Improper refuelling and maintenance practices.	• Soil • Wetlands • Fauna (including burrowing animals) • Flora	• Soil erosion may occur from disturbance caused by the movement of the vibroseis trucks and other vehicles. • Wheel ruts caused by equipment on wet/saturated soils may channel run-off and increase rill erosion. • Compaction of soils by heavy equipment and vehicles along survey transects, access roads and tracks. • Increase of sediment loads to watercourses from run-off over areas disturbed by the project's activities. • Ponding may impede certain activities to be carried out during rains. • Loss of topsoil at areas to be cleared (drill area, site camp and parking area). • Soil contamination.	• Any in-field refuelling or maintenance shall only be undertaken while using a drip tray with a spill-kit available. • Appropriately stockpile topsoil cleared from the site for use during rehabilitation. • Refer to the provisions in the Erosion Control Plan (Appendix F).
	• Inadequate management of waste and wastewater. • Improper storage of hazardous substances. • Spillages of fuel, oil and other dangerous goods.		• Soil may be polluted by poor storage or handling of material, spillages and inadequate housekeeping practices.	• Refer to the provisions in the Waste Management Plan (Appendix E) and Hazardous Materials Management Plan (Appendix G).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Low	Medium to High	Long-Term	Likely	Moderate	With the successful implementation of stipulated mitigation measures in the relevant thematic management plans, and the provisions of the ESMP, it is anticipated that the residual impacts to soil would be minor.
After Mitigation:	Local	Low	Short-Term	Unlikely	Minor	

5.6.5 Air Quality

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Air Quality	• Emissions from operation of machinery, equipment and vehicles. • Dust from the use of dirt roads by vibroseis trucks and support vehicles. • Dust from bare areas cleared at the drill area, site camp and parking area.	• People • Wildlife • Livestock	• Adverse health effects to the surrounding community, animals and crews undertaking the survey and drilling activities. • Impacts of dust settling on crops.	• Refer to the provisions in the Air Quality Management Plan (Appendix A).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium	Short-Term	Moderate to Likely	Moderate	With the successful implementation of stipulated mitigation measures in the Air Quality Management Plan, and the provisions of the ESMP, it is anticipated that the residual impacts to air quality would be minor. The intensity of the seismic survey with regards to dust generation is considered low, concentrated in the immediate area of the seismic lines at any one time and only for a short duration. The vibroseis trucks also move at a slow rate, which minimises dust generation. Once the seismic trucks pass, the survey for that area is complete.
After Mitigation:	Local	Low	Short-Term	Rare to Unlikely	Minor	

5.6.6 Land Use

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Land Use	• Seismic survey activities in areas used for agricultural purposes (livestock grazing and cultivated land). • Seismic survey activities in urban parts of Leandra.	• People • Structures • Infrastructure	• Loss of crops in cultivated areas traversed by the vibroseis trucks. • Risks to livestock. • Disruption of traffic and human movement. • Disturbances (noise and vibration).	• Seismic survey transects to avoid urban areas in Leandra (including industrial area in south-west). • Refer to the provisions in the ESMP and the following thematic management plans: ○ Air Quality Management Plan (Appendix A); ○ Noise and Vibration Management Plan (Appendix B); ○ Groundwater Management Plan (Appendix C); ○ Surface Water Management Plan (Appendix D); ○ Waste Management Plan (Appendix E); ○ Erosion Control Management Plan (Appendix F); ○ Hazardous Materials Management Plan (Appendix G); ○ Community Health, Safety and Security Management Plan (Appendix H); ○ Traffic Management Plan (Appendix I); and ○ Rehabilitation Plan (Appendix K).

	Significance					Residual Impact
	Extent	**Magnitude**	**Duration**	**Probability**	**Significance**	
Before Mitigation:	Local	Medium	Short-Term	Likely	Major	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to land use would be negligible.
After Mitigation:	Local	Low	Short-Term	Moderate to Unlikely	Negligible	

5.6.7 Terrestrial Biodiversity

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Terrestrial Biodiversity	• Clearing of vegetation to make way for drilling, site camp and parking area. • Creating access roads and tracks. • Fencing around drill site. • Indiscriminate movement of vibroseis trucks and support vehicles through natural areas. • Vehicles potentially spreading seed of invasive alien species. • Improper rehabilitation.	• Fauna • Flora	• Loss, disturbance or displacement of flora and fauna species, including Species of Conservation Concern (SCC). • Destruction, fragmentation and degradation of habitats and ecosystems. • Influence to animal movement. • Mortality/displacement of ground living mammals (moles, gerbils, rats, mice, mongooses) due to vibrations from seismic survey vehicles. • Human - animal conflicts. • Soil compaction and impacts to plant regrowth. • Soil erosion. • Disruption/alteration of species activities (breeding, migration, feeding) due to noise and vibration. • Nights lights may adversely affect nocturnal faunal species. • Illegal harvesting and poaching of faunal and floral species by survey and drilling crews. • Proliferation of invasive alien species in disturbed areas.	• Refer to the provisions in the ESMP.
	• Inadequate management of waste and wastewater. • Improper storage of hazardous substances. • Spillages of fuel, oil and other dangerous goods.		• Pollution of the biophysical environment, with adverse effects to flora and fauna.	• Refer to the provisions in the following thematic management plans: ○ Surface Water Management Plan (Appendix D); ○ Waste Management Plan (Appendix E); and ○ Hazardous Materials Management Plan (Appendix G).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	High	Long-Term to Permanent	Likely	Major	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to terrestrial biodiversity would be minor.
After Mitigation:	Local	Low	Short-Term	Unlikely	Minor	

5.6.8 Noise & Vibration

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Noise & Vibration	Noise and vibration will be caused by the following: • Operation of equipment used to undertake the 3D seismic survey and drilling, including the vibroseis trucks and drilling rig, as well as support activities; • Transportation of equipment, materials and people to and from the site; • Noise created by the labour force and from camp site (e.g., generator).	• People • Schools • Places of worship • Clinics • Residences • Wildlife • Livestock • Below ground services and utilities	• Noise and vibration may disturb surrounding communities, fauna and livestock and can also pose OHS risks. • Vibration may impact of the stability of structures in proximity to the vibroseis trucks. • Underground services can be impacted by vibration caused by the vibroseis trucks.	• Seismic survey transects to avoid urban areas in Leandra and informal settlements in Lebohang to the south. • Refer to the provisions in the Noise and Vibration Management Plan (Appendix B).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium to High	Short-Term	Likely	Moderate to Major	With the successful implementation of stipulated mitigation measures in the Noise and Vibration Management Plan, and the provisions of the ESMP, it is anticipated that the residual impacts would be negligible. The temporary nature of the seismic survey activities, as well as the avoidance of urbanised areas and informal settlements in Lebohang, also reduce the noise and vibration impacts.
After Mitigation:	Local	Low	Short-Term	Unlikely	Negligible	

** It is noted that the rating of noise and vibration impacts were not based on a dedicated Noise and Vibration Impact Assessment.*

5.6.9 Heritage & Palaeontology

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Heritage & Palaeontology	• Indiscriminate movement and operation of vibroseis trucks and support vehicles. • Clearing to make way for drilling, site camp and parking area. • Vibration caused by operation of equipment used to undertake the 3D seismic survey and drilling, including the vibroseis trucks and drilling rig.	• Heritage resources • Graves • Fossils	• Damage to existing historical resources or remains. • Damage to unidentified graves. • Damage to fossils in the bedrock.	• Seismic survey transects to avoid urban areas in Leandra and informal settlements in Lebohang to the south. • Refer to the provisions in the Heritage Resources Management Plan (Appendix J).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	High	Permanent	Likely	Major	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to heritage and palaeontological resources would be minor to negligible.
After Mitigation:	Local	Low	Short-Term	Moderate to Unlikely	Minor to Negligible	

5.6.10 Visual Resources

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Visual Resources	• Clearing of vegetation to make way for drilling, site camp and parking area. • Movement of vibroseis trucks and support vehicles through natural areas. • Poor housekeeping at drill area, site camp and within seismic survey area. • Improper rehabilitation.	• Visual resources • People	• Scars in landscape caused by survey transects in natural areas and cleared areas. • Visual impacts caused by drill site and site camp. • Light pollution due to night lighting at drill site and site camp.	• Refer to the provisions in the ESMP.

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium to High	Short-Term	Almost Certain	Moderate	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to visual resources would be negligible.
After Mitigation:	Local	Low	Short-Term	Unlikely	Negligible	

5.6.11 Socio-Economic Environment

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Socio-Economic Environment	• Poor planning and communication with the affected communities in the project area. • Contamination of air (e.g., fugitive emissions), soil and water (surface and groundwater) from project activities or facilities. • Poor traffic management.	• People (local communities)	• Noise, vibration and dust pollution. • Presence of construction workers. • Increased risk of HIV. • Quality of housing (risk of damage from vibroseis trucks). • Social and community infrastructure disruption. • Affects to daily life. • Employment opportunities.	• Refer to the provisions in the ESMP and the following thematic management plans: ○ Air Quality Management Plan (Appendix A); ○ Noise and Vibration Management Plan (Appendix B);

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
	• Indiscriminate movement of vibroseis trucks. • Inadequate provision for and management of security. • Poor management of labour force.		• Corruption. • Extortion. • Disparities in workforce.	○ Groundwater Management Plan (Appendix C); ○ Surface Water Management Plan (Appendix D); ○ Waste Management Plan (Appendix E); ○ Community Health, Safety and Security Management Plan (Appendix H); ○ Traffic Management Plan (Appendix I); and ○ Emergency Response Plan (Appendix L).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium	Short-Term	Likely	Moderate	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP and relevant Thematic Management Plans, it is anticipated that the residual impacts to the socio-economic environment would be negligible. The temporary nature of the Project activities (i.e., 1 month for seismic survey and 6 months for drilling) is also taken into consideration.
After Mitigation:	Local	Medium	Short-Term	Unlikely	Negligible	

5.6.12 Hazardous Materials & Waste

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Hazardous Substances & Waste	• Inadequate management of hazardous waste and wastewater. • Improper storage of hazardous materials. • Spillages of fuel, oil and other dangerous goods.	• People • Flora • Wildlife • Livestock • Groundwater • Surface water • Soil • Visual resources	• Risk to human health (occupational and community health and safety). • Pollution of soil, groundwater and surface water. • Risk to plant life. • Risk to health and wildlife and livestock. • Malodours. • Compromised aesthetics (e.g., poor storage, windblown litter). • Vermin.	• Hazardous materials – refer to Hazardous Materials Management Plan (Appendix G). • Hazardous waste – refer to Waste Management Plan (Appendix E). • Contaminated soil - ○ Contaminated soil will be removed to a predetermined depth from areas identified to be contaminated. ○ Excavated contaminated soil will be placed into suitable receptacles to prevent pollution and human exposure risks.

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
				○ The contaminated soil will be disposed of offsite at an appropriately licenced facility.

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	Medium to High	Long-Term	Likely	Major	With the successful implementation of stipulated mitigation measures in the Hazardous Materials Management Plan and Waste Management Plan, as well as the provisions of the ESMP, it is anticipated that the residual impacts would be minor to negligible.
After Mitigation:	Local	Low	Long-Term	Unlikely	Minor to Negligible	

5.6.13 Transportation

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Transportation	• Movement of vibroseis trucks and other vehicles in the project area. • Transportation of materials and crew to and around site. • The drill site will be directly accessed from the Provincial Route R29, which is a high-speed environment. • Risks associated with crossing the Provincial Routes (R29) during the seismic survey. • Speeding and reckless driving by construction personnel.	• Traffic. • People (project personnel and the public). • Livestock. • Wildlife.	• Disruptions to traffic. • Deterioration of roads used by vibroseis trucks and support vehicles. • Difficulty with using narrow gravel roads in certain parts of Leandra (may be used to access the southern part of survey area to avoid the railway line that bisects the survey footprint). • Damage to existing watercourse crossings that are unable to carry the weight of the vibroseis trucks. • Safety risk to vehicles travelling on R29 from drill rig, vibroseis trucks and support vehicles accessing and leaving the drill area and site camp. • Risks to road users, pedestrians and livestock from survey equipment and support vehicles.	• Refer to provisions in the Traffic Management Plan (Appendix I).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Low	Medium to High	Short-Term	Likely	Major	The slow pace of the vibroseis survey will allow effective traffic control on the major routes in Leandra.
After Mitigation:	Local	Low	Short-Term	Unlikely	Negligible	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual impacts to traffic would be negligible.

5.6.14 Occupational Health and Safety

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
OHS	Potential OHS hazards to project workers during the seismic survey and drilling are associated with the following: • Working near water (including streams and dams); • Working with heavy machinery; • Working with hazardous substances and dangerous goods; • Working with hazardous waste (e.g., soil contaminated by spillages); • Risk of fires; • Working with electrical and mechanical equipment; • Working on public and private roads; • Risks during rigging; • Geological faults can act as conduits for high pressure oil, gas, or water from depth; • Drill failures; • Borehole Instability; • Slips, trips and falls; • Extended or elevated exposure to dust, noise, the sun, heat and wet weather; • Working at night / shift work / fatigue; • Exposure to illnesses, communicable diseases, COVID-19 and others; and • Exposure to mental or physical harassment, Sexual Exploitation and Abuse and Sexual Harassment (SEA/SH), and injury from interpersonal conflicts.	• People (survey and drilling crews)	• Risk of work-related diseases, injuries or mortality.	• Refer to the provisions in the ESMP.

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	High	Short-Term	Likely	Major	With the successful implementation of stipulated mitigation measures, and the provisions of the ESMP, it is anticipated that the residual OHS risks would be negligible.
After Mitigation:	Local	Low	Short-Term	Unlikely	Negligible	

5.6.15 Community Health and Safety

Themes	Project Activities & Environmental Aspects	Receptors	Negative Impacts	Mitigation
Community Health & Safety	• Poor planning and communication with the affected communities in the project area. • Contamination of air (e.g., fugitive emissions), soil and water (surface and groundwater) from project activities or facilities. • Poor traffic management. • Inadequate provision for and management of security. • Poor management of labour force. • Breakdown in worker–community relationship.	• People (local communities)	• Human health risks and degradation / loss of resources used by local communities caused by project-related pollution. • Accidents (e.g., traffic incidents) occurring during project that involve communities and their animals and livestock. • Impacts of project's security on local communities; • Spread of communicable diseases by project workers to the local communities. • Transfer of Sexually Transmitted Infections (STIs) from in-migrants and workforce to community. • Potential exposure to vector-related diseases. • Increased competition for the direct and indirect economic opportunities created by the project (labour Influx). • Gender-Based Violence (GBV) and SEA/SH regarding community members. • Forced labour and child labour. • Risks to vulnerable and marginalised groups (including informal settlements in Leandra). • Community unrest.	• Refer to the provisions in the Community Health, Safety and Security Management Plan (Appendix H).

	Significance					Residual Impact
	Extent	Magnitude	Duration	Probability	Significance	
Before Mitigation:	Local	High	Short-Term	Likely	Major	With the successful implementation of stipulated mitigation measures in the Community Health, Safety and Security Management Plan, and the provisions of the ESMP, it is anticipated that the residual risks to community health and safety would be minor to negligible.
After Mitigation:	Local	Low	Short-Term	Unlikely	Minor to Negligible	

5.7 Cumulative Impacts

5.7.1 Introduction

A cumulative impact, in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that in itself may not be significant, but may become significant when added to the existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

According to the IFC Good Practice Handbook (Cardinale & Greig, 2013), cumulative impacts are contextual and encompass a broad spectrum of impacts at different spatial and temporal scales. The spatial area of influence (AOI) encompasses the geographical area impacted by the project. The timescale over which the CCUS 3D seismic survey and drilling is likely to cause impacts include the implementation phase of these activities.

The potential negative and positive cumulative impacts are listed in the sub-sections to follow, based on the current understanding of the Project and the receiving environment. The adverse cumulative impacts are address through the management measures contained in the ESMP.

5.7.2 Internal Cumulative Impacts between the Phases of CCUS Pilot Project

It is not anticipated that there will be an overlap between the programmes for the execution of the seismic survey and drilling and the subsequent injection phases on the CCUS pilot project. Nonetheless, there could be legacy impacts (if unmitigated) from the first phase that could be exacerbated during CO_2 injection. This may include the following:

- Environmental pollution at the drill site if remedial measures were not properly undertaken during stratigraphic drilling and new pollution (e.g., spillage of hazardous materials) occurs during injection;
- Continued visual impacts to travellers along the R29, surrounding communities and farmers, if the two phases fail to maintain a tidy and well laid out site;
- Deterioration of the access road from the R29 to the facilities at the respective drill sites during the two phases;
- Risks to traffic along the R29 if traffic management measures are not implemented for heavy equipment and vehicles leaving the drill sites during the two phases;
- Continuation of pollution of aquifers and impacts to groundwater users during the two phases;
- Cumulative impact on yield of registered municipal borehole from where water will be sourced for the two phases;
- Cumulative waste generation (including drilling mud and cuttings) from the respective drilling operations; and
- Continuation of social disturbances between the two phases if community health and safety is not properly managed.

As a positive impact, both phases can continue to support local business and contribute towards the local economy.

5.7.3 External Cumulative Impacts

External cumulative impacts can be identified by combining the potential environmental implications of the CCUS 3D seismic survey and drilling with the impacts of projects and activities that have occurred in the past, are currently occurring, or are proposed in the future within the project area or region. It is noted that the accurate characterisation of the future state of the project area is inherently speculative to an extent, due to the dynamic nature of future decisions related to land use (e.g., development within the urban edge of Leandra), water use (consumptive, waste-related and encroachments), protection of terrestrial and aquatic biological resources, etc.

The following is noted in terms of sources of potential external cumulative impacts:

- Current and reasonably defined/foreseeable third-party projects – At this stage, no other third-party projects have been identified in the project area that closely overlap the seismic survey and drilling in time and location; and
- Developments or activities induced by the Project – The CCUS Project is currently only a pilot project and should thus not induce development in the project area until the feasibility of scaling up the operation can be proven by CGS. The nature of the pilot project needs to be emphasised to the stakeholders by CGS during the ongoing stakeholder engagement to manage unrealistic expectations of local economic stimulation and benefits that will not accrue during the first phase of CCUS.

With the seismic survey area planned in a large part of Leandra, there may be cumulative impacts if other projects occur over the same period and in the same area. The primary receptors will include the social environment. It is not deemed that these impacts will have a high probability of taking place, as the vibroseis trucks are mobile and able to avoid the AOI of other projects.

During the ESIA site inspections it was observed that road upgrades were taking place in certain parts of Leandra. Cumulative traffic impacts are expected if the source lines intersect with the road upgrades. This can, however, be avoided during the planning of the survey grid and adequate logistical arrangements. Other cumulative traffic impacts may occur when the vibroseis trucks are stationary and other traffic disturbances occur at the same time. The impacts should be temporary if properly managed.

Crime is a concern in the project area, which was also pointed out during stakeholders engagement by the Leandra community. Poor management of project security and the labour force will exacerbate this problem.

Chapter 6: Analysis of Alternatives

6 ANALYSIS OF ALTERNATIVES

6.1 Introduction

Alternatives are the different ways in which the Project can be executed to ultimately achieve its objectives. Examples could include carrying out a different type of action, choosing an alternative location or adopting a different technology or design for the Project. An ESIA needs to compare a project's feasible alternatives in terms of their potential environmental and social impacts.

6.2 Project Alternatives

6.2.1 Site Alternatives

CGS identified the currently proposed drill site for the following reasons:

- Geology – based on available boreholes, the CGS needed to find adequately thick and deep basaltic sequences that were distal to any major structures. This region satisfies this requirement;
- Availability of land – the CGS needed to find a piece of land that could be zoned for research and was not currently being used; and
- Landownership – The land where the dill site is proposed was identified to be highly suitable as it is state-owned and vacant, and it can thus be secured for long-term research. In addition, the individual landowners of the surrounding properties where the seismic survey is planned were also engaged by the CGS to confirm that access could be gained, and no restrictions were identified in this regard.

No other site alternatives for the CCUS pilot project were considered.

6.2.2 Technology Alternatives

6.2.2.1 Subsurface Modelling

A seismic survey was identified by CGS as the only alternative for the subsurface modelling to ensure safe and sustainable piloting. This survey allows for any structures or features that may result in migration of the injected CO_2 to be adequately mapped and accounted for.

6.2.2.2 Acoustic Source Technologies

The Vibroseis technology is a state-of-the-art technology that is widely used to carry out seismic surveys worldwide. The only other alternative to Vibroseis is using a dynamite shot-hole.

Vibroseis is generally preferred over dynamite shot-holes for the following reasons:

- Vibroseis is cheaper than explosives as a seismic energy source;

- Vibrator settings can be adjusted in the field and can thus greatly improve the results of the seismic survey;
- Vibroseis source points can easily be recorded again if for some reason the reflected signals are not of the required quality; and
- Vibroseis trucks contain energy over a known bandwidth and produce relatively low levels of ground vibrations.

6.2.2.3 Seismic Data Recording Equipment

According to Makama *et al*. (2021), conventional seismic acquisition systems relied on cables connected to each sensor. The preferred option for the project entails using a wireless seismic acquisition system, which consists of deploying geophone units equipped with wireless transceivers over the survey area.

The benefits of a wireless seismic acquisition system include the following:

- It enables a greater trace density;
- It avoids the placement of considerable lengths of cables over the survey area, which complicates survey logistics; and
- It increases productivity during the survey;

6.2.3 Drilling Fluid System Alternatives

6.2.3.1 Types of Drilling Fluids

Liquid drilling fluids can be broadly classified as follows:

1. Water Based Mud (WBM) – Most basic water-based mud systems begin with water, then clays and other chemicals are incorporated into the water to create a homogeneous blend;
2. Oil Based Muds (OBM) – This consists of a mud where the base fluid is a petroleum product such as diesel fuel; and
3. Synthetic Based Muds (SBM) – Environmentally-friendly organic-based muds using a base fluid produced from natural gas or processed base oil or natural (non-petroleum) oils which are nontoxic and quickly biodegradable, such as the synthetic-based mud.

The preferred drilling fluid to be used for the stratigraphic drilling will be determined during the design phase.

6.2.3.2 Management of Drilling Fluids and Waste

Drilling fluids are routed to a solids control system at the surface facilities, where fluids can be separated from the cuttings. Examples of methods used to separate cuttings from drilling fluids include mud pits (refer to Figure 87 below) and storage tanks (refer to Figure 88 below). The drilling fluids are then recirculated downhole leaving the cuttings behind for disposal.

For the CCUS stratigraphic drilling, the preferred option entails the use of storage tanks. One 5000L storage tank will be available on site during the drilling. There will also be two sumps for mud recirculation. The water coming out of the borehole will be circulated through a solid removal unit to extract drill cuttings prior to the mud returning to the sumps for recirculation. Cuttings will be transported to a certified waste disposal site.

Figure 87: Examples of pits used to separate cuttings from drilling fluids (by Joshua Doubek - Own work, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=27167604)

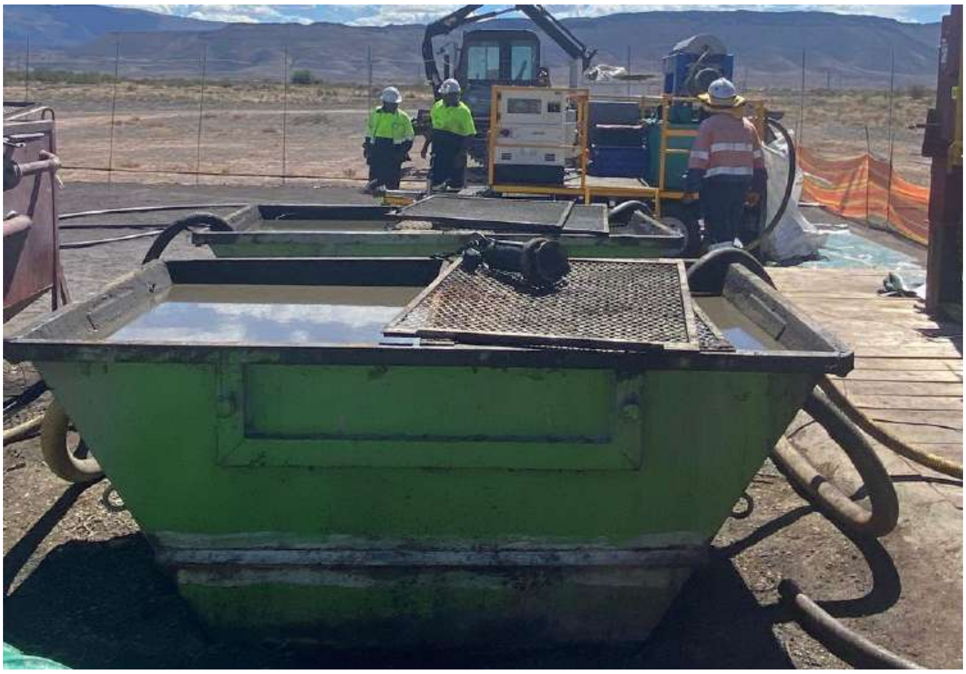


Figure 88: Example of storage tanks used to manage drilling fluids

Alternatives for the treatment and disposal of drilling fluids and cuttings may include one, or a combination of, the following:

- Injection of the fluid and cuttings mixture into a dedicated disposal well;
- Injection into the annular space of a well;
- Storage in dedicated storage tanks or lined pits prior to treatment, recycling, and / or final treatment and disposal;

- On-site or off-site biological or physical treatment to render the fluid and cuttings non-hazardous prior to final disposal; and
- Recycling of spent fluids back to the suppliers for treatment and re-use.

Alternatives for the treatment and disposal of drilling fluids and cuttings will be evaluated during the planning and design of the drilling operations.

6.3 No-Go / Without Project Option

Under the “no-go option”, the project does not go ahead and the status quo remains. The option of not proceeding needs to be considered in light of the need and desirability of the Project.

Some key considerations in this regard include:

- CCUS has been acknowledged by SA as one of the technologies to mitigate the emissions of carbon dioxide into the atmosphere and forms one of the NAMA. It is also one of the national flagship projects and forms part of a just transition to a future low-carbon energy economy. The purpose of the project is to demonstrate the application of CCUS technology to SA conditions.
- It is noted that this ESIA covers the initial phase of the pilot project, which entails data acquisition that will enable evaluation of the proposed CCUS drill site. Without the geological characterisation that will be provided by the 3D seismic survey and stratigraphic drilling, the injection phase of the pilot project will not the able to proceed.

The “no-go option” is not preferred, as the objectives of the CCUS pilot project will not be met, and the associated benefits will not materialise. Although not proceeding with the activities associated with the geological characterisation would avoid the adverse environmental impacts, these impacts are considered to be manageable through the provisions contained in the ESIA Report and ESMP.

Chapter 7: Stakeholder Engagement

7 STAKEHOLDER ENGAGEMENT

7.1 Aims of Stakeholder Engagement

The objectives of stakeholder engagement that forms part of the ESIA for the seismic survey and drilling include the following:

- Building Relationships: Designing a systematic approach to engagement that supports open dialogue between CGS and stakeholders. This allows for productive relationships to be built and maintained, which facilitates the ESIA process.
- Ensuring Understanding: The stakeholder engagement process serves to increase mutual understanding between CGS and the stakeholders. This will allow stakeholders to be well informed about the project and the associated environmental and social impacts, and for CGS to understand the concerns as well as the level of support stakeholders have with regards to the project. This way CGS can take into consideration the stakeholders' views when designing the project.
- Foster Effective Communication: Effective stakeholder engagement will foster effective communication between the different parties involved. Information regarding the project and its environmental and social impacts should be disclosed to stakeholders in a timely and understandable manner. This means information will be disclosed in an accessible place and in a form and language that is appropriate and understandable to project-affected parties and other interested parties. It should be easy for stakeholders to communicate issues and grievances and for CGS to respond to concerns.
- Involving Stakeholders in the Assessment: Stakeholders can inform the ESIA by providing important information and local knowledge, such as the social baseline, scoping of issues as well as assessment of impacts and mitigation measures.
- Gaining access to properties: Engaging with landowners to seek consent to access the land that is directly affected by the Project's activities. This includes understanding any concerns of the landowners and ensuring that these are addressed through formal agreements (as necessary) and provisions in this ESIA Report.

For the purposes of the ESIA, the key reasons for engaging with stakeholders include:

1. To provide stakeholders with an opportunity to obtain information about the project;
2. To allow stakeholders to express their views and concerns regarding the project;
3. To grant stakeholders an opportunity to recommend measures to avoid or reduce adverse impacts and enhance positive impacts associated with the project; and
4. To enable the CGS to incorporate the needs, concerns, and recommendations of stakeholders into the project, where feasible.

Apart from the ESIA, CGS also have particular objectives for stakeholder engagement, such as creating project awareness, garnering project support, seeking funding, facilitating project implementations, etc.

7.2 Identification of Stakeholders

Stakeholders were identified by the following means:

1. Reviewing the various structures governing the project activities in the study area to identify the regulatory and interested authorities in the spheres of government;
2. Undertaking a spatial assessment of the project's locational context to identify stakeholders that may be affected by, or have an in interest in, the project;
3. Reviewing literature (including best practices) to identify stakeholders commonly linked to a project of this nature; and
4. Guidance received from the project team on key stakeholders to be involved.

Within the context of the CCUS Project, stakeholders are regarded as the following:

- Parties that have a governance function in terms of the project (including the three spheres of government);
- Parties who will be affected by or may have an interest in the Project; and
- Parties who have the ability to influence the outcome of the Project.

Following an upfront stakeholder mapping exercise, the following categories of stakeholders were identified for the project:

1. Government (national, provincial and local);
2. Businesses;
3. Agriculture;
4. Institutions;
5. NPOs/NGOs and civil society groups;
6. Special interest groups;
7. Infrastructure custodians;
8. Research organisations; and
9. Local communities (including vulnerable individuals, communities and groups).

7.3 Stakeholder Analysis

It is necessary to prioritise the identified stakeholders in order to optimise engagement. This was undertaken by categorising the stakeholders according to their relative levels of impact and influence with regards to the project.

The key stakeholders listed in Table 30 below were plotted in Figure 89 below according to whether they have a high or low impact and influence on the project. The four boxes each represent a level of engagement, from the lowest level (information sharing), through the middle levels (active engagement) to the highest level (in-depth engagement). It is noted that this analysis considers the reasons for engaging with stakeholders for the project and not only for the specific purposes of the ESIA.

Table 30: List of key stakeholder and level of involvement

Stakeholders		*Level of involvement expected*
MP Department of Economic Development and Tourism	MP DEDT	Oversight
MP Office of the Premier	MP OTP	Political
Govan Mbeki Local Municipality	GMLM	Project Implementation
Gert Sibande District Municipality	GSDM	Oversight to LM
Eskom	Eskom	Collaborate
SASOL	SASOL	Collaborate
Env Authorities	Env Auth	Oversight
MP Traditional Leaders	MPTL	Support
MP Department of Public Works, Roads and Transport	DPWRT	Oversight
SAPS	SAPS	Oversight
Council for Scientific and Industrial Research	CSIR	Scientific support
National Treasury	NT	Funding
Env NGOs	NGOs	Project Implementation
Leandra Community	Leandra	Project Implementation
University of Mpumalanga	UMP	Future collaboration
Farming Community (Farmers)	Farmers	Support (Access to property)
Ward Councillors	Ward Cllrs	Support (Access to property)
Business Forums	Buz Forums	Business support

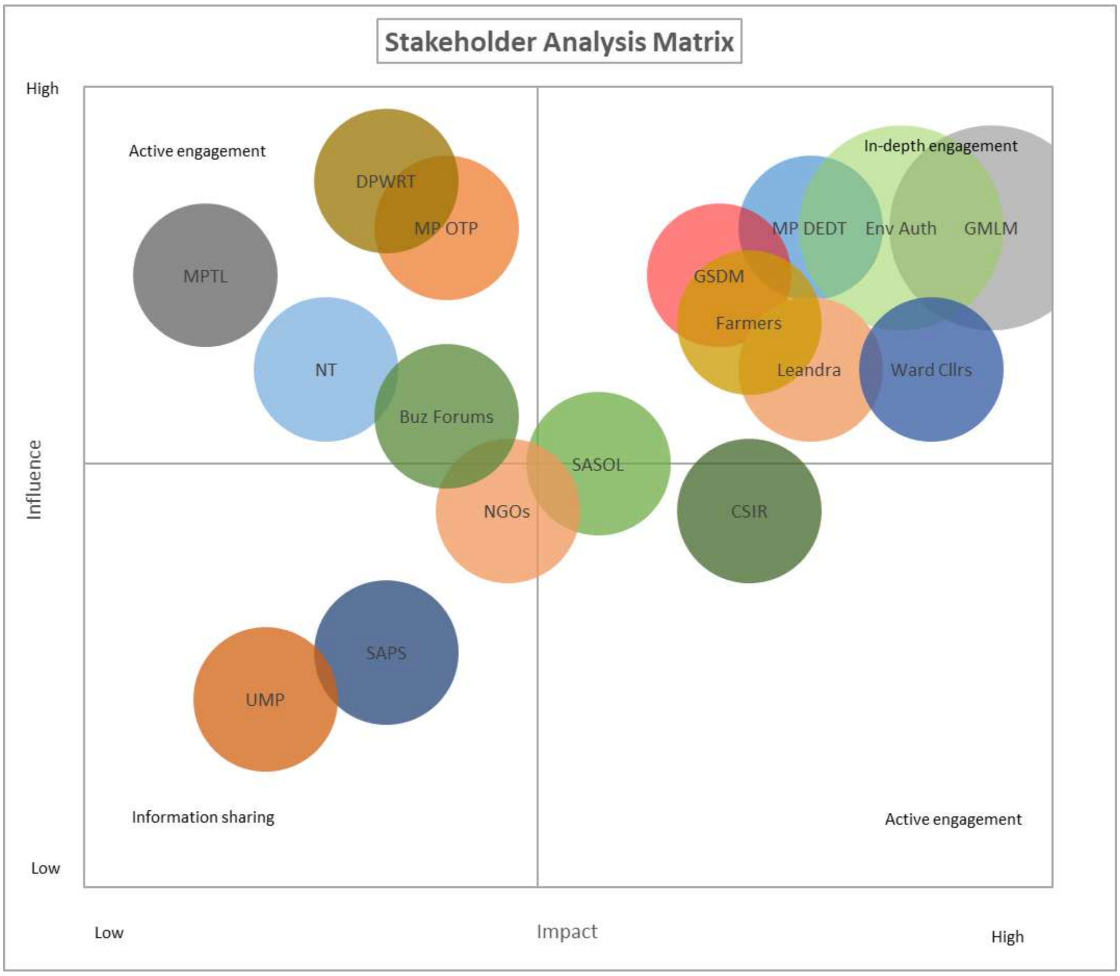


Figure 89: Stakeholder Analysis Matrix

7.4 Notification and Obtaining Input

Input from stakeholders for the proposed CCUS 3D seismic survey and drilling was garnered in the following ways from February to March 2023:

- A Background Information Document and Reply Form were emailed to stakeholders contained in the project-specific database;
- Pamphlets were distributed to the community members;
- A notice was placed in the Ridge Times Newspaper, which is distributed regionally;
- A notice was placed in The Bulletin, which is a regional online newspaper;
- Site notices were placed in various public places in Leandra;
- Questionnaires were administered in the communities in the seismic survey area (see Figure 93 below);
- A meeting was held with municipal councillors and community leaders on 22 February 2023 (see Figure 91 below);
- A public meeting was held on 15 March 2023 (see Figure 92 below); and
- Various focus group meetings were held with members of the community.

Communication during stakeholder engagement was primarily undertaken in English and isiZulu. Afrikaans was also used during communication with the local farmers.

Figure 90: Examples of site notices placed during stakeholder engagement

Figure 91: Meeting with municipal councillors and community leaders on 22 February 2023 in Leandra

Figure 92: Public meeting on 15 March 2023 in Leandra

Figure 93: Administering of questionnaire

7.4.1.1 Summary of Comments Received

Table 31 below summarised the main categories of comments received during stakeholder engagement. Generally, the project was supported but the need for the local communities to benefit from the project was emphasised.

Table 31: Summary of Comments Received

Comment Category	Collective Summary
Communication Clarity	A request was made for the CGS to provide specific information regarding the project, including the following (amongst others): • The number of people that will be employed during the project; • The project's budget; • Benefits to the local economy; and • The project's implementation programme.
Public Safety and Security	Concerns were raised regarding the impacts of the project to the security and safety of the local communities. Impacts of the 3D seismic survey are still unknown and misunderstood by the local communities. As the movement of the truck will be within neighbourhoods, CGS should ensure safety and security measures are in place. Crime is a significant problem in the area and the SAPS in Leandra and the Community Police Forum do not have sufficient capacity to manage

Comment Category	Collective Summary
	additional safety and security problems that may be caused by the project.
Skills Development	The importance of transferring skills to the local communities was emphasised.
Support To Local Businesses	Local businesses need to be supported by the project.
Employment opportunities	Local communities need to be considered for employment opportunities that may arise for the project.
Socio-economic status of Leandra	Stakeholders stressed the poverty-stricken status of Leandra. The need for services (e.g., healthcare facilities) and increase in policing capacity were highlighted. Drug and substance abuse were noted as impacts resulting from the high unemployment levels in the area.
Vibration impacts	Concerns were raised about the vibration impacts during the seismic survey and the risks to houses.
Impacts to community facilities and places of worship	Concerns were raised about the project's impacts to childcare facilities and churches in the seismic survey area.

7.5 Public Disclosure of Abbreviated ESIA Report

A 30-day review period is granted to stakeholders to review and comment on the draft abbreviated ESIA Report, which will run from 12 July until 14 August 2023.

Stakeholders contained in the project-specific database will be notified of the review of the report via email, text messages and newspapers. Proof of notification will be included in the final EIA Report.

The draft abbreviated ESIA Report can be accessed as follows:

- ❑ Hardcopies of the report will be placed at the following public places –
  - Leandra Public Library;
  - Lebohang Public Library; and
  - Secunda Public Library.
- ❑ An electronic copy will be uploaded to the following website, for downloading purposes: https://nemai.co.za/downloads/.

7.6 Future and On-Going Consultation

The CGS will develop a Stakeholder Engagement Plan (SEP) for the remaining phases of the CCUS Project.

The CGS will continue to engage with the relevant landowners and stakeholders throughout the CCUS Project, which will include making use of the existing communication channels established for the Project.

Future stakeholder engagement by the CGS may include the following:

- Additional meetings with the public, specific government departments and interest groups; and
- Dissemination of information to stakeholders via email, newspapers, social media, the local radio station and communication channels used by the municipal councillors.

Continuous consultation will be undertaken with the directly affected landowners within the seismic survey area and drill site, as required. Forms of notification may include:

- Traffic management notifications – as required;
- Regular community updates and project newsletters;
- Advertising in local newspapers; and
- Project telephone and email facilities.

CGS will also implement a Grievance Redress Mechanism (GRM) to allow stakeholders to raise concerns or complaints (see Section 8.5 below).

Input received from stakeholders will be incorporated into the planning, design and implementation of the CCUS Project.

CHAPTER 8: ENVIRONMENTAL & SOCIAL MANAGEMENT PLAN

8 Environmental & Social Management Plan

8.1 Purpose of the ESMP

According to OP 4.01 (Annexure C), a project's ESMP consists of the set of mitigation, monitoring, and institutional measures to be undertaken during implementation and operation to eliminate adverse environmental and social impacts, offset them, or reduce them to acceptable levels. The plan also includes the actions needed to implement these measures.

This ESMP for CCUS 3D seismic survey and drilling is based on the findings of the abbreviated ESIA. It is regarded as a dynamic document that needs to be reviewed and updated, as required, on a periodic basis depending on the outcomes of monitoring, unforeseen events, nature of impacts occurring, changes to the receiving environment, updates to the environmental legal framework, changes in organizational arrangements, etc.

8.2 Environmental and Social Governance Framework for the Project

The Project's Environmental and Social Governance Framework will include the following (amongst others):

- Environmental and Social Policy;
- Organogram of Environmental and Social Team;
- Code of Conduct;
- Operational Controls;
- GRM;
- SEP;
- OHS Management Plan;
- Competency and Training Plan;
- Document Control System; and
- ESMP, including General Management Plan and Thematic Management Plans (see Section 8.7 below).

8.3 Environmental and Social Management Objectives of Project

The Environmental and Social Management Objectives for the CCUS 3D seismic survey and drilling, which define the successful execution of the work, are as follows:

- Complying with the national legislation governing the related activities;
- Preventing any risks in terms of occupational and community health and safety;
- Undertaking the 3D seismic survey and drilling in accordance with best international practices in terms of environmental, health, and safety requirements, as tailored to the hazards and risks determined for the Project;
- Mitigating all potential impacts to ensure that no residual impacts remain significant;

- Ensuring that all waste is managed to prevent environmental pollution;
- Rehabilitating the areas affected by the project activities; and
- Maintaining all records necessary to demonstrate compliance with mitigation measures.

8.4 Roles and Responsibilities

8.4.1 Introduction

The ESMP informs all project participants about their duties in the fulfilment of the project objectives, with particular reference to the mitigation of environmental and social impacts that may potentially be caused by the 3D seismic survey and drilling activities. All contractors and subcontractors will comply with the ESMP requirements, as applicable to their respective tasks.

An overview of the roles and responsibilities of the project participants from an environmental and social perspective is provided in the sections to follow. The diagram in Figure 94 below shows the reporting lines of the officers involved in the Project.

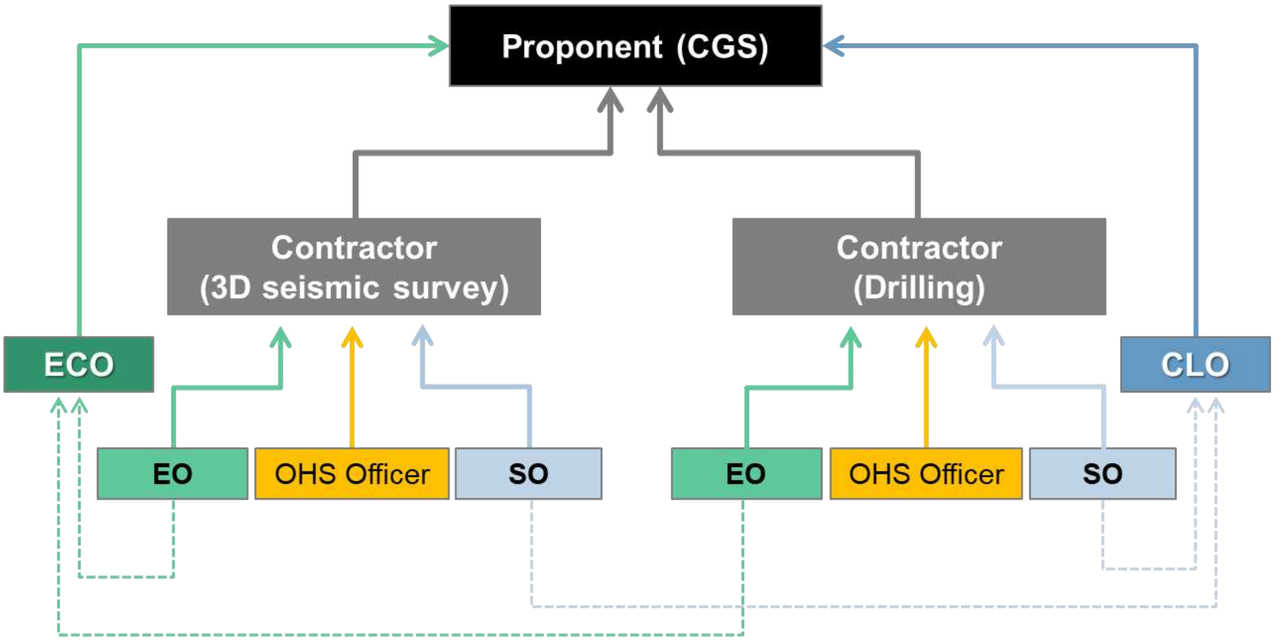


Figure 94: Reporting lines of officers involved in the Project

8.4.2 CGS

As the project proponent, CGS is ultimately responsible for the implementation of the ESMP. CGS is further responsible for ensuring that the CCUS Project complies with all relevant environmental legislation.

Key responsibilities of CGS include the following:

- To be fully conversant with the findings of the ESIA;
- To ensure that all stipulations within the ESMP are adhered by the Contractors;
- To issue site instructions to the Contractors for corrective actions required;
- To monitor the implementation of the ESMP throughout the project; and
- To ensure that periodic environmental performance monitoring is undertaken.

Designated representatives from CGS that will be involved with the above tasks will include a Project Manager and Site Supervisor.

8.4.3 Contractors

8.4.3.1 Contractors' Duties

Separate Contractors will be appointed by the CGS to undertake the 3D seismic survey and drilling. In order to carry out the requirements of this ESMP, the Contractors must make sure that they have a clear understanding of all environmental matters relating to the project.

The responsibilities of the Contractor will, as a minimum, include the following:

- To implement the ESMP;
- To employ a suitably qualified person to monitor and report to the CGS' appointed person on the daily activities on-site during the execution of the project;
- To ensure all sub-contractors under their supervision adhere to the ESMP;
- To report any non-compliance to the CGS;
- To report any non-compliance event that constitutes an emergency immediately and in line with the protocol applicable to that particular emergency event;
- To ensure that all employees and sub-contractors attend the Environmental Awareness Training and subsequent refresher training, and are familiar with or made aware of the contents of the ESMP; and
- To conduct any remedial work required in terms of the ESMP as a result of environmental negligence, mismanagement and/or non-compliance.

8.4.3.2 Contractors' Environmental & Social Officers

The Environmental Officer (EO) and Social Officer (SO) for each Contractor are responsible for all activities related to the day-to-day on-site implementation of the ESMP. They are also responsible for the compilation of regular (daily, weekly and monthly) Monitoring Reports for the CGS.

The EO and SO must liaise with the CGS PM on all environmental and social related issues (when necessary) and ensure that any complaints received from the public are recorded and dealt with appropriately and expeditiously.

8.4.3.3 Contractors' OHS Officers

Each Contractor will appoint an OHS Officer who will be responsible for implementing and administering all OHS procedures that are relevant to the Project. This will include ensuring compliance with the OHSA, as well as the relevant regulations.

8.4.4 Environmental Control Officer

The Environmental Control Officer (ECO) is directly appointed by CGS. The role of the ECO is primarily to act as an independent monitor for the implementation of the 3D seismic survey and drilling, in accordance with the requirements of the ESMP. The ECO must be competent to fulfill this duty.

The responsibilities of the ECO include the following:

- To be aware of the findings and conclusions of the ESIA;
- To be familiar with the environmental and social management requirements contained in this ESMP;
- To be conversant with relevant environmental legislation, policies and procedures governing the Project;
- To monitor and review the progress towards achieving the specific objectives and performance targets of the ESMP;
- To independently verify that mitigation measures in the ESMP are being applied / implemented; and
- To review the monitoring and auditing undertaken for the Project, as discussed in Sections 8.10.2.2 and 8.10.2.3 below.

8.4.5 Community Liaison Officer

The Community Liaison Officer (CLO) is directly appointed by CGS. The CLO's duties include the following:

- To manage relations with the community and institutional stakeholders;
- To manage the GRM;
- To undertake a weekly grievance review; and
- To organise, manage and monitor all communication mechanisms identified within the SEP;

The CLO must be competent to fulfill the above duties.

8.5 Grievance Redress Mechanism

A grievance is regarded as a concern or complaint (real or perceived) raised by a stakeholder in connection with the 3D seismic survey and stratigraphic drilling as part of the CCUS Pilot Project. Managing grievances is a critical component of effective stakeholder engagement.

The GRM for the Project is the process for publicising, receiving, evaluating, and addressing project-related grievances. As mentioned, the CLO will be responsible for overseeing the GRM.

An outline of the key elements of the GRM are shown in Figure 95 below. An explanation of these elements follows thereafter.

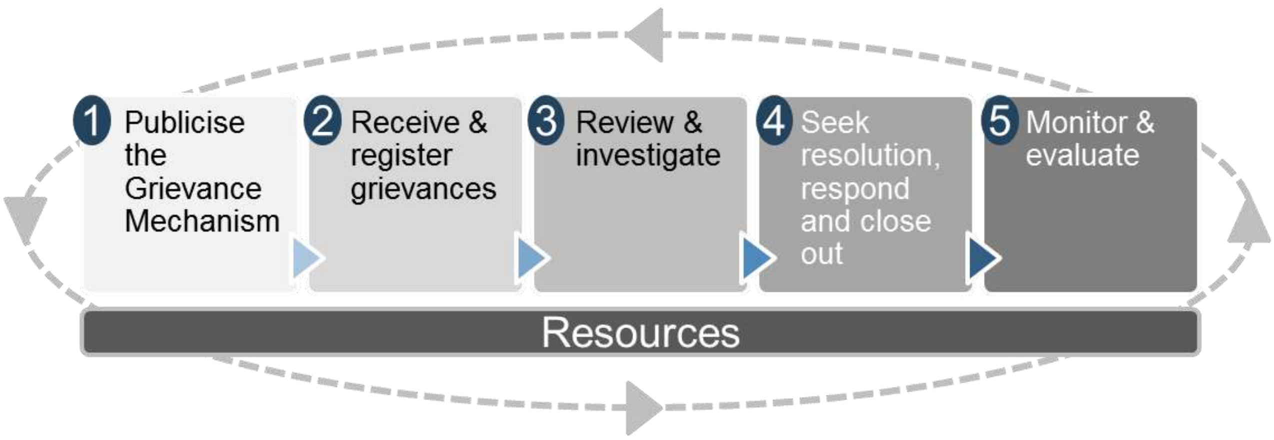


Figure 95: Key elements of the Project's GRM

- **STEP 1:** Publicise the grievance mechanism –
  - Means through which the grievance mechanism can be introduced to the stakeholders via direct notification (via emails, letters, SMS, etc.), website, social media, and community meetings.
  - Information to share regarding the grievance mechanism should include –
    - Where, when and how grievances can be lodged;
    - To whom should grievances be sent; and
    - An overview of the procedure to manage grievances.
  - Care must be taken to overcome language barriers and levels of understanding when broadcasting the grievance process. The local languages of isiZulu and Afrikaans must be used in the communication with local stakeholders, as relevant.
  - It is best to generate proof of notification, as far as possible.

- **STEP 2:** Receive and register grievances –
  - Channels for receiving grievances include telephone calls, emails, letters and website.
  - Grievances will be received, administered and tracked by the CLO. This party will coordinate the corrective actions and responses with the responsible members of the project team.
  - All complaints received will be recorded electronically in a Grievance Register. Information to log in the register includes a reference number, particulars of the complainant, date of receipt, details of the grievance, date acknowledged, response

from the project team, date closed, etc. The entries into the register can be linked to supporting documents and statements.

- Grievances will be acknowledged as soon as possible (preferably within 48 hours) and a written confirmation will be provided to the complainant with a reference number and a timeline for a response (depending on the nature of the grievance).
- The status (record of progress) of grievances will be tracked.

❑ **STEP 3:** Screen and assess grievances –

- Grievances will be screened, validated and categorised (from minor with simple resolution options to complex with more in-depth investigations).
- Tasks to be undertaken as part of the investigation include the following –
  - Identify parties to provide responses / investigate grievances and seek appropriate resolution;
  - Conduct a site visit or arrange a meeting with the complainant, if required; and
  - Log outcome of investigation.

❑ **STEP 4:** Seek resolution, respond and close out –

- Following the review and investigation of the grievance, resolution options will be sought. The process involved is shown in Figure 96 below.
- It is best to generate proof of corrective actions (e.g., photographic or documented evidence, written confirmation of complainant's acceptance of the resolution, etc.).

❑ **STEP 5:** Monitor and evaluate –

- Track grievance statistics, based on records generated during the process, to ascertain the overall effectiveness of the Project's grievance mechanism.
- Monitoring measures need to be proportionate to the type and severity of the grievances, and include the following –
  - Monitor the types and number of grievances, causes, recurring complaints, profile of complainants, number of complaints resolved / unresolved and corrective actions taken;
  - Review the appropriateness of the grievance mechanism as and when required (at least on a bi-annual basis); and
  - Conduct follow-up interviews with individual complainants.

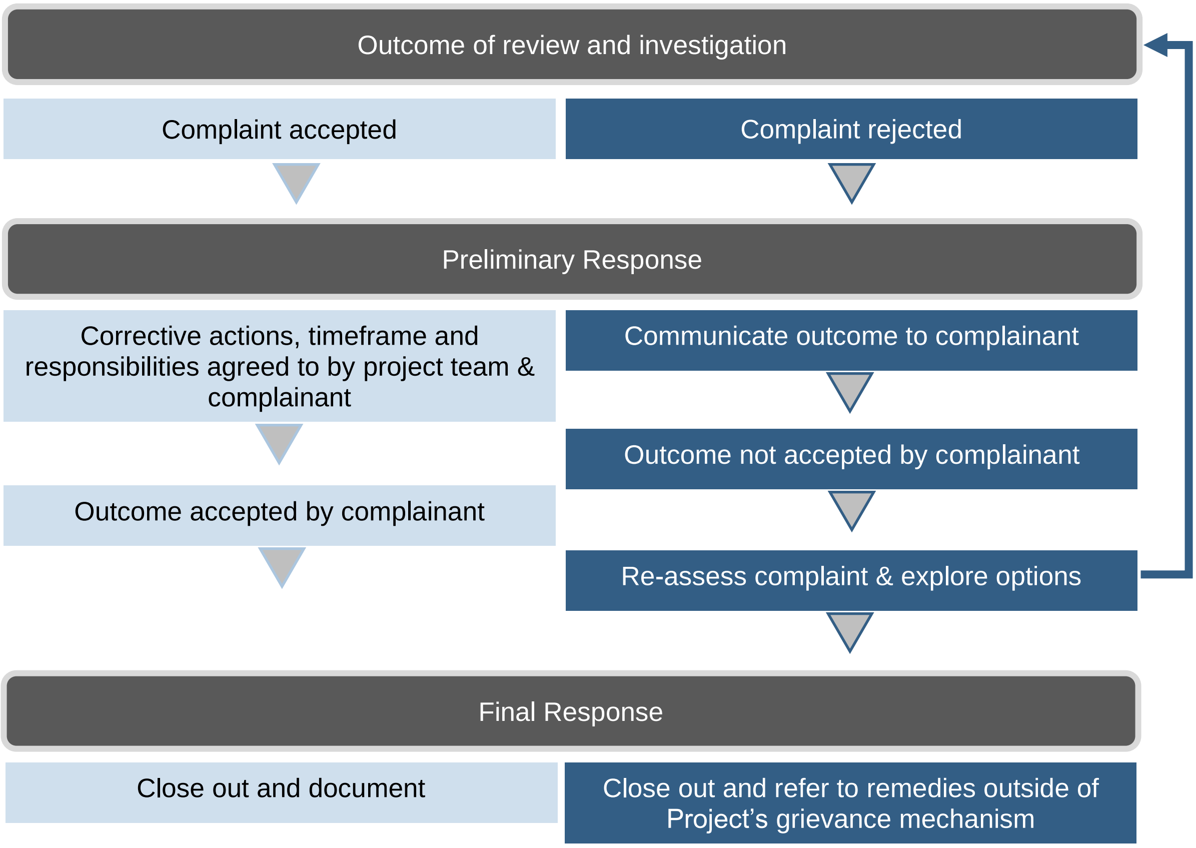


Figure 96: Process to develop resolution options, prepare a response and close out grievances (adapted from WBG, 2007b)

8.6 Summary of Potentially Significant Adverse Environmental Impacts

Table 32 below provides a summary of the potentially significant environmental and social impacts associated with the project.

Table 32: Summary of potential environmental and social impacts associated with the Project

Themes	Potential Significant Environmental & Social Risks & Impacts
Groundwater	• Contamination of groundwater by hazardous substances, waste and wastewater. • Mixing of aquifers may adversely affect groundwater resources. • Groundwater contamination from drilling fluid. • Water wastage. • Impact on groundwater resource volumes. • Compaction of near-surface springs. • Damage to boreholes and associated infrastructure. • Surface vibrations close to boreholes. • Drilling into high yielding confined aquifers. • Drilling into natural gas pockets.
Topography	• Damage to topographic features.
Surface Water	• Damage to structure and functioning of watercourses at vehicle crossings, including loss of vegetation, damage to channel morphology, compaction of wetland soils. • Loss of species that utilise watercourses.

Themes	Potential Significant Environmental & Social Risks & Impacts
	• Temporary increase in turbidity of watercourses from run-off over disturbed areas. • Reduction of water quality in watercourses that receive run-off from contaminated areas. • Livestock that drink surface water contaminated by the project's activities may be adversely affected. • Informal areas occur in certain parts of Leandra. People that do not have access to potable water and who use surface water contaminated by the project's activities may be adversely affected.
Soil	• Soil erosion may occur from disturbance caused by the movement of the vibroseis trucks and other vehicles. • Wheel ruts caused by equipment on wet/saturated soils may channel run-off and increase rill erosion. • Compaction of soils by heavy equipment and vehicles along survey transects, access roads and tracks. • Increase of sediment loads to watercourses from run-off over areas disturbed by the project's activities. • Ponding may impede certain activities to be carried out during rains. • Soil may be polluted by poor storage or handling of material, spillages and inadequate housekeeping practices. • Loss of topsoil at areas to be cleared (drill area, site camp and parking area).
Air Quality	• Adverse health effects to the surrounding community, sensitive animals and crews undertaking the survey and drilling activities. • Impacts of dust settling on crops.
Land Use	• Loss of crops. • Risks to livestock. • Disruption of traffic and human movement. • Disturbances (noise and vibration).
Terrestrial Biodiversity	• Loss, disturbance or displacement of flora and fauna species, including SCC. • Destruction, fragmentation and degradation of habitats and ecosystems. • Mortality/displacement of ground living mammals due to vibrations from seismic survey vehicles. • Human - animal conflicts. • Soil compaction and impacts to plant regrowth. • Soil erosion. • Disruption/alteration of species activities (breeding, migration, feeding) due to noise and vibration. • Influence to animal movement. • Nights lights may adversely affect nocturnal faunal species. • Illegal harvesting and poaching of faunal and floral species by survey and drilling crews. • Proliferation of invasive alien species in disturbed areas. • Pollution of the biophysical environment, with adverse effects to flora and fauna.
Noise & Vibration	• Disturbance to surrounding communities, fauna and livestock. • OHS risks. • Vibration may impact of the stability of structures in proximity to the vibroseis trucks. • Underground services can be impacted by vibration caused by the vibroseis trucks.
Heritage & Palaeontology	• Damage to existing historical resources or remains. • Damage to unidentified graves. • Damage to fossils in the bedrock.
Visual Resources	• Scars in landscape caused by survey transects in natural areas and cleared areas. • Visual impacts caused by drill site and site camp. • Light pollution due to night lighting at drill site and site camp.
Socio-Economic Environment	• Noise, vibration and dust pollution. • Presence of construction workers. • Increased risk of HIV. • Quality of housing (risk of damage from vibroseis trucks). • Social and community infrastructure disruption. • Affects to daily life. • Employment opportunities.

Themes	Potential Significant Environmental & Social Risks & Impacts
	• Corruption. • Extortion. • Disparities in workforce.
Hazardous Materials & Waste	• Risk to human health (occupational and community health and safety). • Pollution of soil, groundwater and surface water. • Risk to plant life. • Risk to health and wildlife and livestock. • Malodours. • Compromised aesthetics (e.g., poor storage, windblown litter). • Vermin.
Transportation	• Disruptions to traffic. • Deterioration of roads used by vibroseis trucks and support vehicles. • Difficulty with using narrow gravel roads in certain parts of Leandra. • Damage to existing watercourse crossings that are unable to carry the weight of the vibroseis trucks. • Safety risk to vehicles travelling on R29 from drill rig, vibroseis trucks and support vehicles accessing and leaving the drill area and site camp. • Risks to road users, pedestrians and livestock from survey equipment and support vehicles.
Occupational Health & Safety	• Risk of work-related diseases, injuries or mortality.
Community Health & Safety	• Human health risks and degradation / loss of resources used by local communities caused by project-related pollution. • Accidents (e.g., traffic incidents) occurring during project that involve communities and their animals and livestock. • Impacts of project’s security on local communities; • Spread of communicable diseases by project workers to the local communities. • Transfer of STIs from in-migrants and workforce to community. • Potential exposure to vector-related diseases. • Increased competition for the direct and indirect economic opportunities created by the project (labour Influx). • GBV and SEA/SH regarding community members. • Forced labour and child labour. • Risks to vulnerable and marginalised groups (including informal settlements in Leandra). • Community unrest.

8.7 Management Plans

8.7.1 Introduction

The following Management Plans were prepared for the Project:

- General Management Plan (see Section 8.7.2 below), which contains mitigation measures to address general aspects and impacts associated with the Project; and
- Thematic Management Plans, which include discipline-specific mitigation and monitoring measures covering the following topics based on the sources of potentially significant environmental and social impacts –
  - Air Quality Management Plan (Appendix A);
  - Noise and Vibration Management Plan (Appendix B);
  - Groundwater Management Plan (Appendix C);
  - Surface Water Management Plan (Appendix D);
  - Waste Management Plan (Appendix E);
  - Erosion Control Management Plan (Appendix F);

- Hazardous Materials Management Plan (Appendix G);
- Community Health, Safety and Security Management Plan (Appendix H);
- Traffic Management Plan (Appendix I);
- Heritage Resources Management Plan (Appendix J);
- Rehabilitation Plan (Appendix K); and
- Emergency Response Plan (Appendix L).

8.7.2 General Management Plan

The General Management Plan is contained in Table 33 below.

The framework for the management measures presented in the plan consists of the following:

- **Management objectives** – desired outcome of management measures for mitigating negative impacts and enhancing the positive impacts related to project activities and aspects (i.e., risk sources);
- **Targets** – level of performance to accomplish management objectives;
- **Management actions** – practical actions aimed at achieving management objectives and targets;
- **Responsibilities** for implementing the management actions;
- **Monitoring requirements** for checking compliance with management actions; and
- **Implementation Timeframe** for achieving the management objectives and executing the management actions.

Note that it is expected that the management requirements for the 3D seismic survey and drilling will be supplemented following the design phase of the project.

Table 33: General Management Plan

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
1.	Administrative Requirements	• Ensure that all administrative measures and arrangements associated with the compliance with the ESMP are in place. • Compliance with legal requirements.	• Administrative measures and arrangements are confirmed, checked and maintained. • Document control procedure is in place.	• Financial provision is made for the implementation of mitigation measures contained in the ESMP. Differentiate between those requirements that relate to CGS and the Contractors. • Document control procedure is to be provided and adhered to. • Filing system is to be provided and maintained. • Maintain register of permits, licences, authorisations, notifications and consents (as relevant).	• CGS – administrative provisions for compliance. • ECO - to monitor compliance. • Contractors – administrative provisions for compliance.	• Document control procedure. • Filing systems. • Financial provisions (e.g., bill of quantities, budgets, etc.).	• Throughout the duration of the project.
2.	Monitoring Requirements	• Check compliance with the ESMP.	• Periodic compliance monitoring. • Identify and mitigate unforeseen impacts and risks.	• Verify compliance on a weekly basis for the duration of the construction phase. • Monitor the effectiveness of the mitigation of impacts. • Establish a procedure for the identification and mitigation of unforeseen risks and impacts.	• ECO to monitor compliance with the ESMP.	• Weekly compliance monitoring report.	• Throughout the duration of the project.
3.	Stakeholder Engagement	• Refer to the provisions in the SEP.					• Throughout the duration of the project.
4.	Environmental Awareness Creation	• Ensure that the Contractor, survey and drilling crews, and site personnel are aware of the relevant provisions of the ESMP.	• All project workers have completed appropriate environmental training before being allowed on the site. • A record of environmental training undertaken is to be kept on site.	• Competency and Training Plan to be developed. • The Contractors will arrange that all of their employees and those of his sub-contractors go through the project specific environmental awareness training courses before the commencement of work and as and when new staff or sub-contractors are brought on site. • The environmental training is compulsory for all project workers and structured in accordance with their relevant rank, level and responsibility, as they apply to the works and site.	• ECO - to monitor compliance. • Contractors to implement management actions.	• Competency and Training Plan. • Records of environmental training and awareness creation.	• Throughout the duration of the project.
5.	Site Planning – Drill Site Layout	• Proper planning of the layout of the drill site and	• No negative impacts to sensitive environmental	• Prior to the seismic survey commencing, pre-planning surveys	• ECO - to monitor compliance.	• Photographic record as part of	• Prior to the establishment

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
	and Survey Grid	camp site to ensure protection of the environment. • Proper planning of the seismic survey grid to avoid sensitive environmental and social features.	features as a result of poor site planning and layout.	will be undertaken. These activities will inform the seismic survey design, including further informing the positioning of survey lines. • The Contractor for the 3D seismic survey is to produce a grid plan for the approval of CGS prior to the establishment of the site, which aims to identify the survey activities in relation to the receiving environment. The grid plan will show the following (as relevant): ○ Access points to private land (farms); ○ Access routes; ○ Sensitive environmental features (based on the ESIA); ○ Road crossing; ○ Areas that pose constraints to the movement of the vibroseis trucks; ○ Areas with erosion risk; and ○ Any other activities, facilities and structures deemed relevant. • Appropriate safety distances between the seismic sources and sensitive environmental and social receptors, as well as infrastructure and structures, shall be calculated using standard operating procedures and project specific parameters prior to the survey. • The Contractor for the drilling is to produce a site plan for approval by CGS prior to the establishment of the site, which aims to identify drilling activities, facilities and structures in relation to the receiving environment. The plan will show the following (as relevant): ○ Buildings and structures; ○ Laydown area; ○ Site offices; ○ Site laboratories; ○ Access route;	• Contractor to implement management actions.	the pre-construction survey of areas to be affected by construction activities. • Approved site plan. • Barricading and signage. • Records of awareness creation.	of the drill site and mobilisation of the seismic survey.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				○ Drainage; ○ Gate and fence; ○ Firebreak; ○ Topsoil stockpiles; ○ Material stores; ○ Workshop; ○ Basic services, including water, sanitation, electricity, and health care; ○ Waste management facilities (non-hazardous and hazardous waste storage areas); ○ Kitchen facilities; ○ Security; ○ Parking area; ○ Wash bay; ○ Fuel storage area; ○ Hazardous substance stores; ○ Sensitive environmental features (based on the ESIA); ○ Drainage lines; ○ Servitudes (R29, railway line); ○ Any other activities, facilities and structures deemed relevant.			
6.	Design - Drilling	• The well at the drill site must be designed to ensure that it is constructed, equipped, commissioned, operated, and decommissioned in a manner that provides for the control of the well at all times and must prevent risks to the groundwater resources and risks to health and safety of persons from the well or anything in the well, or in strata to which the well is connected.	• No contamination of aquifer from drilling. • No impacts to groundwater users from drilling.	• The proposed well design shall conform to construction standards, and it will be ensured that well integrity is maintained. • Refer to management actions for groundwater.	• CGS to approve the Contractor's well design. • ECO - to monitor compliance. • Contractor to implement management actions.	• Approved well design. • Groundwater monitoring programme.	• Prior to the establishment of the drill site for the project.
7.	Community Health, Safety and Security	• Refer to measures contained under the following: ○ Management of Labour Force; ○ Management of OHS; and ○ Community Health, Safety and Security Management Plan (Appendix H).					• Throughout the duration of the project.
8.	Site Clearing	• Manage environmental impacts associated with site clearing. Ensure that only	• No damage is caused to sensitive environmental features outside of the	• Restrict site clearing activities to the demarcated drill site, camp area and parking area.	• ECO - to monitor compliance.	• Approved site plan.	• Prior to and during clearing of any

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
		areas that are specifically required for the seismic survey and drilling are cleared.	demarcated drill site, camp area and parking area.	• Avoid any disturbance to sensitive environmental features, as relevant.	• Contractor to implement management actions.	• No clearing outside of construction domain. • Intact barricading of sensitive environmental features. • Grievance mechanism. • Contractor's method statement.	construction site.
9.	Site Establishment	• Minimise negative environmental impacts associated with site establishment.	• No damage to sensitive environmental features outside demarcated construction areas during site establishment. • Site layout endorsed by Engineer. • No access or encroachment into no-go areas. • No justifiable complaints regarding general disturbance and nuisance received from the affected stakeholders and community members.	• The Contractor is to produce a site plan for the approval by the Engineer prior to the establishment of the site, which aims to identify construction activities, facilities and structures in relation to sensitive environmental features. This plan will serve as a spatial tool that facilitates the execution of the construction phase with due consideration of sensitive environmental features. • Facilities and structures will be located with due cognisance of the terrain and geographical features of the project site. • Positioning of the storage and lay-down areas will aim to minimise visual impacts. • Maintain barricading around sensitive environmental features until the cessation of construction works. • Control the movement of all vehicles and plant (including suppliers), such that they remain on designated routes. • Minimise public disturbance from lighting of the site. For example, proper design of the placing (zones), height, type, direction (inward rather than outward) and intensity of	• ECO - to monitor compliance. • Contractor to implement management actions.	• Approved site plan. • Intact barricading. • Grievance mechanism. • Contractor's method statement. • Secured drill site.	• Prior to and during site establishment.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				floodlights, without compromising safety. • Land required for construction will be acquired in accordance with statutory requirements.			
10.	Land Use	• Minimise negative environmental impacts to the land use in the project area.	• No unwarranted disturbance to land use in the project area. • No loss of crops. • No damage to structures and infrastructure. • No complaints related to poor access control and unauthorised access.	• Pre-planning surveys will be undertaken prior to the seismic survey to inform the seismic survey design. This will include informing the positioning of survey lines. • Identify and avoid potentially sensitive infrastructure (including cultivated areas, below ground services and utilities, etc.). • Take photographs of structures in proximity to survey lines and drill site to monitor future disturbances from seismic survey and drilling. • Once complete, the survey design will be communicated to the local community, custodians of infrastructure and stakeholders. • Adhere to set protocol for entering farms. • Maintain access control to all private property. • Notify affected landowners / tenants / occupiers before entering private property. • Prevent any disturbances to fences as far as practicable. If a fence needs to be crossed, it would be let down or cut (as determined by the owner), crossed, and immediately repaired thereafter. • Structures and infrastructure in the survey area must be left in the same state or better than it was before the commencement of any survey activities. Any damage caused by the seismic survey must be repaired. • Project workers must maintain a safe distance between the vibroseis trucks and people and livestock moving in	• ECO - to monitor compliance. • Contractor to implement management actions.	• Approved site plan. • Photographic record as part of the pre-construction survey of structures in proximity to survey lines. • Grievance mechanism. • Records of awareness creation. • See relevant thematic management plans.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				the vacant areas where the seismic survey is planned. • Refer to measures contained under the following: ○ Air Quality Management Plan (Appendix A); ○ Noise and Vibration Management Plan (Appendix B); ○ Groundwater Management Plan (Appendix C); ○ Waste Management Plan (Appendix E); ○ Erosion Control Management Plan (Appendix F); ○ Hazardous Materials Management Plan (Appendix G); ○ Community Health, Safety and Security Management Plan (Appendix H); ○ Traffic Management Plan (Appendix I); and ○ Rehabilitation Plan (Appendix K). ○ Management of OHS.			
11.	Flora and Fauna	• Manage impacts to indigenous flora species within the construction domain. • Control alien plants and noxious weeds. • Ensure the protection of animals (including wildlife and livestock).	• No unpermitted disturbance to SCC. • Ongoing eradication of alien plants and noxious weeds. • No harm to animals from construction activities.	• A suitably qualified and South African Council for Natural Scientific Professions (SACNASP) registered Terrestrial Ecologist will undertake walkdown survey of transect lines in sensitive areas prior to survey to identify areas where SCC may occur. Plan and design seismic survey transects to avoid sensitive areas from a terrestrial biodiversity perspective. • Where SCC cannot be avoided, a Plant and Animal Rescue Plan shall be prepared by a suitably qualified and SACNASP registered Terrestrial Ecologist. All necessary permits need to be in place if SCC are to be relocated or disturbed, as relevant. • Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Approved site plan. • Grievance mechanism. • Records of awareness creation. • Rehabilitation monitoring.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				• Minimise unnecessary clearing of vegetation beyond the drill area, site camp and parking area. • Manage invasive alien plants in areas disturbed by the seismic survey and drilling activities and prevent them from spreading to adjacent areas. Ensure that the control of these plants is undertaken by suitable contractors using appropriate methods such hoeing, hand pulling, digging, mowing or herbicide applications. The use of any pesticides or herbicides shall not have negative impacts on the surrounding environment. • Create awareness amongst project workers regarding the safeguarding of plants and animals, as well as ecosystems. • No wilful harming of any wildlife or poaching will be tolerated. • No site fires will be allowed. • Project workers must maintain a safe distance between the vibroseis trucks and the livestock moving in the vacant areas where the seismic survey is planned. • Reinstate and rehabilitate disturbed areas (including survey transects, drill area, site camp and parking area). Set targets for vegetative coverage that need to be achieved.			
12.	Existing Services and Infrastructure	• Prevent impacts to existing services and infrastructure. • Adhere to agreements made with owners/custodians of the services (e.g., Transnet – railway line, Eskom – power lines, DPWRT – access from R29, etc.).	• No unwarranted complaints regarding adverse impacts to existing services and infrastructure. • No adverse impacts to existing services and infrastructure.	• Contractor to determine safety distances between seismic sources and existing infrastructure prior to the survey in line with relevant guidelines and standards. • Conform to requirements of relevant service providers. Agreements to be in place.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Grievance mechanism. • Contractor's method statement. • Agreements with owners of services (wayleaves, as relevant).	• Prior to commencement of work and throughout the duration of the project.
13.	Access and Traffic	• Ensure that all equipment and vehicles required to undertake the seismic	• No reports of project equipment and vehicles	• Implementation of measures contained in the Traffic Management Plan (Appendix I).	• ECO - to monitor compliance.	• See Traffic Management	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
		survey and drilling only use dedicated and suitable access routes. • Ensure the safety of all road users by implementing proper traffic control measures. • Ensure proper access control. • Prevent unlawful access to the drill site. • Adhere to agreements made with authorities and landowners regarding the use of the access road, as relevant.	using unauthorised routes. • No transporting of unsafe loads. • No speeding. • No accidents.		• Contractor to implement management actions.	Plan (Appendix I).	
14.	Labour Force	• Ensure suitable management of the labour force to prevent security-related issues or disturbance to stakeholders and community members. • Optimise the use of local labour, where possible. • Provide a work environment that is conducive to effective labour relations.	• No complaints from stakeholders and community members regarding trespassing or misconduct by labour force. • All unskilled labour to be sourced from local area.	• Implementation of measures contained in the Human Resources policies and procedures, as well as Labour Plan. • Prohibit unauthorised access of project workers on private property. • Project workers will be provided with identity cards and will wear identifiable clothing. • Creating nuisances and disturbances in or near communities will be prohibited. • Machine / vehicle operators will receive clear instructions to remain within demarcated access routes. • Designated smoking areas will be provided, with special bins for discarding of cigarette butts. • Establish a 'labour and employment desk' in consultation with local authorities. • Use local labour as far as possible, where necessary (e.g., unskilled labour). • Implement applicable training of labour to benefit individuals beyond completion of the project. • Prevent loitering within the vicinity of the site.	• As per Human Resources policies and procedures.	• As per Human Resources policies and procedures, as well as Labour Plan. • See relevant thematic management plans. • Grievance mechanism. • Records of awareness creation. • See Community Health, Safety and Security Management Plan (Appendix H).	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe

				• Ensure the infrastructure and social facilities within Leandra will not be compromised with the arrival of additional people into the area.
				• All employment of locally sourced labour will be controlled on a contractual basis.
				• People in search of work may move into the area, however, the project will create a limited number of job opportunities. Locally based people will be given opportunities and preferences over others.
				• No staff accommodation will be allowed on site, apart from security personnel.
				• Refer to measures contained under the following:
				  ○ Management of OHS; and
				  ○ Community Health, Safety and Security Management Plan (Appendix H).			

15.	OHS	• Provide a safe working environment to project workers and the public.	• No incidents. • Compliance with the local OHS legislation. • OHS Management System.	• Contractors for seismic survey and drilling to prepare OHS Management Plans (including risk assessments and safe working procedures) and to implement OHS Systems consistent with the requirements of the OHSA. • Undertake OHS training with project workers. • Contractors to provide project workers with appropriate Personal Protective Equipment (PPE) in conjunction with training, use, and maintenance of the PPE. • Contractors to conduct OHS orientation training to all new employees and to provide visitor orientation. • Contractors to prepare a project-specific Emergency Response Plan. • Ensure the safety of the public. Maintain access control to prevent access of the public to the drill site.	• Safety Officer - to monitor compliance. • Contractor to implement management actions.	• Approved OHS Management Plans • OHS Management System. • Training records. • Risk Assessment. • Toolbox talks register. • Induction register.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe

				• Main safe distance between vibroseis trucks and the community.
				• Use approved communication channels to inform the community of OHS measures to prevent incidents involving community members.
				• Applicable notice boards and hazard warning notices will be put in place and secured.
				• Emergency contact details will be prominently displayed.
				• Contractors to prepare Standard Operating Procedures for the following (amongst others):
				  ○ Investigating and reporting on incidents and near misses;
				  ○ Managing flammables storage areas;
				  ○ Classifying and labelling of hazardous substances and dangerous goods;
				  ○ Preventing hazards associated with electrical and mechanical equipment;
				  ○ Requirements for vehicle accident prevention to include the broader risks of community and site transportation safety;
				  ○ Stacking and storage;
				  ○ Fall prevention and protection measures;
				  ○ Rigging; and
				  ○ Safeguarding existing infrastructure and structures.			

16.	Laydown Area	• Minimise environmental impacts associated with the laydown area.	• No environmental contamination associated with laydown area. • Minimise visual impact associated with laydown area.	• Erect suitable fencing around the drill site. • Provide essential services (including appropriate sanitation and drinking water facilities) at the laydown area. Maintain essential services in a functional state. • Provide adequate parking for site staff and visitors. • The laydown area is to avoid all drainage lines.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Approved site plan. • Contractor's method statement. • Disposal certificates. • Approved de-establishment plan.	• Period from when the laydown area is created up to de-establishment.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				• Open uncontrolled fires will be forbidden. • Eating areas will be designated and demarcated. • Sufficient vermin / weatherproof bins will be present in this area for all waste material. • Ensure that wastewater is appropriately disposed of. • Locate all storage areas and material laydown sites within predetermined zones as per the approved site plan. • Keep the laydown area secure and neat at all times. • Employ appropriate access control measures. • Suitable security to be provided at the laydown area. • Manage stormwater from laydown area to avoid environmental contamination and erosion. • Prohibit the felling of trees for firewood. • Provide medical and first aid facilities at the laydown area. • Prepare de-establishment plan for laydown area for approval by the CGS Project Manager.			
17.	Ablution Facilities	• Minimise environmental impacts associated with ablution facilities.	• No environmental contamination associated with ablution facilities. • Minimise visual impact associated with ablution facilities.	• Provide sufficient ablution facilities (1 per 15 workers) (e.g., chemical toilets), which conform to all relevant health and safety standards and codes. • No pit latrines, french drain systems or soak away systems will be allowed. • Toilets may not be situated within 50m of any water body. • A sufficient number of toilets will be provided to accommodate the number of personnel working in any given area. • All temporary / portable / mobile toilets will be secured to the ground to prevent them from toppling over due to wind or any other cause.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Maintenance register for ablution facilities. • Waste disposal certificates. • Contractor's method statement.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				• Ensure the proper utilisation, maintenance and management of toilet, wash and waste facilities. • The entrances to the toilets will be adequately screened from public view. • Toilet facilities will be maintained in a hygienic state and serviced regularly. • Toilet paper will be provided. • The Contractor will ensure that no spillage occurs when the toilets are cleaned or emptied and that a licensed service provider removes the contents from site. Disposal of such waste is only acceptable at a licensed waste disposal facility.			
18.	Waste and Wastewater	• Refer to the provisions in the Waste Management Plan (Appendix E).					• Throughout the duration of the project.
19.	Visual Resources	• Minimise impacts to the aesthetics / visual quality. • Ensure that the visual appearance of the construction site is not an eyesore the adjacent areas.	• No complaints regarding impacts to visual quality.	• Minimise unnecessary clearing of vegetation beyond the drill area, site camp and parking area. • Ensure that waste generated during seismic survey and drilling is properly managed. • The camp site and waste management facilities are to be shielded / screened to minimize visual impacts, where practicable. • Undertake on-going housekeeping during project activities to maintain a tidy site. • Position and type of lighting to be used at the drill site will be planned to ensure that unnecessary light pollution will be eliminated. All lighting installed on site must not lead to unacceptable light pollution to the surrounding community and natural environment. • Following cessation of seismic survey and drilling, the areas disturbed will be suitably rehabilitated. • Rehabilitate temporary access roads that are no longer to be used.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Grievance mechanism. • Contractor's method statement.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
20.	Socio-Economic Environment	• Provide a safe working environment to construction workers and the public. • All necessary precautions linked to the spread of disease are taken.	• Labour targets to be determined. • No incidents of diseases caused by project workers. • No incidents of corruption or extortion by project workers.	• Ensure that considerable effort is taken to include the community in the appointment of construction workers through the ward councillors and traditional leaders • Ensure that there is a list made available to the ward councillors of those who are employed to work on the site, to accommodate community safety. • Ensure an HIV policy is devised for the project site. • Make information readily accessible. • Make condoms readily available. • Promote counselling options to account for risk behaviour. • Ensure site manager has HIV training certificate. • Ensure that community housing or other buildings are not within the surface vibration radius of the Vibroseis trucks and the borehole drilling rig, to ensure that the quality of housing and other buildings in the communities is not negatively impacted. • Ensure that there is adequate and timely information made available to businesses likely to be affected by project activity. • Ensure that all effort is taken to prevent substantial impacts on the daily lives of the community. • There should be a concerted effort made to work with ward councillors to create equitable opportunities for local employment. • Where possible, ward councillors should be engaged on the importance of utilising the project to educate youth about careers in the project industry. • Strictly follow the employment policy for the project. • Report irregular processes.	• ECO and CLO - monitor compliance. • Contractor - implement management actions.	• Grievance mechanism. • Training records. • Visual inspection. • Proof of engagement with stakeholders. • Labour records.	• Throughout the duration of the project.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				• Ensure that there is a policy to deal with situations such as these. • Ensure that construction workers know to report to the most senior member of the project if such a situation arises. • Ensure that construction workers are protected. • Ensure that a fair policy is designed to account for opportunities being made available to women workers. • Ensure that women who do work on the project feel and are protected at all times. • Ensure that there are separate toilet facilities for women and that the separation is respected.			
21.	Resource Efficiency	• Promote the sustainable use of resources.	• No undue wastage of water, energy or material.	• Implement the Water Resources Management Plan, with specific reference to preventing water wastage. • Implement the Waste Management Plan, with specific reference to applying the principles of the waste management hierarchy. • The Contractors are to implement energy saving measures. • Undertake training of resource efficiency with project workers.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Training and awareness creation records. • Contractor's method statement.	• Throughout the duration of the project.
22.	Emergency Response	• Refer to the provisions in the Emergency Response Plan (Appendix L).					
23.	Storage and Handling of Non-Hazardous Materials	• Effective and safe management of materials on site, in order to minimise the impact of non-hazardous materials on the environment.	• No pollution due to handling, use and storage of non-hazardous material. • Adherence to MSDS.	• Materials to be suitably stored to prevent environmental contamination and visual impacts. Storage requirements to be determined based on chemical qualities of material and MSDS. • Where required, stored material to be protected from rain and run-off to avoid environmental contamination. • Materials to be appropriately transported to avoid environmental contamination. • Loose loads (e.g. sand, stone chip, refuse, paper and cement) to be	• ECO - to monitor compliance. • Contractor to implement management actions.	• Evidence of spillages. • MSDS register. • Contractor's method statement.	• Period during which materials are stored and handled on site.

No.	Theme	Objectives	Targets	Management Actions	Responsibilities	Monitoring Requirements / Records	Implementation Timeframe
				covered when vehicles travel on public roads. • Suitable remedial measures, depending on the nature of the contaminant and the receiving environment, to be instituted for spillages. • Materials to be suitably used to prevent environmental contamination.			
24.	Storage and Handling of Hazardous Materials	• Refer to provisions in the Hazardous Materials Management Plan (Appendix G).					• Throughout the duration of the project.
25.	Fire Prevention and Control	• Prevent fires.	• No site fires to be caused by project activities and workers.	• Proper emergency response procedure to be in place for dealing with fires. • Burning of waste is not permitted. • Suitable precautions will be taken (e.g., suitable fire extinguishers) when working with equipment that can causes fires. • All fire control mechanisms (fire-fighting equipment) will be routinely inspected. • All staff on site will be made aware of general fire prevention and control methods. • No fires are allowed on site. • Firebreaks to be made for the drill site, as required. • Dedicated smoking areas to be provided.	• ECO - to monitor compliance. • Contractor to implement management actions.	• Approved Emergency Preparedness and Response Plan. • Training and awareness creation records. • Signage displayed. • Contractor's method statement. • Incident Register and Report.	• Throughout the duration of the project.
26.	Cultural Heritage	• Refer to the provisions in the Heritage Resources Management Plan (Appendix J)					• Throughout the duration of the project.
27.	Reinstatement and Rehabilitation	• Refer to the provisions in the Rehabilitation Plan (Appendix K).					• Throughout the duration of the project, as relevant to the end of site de-establishment.

8.8 Construction Environmental Management Plan

The Contractors for the 3D seismic survey and drilling will each be required to prepare a Construction Environmental Management Plan (CEMP) which show how their environmental and social obligations will be met and which will be approved by CGS.

8.9 Training & Awareness Creation

Training aims to create an understanding of environmental and social management obligations and prescriptive measures governing the execution of the project. It is generally geared towards project team members that require a higher-level of appreciation of the environmental management context and implementation framework for the project.

Awareness creation strives to foster a general attentiveness amongst the seismic survey and drilling crews to sensitive environmental features and an understanding of implementing environmental best practices.

The various means of creating environmental and social awareness during the project may include:

- Induction course for all project workers before commencing work on site;
- Refresher courses (as and when required);
- Daily toolbox talks, focusing on particular environmental issues (task- and area specific);
- Erecting signage and barricading (where necessary) at appropriate points in the project area, highlighting sensitive environmental features (e.g., wetlands); and
- Placing posters containing environmental information at areas frequented by the project workers (e.g., eating facilities).

Key topics to be covered during training and awareness creation shall include, but not be limited, to the following:

- Environmentally sensitive areas;
- Potentially significant environmental impacts related to work activities;
- Mitigation measures to be implemented when carrying out specific activities;
- OHS hazards and safe working procedures;
- Emergency preparedness and response;
- Code of Conduct;
- Procedures to be followed when working near or within sensitive areas;
- Wastewater management;
- Solid waste management;
- Water usage and conservation;
- Sanitation;
- Fire prevention; and
- Disease prevention.

Training and awareness courses must be provided by suitably qualified persons and in a language and medium understood by the project workers.

Training and awareness creation will be tailored to the audience, based on their designated roles and responsibilities. Records will be kept of the type of training and awareness creation provided, as well as containing the details of the attendees.

The Contractors will compile a project-specific Environmental Training and Awareness Programme, taking into consideration the abovementioned factors, to be approved by the CGS Project Manager.

8.10 Monitoring & Auditing Plan

8.10.1 Assurance

Assurance refers to the set of activities and processes by which a project provides stakeholders with accurate information concerning the effectiveness of environmental and social performance. Assurance includes (but is not limited to) the planning of audit and verification activities. Audit activities are formal, structured reviews of effectiveness of implementation of management system elements and compliance with plan requirements. Verification activities relate to internal process and activities which provide confirmation that assurance activities (including audit) have been carried out correctly.

The CGS audit programme includes the following:

- Internal audits -
  - ESMP (weekly);
  - Regulatory compliance (against permits, licenses, authorisations, wayleaves, etc.) (as relevant) (monthly);
  - Other Plans, such as the SEP (based on audit frequencies determined in plans).
- Contractors' Assurance -
  - Review Contractors own audits (fortnightly) and close out;
  - Planned compliance audits of Contractors (weekly); and
  - Responsive checks (informed by non-conformance) (*ad hoc*).
- Verification (internal and Contractors).

8.10.2 Environmental & Social Monitoring

8.10.2.1 Introduction

Monitoring is required to ensure that the receiving environment is suitably safeguarded against the identified potential impacts, and to ensure that the environmental management requirements are adequately implemented and adhered to during the Project.

Monitoring frequency will be sufficient to provide representative data for the parameter being monitored. Monitoring will be conducted by trained individuals (competent in environmental and social management) following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data will be analysed and reviewed at regular intervals and compared with the operating standards, so that any necessary corrective actions can be taken.

8.10.2.2 Baseline Monitoring

Baseline monitoring aims to determine the pre-construction state of the receiving environment and serves as a reference to measure the residual impacts of the project by evaluating the deviation from the baseline conditions and the associated significance of the adverse effects.

The environmental parameters included in the baseline monitoring are shown in Table 34 below.

8.10.2.3 Environmental and Social Monitoring Programmes

Environmental monitoring entails checking at pre-determined frequencies whether thresholds and baseline values for certain environmental parameters are being exceeded. The parameters and sampling localities used during the baseline monitoring will form the basis of the environmental monitoring programmes.

The Environmental Monitoring Programmes, which are to be undertaken by the Contractors during the implementation phase, are shown in Table 34 below. The results from the Environmental Monitoring Programmes must be checked by the CGS and ECO at the same frequency at which the monitoring is undertaken and results are provided, or at regular intervals to determine the success of the mitigation measures and environmental performance and to identify the need for corrective actions.

Table 34: Environmental Monitoring Programmes

Environmental Monitoring Programme	Environmental Parameter	Monitoring Locations	Requirements *	Frequency
Air Quality	Dust	Air Quality Baseline Monitoring Sites	• WBG EHS General Guidelines (2007), Section 1.1 - Air Emissions and Ambient Air Quality. • World Health Organization (WHO) Air Quality Guidelines Global Update, 2005. • National Dust Control Regulations • SA Ambient Air Quality Standards	Weekly
Noise & Vibration	Noise Level Guidelines stated in WBG EHS General Guidelines (2007)	Noise & Vibration Baseline Monitoring Sites	• WBG EHS General Guidelines (2007), Section 1.7 – Noise. • WHO Guidelines for Community Noise, 1999	Weekly

Environmental Monitoring Programme	Environmental Parameter	Monitoring Locations	Requirements *	Frequency
			• SA Noise and Vibration Standards	
Groundwater	Variables stated in SANS 241:2015	Groundwater Baseline Monitoring Sites	Drinking Water Quality Standard (SANS 241:2015)	Monthly
Surface Water	Variables stated in WBG EHS General Guidelines (2007)	As per WBG EHS General Guidelines (2007)	WBG EHS General Guidelines (2007), Section 1.3 - Wastewater and Ambient Water Quality	Monthly

* The most stringent requirements as set out in the list of guidelines, regulations, etc. need to be complied with.

The Project will establish a Monitoring Plan to address the following (as relevant):

- Monitoring during normal operations, abnormal situations and emergency situations (e.g., unexpected spillage of hazardous substance);
- Measuring equipment calibration;
- Adequate quality control of the sampling;
- Use of certified laboratory for analysis and certified methods of testing;
- Legal specifications for testing and sampling, where applicable; and
- A process for identifying and implementing corrective measures.

Additional project elements to be monitored on a weekly basis, or in accordance with the respective management plans, include the following:

1. Groundwater (Appendix C) –
   a. Monitoring of water usage / consumption.
2. Surface water (Appendix D) –
   a. Monitoring of watercourse crossings and rehabilitation.
3. Waste (Appendix E) –
   a. Monitoring of waste inventory and updating, as necessary;
   b. Monitoring of recycling rates; and
   c. Inspection of adequate waste storage practices and facilities.
4. Erosion (Appendix F) –
   a. Undertake visual inspections or following heavy rainfall events of stabilised areas.
5. Hazardous materials (Appendix G) –
   a. Inspection of adequate storage practices and facilities for hazardous materials.

8.10.2.4 Compliance Monitoring and Auditing

Compliance monitoring will commence in the pre-implementation phase, to check compliance with the provisions in the ESMP (including thematic management plans) and the Contractors' CEMP's.

The objectives of compliance monitoring and auditing are to determine the following:

- The ability of the ESMP and CEMP's to sufficiently provide for the mitigation of environmental impacts associated with the project on an ongoing basis; and

- The level of compliance with the provisions of the ESMP and CEMP.

The ECO will undertake weekly inspections of the site, monthly monitoring and biannual full compliance auditing, including an audit at the end of the seismic survey and drilling. These reports will be submitted to the CGS Project Manager.

8.10.3 Reporting

The ESMP and all associated records will be controlled as part of the project's Document Control System to be developed by CGS.

The environmental and social documents include, but are not limited to:

- Copy of the ESMP and all other authorisations;
- Method Statements;
- Site instructions;
- Emergency preparedness and response procedures;
- Emergency contact numbers;
- Record of environmental incidents;
- Photographic records;
- Non-conformance register;
- Toolbox talks register;
- Induction register;
- MSDS register;
- Waste management and disposal register;
- Worker grievance mechanism;
- Community grievance mechanism;
- Training and induction records;
- Records of site meetings;
- Site inspection reports;
- Monitoring reports;
- Auditing reports; and
- Public complaints register.

8.11 Preliminary Implementation Schedule & Cost Estimate

The preliminary implementation schedule for the ESMP, as presented in Table 35 below, needs to be integrated into the overall project schedule for the CCUS 3D seismic survey and drilling.

Table 35: Tentative ESMP Implementation Schedule

No.	Activity	Phase	Timeline
1.	**CGS' Acceptance of ESMP**	Planning	*To be confirmed by the CGS*
2.	**Finalisation of Designs for 3D seismic survey and drilling**	Planning	

No.	Activity	Phase	Timeline
3.	**Inclusion of E&S Requirements in Bid Docs**	Planning	
4.	**Review and approval of Contractors' CEMP**	Planning	
5.	**Mobilisation of Contractors**	Implementation	
6.	**ESMP Implementation**	Implementation	
7.	**Monitoring & Reporting on ESMP Implementation**	Implementation	For the duration of the phase

The estimated costs involved for CGS to implement the ESMP are shown in Table 36 below. The costs for the implementation of the mitigation measures contained in the ESMP that are relevant to the Contractors will be included in their respective contracts. All costs associated with the ESMP will be included in the CCUS Project's overall budget. The cost estimate will be updated following completion of detailed design and prior to the implementation phase.

Table 36: Preliminary ESMP Implementation Costs

No.	Activity	Costs
1.	**Baseline Monitoring**	*Breakdown to be confirmed*
2.	**Environmental Monitoring Programs**	
3.	**Compliance Monitoring & Auditing**	
4.	**Training**	
5.	**Community Relations**	
6.	**Estimated Annual Cost**	
7.	**Estimated cost over Project implementation period**	
	Total	Approximately R4.7 million

CGS and the Contractors Costs will need to determine the costs for implementing specific mitigation measures, such as the following:

- Appointment of parties responsible for environmental, social and OHS duties related to the ESMP, including –
  - CGS – ECO, CLO and OHS personnel; and
  - Contractor – EO, SO and OHS personnel.
- Consultation with landowners/occupiers and agreeing on access control and routes;
- Develop Plan for Local Content to identify and maximise the opportunities to drive value through use of local content and services;
- Planning and designing of seismic survey to avoid sensitive areas (including wetlands, SCC, heritage resources, existing structures and infrastructure, etc.);
- Fencing, marking and protecting sensitive sites in the vicinity of the access roads;
- Maintenance of access roads;
- Management of drilling fluid and cuttings;
- Sanitation facilities at camp site;

- Security at camp site;
- Managing hazardous chemical substances;
- Measures necessary for emergency preparedness;
- Waste management;
- Training and awareness creation;
- Environmental monitoring and auditing during the implementation of the seismic survey and drilling; and
- Rehabilitation of the site.

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APPENDIX A

AIR QUALITY MANAGEMENT PLAN

AIR QUALITY MANAGEMENT PLAN

Potential Sources & Receptors of Impacts

Potential sources of air quality impacts associated with the project may include:

- Emissions from operation of machinery, equipment and vehicles;
- Dust from the use of dirt roads by vibroseis trucks and support vehicles; and
- Dust from bare areas cleared at the drill area, site camp and parking area.

Potential receptors could include people (local community and project workers) and specific fauna.

Management Objectives

Ensure that all possible causes of air pollution associated with the project are mitigated as far as possible to minimise adverse impacts to the surrounding environment.

Targets

- No warranted complaints from the surrounding community regarding air quality deterioration.
- Refer to WBG EHS Guideline Requirements for specific Ambient Air Quality Guidelines, National Dust Control Regulations and SA Ambient Air Quality Standards.

WBG & National Requirements

- WBG EHS General Guidelines (2007), Section 1.1 - Air Emissions and Ambient Air Quality:
  - Emissions do not result in pollutant concentrations that reach or exceed relevant ambient quality guidelines and standards by applying national legislated standards, or in their absence, the current World Health Organisation (WHO) Air Quality Guidelines, or other internationally recognized sources. The following guidelines apply (only consider the variables relevant to the project activities):

WHO Ambient Air Quality Guidelines *, **		
	Averaging Period	**Guideline value in μg/m^3**
Sulfur dioxide (SO_2)	24-hour 10 minute	125 (Interim target-1) 50 (Interim target-2) 20 (guideline) 500 (guideline)
Nitrogen dioxide (NO_2)	1-year 1-hour	40 (guideline) 200 (guideline)
Particulate Matter PM_{10}	1-year 24-hour	70 (Interim target-1) 50 (Interim target-2) 30 (Interim target-3) 20 (guideline) 150 (Interim target-1) 100 (Interim target-2) 75 (Interim target-3) 50 (guideline)
Particulate Matter $PM_{2.5}$	1-year 24-hour	35 (Interim target-1) 25 (Interim target-2) 15 (Interim target-3) 10 (guideline) 75 (Interim target-1) 50 (Interim target-2) 37.5 (Interim target-3) 25 (guideline)
Ozone	8-hour daily maximum	160 (Interim target-1) 100 (guideline)

* *WHO Air Quality Guidelines Global Update, 2005. PM 24-hour value is the 99th percentile.*

** *Interim targets are provided in recognition of the need for a staged approach to achieving the recommended guidelines.*

- WBG EHS General Guidelines (2007), Section 2.0 & 4.2 – Occupational Health and Safety.
- WBG EHS General Guidelines (2007), Section 4.1– Environment: Air Quality.
- SA National Dust Control Regulations and Ambient Air Quality Standards.

Related Management Plans	• Waste Management Plan. • Erosion Control Plan. • Hazardous Materials Management Plan. • Stakeholder Engagement Plan.
Monitoring Requirements / Records	• Air Quality Monitoring Program. • Grievance mechanism. • Incident reports. • Training records.
Training	The Contractor will ensure that the necessary training is provided to the project workers on the Air Quality Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
A.1	Air quality to be monitored (baseline and during the project) for dust fallout. Sampling locations to consider major sources of dust and sensitive receptors. Refer to the Environmental Monitoring Programme in the ESMP for the environmental parameters, locations, requirements, and frequency for monitoring.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	Weekly / based on most stringent requirements in guidelines / standards / regulations
A.2	Appropriate dust suppression measures or temporary stabilising mechanisms to be used when dust generation is unavoidable (e.g., dampening with water, chemical soil binders, straw, brush packs, chipping), particularly during prolonged periods of dry weather. Note that all dust suppression requirements should be based on the results from the dust monitoring and the proximity of sensitive receptors.			On-going / As required
A.3	All vehicles and machinery used at the site are to be well maintained and in good working condition, as well as fitted with appropriate emission controls.			
A.4	Plant to be operated efficiently and turned off when not in use.			
A.5	Speed limits to be strictly adhered to.			
A.6	Retain as much vegetative cover as possible to minimise bare areas on the site.			
A.7	Ensure construction vehicles are switched off when not in use.			
A.8	All reasonable attempts will be made to maximise energy efficiency.			
A.9	Retain as much vegetative cover as possible to minimise bare areas on the site.			

APPENDIX B

NOISE AND VIBRATION MANAGEMENT PLAN

NOISE AND VIBRATION MANAGEMENT PLAN

<table>
<tr><td>Potential Sources & Receptors of Impacts</td><td>Potential sources of noise and vibration impacts associated with the project may include the following:
Operation of equipment used to undertake the 3D seismic survey and drilling, including the vibroseis trucks and drilling rig, as well as support activities;
Transportation of equipment, materials and people to and from the site; and
Noise created by the labour force and from camp site (e.g., generator).
Potential receptors could include people (local community and project workers), specific fauna, schools, places of worship, clinics, residences, unstable structures in informal settlements, old structures, and below ground services and utilities.</td></tr>
<tr><td>Management Objectives</td><td>Control sources of noise and vibration associated with the project to minimise potential impacts on receptors.</td></tr>
<tr><td>Targets</td><td>Noise levels of seismic survey and drilling activities will need to remain within the lawfully acceptable limits as per SANS 10103:2008.
Noise from project activities will not cause an environmental nuisance at any noise sensitive place.
No damage to off-site property caused by vibration from drilling and seismic survey.
Corrective action to respond to complaints is to occur within 48 hours.
Refer to WBG EHS Guideline Requirements for specific Noise Level Guidelines.</td></tr>
<tr><td>WBG & National Requirements</td><td>WBG EHS General Guidelines (2007), Section 1.7 – Noise. Noise impacts should not exceed the levels presented below, or result in a maximum increase in background levels of 3 dB at the nearest receptor location off-site:
<table>
<tr><th colspan="3">Noise Level Guidelines*</th></tr>
<tr><th rowspan="2">Receptor</th><th colspan="2">One Hour LAeq (dBA)</th></tr>
<tr><th>Daytime
07:00 – 22:00</th><th>Night-time
22:00 - 07:00</th></tr>
<tr><td>Residential; Institutional; Educational</td><td>55</td><td>45</td></tr>
<tr><td>Industrial; Commercial</td><td>70</td><td>70</td></tr>
</table>
* Guidelines values are for noise levels measured out of doors. Source: Guidelines for Community Noise, World Health Organization (WHO), 1999.
WBG EHS General Guidelines (2007), Section 2.0 & 4.2 – Occupational Health and Safety.
WBG EHS General Guidelines (2007), Section 4.1– Environment: Noise and Vibration.
SA Noise and Vibration Standards, including SANS 10103:2008.</td></tr>
<tr><td>Related Management Plans</td><td>Community Health, Safety and Security Management Plan.
Stakeholder Engagement Plan.</td></tr>
<tr><td>Monitoring Requirements / Records</td><td>Noise and Vibration Monitoring Program.
Traffic Management Plan.
Grievance mechanism.
Training records.
Photographic records.</td></tr>
<tr><td>Training</td><td>The contractor will ensure that the necessary training is provided to the project workers on the Noise and Vibration Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.</td></tr>
</table>

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
N.1	Pre-planning surveys will be undertaken prior to the seismic survey to inform the seismic survey design. This will include informing the positioning of survey lines based on sensitive noise and vibration receptors.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	Prior to seismic survey
N.2	Undertake noise and vibration monitoring at established baseline monitoring sites. Refer to the Environmental Monitoring Programme in the ESMP for the environmental parameters, locations, requirements, and frequency for monitoring.			Weekly / based on most stringent requirements in guidelines / standards / regulations
N.3	All seismic survey activities will only take place during working hours. Should overtime work be required that will generate noise and vibration, consultation with the affected community shall take place.			On-going / As required
N.4	Once complete, the survey design will be communicated to the local community, custodians of infrastructure and stakeholders.			
N.5	Identify and avoid potentially sensitive infrastructure (including below ground services and utilities).			
N.6	Safety distances between the seismic lines and sensitive receptors will be maintained, based on relevant standards and project-specific parameters.			
N.7	Record the condition of structures and infrastructure at risk from seismic survey and drilling activities prior to work being done (e.g., photographic records), as required.			
N.8	Use the lowest practicable vibrator power levels in sensitive areas.			
N.9	All vehicles and equipment used for the seismic survey and drilling will be properly operated and maintained.			
N.10	Noise preventative measures (e.g., screening, muffling, timing, pre-notification of affected parties) will be implemented.			
N.11	The survey crew will undergo environmental awareness training. The training will include mitigation measures that serve to minimise noise and vibration.			
N.12	The survey and drilling crews will be provided with suitable Personal Protective Equipment (PPE) (such as ear muffs).			
N.13	The movements of vehicles will be restricted to the survey lines, as far as possible.			
N.14	Consult with nearby residents in advance where potentially significant noise and vibration levels are to result from survey activities (as per the SEP).			

APPENDIX C

GROUNDWATER MANAGEMENT PLAN

GROUNDWATER MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of impacts to groundwater resources associated with the project may include the following:
	• Inadequate management of wastewater;
	• Improper storage of hazardous substances;
	• Spillages of fuel, oil and other dangerous goods;
	• Imprudent use of groundwater from local boreholes by the Contractor to execute the project's activities;
	• Indiscriminate movement of vibroseis trucks and other vehicles in natural areas, which may compact near-surface springs and damage boreholes and associated infrastructure;
	• Drilling –
	  ○ The proposed drilling may result in the mixing of aquifers; and
	  ○ Groundwater pollution from inadequate drilling practices and poor management of drilling fluid.
	
	Receptors of groundwater impacts include:
	• Groundwater reserve;
	• Groundwater users (groundwater is the primary water source used by local farmers); and
	• Ecosystems reliant on groundwater.

Management Objectives	Minimise potential impacts of the 3D seismic survey and drilling activities to groundwater resources.
Targets	• The proposed well design shall conform to construction standards, and it will be ensured that well integrity is maintained/ • No contamination of aquifer from drilling. • No impacts to groundwater users from drilling. • No environmental contamination of water resources associated with wastewater or storm water practices. • No water wastage (water conservation). • No discharges of untreated wastewater to the environment.
WBG & National Requirements	• WBG EHS General Guidelines (2007), Section 1.3 - Wastewater and Ambient Water Quality. • WBG EHS General Guidelines (2007), Section 3.1 - Water Quality and Availability. • WBG EHS General Guidelines (2007), Section 4.1 - Environment: Wastewater Discharges. • SA National Water Act (Act No. 36 of 1998).
Related Management Plans	• Surface Water Management Plan. • Waste Management Plan. • Hazardous Materials Management Plan. • Community Health, Safety and Security Management Plan. • Stakeholder Engagement Plan.
Monitoring Requirements / Records	• Monitoring programme for groundwater. • Approved well design. • Training records. • Water consumption records. • Incident reports.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Groundwater Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
GWR.1	Implement a groundwater monitoring programme at the drill site. Refer to the Environmental Monitoring Programme in the ESMP for the environmental parameters, locations, requirements, and frequency for monitoring.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	Monthly / based on most stringent requirements in guidelines / standards / regulations
GWR.2	The well at the drill site must be designed to ensure that it is constructed, equipped, commissioned, operated, and decommissioned in a manner that provides for the control of the well at all times and must prevent risks to the groundwater resources and risks to health and safety of persons from the well or anything in the well, or in strata to which the well is connected.			On-going / As required
GWR.3	Groundwater use: • If any groundwater is to be used, it will need to be sourced from municipal-owned registered sources and will need to comply with the provisions of the NWA. • Groundwater use from registered boreholes is to remain within allocated volumes. • Prevent water wastage. Log water uses for the project.			
GWR.4	Avoid damaging springs and boreholes along survey lines. The vibroseis trucks shall not shoot vibration within 10m from existing boreholes.			
GWR.5	Ensure that the storage of hazardous substances and waste is in a contained area with impervious surfaces that meets all legal requirements and best practices (including signage, fire protection, spill containment, weatherproofing, ventilation, etc.).			
GWR.6	All storage tanks containing hazardous materials must be placed in bunded containment areas with impermeable surfaces. The bunded area must be able to contain 110% of the total volume of the stored hazardous material.			
GWR.7	Provide sufficient and suitable sanitation facilities during construction and operational phases, which shall conform to all relevant health and safety standards and codes.			
GWR.8	Implement a spill response procedure. Contaminated areas to be contained. Contaminated material to be collected in spill proof containers and to be disposed of at a registered facility.			
GWR.9	All diffuse pollution sources to be managed to prevent pollution of the groundwater resources.			
GWR.10	Consider findings from hydrogeological investigations during project design phase and incorporate mitigation measures (as relevant).			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
GWR.11	Drilling must not interfere with groundwater used by surrounding farmers. When confined aquifer with artesian water is encountered, construction of the borehole should be designed in a way to seal the pressurized water. The borehole must be designed to minimize interaction between shallow and deep aquifers.			
GWR.12	Well drilling must not result in contamination of aquifers.			
GWR.13	Drilling into pockets of gas may result in cross contamination of aquifers. The borehole must be designed in such a way that separates aquifers to mitigation cross-contamination. To prevent explosions because of pressure of natural gas, a gas diverter must be fitted on the drilling rig.			
GWR.14	Implement a suitable drilling fluid system to prevent environmental contamination. The following will be catered for (amongst others): • Use of non-toxic and environmentally-friendly drilling fluid additives. • A list of all drilling fluid additives that are proposed to be used, with their Material Safety Data Sheet, shall be available. • Suitable storage and mixing facilities shall be provided, including dedicated storage tanks or lined pits. • Suitable treatment to render the fluid and cuttings non-hazardous. • Proper re-use, recycling or disposal of drilling fluids. • Proper handling and disposal of drilled cuttings. Classify drilled cuttings in terms of the Waste Classification and Management Regulations to determine suitable disposal options. • Responsible crew members shall be fully trained in the design, mixing and testing procedures of the drilling fluid system. • A detailed fresh water-based drilling fluid programme shall be prepared, which will ensure the integrity of the borehole during the drilling and logging operations.			
GWR.15	Manage surface water drainage to prevent ponding and water flow in the vicinity of the finished borehole.			
GWR.16	Provide a sanitary seal below surface at the groundwater interface to limit direct surface contamination down the side of the casing.			
GWR.17	The borehole must be designed to minimize interaction between shallow and deep aquifers. Prevent mixing of aquifers (e.g., installation of seals between water-bearing horizons).			
GWR.18	On completion, the borehole will be securely capped with a concrete sanitation block and a lockable metal cap with clear signage to avoid potential hazards to people and animals.			

APPENDIX D

SURFACE WATER MANAGEMENT PLAN

SURFACE WATER MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of impacts to surface water resources associated with the project may include the following: • Clearing of land to make way for drilling, site camp and parking area; • Movement of vibroseis trucks and support vehicles through riparian or wetland areas; • Inadequate management of wastewater; • Improper storage of hazardous substances; • Spillages of fuel, oil and other dangerous goods; and • Improper rehabilitation. Receptors of surface water impacts include: • Resource quality (i.e., flow, in-stream and riparian habitat, aquatic biota and water quality) of the receiving watercourses; • Users of surface water; and • Animals that drink surface water.
Management Objectives	• Minimise potential impacts of the 3D seismic survey and drilling activities to surface water resources. • Ensure that the water resources are protected and incur minimal negative impact to their flow, water quality, riparian habitat, morphology and aquatic biota.
Targets	• No environmental contamination associated with wastewater or storm water practices. • No water wastage (water conservation). • No discharges of untreated wastewater to the environment. • No damage to the structure of watercourses in the project area from the seismic survey and drilling activities / complete rehabilitation of affected watercourses.
WBG & National Requirements	• WBG EHS General Guidelines (2007), Section 1.3 - Wastewater and Ambient Water Quality. • WBG EHS General Guidelines (2007), Section 3.1 - Water Quality and Availability. • WBG EHS General Guidelines (2007), Section 4.1 - Environment: Wastewater Discharges. • SA National Water Act (Act No. 36 of 1998).
Related Management Plans	• Groundwater Management Plan. • Waste Management Plan. • Hazardous Materials Management Plan. • Erosion and Sediment Control Plan. • Community Health, Safety and Security Management Plan. • Stakeholder Engagement Plan.
Monitoring Requirements / Records	• Monitoring of watercourse crossings and rehabilitation. • Monitoring discharges of treated wastewater. • Training records. • Water consumption records. • Incident reports.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Surface Water Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
SWR.1	Implement a surface water monitoring programme for watercourses that may be impacted by the Project. Refer to the Environmental Monitoring Programme in the ESMP for the environmental parameters, locations, requirements, and frequency for monitoring.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	Monthly / based on most stringent requirements in guidelines / standards / regulations
SWR.2	Monitor watercourse crossings along seismic line transects for destabilisation of channel structure and erosion.			Daily / As required
SWR.3	Plan and design seismic survey transects to avoid sensitive topographic features, including sensitive watercourses.			On-going / As required
SWR.4	The facilities at the drill site and camp site must avoid the drainage line that flows across the property and drains to the south-west and remain outside of its 32m buffer zone.			
SWR.5	Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible.			
SWR.6	All activities (including driving and equipment storage) must remain outside of watercourses. Watercourses must be traversed at existing crossing points.			
SWR.7	Rehabilitate existing crossing points at watercourse if any damage has been caused by the movement of the vibroseis trucks and support vehicles.			
SWR.8	The stopping of the vibroseis trucks and refuelling/maintenance of the trucks and support vehicles shall not take place within the 32m buffer zones of watercourses.			
SWR.9	Where possible, it is recommended that the seismic survey be undertaken within the dry season should watercourses need to be crossed by the vibroseis trucks and there are no existing crossings, to minimise the impact on the hydrology of the wetlands.			
SWR.10	Minimise unnecessary clearing of vegetation beyond the drill site, site camp and parking area.			
SWR.11	Locate storage areas, stockpiles and ablution facilities further than 50m of watercourses.			
SWR.12	Ensure that storage sites, stockpiles and ablution facilities are not located within high water levels associated with rainy season.			
SWR.13	Implement appropriate temporary drainage of the site.			
SWR.14	Implement water conservation measures to prevent water wastage, including the identification, regular measurement, and recording of principal water usage.			
SWR.15	Establish a dedicated vehicle maintenance area and wash-bay, where suitable storm water management measures are in place to prevent pollution.			
SWR.16	Manage storm water from drill site and camp site to avoid environmental contamination and erosion.			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
SWR.17	Storm water runoff from workshop, vehicle maintenance area, wash-bay and other potential pollution sources will be collected and treated in hydrocarbon separation pits/tanks before discharged to the environment.			
SWR.18	Discharges of treated wastewater to form part of water monitoring programme.			
SWR.19	No discharge of any sewage and/or wastewater to surface waters without treatment and a permit from the relevant authority.			
SWR.20	Prevent erosion on access roads due to construction traffic.			
SWR.21	Ensure the proper storage and handling of hazardous material (refer to the provisions in the General Management Plan and Groundwater Management Plan).			
SWR.22	Rehabilitate cleared areas that do not form part of the injection phase.			

APPENDIX E

WASTE MANAGEMENT PLAN

WASTE MANAGEMENT PLAN

<table>
<tr><td>Potential Sources & Receptors of Impacts</td><td>
Potential sources of impacts related to waste associated with the project may include the improper management of the following waste types that will be generated by the project activities:
<table>
<tr><td>Non-Hazardous / General Waste</td><td>• Food waste, litter, paper, cardboards
• Metallic drums
• Drill cuttings (water-based muds)
• Construction debris – inert waste</td></tr>
<tr><td>Hazardous Waste</td><td>• Chemicals (solvents, others)
• Batteries (dry and acid-based)
• Aerosol cans
• Contaminated soil from accidental spills on site
• Electrical and electronic equipment
• Used oil
• Oil filters
• Oily rags
• Cement slurries
• Medical waste
• Liquid waste (fluids, lubricating oils, chemical substances, fuel)</td></tr>
<tr><td>Hazardous Wastewater</td><td>• Drilling fluids
• Gray and black water from showers, toilets and kitchen facilities
• Water used for washing purposes (e.g., equipment, staff)
• Drainage over contaminated areas (e.g., workshop, equipment storage areas, etc.)
• General oily water (e.g., from drip trays)</td></tr>
</table>
Receptors of waste-related impacts include:
• People;
• Flora;
• Wildlife;
• Livestock;
• Groundwater;
• Surface water;
• Soil; and
• Visual resources.
</td></tr>
<tr><td>Management Objectives</td><td>• Minimise negative environmental impacts associated with waste.
• Apply waste management principles to prevent, minimise, recycle or re-use waste, with disposal as a last option.</td></tr>
<tr><td>Targets</td><td>• Maintain a clean and tidy construction site.
• A 100% record of all waste generated and disposed of at licenced waste disposal facilities.
• Valid disposal certificates for all waste disposed.
• Provision of adequate waste containers that are easily accessible and maintained.
• Waste bins are to be removed and cleaned on a regular basis.</td></tr>
<tr><td>WBG & National Requirements</td><td>• WBG EHS General Guidelines (2007), Section 1.6 - Waste Management.
• WBG EHS General Guidelines (2007), Section 4.1 - Environment: Solid Waste.
• WBG EHS General Guidelines (2007), Section 4.1 - Environment: Wastewater Discharges.
• SA National Environmental Management: Waste Act (Act No. 59 of 2008), Regulations, and Norms and Standards.</td></tr>
<tr><td>Related Management Plans</td><td>• Spill Prevention and Response Plan.
• Community Health, Safety and Security Management Plan.
• Stakeholder Engagement Plan.</td></tr>
</table>

Monitoring Requirements / Records	• Waste inventory. • Daily inspection of waste facilities (register). • Records for waste collection, transport and disposal. • Grievance mechanism. • Training records. • Incident reports.
Training	The Contractor will ensure that the necessary training is provided to the project workers on the Waste Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
W.1	Develop a waste inventory, which includes the different waste streams, classification, quantities, storage requirements, potential use, and treatment and disposal arrangements.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	On-going / As required
W.2	Apply the principles of the waste management hierarchy.			
W.3	Vermin / weatherproof bins will be provided in sufficient numbers and capacity to store domestic waste. These bins will be kept closed to reduce odour build-up and emptied regularly to avoid overfilling and other associated nuisances.			
W.4	Provide waste skips at the camp site. These skips will be sufficient in number, the skip storage area will be kept clean, and skips will be emptied and replaced before overflowing or spillage occurs.			
W.5	Where possible, waste will be separated at source (e.g., containers for glass, paper, metals, plastics, organic waste and hazardous wastes).			
W.6	Management of hazardous waste. • Hazardous waste will be segregated from general wastes. • Hazardous waste will be stored in such a way as to prevent or control accidental releases to air, soil, and water resources. • Hazardous waste will be stored in a manner that prevents the commingling or contact between incompatible waste types. • Hazardous waste will be stored in closed containers away from direct sunlight, wind and rain. • Each container will be labelled to identify its contents. • Secondary containment systems (least 110% of the largest storage container / 25% of total storage capacity, whichever is greater) will be in place at the storage facility. • Adequate ventilation will be provided where volatile wastes are stored. • Relevant signage will be provided at the storage area. • All relevant Personnel Protective Equipment (PPE) will be provided to employees handling hazardous waste. • Access to the hazardous waste storage area will be strictly controlled. • Adequate training will be provided to the employees responsible for handling and managing hazardous waste. • The storage area will be monitored frequently for leaks or spills, and for compliance against regulatory requirements. • All relevant documentation (e.g., Emergency Response Plan) and records will be maintained			
W.7	Ensure suitable housekeeping.			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
W.8	The Contractor will ensure that no burying, dumping or burning of waste materials, vegetation, litter or refuse occurs. All waste will be disposed of at suitable licensed disposal sites, based on the waste type (general versus hazardous).			
W.9	Ensure that waste is transported so as to avoid waste spills en-route. All waste containers designated for off-site transport should be secured and labelled with the contents and associated hazards. Waste loads should be covered.			
W.10	Undertake audits of contractors transporting and disposing of waste.			
W.11	Generate and maintain records for waste collection, transport and disposal.			
W.12	Waste will be disposed of at licenced sites or handed to registered waste disposal facilities for disposal / recycling.			

APPENDIX F

EROSION CONTROL MANAGEMENT PLAN

EROSION CONTROL MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of erosion associated with the project may include the following: • Exposure of soil surfaces to rain and wind during site clearing, drilling and seismic survey activities; • Indiscriminate movement of vibroseis truck, drill rig and other vehicles over untransformed terrain, as well as trampling by survey and drilling crews; • Inadequate storm water management; and • Improper rehabilitation. Receptors of impacts related to erosion include: • Soil; • Wetlands; • Fauna (including burrowing animals); and • Flora.
Management Objectives	• Stabilise and control erosion and manage off-site sediment transport.
Targets	• Rehabilitation of all areas at risk of erosion from project activities. • No sedimentation of watercourses from silt-laden runoff from the drill site and camp area.
WBG Requirements	• WBG EHS General Guidelines (April 2007), Section 4.1 – Environment: Soil Erosion.
Related Management Plans	• Air Quality Management Plan. • Waste Management Plan. • Hazardous Materials Management Plan. • Water Management Plan.
Monitoring Requirements / Records	• Sediment and erosion control measures in place. • Compliance with all reinstatement and rehabilitation requirements. • Inspect erosion risk areas after heavy rainfall events. • No visual evidence of erosion caused by project activities. • Training records.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Erosion Control Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
E.1	Identify areas where there is a risk of erosion. Include details in the grid plan of the seismic survey.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	On-going / As required
E.2	Strip topsoil in areas to be cleared for the project and ensure suitable storage to preserve the integrity of topsoil for use during rehabilitation.			
E.3	Minimise movement of traffic on site. Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible.			
E.4	Halt operation of the vibroseis trucks in areas where saturated ground conditions are present and topsoil rutting may occur.			
E.5	Avoid operating the vibroseis trucks in areas with barren clay soils as far as possible.			
E.6	Avoid vehicle movement in steep man-made areas in the town of Leandra (e.g., road embankments).			
E.7	Manage drainage from drill site to prevent erosion and environmental contamination.			
E.8	Minimise unnecessary clearing of vegetation beyond the drill area, site camp and parking area. Soils will only be disturbed within designated areas, as per the approved site layout.			
E.9	Reinstate and rehabilitate disturbed areas (including survey transects, ruts, erosion, drill area, site camp and parking area) to remediate compaction / prevent future erosion.			
E.10	Suitable erosion protective measures are to be implemented for the access roads created for the project.			

APPENDIX G

HAZARDOUS MATERIALS MANAGEMENT PLAN

HAZARDOUS MATERIALS MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of impacts related to hazardous materials associated with the project may include the following: • Improper storage of hazardous materials; and • Uncontrolled releases of hazardous materials to the environment. Receptors of impacts related to hazardous materials include: • People; • Flora; • Wildlife; • Livestock; • Groundwater; • Surface water; • Soil; and • Visual resources.
Management Objectives	• Ensure the protection of the natural environment and the safety of the community and personnel on site, by the correct management and handling of hazardous materials. • Avoid or, when avoidance is not feasible, minimize uncontrolled releases of hazardous materials or accidents the handling, storage and use of hazardous materials.
Targets	• No pollution due to handling, use and storage of hazardous material. • In the event of a spill, appropriate containment, clean up and disposal of contaminated material. Spills to be cleaned within 24 hours. • Adherence to Material Safety Data Sheet.
WBG & National Requirements	• WBG EHS General Guidelines (April 2007), Section 1.5 - Hazardous Materials Management. • WBG EHS General Guidelines (April 2007), Section 3.5 - Transport of Hazardous Materials. • SA Hazardous Substances Act (Act No. 15 of 1973), Occupational Health and Safety Act (No. 85 of 1993) and relevant associated Regulations.
Related Management Plans	• Occupational Health and Safety Management Plan. • Emergency Response Plan.
Monitoring Requirements / Records	• Audits and inspections of all hazardous materials transportation, handling and use procedures and of storage facilities. • Evidence of spillages. • Material Safety Data Sheet register. • Training register. • Disposal certificates. • Contractor's method statement. • Training records.
Training	The Contractor will ensure that the necessary training is provided to the project workers on the Hazardous Materials Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
HM.1	Undertake a hazard assessment in accordance with WBG EHS General Guidelines (April 2007), Hazardous Materials Management.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	Prior to commencement and throughout Project
HM.2	Prepare a register of all hazardous materials used on site, along with each appropriate MSDS.			On-going / As required
HM.3	Storage and use of hazardous materials will be strictly controlled to prevent environmental contamination and will adhere to the requirements stipulated on the MSDS.			
HM.4	Appropriate signage to be displayed at storage areas for hazardous materials.			
HM.5	Where flammable liquids are being used, applied or stored the workplace will be effectively ventilated.			
HM.6	No person may smoke in any place in which flammable liquid is used or stored.			
HM.7	Install an adequate number of fire-fighting equipment in suitable locations around the flammable liquids store.			
HM.8	Where flammable liquids are decanted, the metal containers will be bonded or earthed.			
HM.9	No flammable material (e.g., paper, cleaning rags or similar material) may be stored together with flammable liquids.			
HM.10	Staff that will be handling hazardous materials will be trained to do so.			
HM.11	Any hazardous materials (apart from fuel) will be stored within a lockable store with a sealed floor. Suitable ventilation to be provided.			
HM.12	All storage tanks containing hazardous materials will be placed in bunded containment areas with impermeable surfaces.			
HM.13	MSDS', which contain the necessary information pertaining to a specific hazardous substance, will be present for all hazardous materials stored on the site.			
HM.14	Spill kits will be available for the clean-up of hazardous material spillages.			
HM.15	Provide secondary containment where a risk of spillage exists.			
HM.16	Drip trays to be placed under parked heavy vehicles, equipment, and other receptacles of hazardous material to prevent spillages.			
HM.17	In the event of spillages of hazardous materials, the appropriate clean up and disposal measures are to be implemented.			
HM.18	Spill reporting procedures to be displayed at all locations where hazardous materials are being stored.			
HM.19	Hazardous materials will be disposed of at registered sites or handed to registered hazardous waste disposal facilities for disposal / recycling.			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
HM.20	Proper and timeous notification of any pollution incidents associated with hazardous materials.			
HM.21	Ensure that all hazardous materials are transported in an appropriate manner, in accordance with WBG EHS General Guidelines (April 2007), Section 3.5, and national legislative requirements.			

APPENDIX H

COMMUNITY HEALTH, SAFETY AND SECURITY MANAGEMENT PLAN

COMMUNITY HEALTH, SAFETY AND SECURITY MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of impacts to the public and/or affected communities associated with the project may include the following (amongst others): • Poor planning and communication with the affected communities in the project area; • Contamination of air (e.g., fugitive emissions), soil and water (surface and groundwater) from project activities or facilities; • Poor traffic management; • Inadequate provision for and management of security; • Poor management of labour force; and • Breakdown in worker–community relationship.
Management Objectives	• The safety and security of the public is of paramount importance and will not be compromised by the activities associated with the project. • Respect cultural diversity and the livelihoods of local communities. • Protect the health and safety of local communities. • Effectively manage grievances raised by local communities. • Prevent the spreading of communicable diseases and STIs from project workers.
Targets	• No security related incidents associated with the labour force and project activities.
WBG & National Requirements	• WBG Performance Standard 4 and Guidance Note 4: Community Health, Safety and Security (2012). • WBG EHS General Guidelines (April 2007), Section 3 - Community Health and Safety. • WBG EHS General Guidelines (April 2007), Section 4.3 - Community Health & Safety • SA Occupational Health and Safety Act (Act No. 85 of 1993) and relevant Regulations.
Related Management Plans	• Occupational Health and Safety Management Plan. • Emergency Response Plan. • SEP. • Air Quality Management Plan. • Noise and Vibration Management Plan. • Groundwater Management Plant • Surface Water Management Plan. • Waste Management Plan. • Hazardous Materials Management Plan. • Traffic Management Plan.
Monitoring Requirements / Records	• Monitoring to verify the effectiveness of the control measures for community health and safety. • Signage displayed. • Training register. • Contractor's method statement. • Grievance mechanism. • Training records.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Community Health, Safety and Security Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
CHSS.1	Provide suitable health services for project workers. Engage with the relevant local authorities.	Implementation	• ECO and CLO - monitor compliance. • Contractor - implement management actions.	On-going / As required
CHSS.2	Ensure suitable management of the labour force to prevent security-related issues or disturbance to stakeholders and community members.			
CHSS.3	Prohibit the trespassing by project workers on neighbouring properties. Implement disciplinary action in the case of transgression.			
CHSS.4	Implement a public awareness programmes for community health and safety, taking into consideration all areas that may potentially be affected by the seismic survey. Applicable notice boards and hazard warning notices for the public will be erected and secured.			
CHSS.5	The Contractor and project workers will abide by the Code of Conduct, which will form part of the induction training.			
CHSS.6	The Contractor will control direct communication of unauthorised project workers with third parties.			
CHSS.7	The Contactor will develop and implement a formal grievance redress mechanism to record, investigate and resolve any complaints from communities.			
CHSS.8	Security: • Undertake a due diligence on the security services provider. • Define and implement pre-employment requirements for candidates for security positions, which includes screening of candidates for previous offences. • Training of security team with respect to the appropriate use of force (and where applicable, firearms), appropriate conduct toward project workers and affected communities. • Audit the performance of security providers. • Record and track any security incidents due to the use of inappropriate, disproportionate or unlawful use of force. • Initiate and maintain effective community engagement on security arrangements.			
CHSS.9	Respect cultural diversity and the livelihoods of local communities.			
CHSS.10	Respect the sites of worship, religious symbols, cemeteries, and other social emblems.			
CHSS.11	Respect the hours of silence and access restrictions, according to the traditions of local communities and engage community when diverting from the norm.			
CHSS.12	No encouragement of any kind of child labour and avoid the purchase of products sold by children and teenagers of less than the minimum age.			
CHSS.13	Project workers will be provided with identity cards and will wear identifiable clothing.			
CHSS.14	Creating nuisances and disturbances in or near communities will be prohibited.			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
CHSS.15	Machine / vehicle operators will receive clear instructions to remain within demarcated access routes.			
CHSS.16	Ensure that operators and drivers are properly trained and make them aware, through regular toolbox talks, of any risk they may pose to the community. Place specific emphasis on the vulnerable sector of the population such as children, the elderly and residents in informal settlements in Leandra.			
CHSS.17	Implement a Sexually Transmitted Diseases (STD) and HIV/AIDS awareness and prevention programme amongst project workers. The Contractor will provide an adequate supply of free condoms to all project workers. Condoms will be located at suitable points. If viable, a voluntary counselling and testing programme will be introduced.			
CHSS.18	Develop a clear HIV/AIDS policy and program, which needs to be functional prior to commencement of the Project's activities.			
CHSS.19	Develop and implement a policy for hiring of local labour and support to local sub-contractors.			
CHSS.20	Disseminate clear employment and contracting requirements to the local communities.			
CHSS.21	Collaborate with local authorities and comply with local systems for recruitment of local labour and contracting.			
CHSS.22	Implement all necessary measures to contain the spread of COVID-19 and to safeguard project workers and the local communities from this virus.			
CHSS.23	Ensure the infrastructure and social facilities within the host communities will not be compromised with the arrival of additional people into the area.			
CHSS.24	Prevent livestock from entering the drill site.			
CHSS.25	Maintain access control to prevent unauthorised access of the public to the drill site.			

APPENDIX I

TRAFFIC MANAGEMENT PLAN

TRAFFIC MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of traffic impacts associated with the project may include the following: • Movement of vibroseis trucks and other vehicles in the project area. • Transportation of materials and crew to and around site. • The slow pace of the vibroseis truck. • The drill site will be directly accessed from the Provincial Route R29, which is a high-speed environment. • Risks associated with crossing the Provincial Routes (R29 and R50) and other roads in the town of Leandra during the seismic survey. • Speeding and reckless driving by construction personnel. Receptors of traffic impacts include people (project personnel and the public) and animals (including livestock and wildlife).
Management Objectives	• Ensure that all equipment and vehicles required to undertake the seismic survey and drilling only use dedicated and suitable access routes. • Ensure the safety of all road users by implementing proper traffic control measures.
Targets	• No reports of project equipment and vehicles using unauthorised routes. • No transporting of unsafe loads. • No speeding. • No accidents.
WBG & National Requirements	• WBG EHS General Guidelines (2007), Section 3.4 - Traffic Safety. • SA Occupational Health and Safety Act (Act No. 85 of 1993) and relevant Regulations. • Mpumalanga Roads Act, 2008.
Related Management Plans	• Community Health, Safety and Security Management Plan. • Stakeholder Engagement Plan.
Monitoring Requirements / Records	• Grievance mechanism. • Contractor's method statement. • Agreements with landowners. • Training records. • Incident reports.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Traffic Management Plan to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
T.1	Obtain approval from the Mpumalanga Department of Public Works, Roads and Transport (DPWRT) for accessing the drill site from the Provincial Route R29	Implementation	• ECO and CLO - monitor compliance. • Contractor - implement management actions.	On-going / As required
T.2	Pre-planning surveys will be undertaken prior to the seismic survey to inform the seismic survey design. This will include informing the positioning of survey lines to take into consideration access and route limitations.			
T.3	The operators of the vibroseis trucks, drill rig and other industrial vehicles need to be appropriately trained and licenced.			
T.4	All vehicles used for the purposes of the project need to be safely operated.			
T.5	Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible.			
T.6	Clearly demarcate the access road to the drill site, site camp and parking area.			
T.7	Maintain proper access control to prevent livestock from accessing the drill site and site camp, as well as for any other unauthorised access. The overall drill area will be fenced.			
T.8	Establish site speed limits.			
T.9	Strict adherence to speed limits by all vehicles on public roads and access roads / tracks.			
T.10	Implement appropriate safety and traffic calming measures for vehicles leaving and accessing the R29. This will include flag men, speed reductions and warning signage (as relevant).			
T.11	Implement effective traffic control measures for the vibroseis trucks.			
T.12	Establishing operating rules for vibroseis trucks.			
T.13	Implement measures to manage dust caused by site traffic.			
T.14	Collaborate with local communities in Leandra on education about traffic and pedestrian safety related to the seismic survey.			
T.15	Identify best locations for vibroseis trucks to cross over public roads.			
T.16	Vehicles are to be inspected and maintained as per manufacturer specifications.			

APPENDIX J

HERITAGE RESOURCES MANAGEMENT PLAN

HERITAGE RESOURCES MANAGEMENT PLAN

Potential Sources & Receptors of Impacts	Potential sources of impacts to heritage resources associated with the project may include the following: • Indiscriminate movement and operation of vibroseis trucks and support vehicles. • Clearing to make way for drilling, site camp and parking area. • Vibration caused by operation of equipment used to undertake the 3D seismic survey and drilling, including the vibroseis trucks and drilling rig. Receptors include heritage resources and graves, including those sites identified during the Heritage Impact Assessment as well as unidentified sites. According to SAHRIS, the majority of the project footprint falls within an area where the underlying geology has "insignificant to zero" fossil sensitivity, except for a small area in the northern tip of the seismic survey area.
Management Objectives	• Ensure that all heritage resources and graves are protected against damage from the project activities.
Targets	• No damage to heritage resources and graves as a result of the project.
WBG & National Requirements	• National Heritage Resources Act (Act No. 25 of 1999) (NHRA) and Regulations.
Related Management Plans	• Stakeholder Engagement Plan.
Monitoring Requirements / Records	• Grievance mechanism. • Contractor's method statement. • Training records. • Incident reports. • Documented chance find procedure.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Heritage Resources Management Plan, including the chance finds procedure, to allow them to be competent with regards to the management requirements. Training records to be maintained.

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
H.1	Heritage Specialist to undertake walkdown survey of transect lines prior to seismic survey to identify areas where heritage resources and graves may occur. Include the heritage site identified during the Heritage Impact Assessment. Plan and design seismic survey to avoid these areas. Heritage sites and buffer areas are to be shown in the grid plan.	Implementation	• ECO - monitor compliance. • Contractor - implement management actions.	On-going / As required
H.2	Implement a chance find procedure should unknown heritage resources or fossils be encountered during the seismic survey and drilling activities. An outline of the procedure is as follows: • Possible finds include unidentified graves, historical artefacts or material, remains of historical structures; and palaeontological deposits. • In the event that a possible find is discovered, all activities must be halted in the area of the discovery and a qualified archaeologist contacted. • The archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures. • If mitigation is necessary, an application for a rescue permit must be lodged with the South African Heritage Resources Agency (SAHRA). • After mitigation, an application must be lodged with SAHRA for a destruction permit. This application must be supported by the mitigation report generated during the rescue excavation. Only after the permit is issued may such a site be destroyed. • If during the initial survey sites of cultural significance are discovered, it will be necessary to develop a management plan for the preservation, documentation or destruction of such a site. Such a program must include an archaeological/palaeontological monitoring programme, timeframe and agreed upon schedule of actions between the company and the archaeologist. • In the event that human remains are uncovered, or previously unknown graves are discovered, a qualified archaeologist needs to be contacted and an evaluation of the finds made. • If the remains are to be exhumed and relocated, the relocation procedures as accepted by SAHRA need to be followed. This includes an extensive social consultation process. • Work in the area may only proceed once all the requirements have been met.			
H.3	Utilise existing access roads and tracks for the seismic survey and for vehicle movement, as far as possible.			
H.4	Minimise unnecessary clearing of vegetation beyond the drill area, site camp and parking area.			
H.5	<u>Historical Structures</u>			

Ref. No.	Management Actions	Project Phase	Responsibilities	Monitoring / Frequency
	• All Historical Houses and other structures are protected in terms of Section 34 of the NHRA and should be avoided with a 20-30m buffer to prevent any indirect impact and ensure that during the seismic survey these sites are not damaged. • The material demarcating the 30m buffer must be highly visible and made of durable material to ensure that they are still in place during the seismic survey. • If any negative impact is anticipated on any historical structures, including the remains of demolished structures, a permit will be required for the destruction/clearance of any such sites (from MPHRA or SAHRA).			
H.6	<u>Graves and Cemeteries</u> • The graveyard at CCUS-31 and the three community cemeteries (CCUS-12, CCUS-20 and CCUS-36) should be protected with a buffer of at least 30m to ensure that the graves are not damaged during the seismic survey. The materials demarcating the buffer area must be highly visible and durable to ensure that they remain in place during the seismic survey. • The possible grave at CCUS-02, that may be located within or on the boundary of the proposed drill site, requires that any site clearance activities for the proposed drill site should be monitored by a Heritage Specialist. If an unidentified grave site is uncovered during site clearance, a buffer of at least 30m must be placed around the site to ensure that it is not damaged by the project activities.			
H.7	<u>Living / Intangible Heritage</u> • The informal community church site at CCUS-11 is an example of living and intangible heritage and is protected under Section 2 of the NHRA as part of the national estate. If any negative impact is anticipated, then the local community must be consulted about possible mitigation measures.			
H.8	If any heritage sites are unavoidable, a permit shall be obtained from the South African Heritage Resources Agency (SAHRA) (national) and Mpumalanga Provincial Heritage Resource Authority (MPHRA) (provincial), as relevant.			

APPENDIX K

REHABILITATION PLAN

REHABILITATION PLAN

Management Objectives	▪ Adequate reinstatement and rehabilitation of areas disturbed by the CCUS 3D seismic survey and drilling activities. ▪ Conduct concurrent or progressive rehabilitation of areas affected by the seismic survey.
Targets	▪ Complete site clean-up. ▪ Reinstate and rehabilitate areas disturbed by project activities.

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	**Frequency**
▪ Review and update the Rehabilitation Plan to reflect the revised project design. ▪ The areas affected by project activities, which will not form part of the footprint of the CCUC injection phase, shall be reinstated and rehabilitated. ▪ Cordon off areas that are under rehabilitation as no-go areas. ▪ Removal of structures and infrastructure - ○ Clear and completely remove from site all plant, equipment, storage containers, temporary fencing, temporary services and fixtures. ○ Rehabilitate all temporary access roads and tracks utilised during the project which are not earmarked for use during the injection phase. ▪ Inert waste and rubble - ○ Clear the site of all inert waste and rubble. After the material has been removed, the site shall be re-instated and rehabilitated. ▪ Domestic waste - ○ Remove from site all domestic waste and dispose of in the approved manner at a licenced waste disposal site. ▪ Hazardous waste and pollution control - ○ Remove from site all pollution containment structures. ○ Remove from site all temporary sanitary infrastructure and wastewater disposal systems.	▪ Contractor to implement management actions. ▪ ECO - to monitor compliance.	▪ Throughout the duration of the project, as relevant to the concurrent or progressive reinstatement and rehabilitation of affected areas. Up to end of Defects Notification Period.	▪ Approved Rehabilitation Plan. ▪ Inspection of project area (photographic records).	▪ Once-off – Rehabilitation Plan approval. ▪ Monthly.

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	Frequency
Take care to avoid leaks, overflows and spills and dispose of any waste in the approved manner. ▪ Final shaping - ○ Shape all disturbed areas to blend in with the surrounding landscape, where possible. ○ Ensure that no stockpiles are left on site and that all material is landscaped to blend in with the surrounding landscape. ▪ Topsoil replacement and soil amelioration - ○ Execute top soiling activity prior to the rainy season or any expected wet weather conditions. ○ Execute topsoil placement only after all project activities have ceased in area to be rehabilitated. ○ Contractor to test top 15 cm soil at predetermined distances for fertilizer requirements. All testing to occur at a SANS 17025 approved laboratory. ○ Replace and redistribute stockpiled topsoil together with herbaceous vegetation, overlying grass and other fine organic matter in all disturbed areas of the drill site, including temporary access routes. Replace topsoil to the original depth. ○ Place topsoil in the same area from where it was stripped. ○ Do not use topsoil suspected to be contaminated with the seed of alien vegetation. Alternatively, the soil is to be appropriately treated. ○ Shape remaining stockpiled topsoil not utilised elsewhere in an acceptable manner so as to blend in with the local surrounding area. ○ After topsoil placement is complete, spread available stripped vegetation randomly by hand over the top-soiled area. ▪ Ripping and scarifying - ○ Rip and/or scarify all areas following the application of topsoil to facilitate mixing of the upper most layers. Whether ripping and/or				

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	Frequency
scarifying is necessary it will be based on the site conditions immediately before these works commence. o Rip and/or scarify all disturbed (and other specified) areas of the site, including temporary access routes and roads, compacted during the execution of the works. o Rip and/or scarify along the contour to prevent the creation of down-slope channels. o Do not rip and/or scarify areas under wet conditions, as the soil will not break up. ▪ Planting - o All plant species for use by the project must be reviewed and approved by qualified specialists prior to use on site. o Revegetation must match the vegetation type which previously existed, unless otherwise indicated by a suitable specialist. o Use of indigenous vegetation during rehabilitation. o All planting work is to be undertaken by suitably experienced personnel, making use of the appropriate equipment. o After planting, each plant must be well watered, adding more soil upon settlement if necessary. ▪ Grassing - o Suitably trained personnel must undertake grassing by making use of the appropriate equipment and indigenous grass species, as specified by the qualified specialists. o Sodding may be done at any time of the year, but seeding must be done by sowing appropriate seed mixtures at the most suitable time under the guidance of a qualified specialist.				

APPENDIX L

EMERGENCY RESPONSE PLAN

EMERGENCY RESPONSE PLAN

Potential Sources & Receptors of Impacts	Receptors of impacts related to emergency incidents include: • People(members of the public and project workers); • Flora; • Wildlife; • Livestock; • Groundwater; • Surface water; and • Soil.
Management Objectives	• Ensure adequate measures are in place to attend to environmental impacts associated with emergencies.
Targets	• All emergencies to be timeously responded to by trained project workers. • No loss of sensitive environmental features as a result of environmental incidents. • Safeguard potential receptors against emergency incidents.
WBG & National Requirements	• WBG EHS General Guidelines (2007), Section 3.7 - Emergency Preparedness and Response. • SA National Environmental Management Act (Act No. 107 of 1998) - Section 30A (Emergency Situations). • SA National Water Act (Act No. 36 of 1998) - Section 20 (Control of Emergency Incidents). • SA Occupational Health and Safety Act (Act No. 85 of 1993) and relevant Regulations.
Related Management Plans	• Occupational Health and Safety Management Plan. • Hazardous Materials Management Plan. • Community Health, Safety and Security Management Plan.
Monitoring Requirements / Records	• Grievance mechanism. • Contractor's method statement. • Training records. • Incident reports.
Training	The contractor will ensure that the necessary training is provided to the project workers on the Heritage Resources Management Plan, including the chance finds procedure, to allow them to be competent with regards to the management requirements. Training records to be maintained.

<table>
<tr><th rowspan="2">Management Actions</th><th rowspan="2">Responsibilities</th><th rowspan="2">Implementation Timeframe</th><th colspan="2">Monitoring Requirements</th></tr>
<tr><th>Evidence</th><th>Frequency</th></tr>
<tr><td>• Emergency contact details will be prominently displayed.
• Practice emergency response procedures with the project workers,
• Where there is a risk posed to the local community by the emergency incident, the nature of the emergency and response measures need to be communicated to the affected parties.
• The Contractor shall ensure that alternative arrangements be made for incidents occurring after working hours.
• Develop a procedure for reporting environmental emergencies, which include the following (as relevant):
o Details of responsible person
o Incident details
o Pollutants released during incident
o Incident impact
o Existing prevention procedures/systems/measures
o Initial incident management
o Clean-up and/or decontamination
o Mitigation measures
o Reporting to authorities
o Close-out
• First aid and medical equipment -
o First aid attendants shall be appointed.
o Suitable medical equipment suitable for the personnel, type of operation, and the degree of treatment likely to be required prior to transportation to hospital, shall be provided.
o Contractors shall have one first aid box for the first 10 persons and thereafter one for every 50 or team of workers on site or part thereof, taking into account the type of work performed and the distance between teams.
o More first aid boxes shall be provided in accordance with the risk assessment. Boxes must be available</td><td>▪ Contractor to implement management actions.
▪ ECO and CLO- to monitor compliance.</td><td>▪</td><td>▪ Emergency contact list displayed.
▪ Updated maintenance schedule for fire-fighting equipment.
▪ Visual inspections (photographic records).
▪ Records of incidents and corrective measures taken.
▪ Proof of training.</td><td>▪ Throughout duration of seismic survey and drilling operations.</td></tr>
</table>

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	Frequency
and accessible for the immediate treatment of injured persons at the workplace. ○ For offices, signs indicating where the first aid box or boxes are kept as well as the name and contact details of the First Aider of such first aid box or boxes shall be erected. ○ A content check list must be available with all first aid boxes and boxes shall be checked on a regular basis, kept clean and dust free. • Venomous species (including snakes, scorpions and spiders) - ○ Prepare an emergency response procedure for dealing with bites or stings from venomous species. ○ Display photographs of venomous species at the camp site to heighten awareness. ○ Educate project workers about venomous species. ○ Determine the availability of antivenom at local clinics / hospitals. • Fire - ○ Comply with the National Veld and Forest Fire Act (No. 101 of 1998) and National Veld and Forest Fire Bill (B122B of 1998). ○ Work closely with the local Fire Protection Association. Determine requirements and add to list of emergency telephone numbers. ○ Keep a fire danger index displayed on site and comply with requirements. ○ Fire breaks will be agreed with neighbours and the local Fire Protection Association. ○ Proper emergency response procedure shall be in place for dealing with fires. ○ Identify ignition risks and prevent risk of fires from these sources. ○ Manage construction domain to prevent the build-up of combustible material. ○ Burning of waste is not permitted.				

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	Frequency
○ Provide adequate fire control mechanisms (fire-fighting equipment). ○ All fire control mechanisms (fire-fighting equipment) will be routinely inspected by a qualified investigator for efficacy thereof and shall be approved by local fire services. ○ All staff on site will be made aware of general fire prevention and control methods, and the name of the responsible person to alert to the presence of a fire. The contact details of the emergency services must be displayed and easily accessible on site. ○ No fires are allowed on site. ○ Firebreaks shall be made for construction areas, as required. ○ Dedicated smoking areas to be provided. • Accidental Leaks and Spillages - ○ Proper emergency response procedure shall be in place for dealing with spills and leaks. ○ Ensure that the necessary materials and equipment for dealing with spills and leaks are available on site, where practicable. ○ Remediation of the spill areas will be undertaken to the satisfaction of the Project Manager and ECO. ○ In the event of a hydrocarbon spill, the source of the spillage will be isolated and contained. The area will be cordoned off and secured. The Contractor will ensure that there is always a supply of an appropriate absorbent material readily available to absorb, breakdown and where possible, encapsulate a minor hydrocarbon spillage. ○ All staff on site will be made aware of actions to be taken in case of a spillage. ○ Provide contact details of person and emergency services to be notified in a case of spillages – signage to be displayed at strategic points within the				

Management Actions	Responsibilities	Implementation Timeframe	Monitoring Requirements	
			Evidence	Frequency
drill site (e.g., workshop, fuel storage area, hazardous material containers). ○ All major incidents (i.e., uncontrolled release of a hazardous substance, including from a major emission, fire or explosion, that causes, has caused or may cause significant harm to the environment, human life or property) to be reported to DFFE and/or other relevant authorities. • Security threats - ○ Coordinate with the South African Police Service (SAPS) (nearest police office in Leslie) and the local municipality on the safety and security of the project workers. ○ Establish a security protocol in consultation with the SAPS. ○ Maintain access control to the drill site. ○ Provide security at the drill site. ○ Report suspicious people and vehicles. ○ Engage with the local community through the appropriate communication channels established for the Project. ○ Train project workers on site security procedures. ○ Ensure project workers are able to communicate with the relevant members of the project team (e.g., two-way radios). • See requirements in ESMP for additional control measures related to potential emergency events.				

APPENDIX M

SPECIALIST STUDIES

Appendix M1: Wetland Assessment

Council for Geoscience

Wetland Delineation and Risk Assessment for the proposed CCUS Drilling & 3D Seismic Survey, Mpumalanga Province, South Africa

01 APRIL 2023

Prepared by

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NITAI CONSULTING

SPECIALIST ENVIRONMENTAL CONSULTING

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Reviewed by	**Qualification**	**Date**	**Signature**	**Version No.**
Elzet Human	M-Tech Nature Conservation (TUT) (Pri. Sci. Nat. Conservation Science 147031)	02 April 2023		2.0
Antoinette Bootsma	M.Sc. Environmental Science (UNISA) (Pri. Sci. Nat. Ecology & Botany 400222-09)	06 April 2023		3.0
Prepared for	Nemai Consulting (PTY) Ltd. 147 Bram Fischer Drive, Ferndale Randburg, 2194 NEMAI CONSULTING			

Executive Summary

Nitai Consulting (Pty) Ltd. was appointed by Nemai Consulting (Pty) Ltd. to undertake a wetland delineation and risk assessment for the proposed Carbon Capture Utilisation and Storage (CCUS) drilling & 3D seismic survey near Leandra, Mpumalanga Province, South Africa.

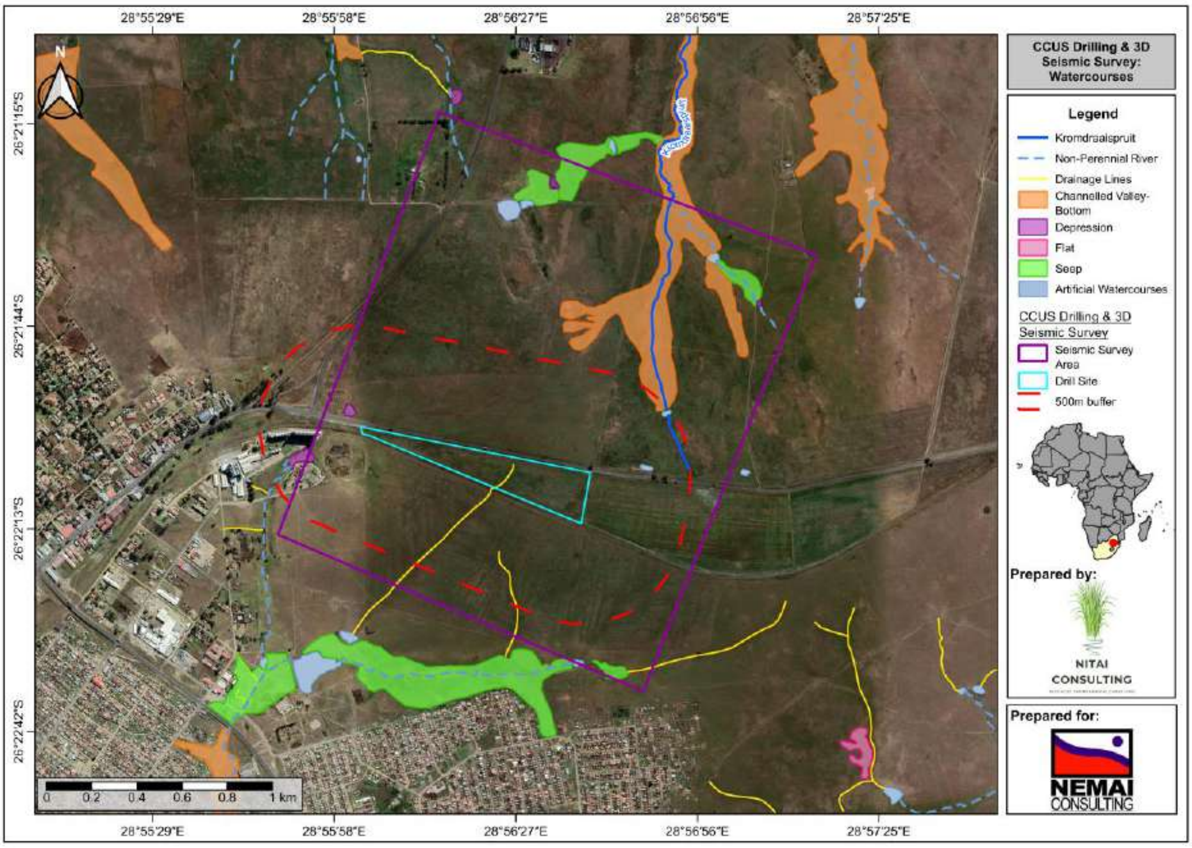
The terms of reference for this study are as follows:

- Identify and delineate of all associated wetlands within the proposed study area;
- Classify each watercourse according to the National Wetland Classification Systems;
- Compile a baseline description of all the potentially impacted aquatic environments according to Government Notice (GN) No. 320, March 2020;
- Assess the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all identified wetlands; and
- Comply with Appendix 6 of the EIA Regulations by undertaking a risk assessment and identifying suitable mitigation measures.

According to the National Web Based Environmental Screening Tool of the Department of Forestry, Fisheries and the Environment, the proposed site has a very high sensitivity due to Strategic Water Source Areas and watercourses (wetlands and rivers). The proposed drill site is not located within any wetlands, however, two wetlands are found within 500 m of this site, which is in the regulated area. Furthermore, one drainage line traverses the proposed drill site boundary (see Figure below). In addition, several wetlands occur throughout the seismic survey area (including Channelled Valley-Bottom, Seep, Depression and Flat). The largest river within the proposed study area is the Kromdraaispruit and its tributaries.

Several vegetation species indicating wetlands were found within the proposed study area. Species include. In addition, augered soil samples indicated signs of wetness in the form of gleyed soil types, however, mottling in these soils was generally absent.

The Present Ecological State of all the wetlands within the study area was calculated as C (Moderately modified), while the Ecological Importance and Sensitivity was determined as Moderate (C). These wetlands hold high ecosystem service values due to being identified as Ecological Support Areas that needs to be maintained in an ecologically functional state in order to support the Critical Biodiversity Areas and Protected Areas. However, although these wetlands hold high value, they are not protected from degradation and are subjected to various types of impacts.



As a result of the very high sensitivity according to the Department of Forestry, Fisheries and the Environment Screening Tool, a Risk-based Impact Assessment was conducted in order to minimise and mitigate possible groundwater pollution, loss of wetland habitat and ecological structure as well as erosion during the seismic survey and drilling. Possible impacts to groundwater associated with the proposed development is hydrocarbon spillages that could lead to infiltration to groundwater. In addition, loss of wetland habitat could result due to moving truck while the possibility for erosion is increased if proper mitigation measures are not implemented. The impact on the wetlands is perceived to be low and can be further lowered if mitigation measures described in this report are followed.

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List of Abbreviations

BA	Basic Assessment
CBA	Critical Biodiversity Area
CCUS	Carbon Capture Utilisation and Storage
CGS	Council for Geoscience
CO_2	Carbon Dioxide
CR	Critical
CRR	Comments and Response Report
CVB	Channel Valley-Bottom
Dep	Depression
DFFE	Department of Forestry, Fisheries & the Environment
DEM	Digital Elevation Model
DWAF	Department of Water Affairs and Forestry
DWS	Department of Water and Sanitation
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
ESIA	Environmental and Social Impact Assessment
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EN	Endangered
ESA	Ecological Support Area
F	Floodplain
FL	Flat
GIS	Geographic Information System
GN	Government Notice
ha	Hectares
HGM	Hydrogeomorphic
km	Kilometer (1 000m)
LC	Least Concern
MAP	Mean Annual Precipitation
m	Meters
NASA	National Aeronautics Space Administration
NBA	National Biodiversity Assessment
NEMA	National Environmental Management Act (No. 107 of 1998)
NFEPA	National Freshwater Priority Areas

NWA	National Water Act
NWCS	National Wetland Classification System
NWM	National Wetland Map
PES	Present Ecological State
REMP	River Ecostatus Monitoring Program
S	Seep
SAIIEA	South Africa Inventory of Inland Aquatic Ecosystems
SANBI	South African National Biodiversity Institute
SRTM	Shuttle Radar Topography Mission
SWA	Strategic Water Areas
TWI	Topographic Wetness Index
UCVB	Unchanneled Valley-Bottom
VU	Vulnerable
WMA	Water Management Area
WRC	Water Research Commission
WUL	Water Use License
WULA	Water Use License Application
WSS	Water Supply Scheme

1 INTRODUCTION

1.1 Background

The Council for Geoscience (hereafter referred to as the proponent) proposes a CCUS Drilling and 3D Seismic Survey (hereafter referred to as the study area) near Leandra, Mpumalanga Province, South Africa (hereafter referred to as the study area) (Figure 1). South Africa is one of the leading producers of coal in the world and emits carbon dioxide (CO_2) into the atmosphere through the coal-fired powerplants. As such, South Africa has decided to attempt and minimise these emissions by utilising CCUS technologies where it is proposed to inject CO_2 into deep geological formations that is approximately 1 km below the earth's surface. Nitai Consulting was appointed to conduct a wetland delineation and risk assessment as part of the Environmental and Social Impact Assessment (EISA) of the proposed CCUS Drilling and 3D Seismic Survey.

The presence of possible wetlands within the development area triggers the need for wetland delineation and risk assessment. Moreover, this assessment was done in accordance with the Environmental Impact Regulations (EIA) that were published under GN No. 982 in Gazette No. 38282 of 4 December 2014 and amended by GN 326 of 7 April 2017 published in Gazette No. 40772 (hereafter referred to as "the EIA Regulations") promulgated in terms of the National Environmental Management Act (Act No. 107 of 1998) (NEMA). Furthermore, the findings of this report are in accordance with the requirements of Appendix 6 of the EIA Regulations or to the Procedures for the. Assessment and Minimum Criteria for Reporting on Identified Environmental Themes (GN No. 320 in Government Gazette No. 43110 of 20 March 2020) (see Table 1 for the minimum requirements and criteria for Appendix 6 and Aquatic Biodiversity Themes).

The National Water Act (Act No. 36 of 1998) (NWA) ensures that South Africa's water resources are "protected, used, developed, conserved, managed and controlled." As such, any activity taking place within the regulated area of a watercourse, as defined in GN 509 published in the Government Gazette 40229 of 26 August 2016, would require authorisation in terms of NWA.

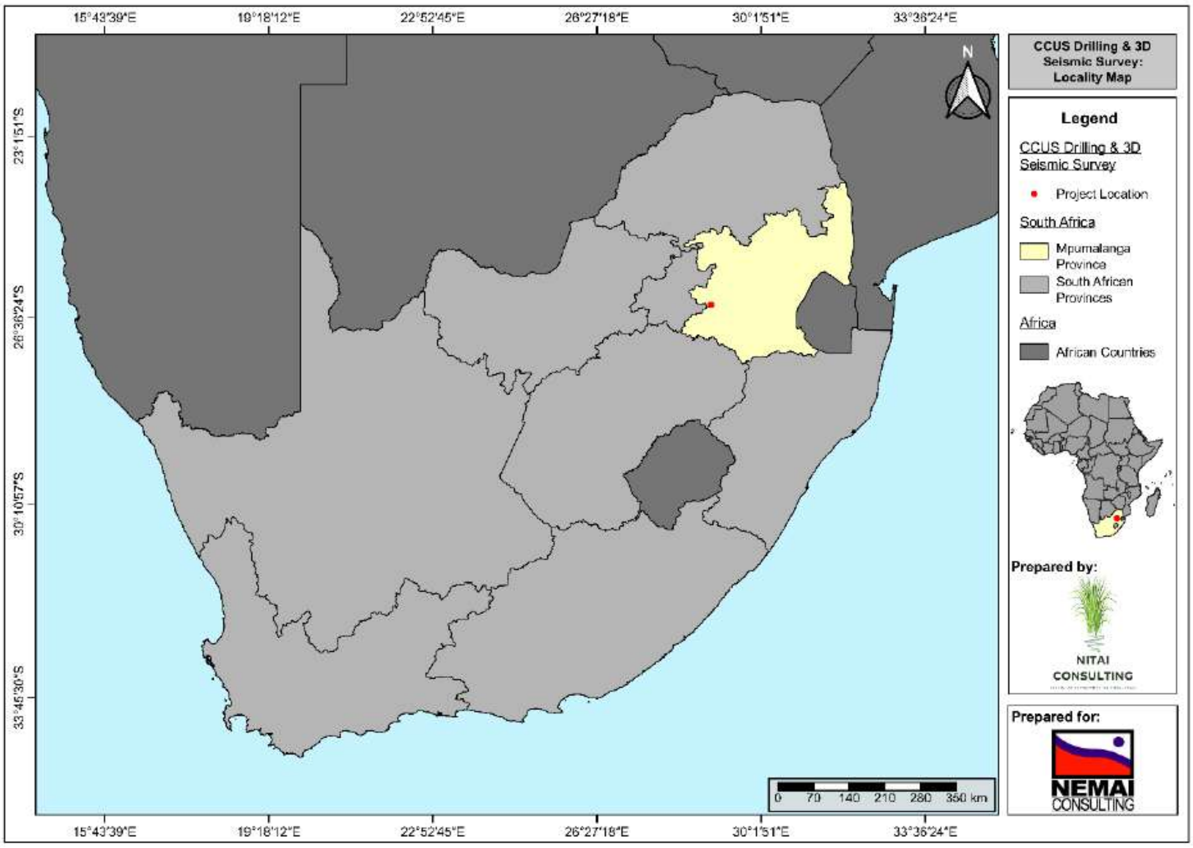

Figure 1: Study area locality in relation to South Africa

1.2 Importance of wetlands

A wetland is defined as per the NWA as "land that 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 in normal circumstances supports or would support vegetation typically adapted to life in saturated soil" (NWA, 1998).

The term "Wetlands" describes a variety of aquatic ecosystems, ranging from rivers, springs, seeps and mires in the upper catchment, to midlands marshes, pans and floodplains, to coastal lakes, mangrove swamps and estuaries at the bottom of the catchment (DWAF, 2005).

For an ecosystem to be identified as a wetland, it should comprise the following attributes:

- Hydromorphic soils that display characteristics resulting from prolonged saturation;
- Presence, at least occasionally, of water loving plants (hydrophytes); and,
- A high-water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.

Wetlands play valuable functions in the landscape and more importantly, they also provide a wide range of ecosystem goods and services such as (DWAF, 2008) such as:

- Flood attenuation;

- Sediment trapping and stabilisation;
- Biodiversity support; and,
- Water quality improvement.

The primary task of wetlands is to regulate runoff and process water. They act as sponges where they hold water during floods and releases it during the dry periods. Therefore, during flooding, wetlands regulate water flows to reduce flood damage and aids in preventing soil erosion. Wetlands recharge groundwater resources and also removes pollutants from water. They are natural filters and aid in purifying water through trapping many pollutants, including sediment, heavy metals and disease-causing organisms (DWAF, 2005).

1.3 Terms of Reference

The aim of the study was to provide a baseline wetland delineation and risk assessment of all associated wetlands within the study area. This was achieved through the following:

- Identify and delineate of all associated wetlands within the proposed study area;
- Classify each watercourse according to the National Wetland Classification Systems;
- Compile a baseline description of all the potentially impacted aquatic environments according to GN No. 320, March 2020 (Table 1);
- Assessing the PES and EIS for all identified wetlands; and
- Comply with Appendix 6 of the EIA Regulations by undertaking a risk assessment and identifying suitable mitigation measures.

1.4 Structure of the report

The report has been structured as follows:

- Introduction;
- Legislation;
- Project Description;
- Methodology;
- Status Quo Analysis;
- Findings of the Assessment; and
- Conclusion.

Table 1: Compliance with Appendix 6 and criteria and minimum requirements for the various environmental themes as published in GN 320, March 2020

No.	Content	Reference
a	A specialist report prepared in terms of these Regulations must contain— details of— i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 1
2.7	SACNASP Qualification and field of practice	Appendix 1
b	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 1
2	The assessment must be undertaken on the preferred site and within the proposed development footprint	Section 3.2
2,3	Threat status of the ecosystem and species as identified by the DEA screening tool	Section 6.4.1
c	An indication of the scope of, and the purpose for which, the report was prepared;	Section 1
cA	An indication of the quality and age of base data used for the specialist report;	Section 2 and Section 4.1.2
cB	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 7
d	The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.3
e	A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
2.3	Description of the aquatic biodiversity and ecosystems on the site including: • aquatic ecosystem types • Presence of aquatic species, and compositions of aquatic species communities their habitat, distribution and movement patterns	Section 6.3
2,3,4	A description of the ecological importance and sensitivity of the aquatic ecosystem including: • a) The description (spatially if possible) of the ecosystem process that operate in relation to the aquatic ecosystems on and immediately adjacent to the site (e.g. movement of surface water and subsurface water, recharge, discharge, sediment transport etc.); • b) The historic ecological condition (reference) as well as present ecological state of rivers (in-stream, riparian and floodplain habitat), wetlands and or estuaries in terms of possible changes to channel and flow regime (surface and groundwater)	Section 6.3.7
f	Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 6 and Section 7
g	An identification of any areas to be avoided, including buffers;	Section 6.3.1 and 6.4.2

No.	Content	Reference
h	A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 6.4.2
i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4.1.9
j	A description of the findings and potential implications of such findings on the impact of the proposed activity (including identified alternatives on the environment) or activities;	Executive Summary, Section 6
	The following questions should be answered: • Is the proposed development consistent with maintaining the priority aquatic ecosystem in its current state and according to the stated goal? • Is the proposed development consistent with maintaining the resource quality objectives for the aquatic ecosystems present?	Section 6
	How will the development impact on fixed and dynamic ecological processes that operate within or across the site: • a. Impacts on hydrological functioning at a landscape level and across the site which can arise from changes to flood regimes (e.g. suppression of floods, loss of flood attenuation capacity, unseasonal flooding or destruction of floodplain processes); and • b) Change in the sediment regime (e.g. sand movement, meandering river mouth /estuary, changing flooding or sedimentation patterns) of the aquatic ecosystem and its sub -catchment; • c) The extent of the modification in relation to the overall aquatic ecosystem (i.e. at the source, upstream or downstream portion, in the temporary, seasonal, permanent zone of a wetland, in the riparian zone or within the channel of a watercourse, etc.). • d) to what extent will the risk associated with water uses and related activities change?	Section 7.1.1
2,5	How will the proposed development impact on the functioning of the aquatic feature? This must include: • a) Base flows (e.g. too little/too much water in terms of characteristics and requirements of system) • b) Quantity of water including change in the hydrological regime or hydroperiod of the aquatic ecosystem (e.g. seasonal to temporary or permanent; impact of over - abstraction or instream or off -stream impoundment of a wetland or river) • c) Change in the hydrogeomorphic typing of the aquatic ecosystem (e.g. change from an unchannelled valley -bottom wetland to a channelled valley -bottom wetland). • d) Quality of water (e.g. due to increased sediment load, contamination by chemical and /or organic effluent, and /or eutrophication) • e) Fragmentation (e.g. road or pipeline crossing a wetland) and loss of ecological connectivity (lateral and longitudinal). • f) The loss or degradation of all or part of any unique or important features (e.g. waterfalls, springs, oxbow lakes, meandering or braided channels, peat soils, etc.) associated with or within the aquatic ecosystem.	Section 7.1.1
2,5	How will the development impact on key ecosystem regulating and supporting services especially: • a) Flood attenuation • b) Stream flow regulation • c) Sediment trapping • d) Phosphate assimilation • e) Nitrate assimilation	Section 7.1.1

No.	Content	Reference
	• f) Toxicant assimilation • g) Erosion Control • h) Carbon Storage?	
2,5	How will the proposed development impact community composition (numbers and density of species) and integrity (condition, viability, predator - prey ratios, dispersal rates, etc.) of the faunal and vegetation communities inhabiting the site?	Refer to terrestrial biodiversity report
k	Any mitigation measures for inclusion in the EMPr;	Section 7
l	Any conditions for inclusion in the environmental authorisation;	Section 7
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 7
n	A reasoned opinion— i. [as to] whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Executive Summary and Section 8
o	A description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A
p	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
q	Any other information requested by the competent authority.	None

2 LEGISLATION

2.1 International Legislation

The protection of wetland systems has been campaigned at international and national level through various legislations. At international level, legislation relevant to this particular project is the World Bank Safeguard Policies (OPs) OP/BP 4.04 Natural Habitats.

Under this policy, Natural Habitats are defined as land and water areas where (i) the ecosystems' biological communities are formed largely by native plant and animal species, and (ii) human activities has not essentially modified the area's primary ecological function. Within the CCUS Drilling and 3D Seismic Survey project, a variety of wetland systems are found within the footprint that are regarded as Natural Habitats and suitable mitigation measures are required to protect these wetland systems.

2.2 South African Legislation

In South Africa, there are a wealth of policies and legislation dealing directly or indirectly with environmental protection and management. Aquatic ecosystems, and in particular wetlands, have been protected and management over the years through various policies and legislation. These include:

- Constitution of the Republic of South Africa (Act 108 of 1996);
- NEMA;
- EIA Regulations
- NWA;
- General Authorisations (GA's);
- National Environmental Management: Biodiversity Act (Act 10 of 2004); and
- National Environmental Management: Protected Areas Act (Act 57 of 2003).

2.2.1 Constitution of the Republic of South Africa (Act 108 of 1996)

The Constitution of the Republic of South Africa (Act 108 of 1996) aims to provide an environment that is protected, for the benefit of the present and future generations, through reasonable legislative and other measures that –

- Prevent pollution and ecological degradation;
- Promote conservation; and,
- Secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

2.3 National Environmental Management Act (NEMA, Act 107 of 1998)

The aims of the NEMA are "to provide for co-operative environmental governance by establishing principles for decision-making on matters affecting the environment, institutions that will promote cooperative governance and procedures for co-ordinating environment functions exercised by organs of state; to provide for certain aspects of the administration and enforcement of other environmental management laws; and to provide for matters connected therewith".

NEMA and the EIA Regulations, states that prior to any development, an Environmental Authorisation (EA) application process should be followed. For an EA application, either a Basic Assessment (BA) process or an EIA process can be followed depending on the scale of the Environmental Impact. On 20 March 2020, new regulations were gazetted (GN No. 43110) that has replaced the requirements of Appendix 6 of the EIA Regulations and therefore provides criteria and minimum requirements for the various environmental themes in terms of Section 24(5)(a) and (h) and Section 44 of the NEMA when applying for an EA (refer back to Table 1).

2.4 Legislation Governing Watercourses

2.4.1 National Water Act (NWA, Act 36 of 1998)

The NWA aims to achieve a balance between the use and protection of the country's water resources, where the entire aquatic ecosystem – not merely the water it provides – is recognised as "the water resource". Moreover, the NWA has redefined the concept of water resource use and protection so that it not only includes water but the full range of goods and services that aquatic ecosystems provide (DWAF, 2008).

A watercourse is defined as:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and,
- Any collection of water which the Minister may, by notice in the *Gazette*, declare to be a watercourse.

According to the Water Use Registration Regulations published under GN R1352 in Government Gazette 20606 of 12 November 1999, any person who uses water as contemplated under Section 21 of the NWA must, register the relevant water use. The registration of a water use must be done by notifying the DWS and complete the registration process. According to the Act and Section 21, water uses include:

(a) Taking water from a water resource;
(b) Storage of water;
(c) Impeding or diverting the flow of water in a watercourse;
(d) Engaging in a stream flow reduction activity contemplated in Section 36;
(e) Engaging in a controlled activity identified as such in Section 37(1) or declared under Section 38(1);
(f) Discharging waste or water containing waste into a water resource through a pipe, canal, sewer, sea outfall or other conduit;
(g) Disposing of waste in a manner which may detrimentally impact on a water resource;
(h) Disposing in any manner of water which contains waste from, or which has been heated in, any industrial or power generation process;
(i) Altering the bed, banks, course or characteristic 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 regulated area of a watercourse for Section 21(c) and (i) water uses is defined as follows in Government Gazette No. 40229 of 26 August 2016:

- The outer edge of the 1 in 100 year flood line and /or delineated riparian habitat, whichever is the greatest distance, measured from the middle of the watercourse of a river, spring, natural channel, lake or dam;
- In the absence of a determined 1 in 100 year flood line or riparian area, the area within 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 NWA); or
- A 500 m radius from the delineated boundary (extent) of any wetland or pan.

2.4.2 National Environmental Management: Biodiversity Act (NEM:BA, Act 10 of 2004)

The main aim of NEM:BA is to protect species and ecosystems while promoting the sustainable use of indigenous biological resources. Moreover, the act addresses the need for protecting threatened ecosystems. Furthermore, the act aims to provide the South African National Biodiversity Institute (SANBI) the tools to assist in achieving the objectives of this act.

2.4.3 National Environmental Management: Protected Areas Act (NEM:PA, Act 57 of 2003)

The aim of NEM:PA is to provide the declaration and management of protected areas (within the framework of national legislation, including NEMA). In addition, the act aims to effect a national system of protected areas in South Africa as part of a strategy to manage and conserve its biodiversity. Also, NEM:PA wants to promote sustainable utilisation of protected areas in such a way that it would preserve the ecological character of protected areas.

3 PROJECT DESCRIPTION

3.1 Study location

The proposed CCUS Drilling and 3D Seismic Survey is situated within the northern portion of the Highveld coalfields in the Mpumalanga Province of South Africa (see Figure 2 below). The study area is located within the Gert Sibande District Municipality and the Govan Mbeki Local Municipality. The R29 runs through the proposed study area where the drilling site is located adjacent to the R29 and a railway line in the central part of the proposed study area.

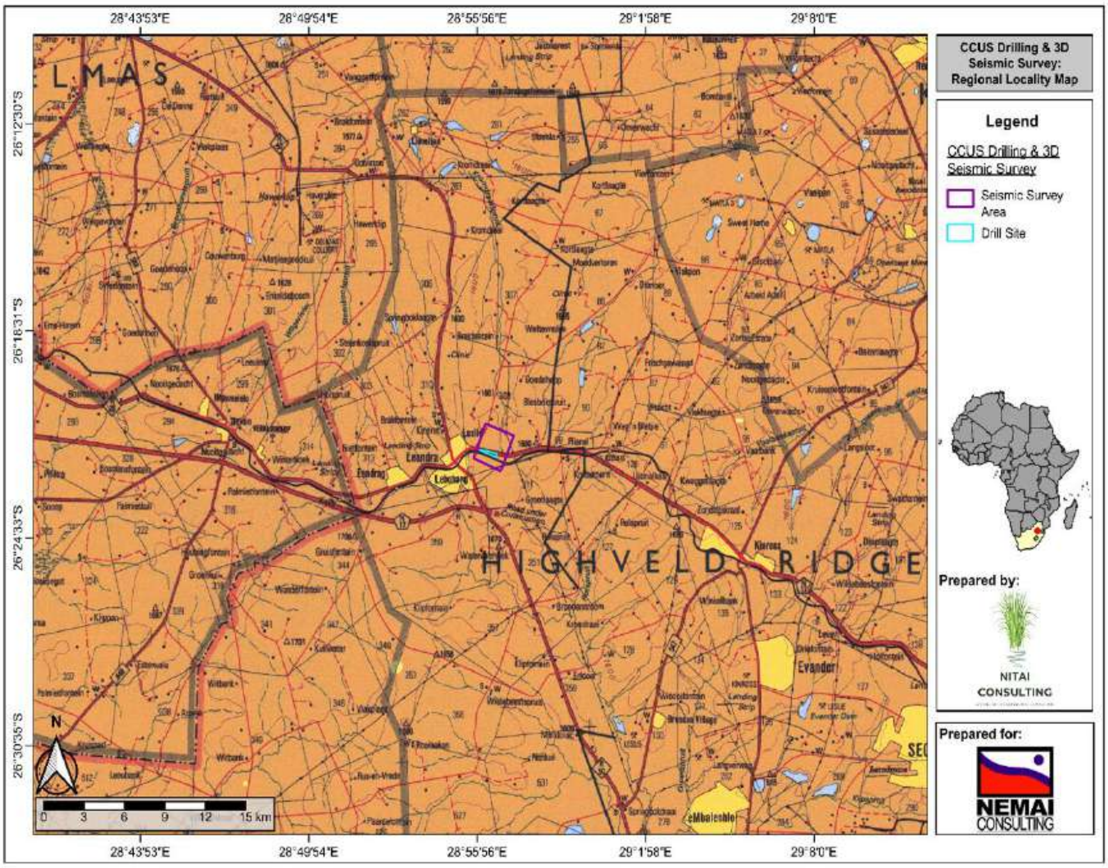

Figure 2: Regional Locality of the proposed study area

3.2 Project Description

The proponent proposes the CCUS Drilling and 3D Seismic Survey located on various farm portions of Farms Goedehoop No. 308 and Grootlaagte No. 311, which is near the town Leandra, in the Mpumalanga Province (Figure 3).

3.2.1 Carbon Capture Utilisation and Storage

Carbon Capture Utilisation and Storage reduces the release of anthropogenic CO_2 emissions into the atmosphere through capturing CO_2 at its source (i.e. point-source emitters such as coal-fired power plants) and transports the captured emissions and stores it in suitable deep geological formations. More importantly, some of the captured CO_2 could further be used in additional downstream industries (Henning, 2023).

The CGS has undertaken an assessment of available geological data in order to identify the availability of deep coal seams and potential CO_2 storage reservoirs and has identified the Mpumalanga Province as the areas that can support the CCUS development. The CCUS project entails two components:

- **Component 1:** Pilot CO_2 Storage Project (PCSP) for the investigation and characterisation of a suitable CO_2 storage site and the subsequent injection, storage and monitoring of between 10,000 and 50,000 tonnes of CO_2 into deep suitable geological formations.

- **Component 2:** A CO_2 Capture Pilot Project (CCPP) Front-End Engineering Design (FEED) for the preparation of a FEED study for a capture pilot plant at the Eskom Kusile Power Station.

Furthermore, the scope of the CCUS project is the Geological Characterisation that falls within Component 1 (PCSP) that includes, amongst others, the drilling of a stratigraphic borehole and undertake a high-resolution 3D seismic survey at the proposed drill site (Henning, 2023).

3.2.2 Drilling Activities

In the drilling site, it is proposed that a 2,000m deep slim hole be drilled for the geological characterisation and to support the pilot CO_2 injection and monitoring. This drill site is located along the R29 from Leandra to Kinross and is bounded by a railway to the south. The site will be approximately 50m x 30m. Furthermore, a well pad will be constructed at the location to accommodate a drilling rig, associated equipment and support services. Boreholes will be drilled from the top of the bedrock to total depth and will have a minimum hole diameter of c. 95 millimetres (mm). During different stages of the drilling process, suites of geophysical instruments will be installed in the hole that will provide geophysical information. In addition, tests to determine the presence and quantity of gasses (hydrocarbons/light gasses) while tests to determine hydrological information will be conducted at systematic horizons (i.e. where water strikes are intersected) in the borehole. Furthermore, the drilling of boreholes will be to acquire core and wireline logs to assist in undertaking high-resolution geological characteristics (Henning, 2023).

Equipment associated with the drilling shall include the following (Henning, 2023):

- Drill rigs including masts or derricks;
- Drilling fluid mixing, pumping and recycling equipment;
- Grouting pumps, mixers and all other equipment necessary to grout casing of the borehole, when necessary;
- Lighting plants and other equipment necessary to allow safe and efficient 24-hour operation;
- Adequate power supply unit for the drilling operation and the staff camp;
- Water supply for drilling and potable water for workers;
- Site office accommodation, stores, workshops, and kitchen facilities at the site;
- Office for Council of Geoscience (CGS) representatives;
- Adequate vehicles to allow completion of the work, including suitable transport to safely transport contractor personnel to and from the drill site;
- Adequate, approved temporary ablution and latrine facilities;
- A reliable communication system; and finally,

- All spare parts and back-up plant and equipment to ensure safe and efficient completion of work.

Upon borehole completion, the borehole will be capped by means of a concrete sanitation block and a lockable metal cap. Furthermore, the borehole will be equipped with a clear sign to avoid potential hazards to people and animals. Finally, the drill site will be rehabilitated accordingly, and new facilities will be created for the injection phase (Henning, 2023).

3.2.3 3D Seismic Survey

In addition to the drilling, a 3D seismic survey is proposed and encompasses majority of municipal land and a small section of private land. The total area of the survey is approximately 360 ha in extent. A 3D seismic survey explains the subsurface discontinuities, layering, and probable rocks/structures (Haldar, 2018). It is particularly useful in the investigation of coal, oil, groundwater, massive metallic deposits and gas (Haldar, 2018). A seismic survey deploys an array of energy sources through an array of sensors or receivers in the area of interest (Aminzadeh & Dasgupta, 2013). The main purpose of the high-resolution 3D survey for the CCUS proposed project is to map detailed structures, reservoirs and seal rocks in order to identify potential injection site (Henning, 2023). Also, the survey will be used to establish the baseline for future time-lapse CO_2 monitoring activities.

The proposed survey will send seismic waves in the form of vibrations through a heavy plate mounted to a truck (Aminzadeh & Dasgupta, 2013; Henning, 2023). This specialist truck is also known as Vibroseis. By analysing the time it takes for the seismic waves to reflect off subsurface formations and return to the surface, formations can be mapped. In addition, 3D surveys are required by layout energy source points (vibroseis) and receiver points (geophones) in a grid over the area to be surveyed (Henning, 2023).

All data will be processed using pre-stack time/depth migration and post-stack time migration approaches for comparisons purposes. Wireless geophones will be deployed on foot by the survey crew and from support vehicles from pre-determined locations. After each day, the geophones will be collected and returned to the camp site to download the collected data and for the batteries to be recharged. Moreover, the 3D seismic survey over the drill site will be conducted at 20m receiver and source line spacing and 5m receiver and source spacing. The survey needs to provide high resolution from shallower depth of 100m to a maximum depth of 2km.

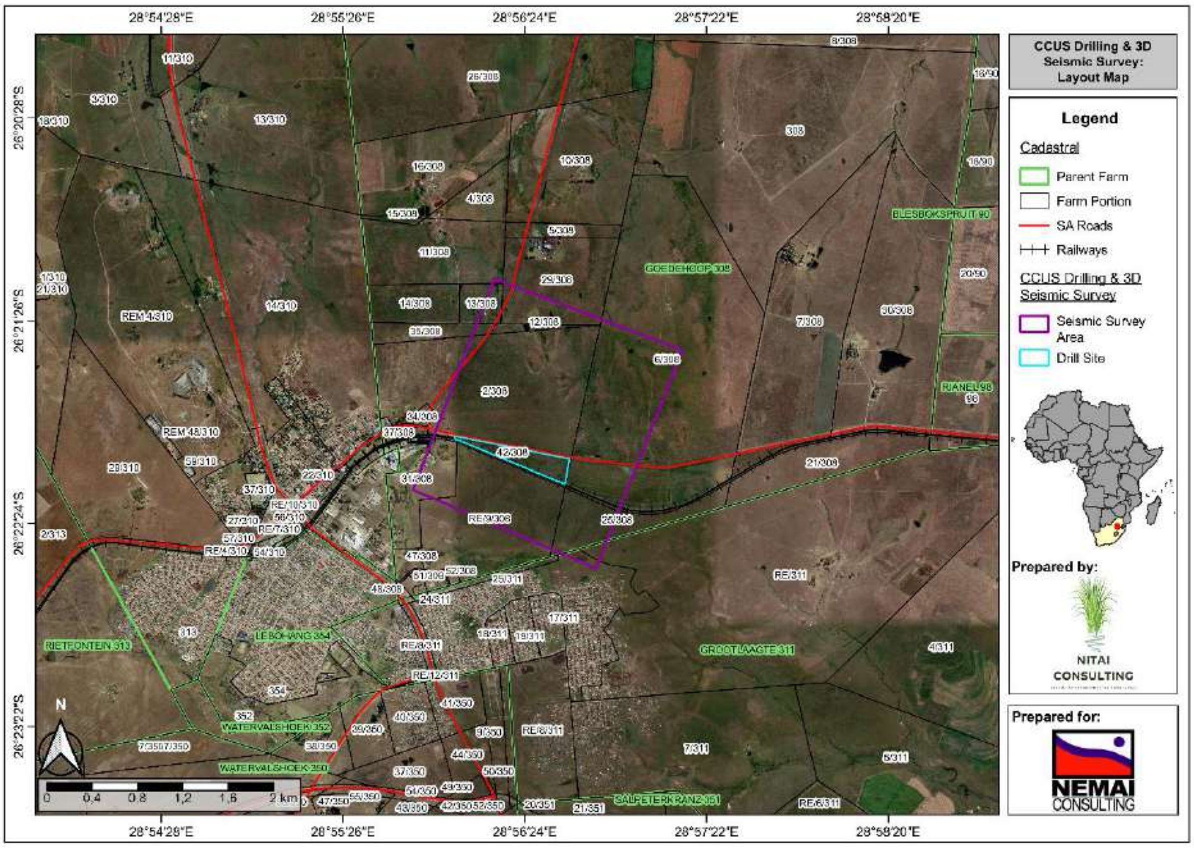

Figure 3: Proposed layout of the CCUS Drilling site and 3D Seismic Survey area

4 METHODOLOGY

The following sections provide an overview of the methodology used for this assessment.

4.1 Approach

4.1.1 Desktop Study

The preliminary mapping and classification of rivers and wetlands within the proposed footprint of CCUS drilling site and 3D seismic survey was undertaken using the latest and historic aerial imagery (Google Earth Pro).

4.1.2 Spatial Data Consulted

The spatial data used over the course of the assessment include the following:

- Aerial imagery (Google Earth Pro);
- National Freshwater Ecosystem Priority Areas (NFEPA) (rivers and wetlands) (Nel *et al*., 2011);

- South African Inventory of Inland Aquatic Ecosystems (SAIIAE) (van Deventer *et al*., 2018);
- South African Inventory of Inland Aquatic Ecosystems (van Deventer *et al*., 2019);
- 5m Contours;
- Geology;
- NASA Shuttle Radar Topography Mission Global 1 arc second digital elevation data;
- South African Vegetation Map (Mucina & Rutherford 2018);
- Mpumalanga Critical Biodiversity Areas (CBA's) and Ecological Support Areas (ESA's) (Showno & Desmet, 2008);
- Strategic Water Source Areas (SWA's) (Nel *et al*., 2013);
- Protected Areas and Protected Areas Expansion Strategy; and,
- DWA Eco-Regions (Kleynhans *et al*., 2005).

4.1.3 Identification and mapping of wetlands

The South African National Biodiversity Institute developed the National Wetland Classification Systems (NWCS) that was considered for this assessment. This is a system that is comprised of a hierarchical classification process that defines a wetland based on the principles of the hydrogeomorphic (HGM) approach.

Wetlands are delineated based on the guidelines set out by DWAF (2005) in their Updated Manual for the Identification and Delineation of Wetlands and Riparian Areas. As stated earlier, wetlands are a land that is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface (see Figure 4 on a cross-section through a wetland). The outer edge of a wetland is delineated by means of considering the following four wetland indicators:

- The Terrain Unit Indicator: Helps to identify those parts of the landscape where wetlands are more likely to occur;
- The Soil Form Indicator: Identifies the soil forms, as defined by the Soil Classification Working Group (1991), which are associated with prolonged and frequent saturation;
- The Soil Wetness Indicator: Identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation;
- The Vegetation Indicator: Identifies hydrophilic vegetation associated with frequently saturated soils.

According to the NWA, vegetation is the primary indicator, which must be present under normal circumstances. However, in practice the soil wetness indicator tends to be the most important, and the other three indicators are used in a confirmatory role.

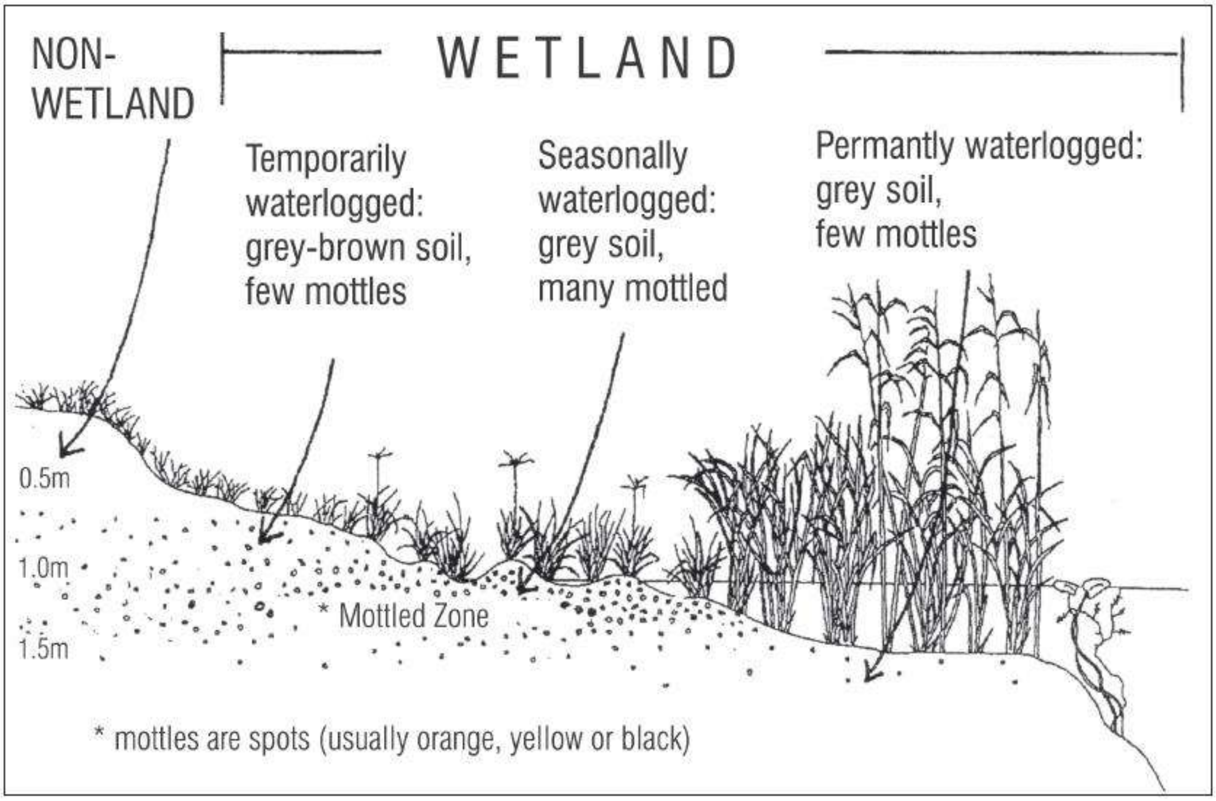

Figure 4: Cross-section through a wetland, indicating how soil wetness and vegetation indicators changes as one moves along a gradient (Extracted from DWAF 2005).

4.1.4 Present Ecological State (PES) of associated watercourses

The approach is to quantify the impacts of human activity or clearly visible impacts on wetland health and then convert it to impact scores to a PES score (Table 2). The PES scores provide an overall indication of the health or integrity of biophysical attributes which is determined through a comparison of the current condition to the natural (or close to natural), so-called "reference" condition (DWAF, 2007). The PES scores are calculated based on four key inter-related drivers namely; hydrology, geomorphology, water quality and vegetation. Moreover, the PES is assessed through evaluating the extent to which anthropogenic activities have altered wetland characteristics across the four inter-related components of wetland health (Macfarlane *et al*., 2020).

Table 2: Present Ecological State categories and Impact Scores (adapted from Macfarlane et al., 2009)

PES	Description	Impact Score Range	Impact Category
A	Unmodified, natural.	0 to 0.9	None
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1.0 to 1.9	Small

PES	Description	Impact Score Range	Impact Category
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2.0 to 3.9	Moderate
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4.0 to 5.9	Large
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6.0 to 7.9	Serious
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8.0 to 10.0	Critical

4.1.5 Ecological Importance and Sensitivity (EIS) of associated watercourses

To determine the EIS, the method of Rountree *et al*. (2013): Manual for the Rapid Ecological Reserve Determination of Inland Wetlands (Version 2.0) was used. This is specifically important to identify those systems that provide higher than average ecosystem services, biodiversity support functions or are especially sensitive to impacts. The determination of the EIS category takes into account the PES scores calculated for WET-Health together with the function and service provision that enables the assessor to determine the EIS category for the wetland or group being assessed. The method uses a scale from 0 to 4 to determine the EIS category where 0 to <=1 is low/marginal importance; >1 to <=2 is moderate; >2 and <=3 is high and >3 to <=4 is very high ().

Table 3: Ecological Importance and Sensitivity Categories (Adapted from Rountree et al., 2013)

Recommended Ecological Management Class	Range of Mean	EIS Category
A	3.0 to 4.0	Very High
B	2.0 to 3.0	High
C	1.0 to 2.0	Moderate
D	0 to 1.0	Low/marginal

4.1.6 The National Wetland Classification System (NWCS)

The SANBI together with the Water Research Commission (WRC) developed the NWCS will be used for this assessment. The basis of this Classification System uses a hierarchical system of defining a wetland based on the HGM units. The wetland HGM units considered are as follows (Ollis *et al*., 2013):

- Unchanneled valley bottom wetland (UCVB);

- Channelled valley bottom wetland (CVB);
- Seep (S);
- Floodplain (F);
- Depression (D); and
- Flat (FL).

4.1.7 Determination of Buffer Zones

The appropriate buffer zones for the proposed CCUS drilling and 3D seismic survey were determined using the "Preliminary Guideline for the Determination of Buffer Zones for Rivers, Wetlands, and Estuaries" by Macfarlane and Bredin (2017).

4.1.8 Risk Assessment of associated watercourses

The Risk-Based Assessment was conducted in accordance with the DWS water use authorisation risk assessment matrix guidelines. The significance ratings were calculated according to Table 4:

Table 4: Significance ratings, classes and management description of the DWS water use authorisation risk assessment matrix

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

4.1.9 Assumptions and limitations

The following assumptions and limitations accompany this assessment:

- This report is based on the information and layout received from the proponent;
- The findings, observations, conclusions and recommendations are based on the author's best professional and scientific knowledge; and
- The assessment of wetlands presented in this report is limited to the proposed project footprint and does not include the extended 500m radius regulated area of surrounding wetlands.

5 Status Quo Analysis

The following sections provide context of the aquatic environment in relation to the proposed CCUS drilling and 3D seismic survey.

5.1 Regional context

5.1.1 Climate

The study area is characterised with summer-rainfall region with an overall Mean Annual Precipitation (MAP) of 662 mm. Cool-temperate climate with thermic continentality (high extremes between maximum summer and minimum winter temperatures, frequent occurrence of frost, large thermic diurnal differences, especially in autumn and spring) (Mucina & Rutherford, 2018).

5.1.2 Ecoregion

South Africa is a geologically, geomorphologically, climatically and ecologically complex country that has a diverse range of ecosystems, including freshwater wetlands and rivers (Kleynhans *et al*., 2005). It is important to understand the biophysical drivers that affect the characteristics of water resources in the region when analysing the ecology of any area. River ecoregional classification or "typing" will allow the grouping of rivers according to similarities based on a top-down nested hierarchy. This aids in simplifying and contextualising assessments and statements on ecological water requirements. One of the big advantages of this systems is the extrapolation of information from data rich rivers to data poor rivers within the same hierarchical typing context (Kleynhans *et al*., 2005).

Ecological regions are regions within which there is relative similarity in the mosaic of ecosystems and ecosystem components (biotic and abiotic, aquatic and terrestrial) (Kleynhans *et al*., 2005). The proposed study is located within the Highveld ecoregion. A summary of this ecoregion is provided in Table 5 with the location and extent shown in Figure 5.

Table 5: Description of the Ecoregion classified for the study area

Ecoregion (Level I)	Ecoregion (Level II)	Description
11	11.05	**Highveld:** Plains with a moderate to low relief, as well as various grassland vegetation types (with moist types present towards the east and drier types towards the west and south), define this high lying region.

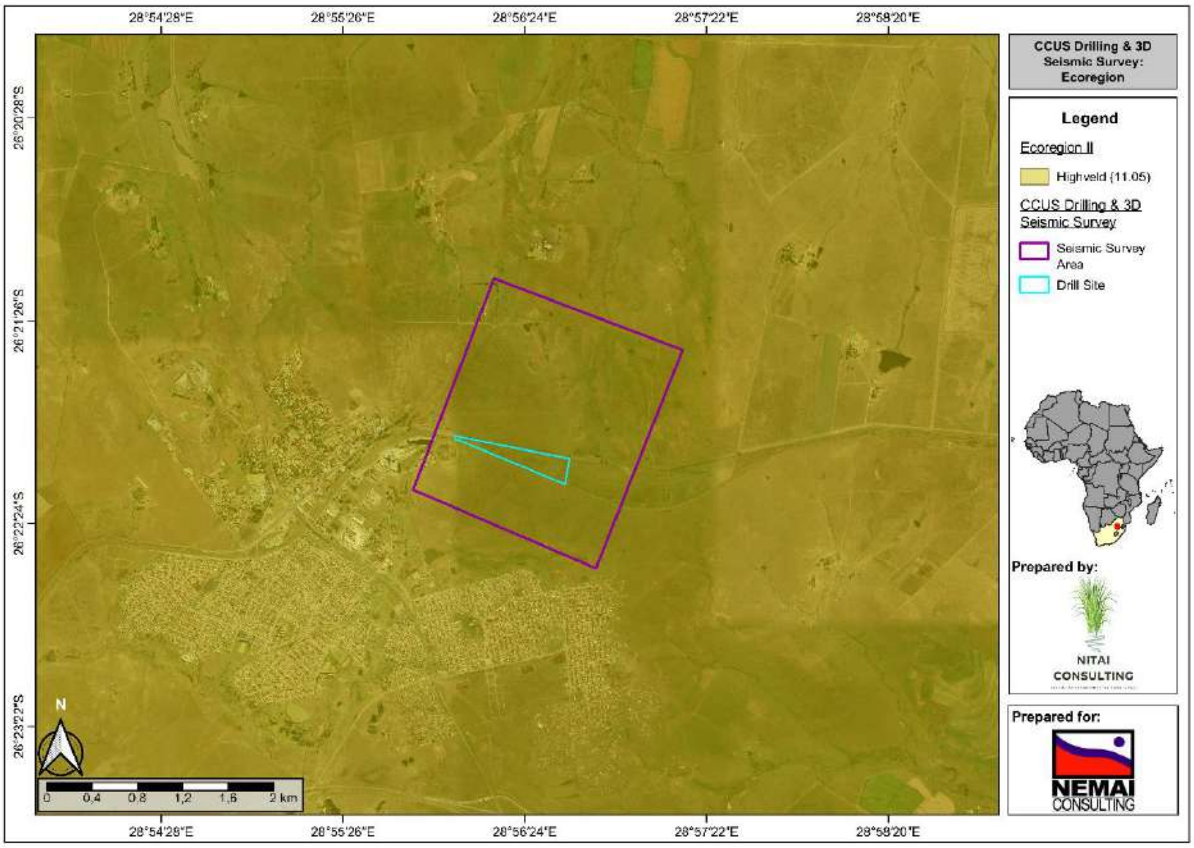

Figure 5: Map indicating the location of the Ecoregion relevant to the study area

5.1.3 Soils and Geology

The geology characteristics of the study area is comprised of Dolerite (Figure 1Figure 6) of the Karoo Dolerite group (Figure 7). The geology mostly supports shale, sandstone or mudstone of the Madzaringwe Formation (Karoo Supergroup) or the intrusive Karoo Suite dolerites which feature prominently in the area. Soils are deep, reddish on flat plains and are typically Ea, Ba and Bb land types (Mucina & Rutherford, 2006). Furthermore, the survey area is categorised with swelling clay soils such as Arcadia and Mayo soils (see Figure 8). These soil types occur in basic igneous geology such as dolerite (van der Waals *et al*., 2019).

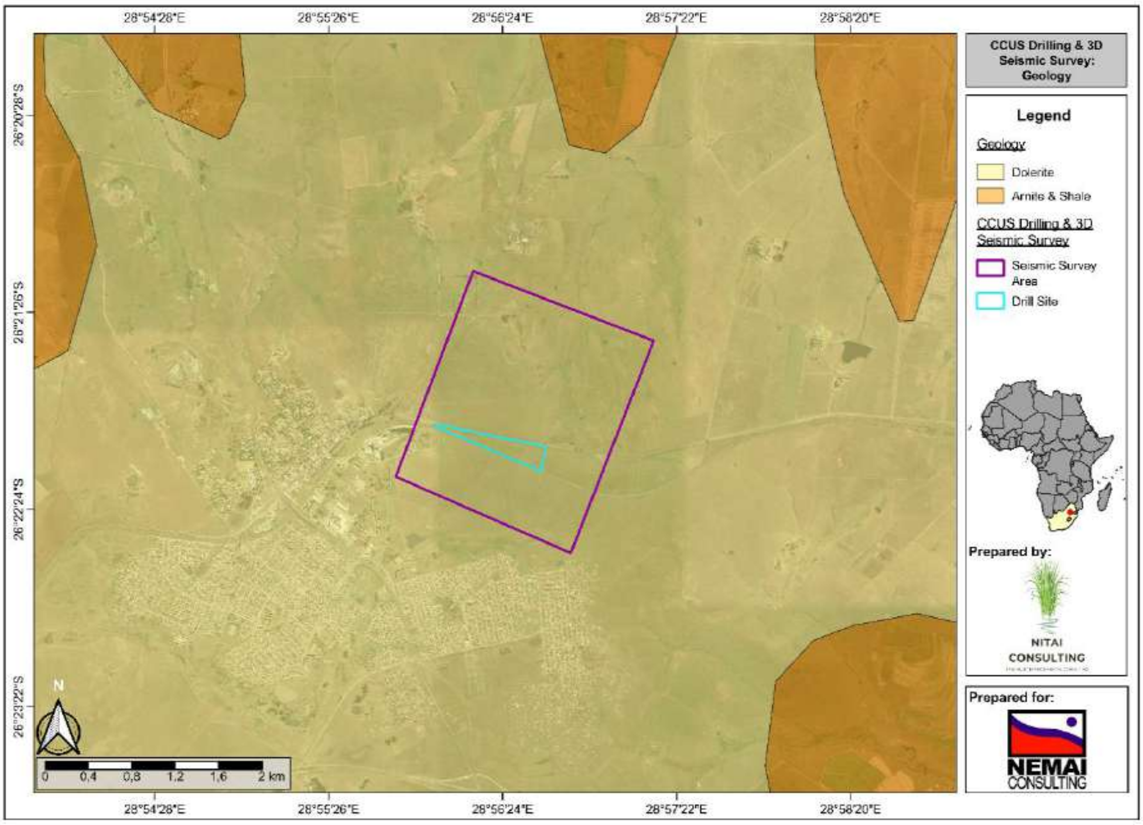

Figure 6: Map indicating the Dolerite group associated with the study area

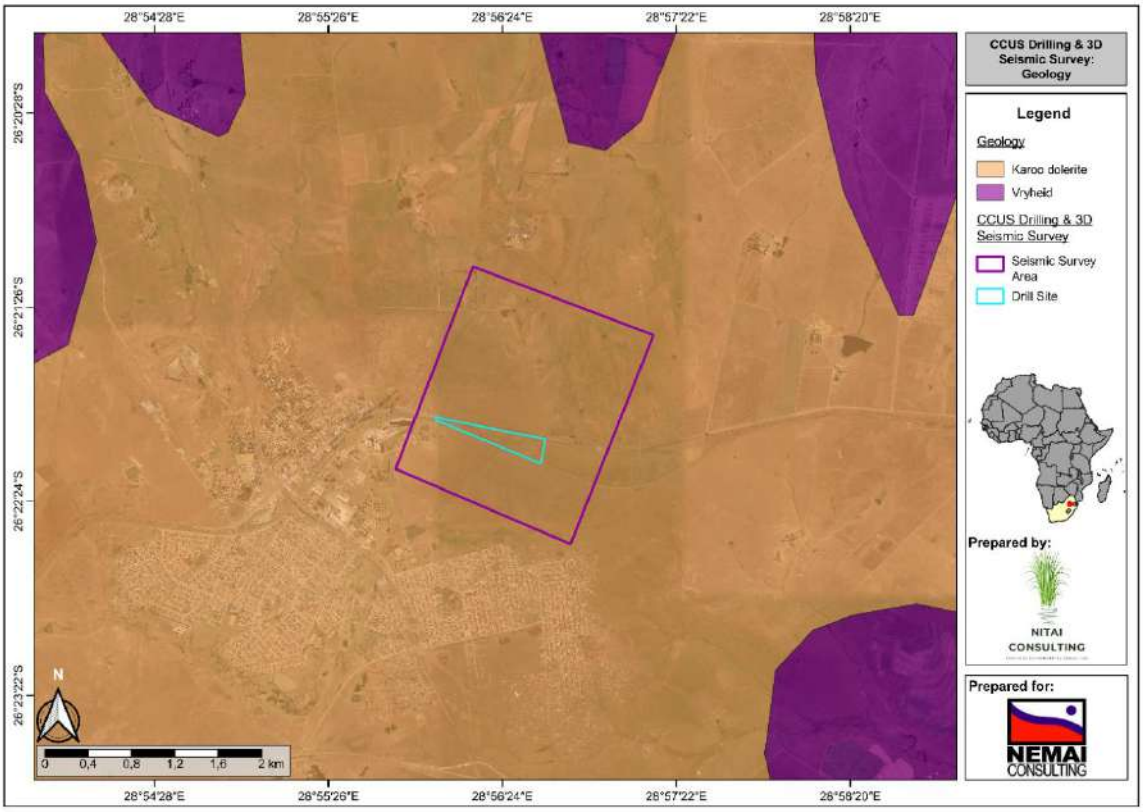

Figure 7: Map indicating the extent of the Karoo Dolerite associated with the study area

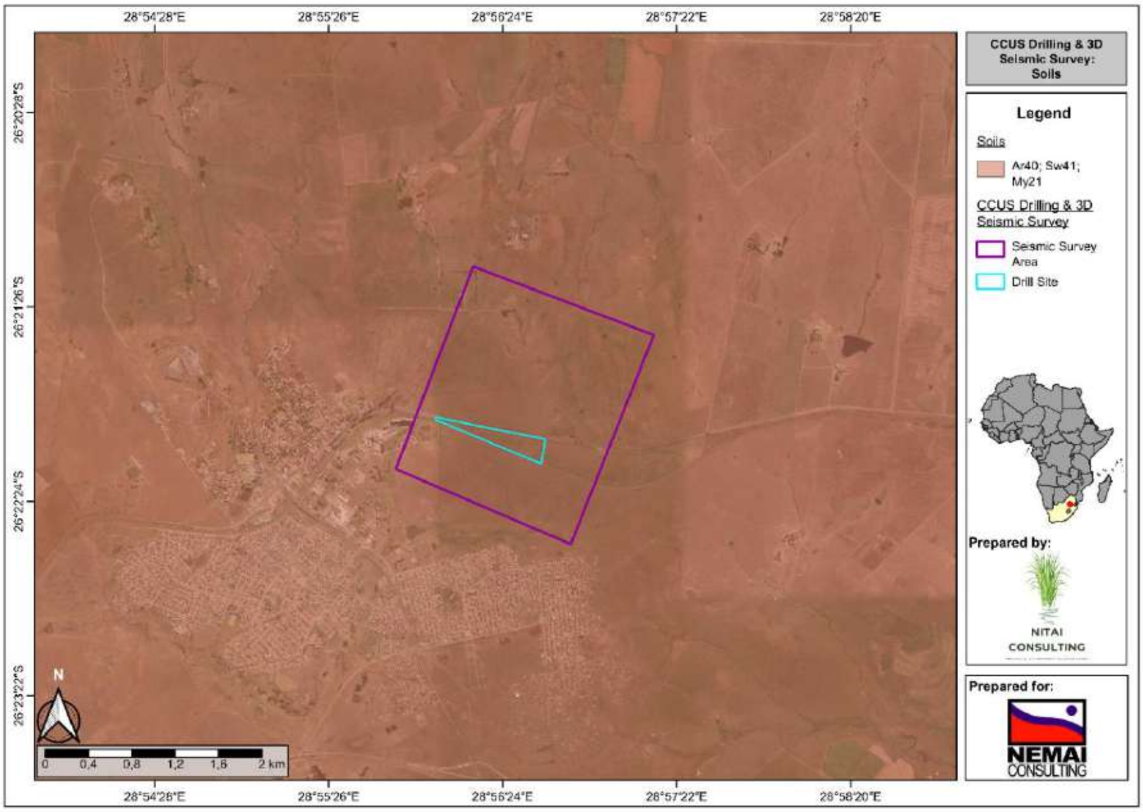

Figure 8: Soil map indicating the Arcadia, Swartland and Mayo soil forms associated with the study area

5.1.4 Vegetation characteristics

The study area falls within the Mesic Highveld Grassland (Gm 8) and is characterized as the Soweto Highveld Grassland (Figure 9). Characterised as gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus*, *Eragrostis racemose*, *Heteropogon contortus* and *Tristachya leucothrix*. In some areas not disturbed, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover (Mucina & Rutherford, 2006).

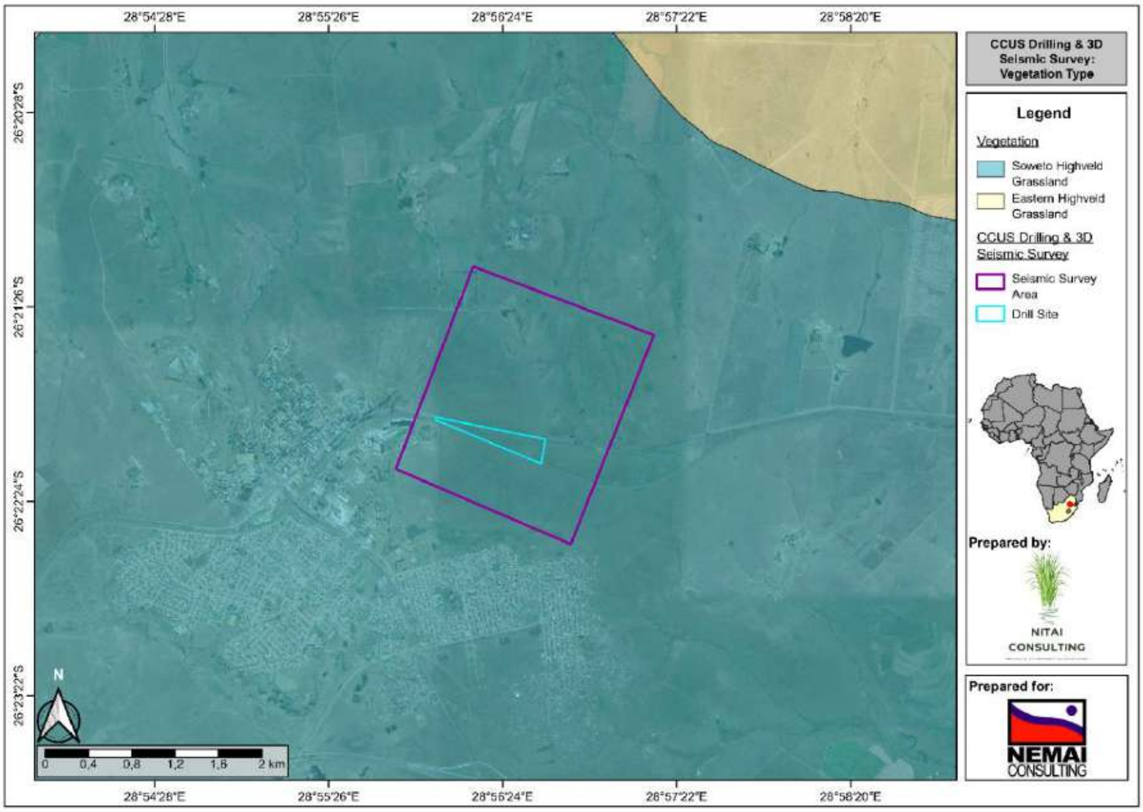

Figure 9: Vegetation type associated with the study area

5.1.5 Water Management Areas and Quaternary Catchment

Previously, the Vaal Water Management Area (WMA) was divided into three categories, namely the Lower Vaal, Middle Vaal and the Upper Vaal WMA's (DWAF, 2004a). However, under the most recent GN 1056 No. 40279 of 16 September 2016, the WMA's has been refined into Limpopo, Olifants, Inkomati-Usuthu, Pongola-Mtamvuna, Vaal, Orange, Mzimvubu-Tsitsikamma, Breede-Gouritz and Berg-Olifants. The study area is located within two WMA's. The proposed study area is situated within the upper region of the Vaal WMA while also in the Olifants WMA (Figure 10). The upper region is the most developed, industrialised and populous of all the Vaal WMA's. In addition, the upper Vaal is also South Africa's most important from a water resource management perspective as this WMA is part of a larger water supply system that includes adjacent WMA's and Lesotho (DWAF, 2002; DWAF, 2004a).

The Olifants WMA is a highly regulated and utilised catchment with its water resources becoming even more under pressure due to the rate of development and scarcity of water (DWA, 2013). Moreover, this WMA is highly diverse in economic activity and is characterised by commercial and subsistence agriculture, mining activities, manufacturing, tourism and commerce. Coal mining forms a large component within the Olifants and as such provides large portions of South Africa with power through several large thermal power stations (DWAF, 2004b; DWA, 2013). In addition to coal mining, copper, phosphate, and diamond mining dominates the Olifants WMA (DWAF, 2004b). In the Upper Olifants Area (where study area is situated) large areas that contribute to natural runoff are isolated from the catchment due to opencast mining. Furthermore, coal mines encompass a large portion of the Upper Olifants WMA and as such contributes to decanting, seepage and dewatering that increases the flow in some natural streams (DWAF, 2004b).

The study area is located within the B20E, and C12D Quaternary Catchment areas (see Figure 11 below). The DWS has determined PES and EIS scores for each Quaternary Catchment area in Southern Africa back in 2014 (DWS, 2014). As such, for the Quaternary Catchments B20E and C12D, DWS has determined a PES as C (Moderately modified), and D (Largely modified), respectively. In addition, the EIS was determined as A (High importance and sensitivity) and C (Moderate importance and sensitivity), respectively (DWS, 2014). The major river in the B20E Quaternary Catchment is the Olifants River and small tributaries such as the Upper Wilge (confluence with the Bronkhorstspruit) and Kromdraaispruit can also be found within this catchment (DWS, 2018). The B20E catchment have been significantly impacted by agriculture, urban areas, dams and some mining (DWS, 2018). The major river within the C12D catchment is the Waterval River and several other unnamed rivers as tributaries of the Waterval River (Brits, 2015). Impacts within this catchment include elevated nutrients (particularly phosphates) and salts. Major sources for these elevated levels of nutrients and salts include irrigation and Sasol (DWA, 2011).

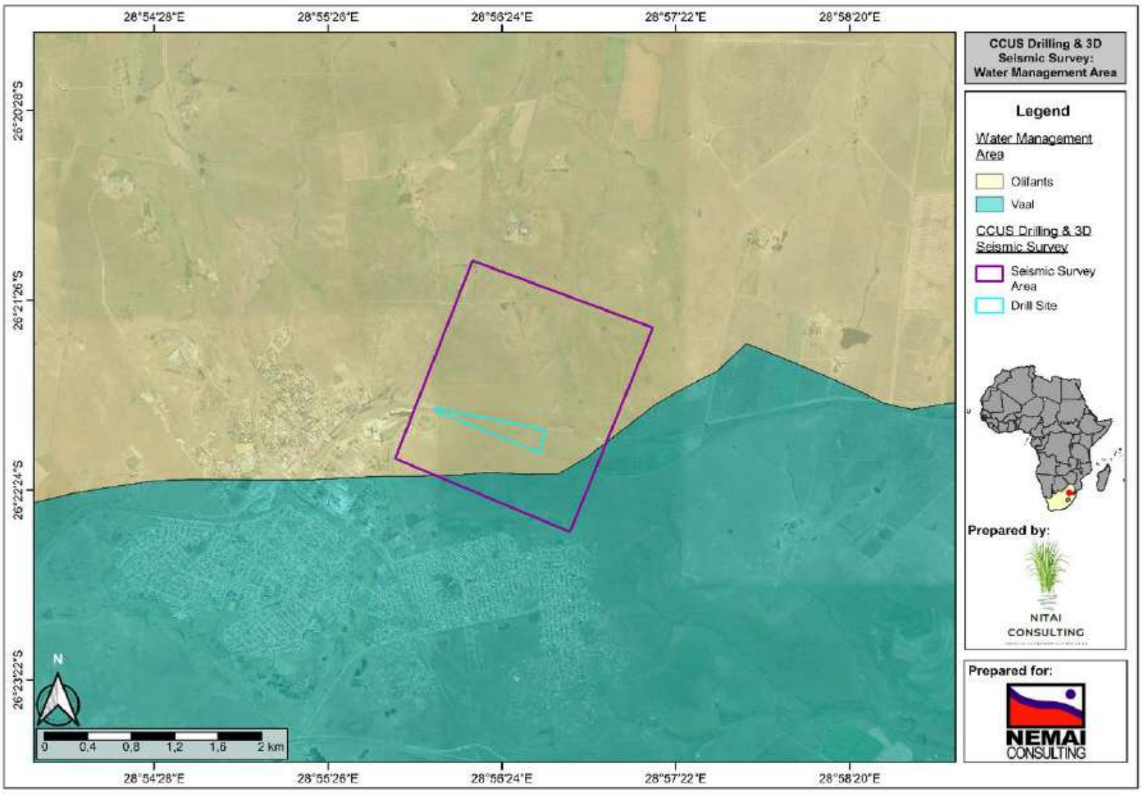

Figure 10: Water Management Area associated with the study area

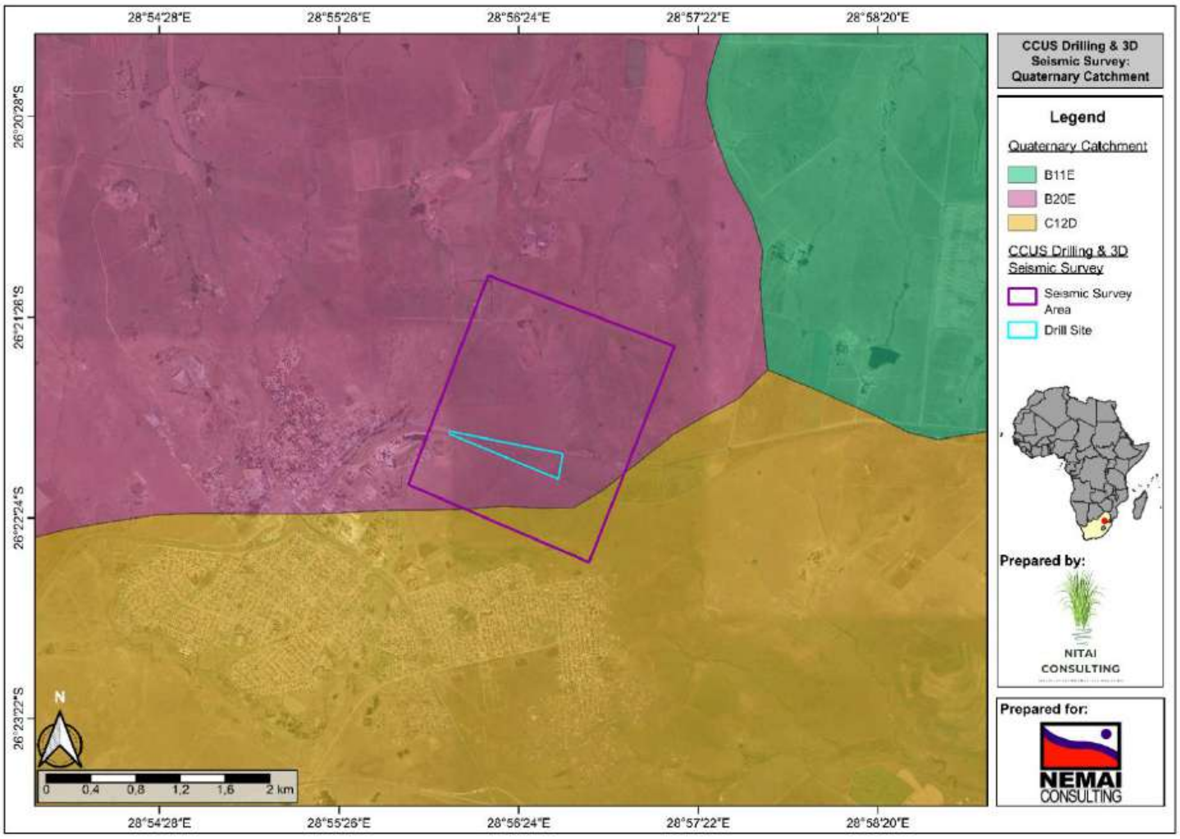

Figure 11:Quaternary Catchments associated with the study area

5.2 Conservation context

5.2.1 National Conservation Priorities

5.2.1.1 National Threatened Ecosystems

A list of threatened ecosystems that are currently under threat of being transformed by other land uses has been identified in a national process. A few different versions of the list of threatened ecosystems have been released since the first release back in December 2011 (NEM:BA: National list of ecosystems that are threatened and in need of protection, G34809, GN 1002, December 2011). The main aim of identifying the threatened ecosystems is to reduce the rate of ecosystem and species extinction by preventing further degradation and loss of structure, function and composition of threatened ecosystems (SANBI, 2011). The NEMA has divided ecosystems into four groups namely; Critically Endangered (CR), Endangered (EN), Vulnerable (VU) or protected.

Figure 12 shows the remaining extent of Threatened Ecosystems in the region surrounding the study area. Majority of the seismic survey area is situated within **Vulnerable (Vu)** land while some portions and the drill site are in unclassified land.

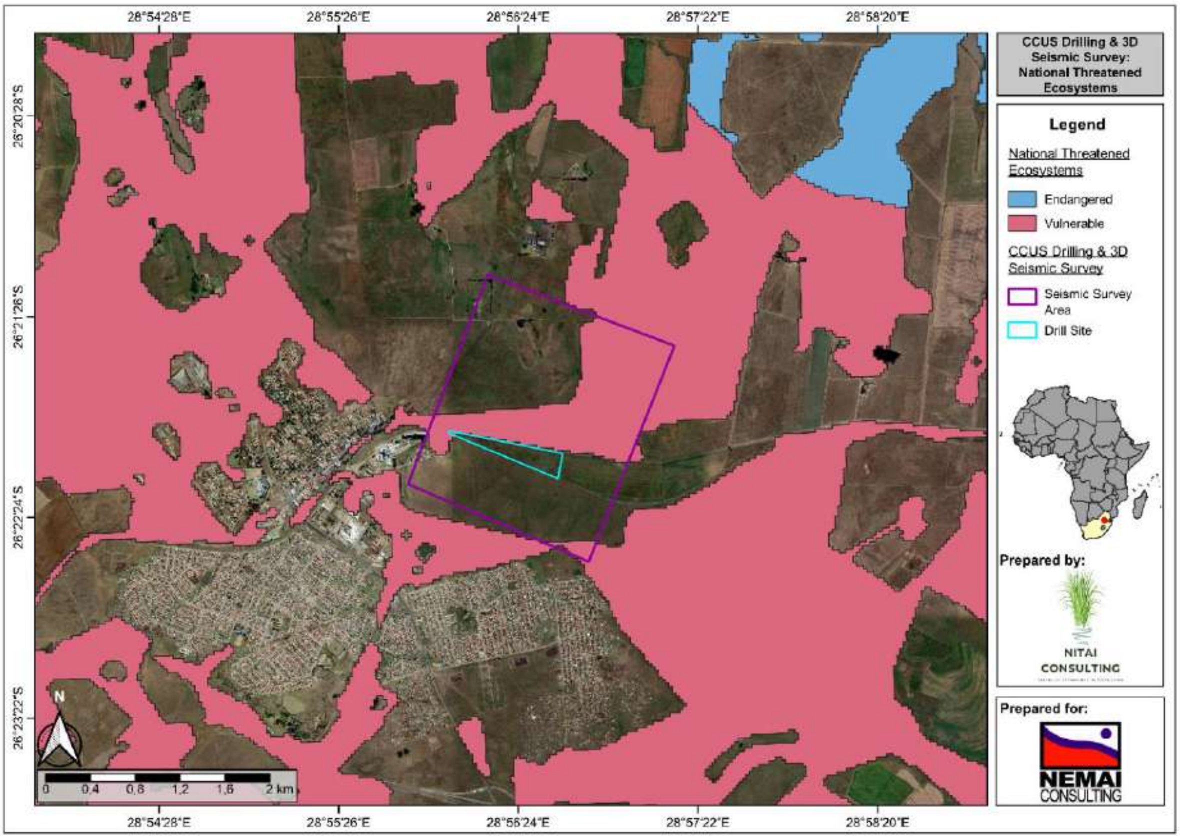

Figure 12: Map showing the location of the study area in relation of the estimated remaining extent of the identified Threatened Ecosystems (SANBI, 2021)

5.2.1.2 National Protected Area Expansion Strategy (NPAES)

The location and extent of the existing National Protected Area Expansion Strategy (NPAES) in relation to the project area is shown in Figure 13. The project area does not encroach into any NPAES.

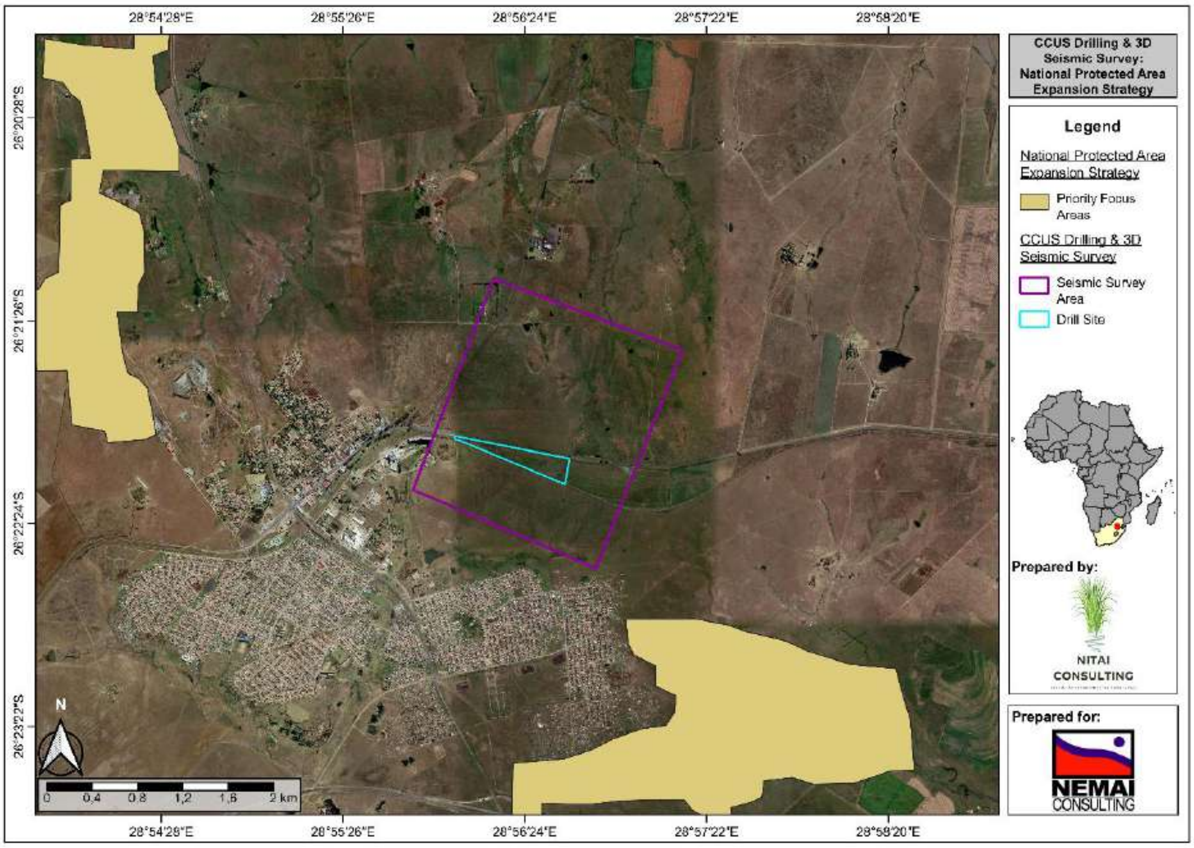

Figure 13: Map showing the study area in relation to the National Protected Areas Expansion Strategy

5.2.1.3 Watercourses

National Freshwater Ecosystem Priority Areas (NFEPA) rivers

The NFEPA rivers map in Figure 14 highlights the NFEPA rivers, non-perennial rivers and dams associated with the study area. The Kromdraaispruit begins just north east of the drill site and flow in a northerly direction, draining in the Wilge River. In addition, the Waterval River is outside to the south of the 3D seismic survey footprint. Moreover, one unnamed tributary of the Waterval River is on the perimeter of the 3D seismic survey area. The study area is not situated within any river FEPA catchments (areas that achieve biodiversity targets for river ecosystems and fish species) and these catchments are identified in rivers that are currently in good condition (Ecological category of A or B).

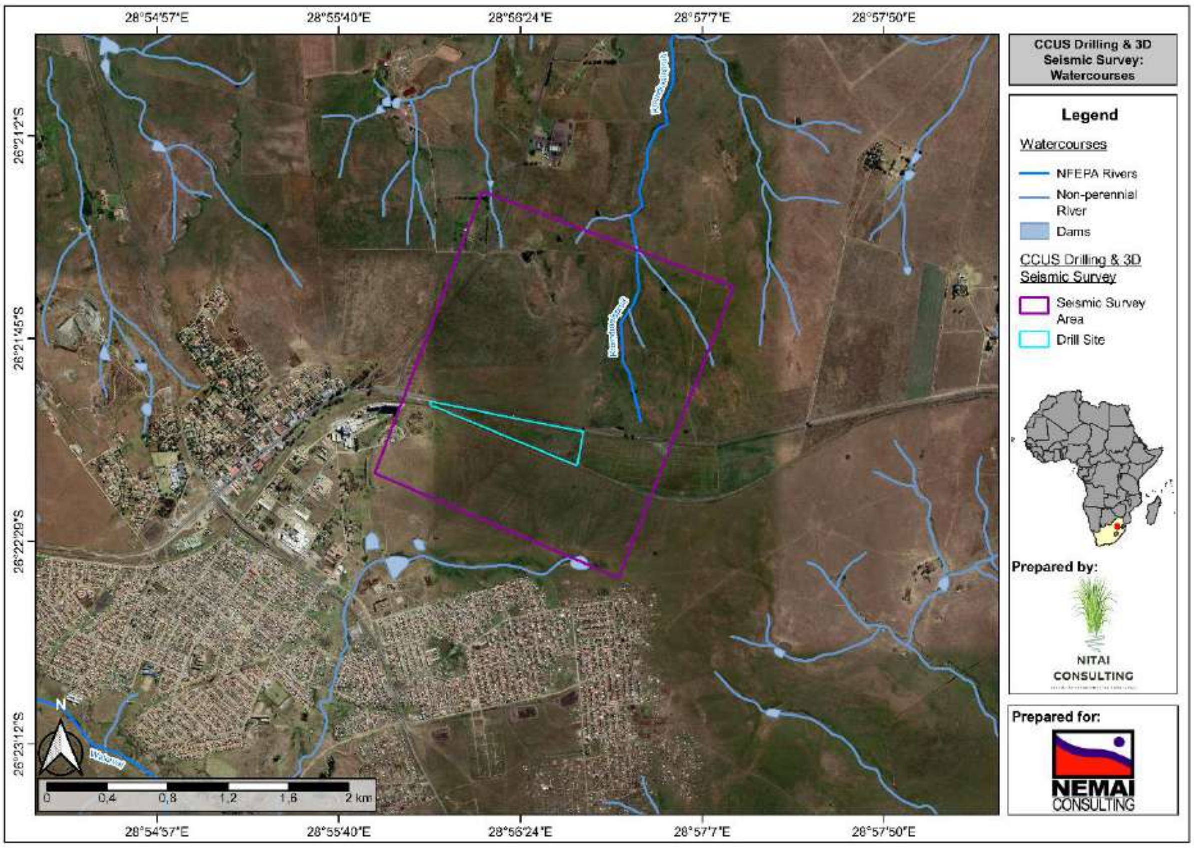

Figure 14: Map showing watercourses (NFEPA rivers, non-perennial rivers and Dams) associated with the study area

National Biodiversity Assessment (NBA) 2018 National Wetland Map (NWM) 5

A South African Inventory of Inland Aquatic Ecosystems (SAIIAE) was established in 2018 during the National Biodiversity Assessment (Van Deventer *et al*., 2018). This inventory highlights a collection of data layers pertaining to ecosystem types and pressures for rivers and inland wetland types. This includes the different wetland HGM units (CVB, UCVB, S, Dep, F and FL) as well its protection level (Well protected, Moderately protected, Poorly protected and Not protected) and threat status (Critical, Endangered, Vulnerable and Least Concern).

Within the footprint of the study area, there is one HGM unit according to the NBA 2018 NWM 5 spatial data (Figure 15). There are several large and small S, CVB's and a FL that is situated outside the 3D seismic survey area. In South Africa, rivers and inland wetlands have the highest percentage of being critically endangered; 42% & 61% respectively (Skowno *et al*., 2019). From the NWM 5 spatial data, all wetlands within the study area are in critical condition (Figure 16). Skowno *et al*. (2019) has further indicated that inland wetlands have the lowest overall protection in South Africa compared to other ecosystem realms. A total of 60% is classified as not protected while as less as 10% is classified as well protected and moderately protected (Figure 17). This has been attributed to their poor ecological condition (Skowno *et al*., 2019). Wetlands are essential ecological infrastructure for water and food security, tourism, recreation and disaster risk reduction (Skowno *et al*., 2019). Therefore, the need for protecting these watercourses is essential.

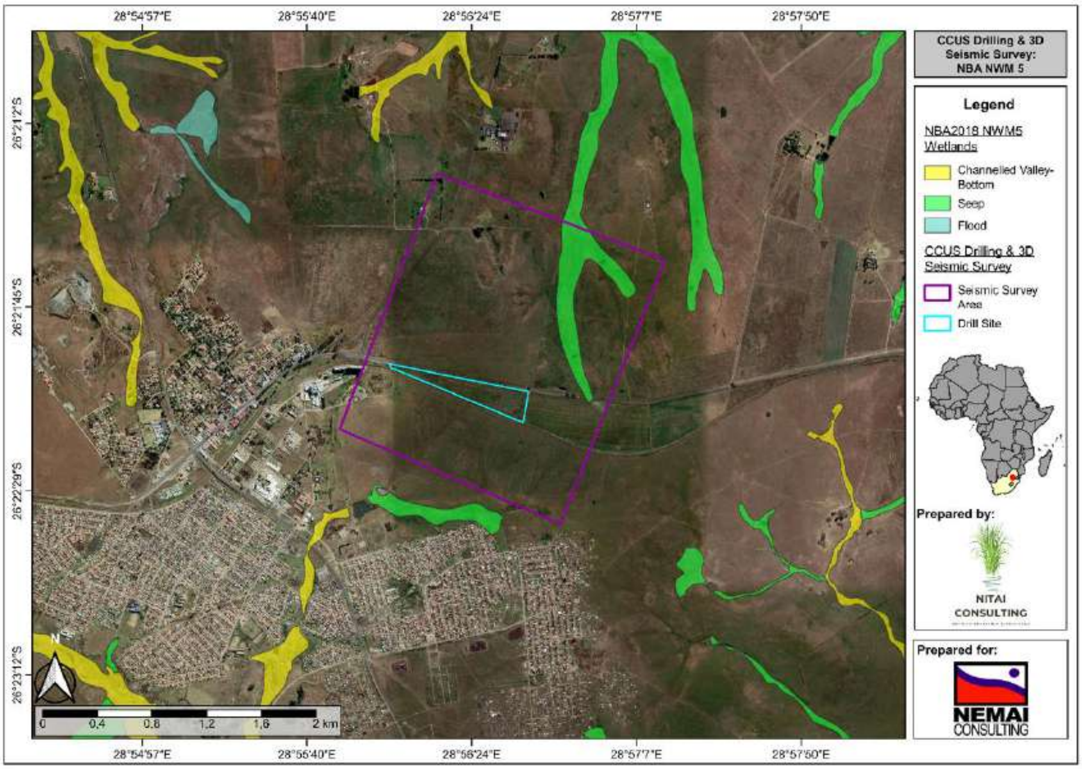

Figure 15: Map indicating the wetland hydrogeomorphic units associated with the study area

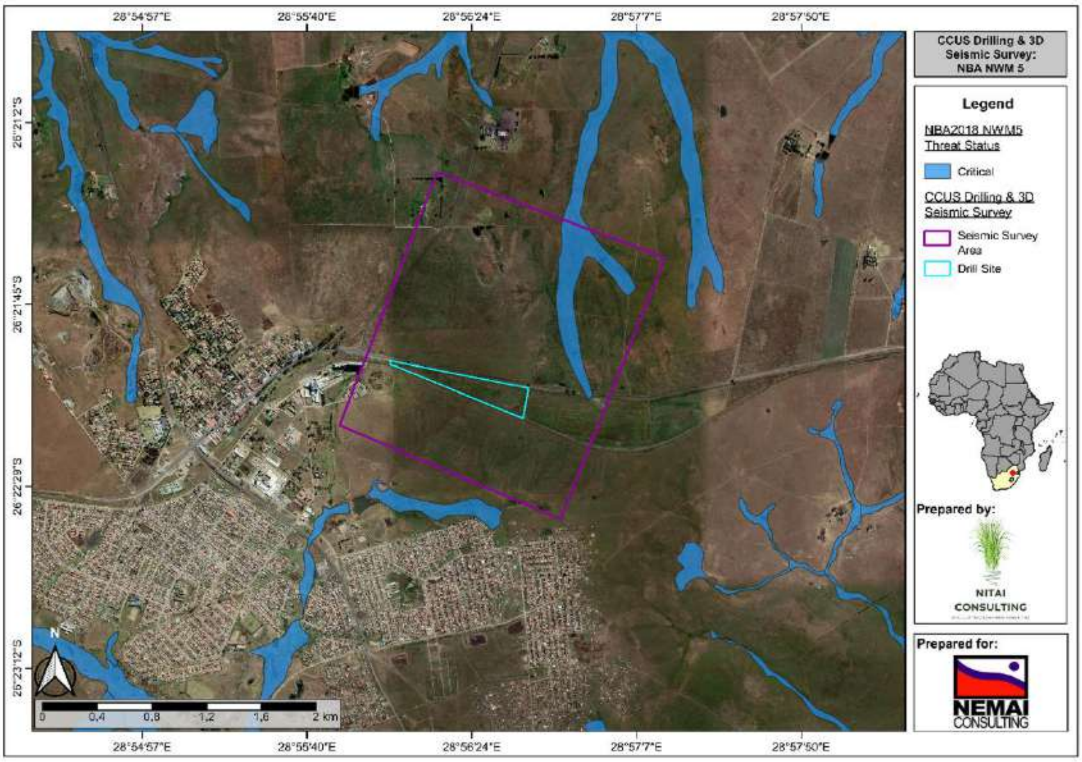

Figure 16: Map indicating the threat status of all the wetlands surrounding the study area

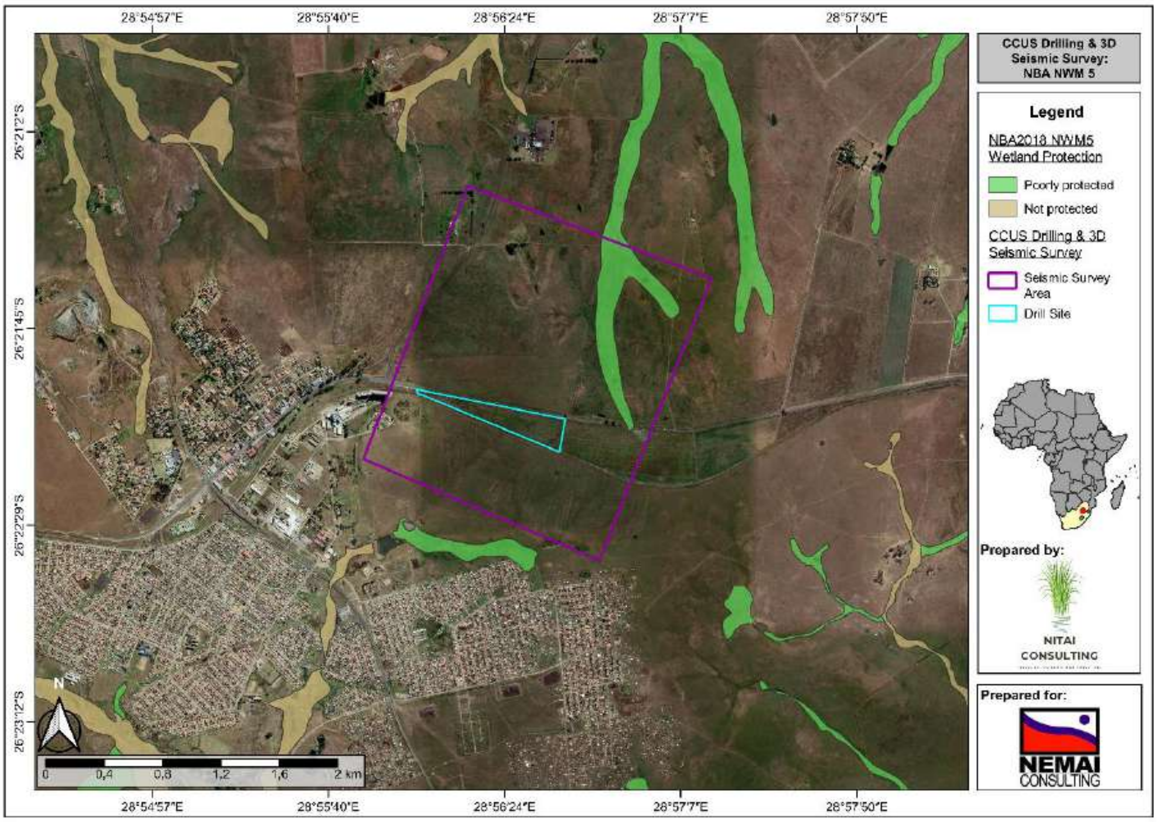

Figure 17: Map indicating the protection level of all the wetlands surrounding the study area

5.2.1.4 Strategic Water Source Areas (SWSA's)

Strategic Water Source Areas (SWSA) are either (a) areas that supply an uneven (large quantity) amount of mean annual surface water runoff in relation to their size and are therefore considered to be nationally important or (b) have high groundwater recharge and where the groundwater forms nationally important resource or (c) areas that meat both criteria (a) and (b) (Nel *et al*., 2013; Le Maitre *et al*., 2018). Areas that supply these disproportionate amounts of water can be because of climatic conditions such as high rainfall, or physical properties (ability of the soils and underlying weathered material and rocks to store water as groundwater) (Le Maitre *et al*., 2018). In South Africa, 22 SWSA surface water and 37 SWSA groundwater areas has been identified to be strategically important at national level for water and economic security (Le Maitre *et al*., 2018).

The study is situated outside the surface water SWSA of South Africa (Figure 18). Seven of the 22 surface water SWSA's are transboundary areas due to Lesotho and Swaziland that includes portions of important SWSA-sw for Southern Africa (Le Maitre *et al*., 2018). Surface water SWSA's accounts for 49% of the total area delineated in South Africa. Within the Vaal Water Supply Scheme (WSS), SWSA-sw accounts for 67% of the total volume of water whereas the Olifants regional WSS accounts for the lowest (Le Maitre *et al*., 2018). Of the total 44 SWSA's in South Africa include conservation areas while 10 SWSA's does not include any forms of protected area. The Upper Vaal (nearest to the study area) is the only SWSA-sw with no protection (Le Maitre *et al*., 2018).

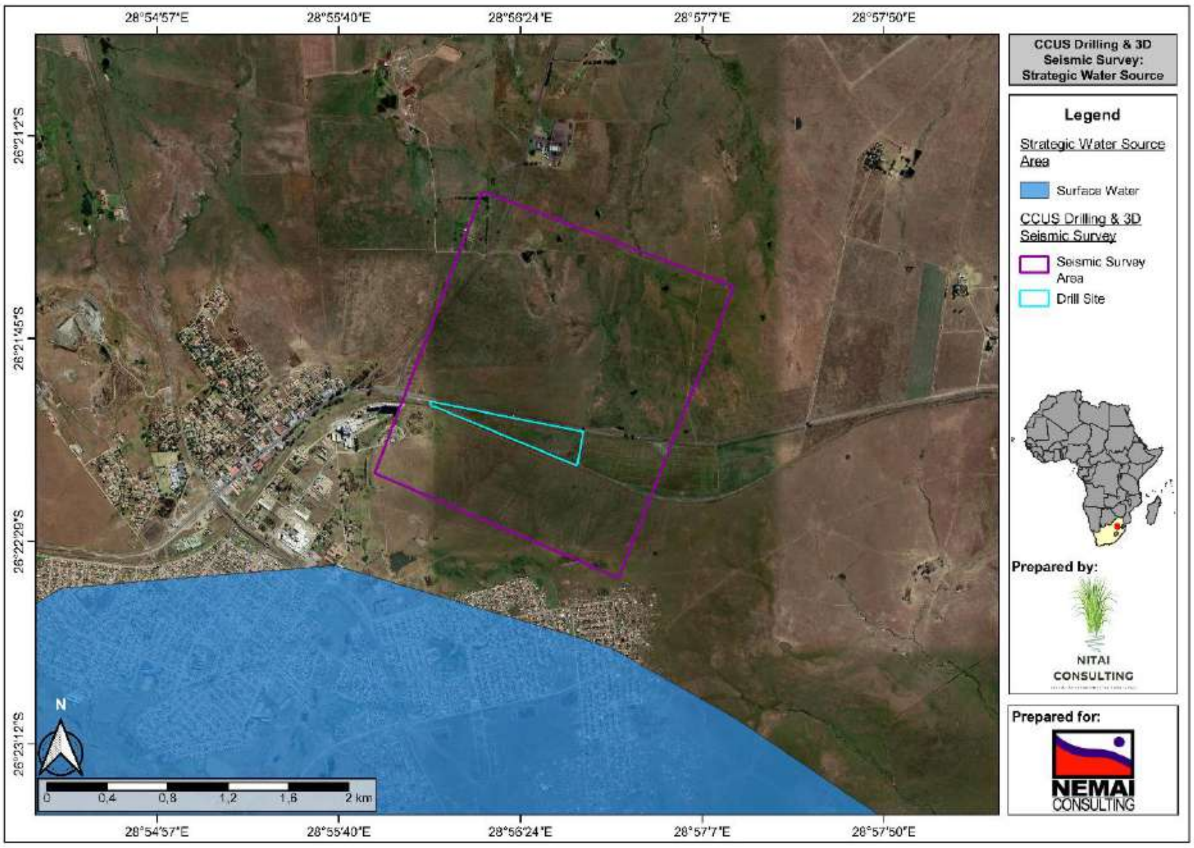

Figure 18: Map indicating the Strategic Water Source Areas in relation to the study area

5.2.2 Regional context

5.2.2.1 Critical Biodiversity Areas (CBA's)

On a regional scale, terrestrial and aquatic biodiversity conservation priorities are highlighted in the Mpumalanga (MP) Biodiversity Sector Plan (Lotter *et al*., 2014). A Biodiversity Sector Plan provides a map (or maps) of terrestrial and freshwater areas that are important for conserving biodiversity pattern and ecological process – these are called CBA's and Ecological Support Areas (ESA's) (Lotter *et al*., 2014). Furthermore, the Biodiversity Sector Plan includes two separate maps (terrestrial and freshwater CBA's).

Critical Biodiversity Areas are areas that are required to meet each ecosystem's biodiversity target while being maintained in an appropriate ecological condition for their category, referred to as the land management objective. These include all areas required to meet biodiversity pattern targets and to ensure continued existence and functioning of species and ecosystems, special habitats and species of conservation concern. In addition, these areas also include critical endangered ecosystems and critical linkages to maintain connectivity. The CBA map of the MP relies on the NFEPA project and includes three sub-categories of CBA's (CBA Aquatic species, CBA Rivers and CBA Wetlands) (Lotter *et al*., 2015).

The spatial dataset from Lotter *et al*. (2014) highlights that the study area does not fall within a CBA (Figure 19). The study area is rather situated heavily modified areas with large portions of the seismic survey area situated in other natural areas (Lotter *et al*., 2015).

5.2.2.2 Ecological Support Areas (ESA's)

Ecological Support Areas (ESA's) are terrestrial and freshwater areas that are not essential for meeting biodiversity representation targets, but which nevertheless play an important role in supporting the ecological functioning of CBA's (Lotter *et al*., 2014). Furthermore, ESA's need to be maintained in a functional or near natural state, supporting the purpose for which they are identified. These include natural features such as riparian habitat surrounding rivers or wetlands, corridors, over-wintering sites for Blue Cranes (Lotter *et al*., 2014).

According to the MP Biodiversity Sector Plan, ESA's are categorised into five sub-groups namely: Wetlands, Wetland Clusters, Important Sub-Catchments, Fish Support Areas and SWSA (Lotter *et al*., 2015).

From the MP Biodiversity spatial data, the study area is not situated within any ESA's (Figure 19). To the south of the drill site, there is an ESA and is as a result of being a wetland.

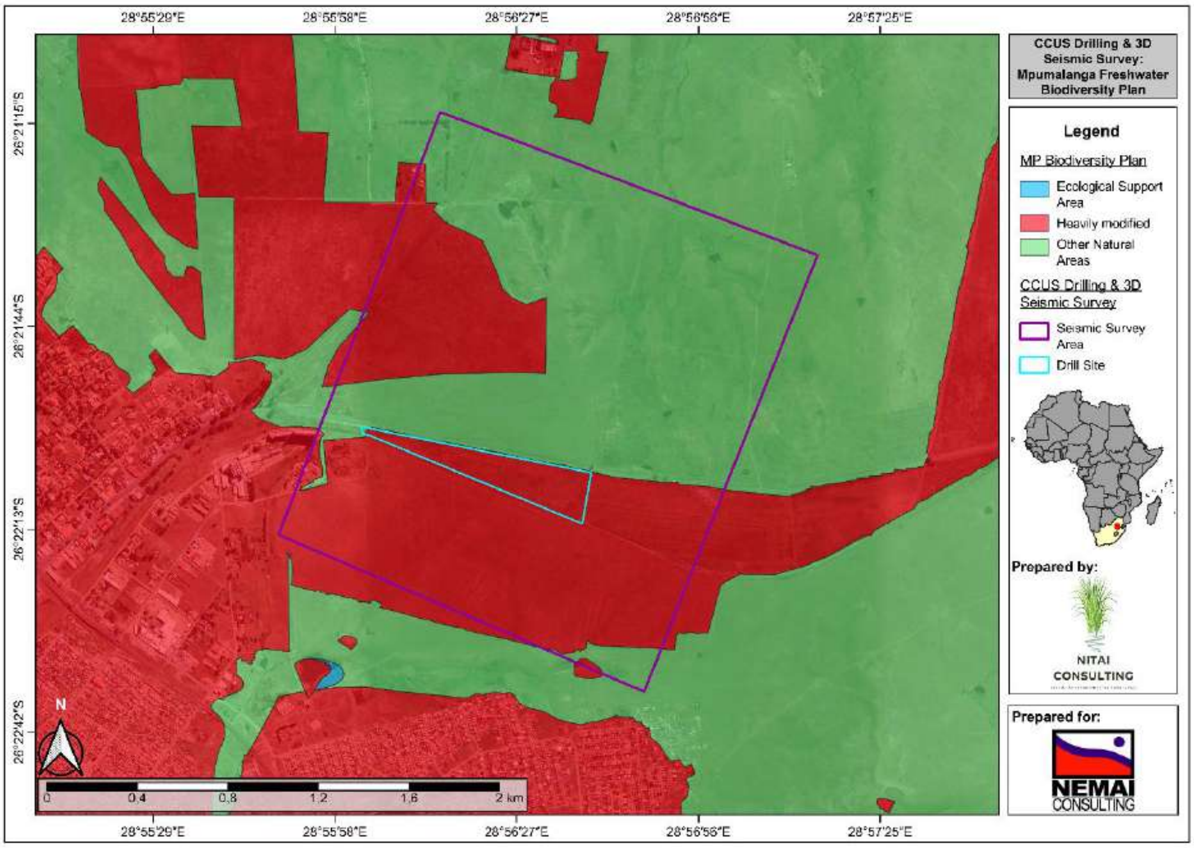

Figure 19: Map indicating Aquatic Critical Biodiversity Areas Levels 1 and 2 in relation to the study area

6 FINDINGS OF THE ASSESSMENT

6.1 Desktop Mapping and Identifying Watercourses

All areas of interest or potential of wetlands were identified, and pin drops were placed around the perimeter of the area of interest. This was done using the latest satellite aerial imagery from Google Earth. All pin drops “flagged” on Google Earth were visually inspected during the site visit (Figure 20).

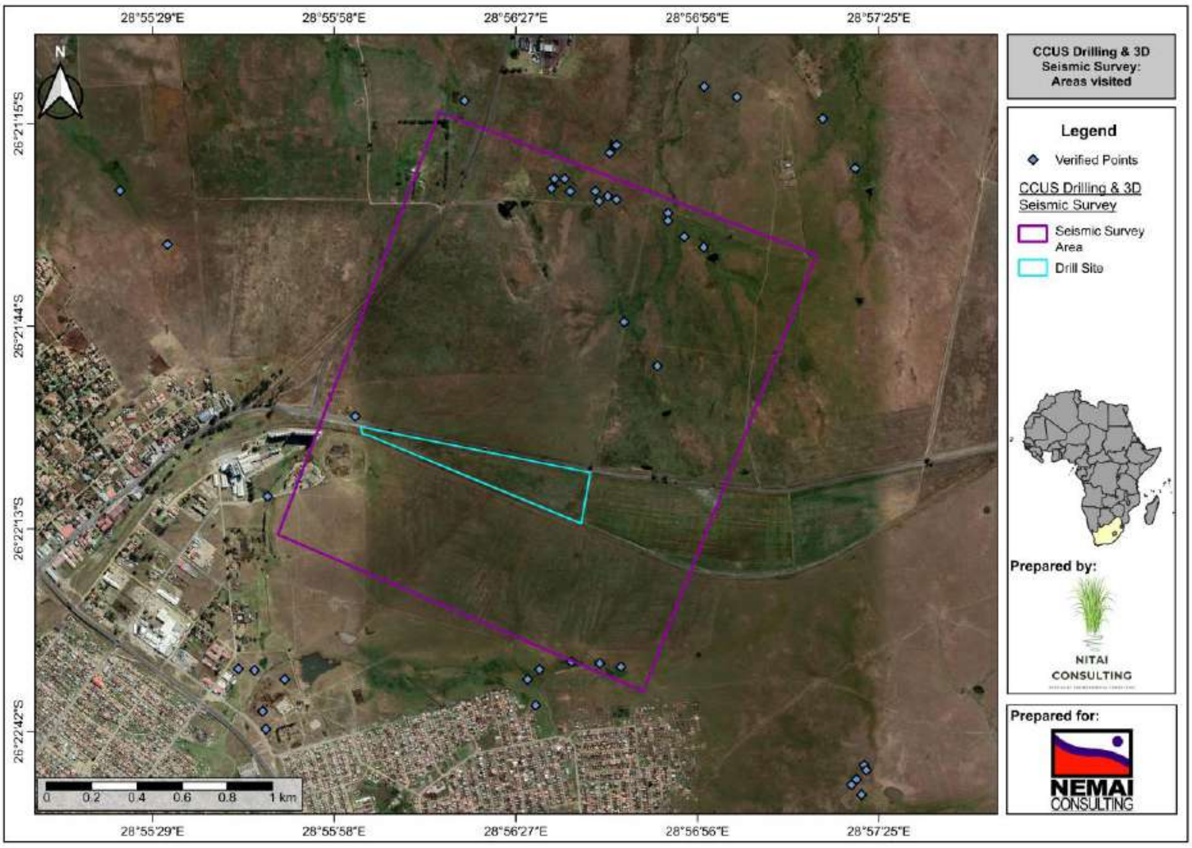

Figure 20: Map indicating the flagged potential wetland areas within the study area

6.2 Available Information (Rivers and Wetlands)

To date, no previous aquatic and wetland specialist studies have been conducted within the proposed study area. One perennial river, Kromdraaispruit, is located to the north of the proposed drill site while several non-perennial rivers are located within the seismic survey and 500m regulated area of the drill site. The Department of Water and Sanitation (2014) has conducted studies on all river catchments and determined the PES and EIS categories. For the Kromdraaispruit, DWS (2014) has determined that the river has a PES category of C

(Moderately modified) and an EIS of A (High importance and sensitivity) in the B20E Quaternary Catchment (DWA, 2014). Furthermore, the study has concluded that the Riparian and Wetland zone continuity modifications is small, meaning that, the modifications are limited to very few localities and the impact on habitat quality, diversity, size, and variability are also very small. In addition, the potential flow modifications are regarded as serious, meaning that, the modifications are generally present with a clear detrimental impact on habitat quality, diversity, size, and variability, however, large areas remain intact and are uninfluenced.

6.3 Ecological findings of the Assessment

During the site visits to the study area, several watercourses (wetlands, rivers, drainage lines and artificial dams) have been identified within the footprint of the proposed seismic survey. In addition, no watercourses were identified within the drill site, however, several watercourses are within the 500m regulated area (Figure 21). One perennial river (Kromdraaispruit) is located north of the drill site and is flowing in a northerly direction away from the drill site. In addition, several small non-perennial rivers are traversing the boundary of the seismic survey together with the 500m regulated area. Furthermore, one drainage line is located within the drill site and flows south towards a small dam located near Lebohang. In addition, two more drainage lines traverses the 500m regulated area.

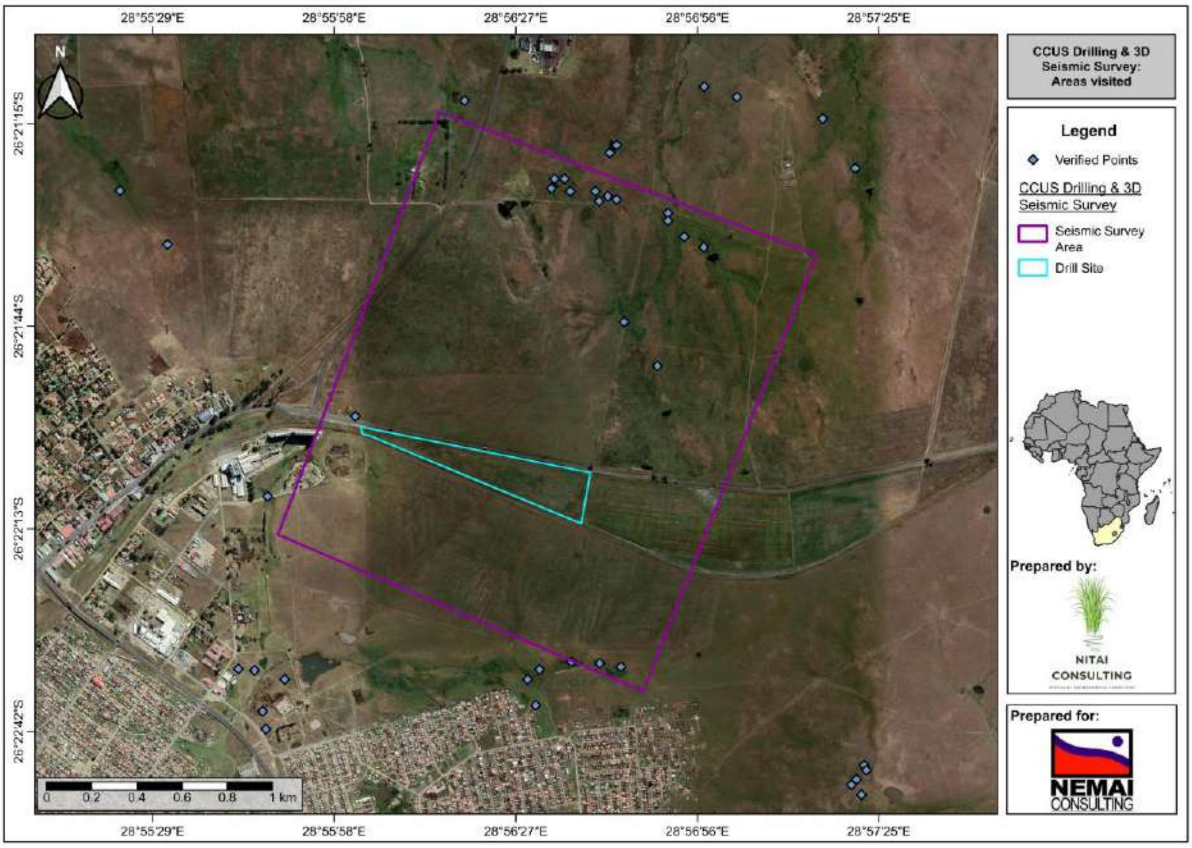

Figure 21: All watercourses associated with the seismic survey as well as the 500 m regulated area

6.3.1 Wetlands

Several wetlands were identified within the seismic survey and within the 500m regulated area (see Figure 22 below). A large CVB is located along the channel of the Kromdraaispruit to the north of the drill site (Figure 22). A large S wetland occurs along the tributary of the Waterval river near Lebohang and is on the perimeter of the 3D seismic survey area. No wetlands were identified to be located within the drill site, however, the drill site does occur within the 500m regulated area of two small Dep to the west and a large CVB to the north east of the drill site (Figure 22).

A large S wetland is located well north of the drill site and is draining towards the large CVB and the Kromdraaispruit (Figure 22).

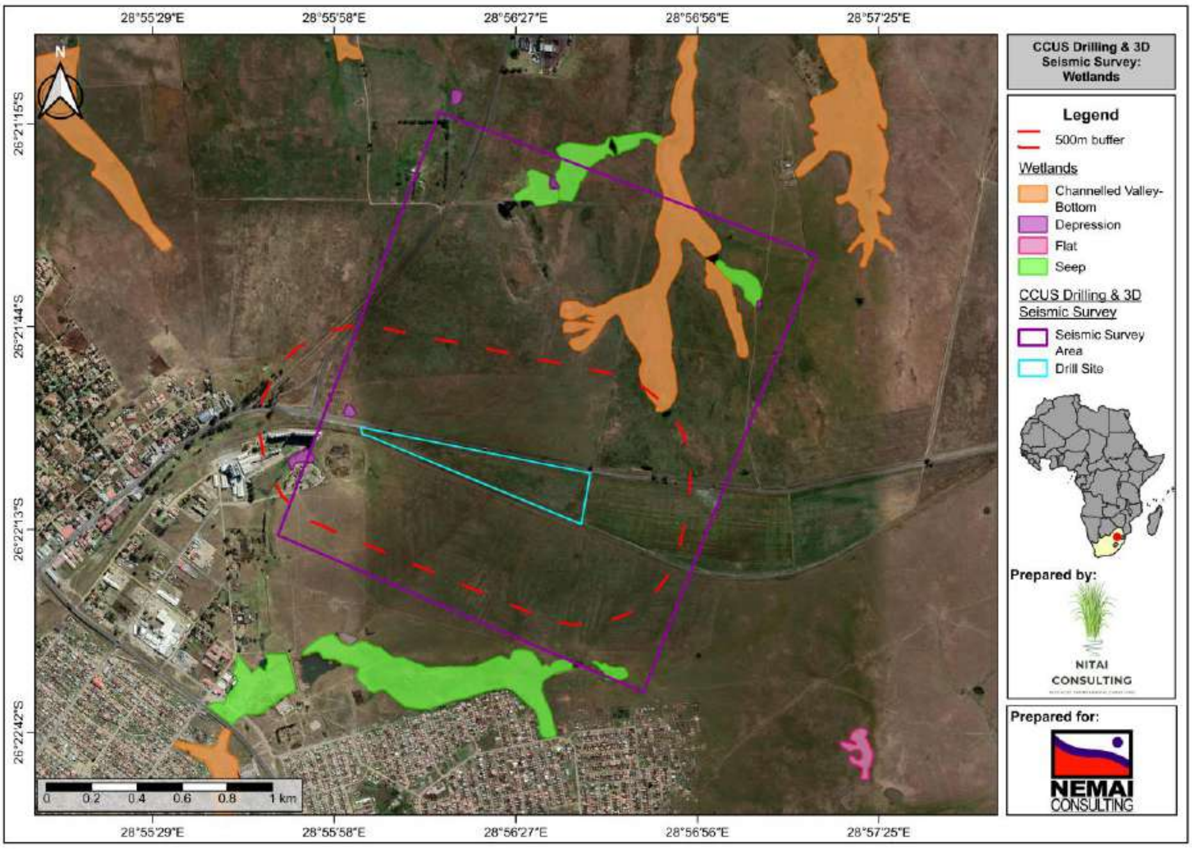

Figure 22: All identified wetlands within the study area

6.3.2 Rivers

One perennial river, Kromdraaispruit, was found in the northern part of the seismic survey and is flowing to the north away from the study area and draining into the Wilge River (Figure 23). Two non-perennial rivers were also identified to occur within the seismic survey area and one non-perennial is within the 500m regulated area. In addition, there are several small drainage lines within the study area while one drainage line traverses the drill site (see Figure 23).

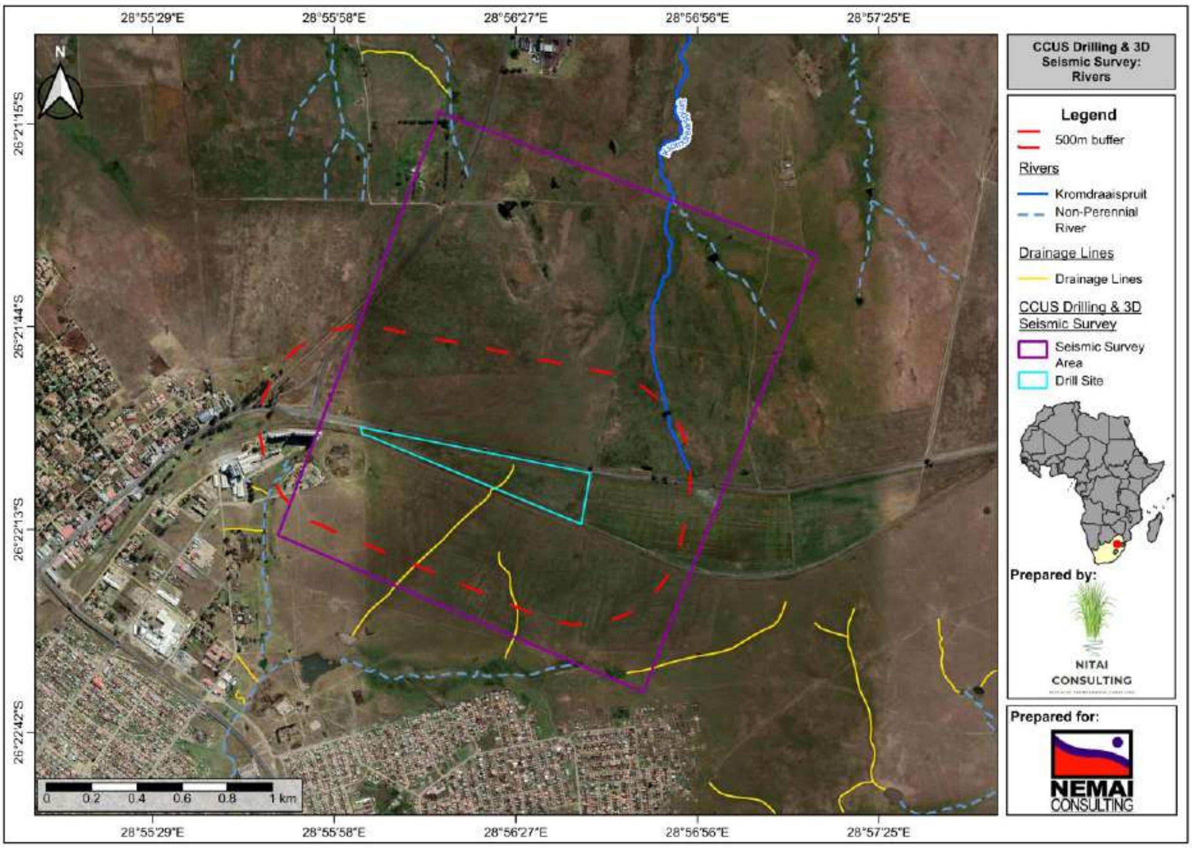

Figure 23: All identified rivers and drainage lines within the study area

6.3.3 Other watercourses

Several dams are situated within the seismic survey footprint. Furthermore, one cattle trough is located just north of Lebohang (Figure 24). A few of these dams are highlighted in Figure 25 below. Figure 26 below shows the general environment around areas of interest within the study area.

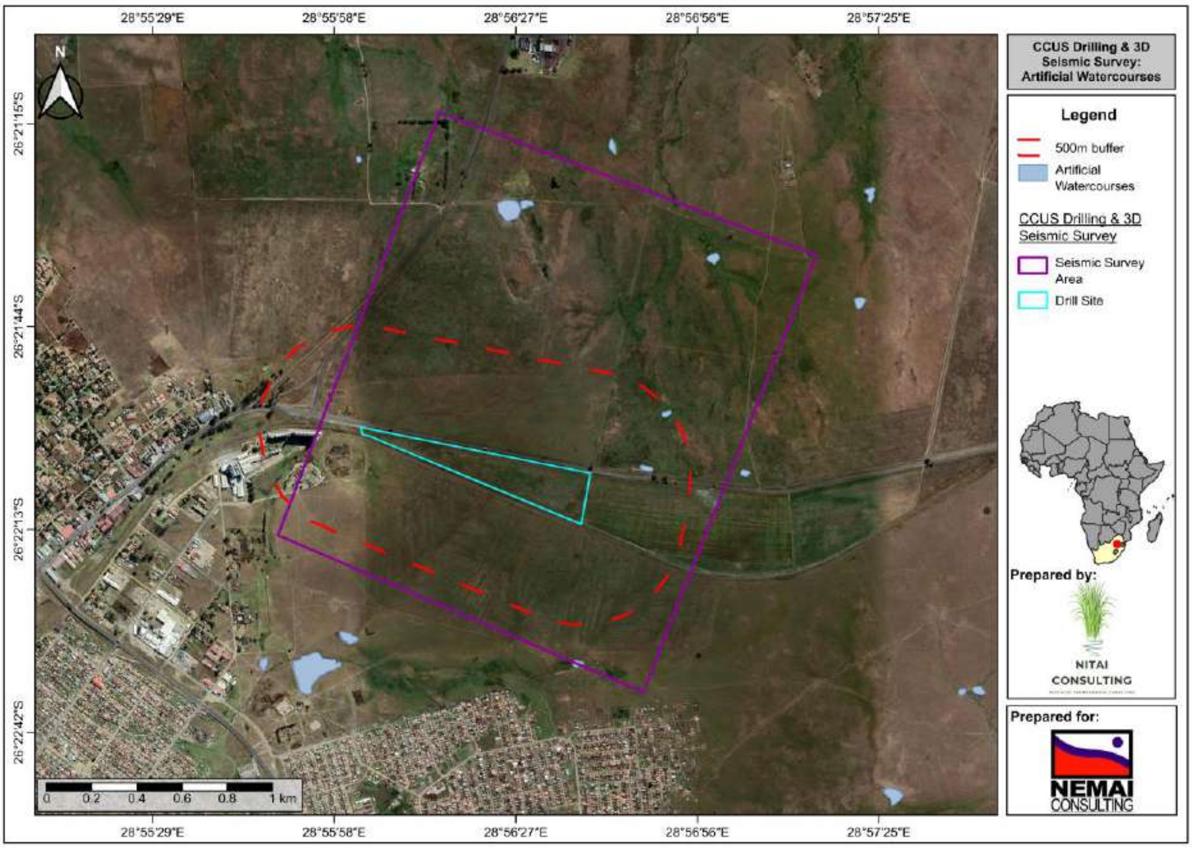

Figure 24: Map showing the location of the dams in relation to the study area

Figure 25: Photographs showing some of the dams located within study area

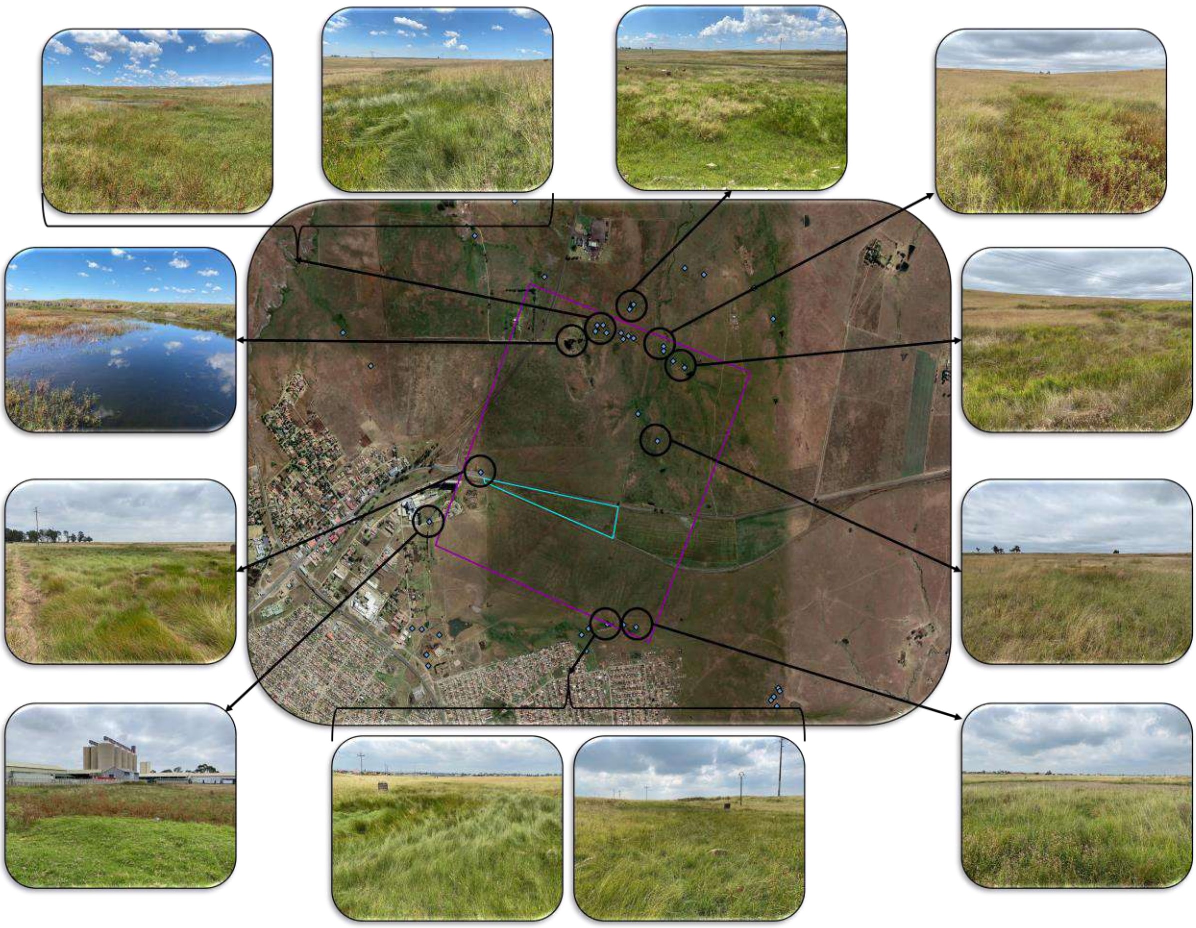

Figure 26: Photographs indicating the general environment around areas of interest within the study area

6.3.4 Vegetation characteristics

During the site visit, vegetation characteristics indicative of wetland habitats were observed within the study area. Typical vegetation species indicating wetness included *Typha capensis*, *Verbena bonariensis*, *Juncus punctorius*, *Cyperus fastigiatus*, *Phragmites australis*, *Persicaria lapathifolia*, *Schoenoplectus brachyceras*, *Sporobolus africanus*, *Eragrostis gummiflua*, *Paspalum dilatatum* and *Imperata cylindrica* (Figure 27).

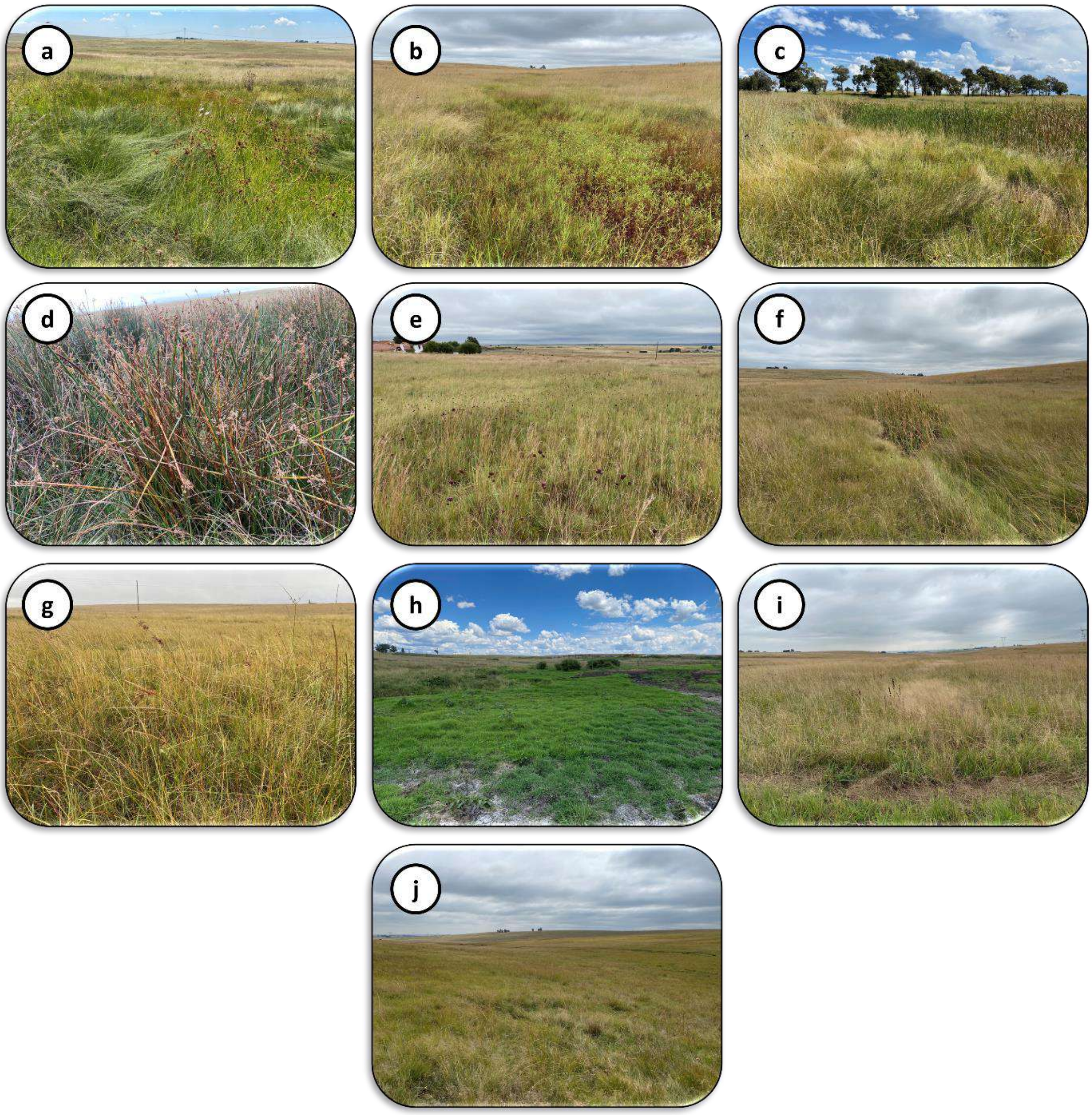

Figure 27: Vegetation characteristics associated with the study area. Photographs highlight the different species (a) Juncus punctorius, (b) Persicaria lapathifolia, (c) Phragmites australis, (d) Schoenoplectus brachyceras, (e) Verbena bonariensis, (f) Typha capensis, (g) Cyperus fastigiatus, (h) Paspalum dilatatum, (i) Imperata cylindrica, and (j) Sporobolus africanus

6.3.5 Soil characteristics

The soil samples that were sampled did indicate the presence of gleyed wetland soil throughout the majority of the seismic survey (Figure 28). In addition, majority of the soil collected did not show any mottles within the 50cm and this due to the land type (Ea) of the particular area. Typical soil types within this land type are Arcadia and Mayo, of which the study area is comprised of (refer to section 5.1.3 and Figure 8). The soil moisture regime of these two soil types largely varies and is determined by the area of formation (van der Waals *et al*., 2019). Furthermore, formation in low lying landscapes highlights the occurrence of vertic and melanic horizons, indicating hillslopes and water related weathering product accumulation processes. These soils are most of the time associated with watercourses and localised wetland conditions (van der Waals *et al*., 2019).

Moreover, some soil samples collected did indicate white mottling within 50cm layer while others showed yellow brown mottling (Figure 29).

Figure 28: Soil samples collected showing the strong clay content and gleyed soil. Soil types is mostly comprised of Arcadia and Mayo soils

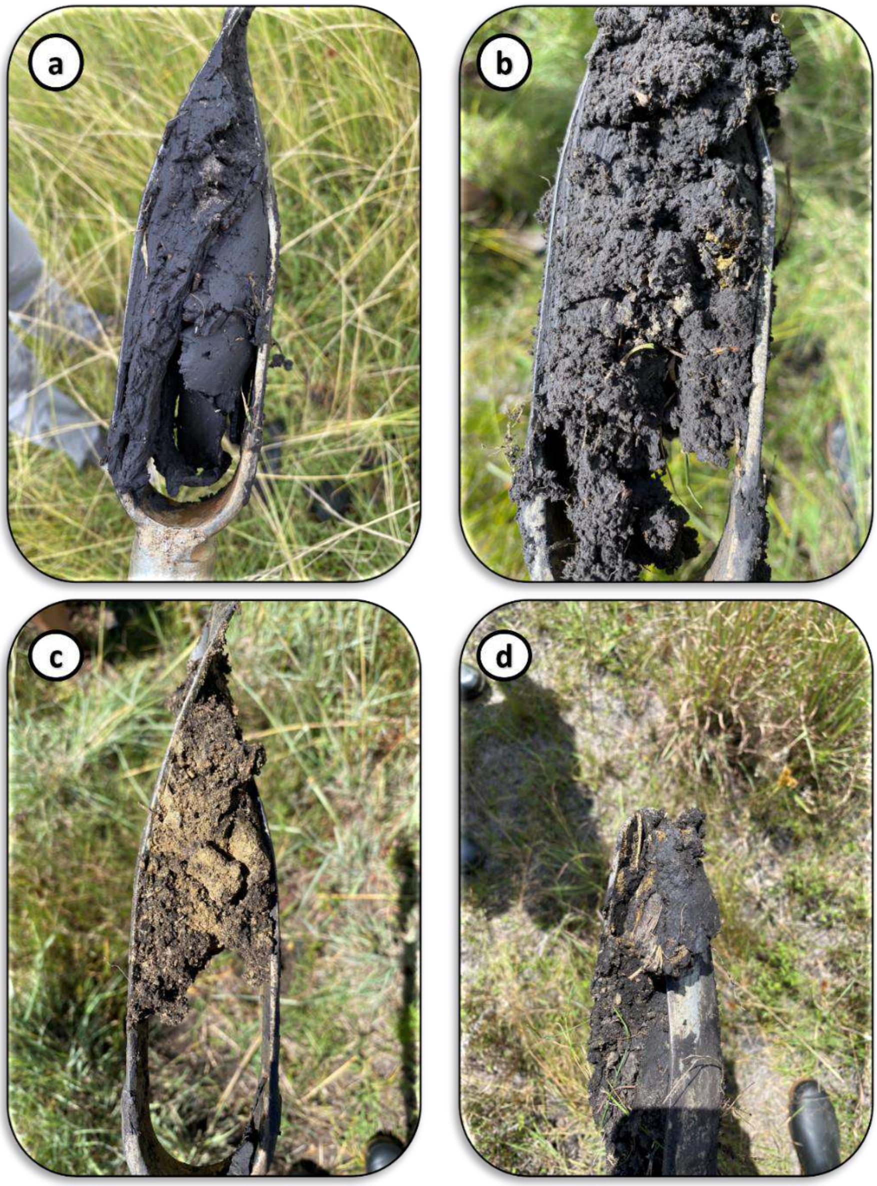

Figure 29: Soils showing the presence of mottling within the first 50cm layer. Photographs (a) and (b) indicating the white/grey mottling. Photographs (c) and (d) indicating the yellow brown mottling within the first 50 cm layer

6.3.6 Present Ecological State (PES)

The PES (Macfarlane *et al*., 2020) has only been determined for the wetlands verified on site during the site visit. The PES scores for all wetlands has been divided into the two different sections (north and south of the drill site). South of the drill site, PES scores were calculated for a S, and Dep wetlands. Present Ecological State categories were calculated for the S, and Dep as C (Moderately modified), C (Moderately modified), respectively (Table 6). Water quality was not included in the PES calculations as water quality did not form part of the overall assessment.

North of the drill site, PES scores were calculated for a CVB, S, and Dep wetlands. Present Ecological State categories were calculated for the CVB, S, and Dep as C (Moderately modified), C (Moderately modified), and C (Moderately modified), respectively (Table 7). Water quality was not included in the PES calculations as water quality did not form part of the overall assessment.

Table 6: Present Ecological State scores calculated for HGM units south of the drill site

HGM Unit	Hydrology	Geomorphology	Vegetation	Overall
Seep	C (Moderately modified) Impact Score: 2.8	C (Moderately modified) Impact Score: 3.1	D (Largely modified) Impact Score: 5.0	C (Moderately modified) Impact Score: 3.4
Depression	C (Moderately modified) Impact Score: 3.7	C (Moderately modified) Impact Score: 3.2	C (Moderately modified) Impact Score: 3.5	C (Moderately modified) Impact Score: 3.5

Table 7: Present Ecological State scores calculated for HGM units north of the drill site

HGM Unit	Hydrology	Geomorphology	Vegetation	Overall
Channelled Valley-Bottom	C (Moderately modified) Impact score: 3.1	C (Moderately modified) Impact Score: 2.8	C (Moderately modified) Impact Score: 3.0	C (Moderately modified) Impact score: 3.4
Depression	B (Largely natural) Impact Score: 1.0	C (Moderately modified) Impact Score: 2.5	C (Moderately modified) Impact Score: 3.5	C (Moderately modified) Impact Score: 2.3
Seep	C (Moderately modified) Impact Score: 2.4	C (Moderately modified) Impact Score: 3.1	D (Largely modified) Impact Score: 5.0	C (Moderately modified) Impact Score: 3.3

6.3.7 Ecological Importance and Sensitivity (EIS)

The EIS (Rountree *et al*., 2013) has been determined for all the wetlands verified on site during the site visit. This includes the large CVB, S, and Dep wetlands. Ecological Importance and Sensitivity categories for wetlands south of the drill site were calculated for the S, and Dep as Moderate (C), and Moderate (C), respectively (see Table 8 below) Furthermore, EIS categories for all wetlands north of the drill site were calculated for the large CVB, S and Dep as Moderate (C), Moderate (C), and Moderate (C), respectively (Table 9). Majority of the wetlands identified are according to the MP Biodiversity Sector Plan situated in Other Natural Areas (refer to Figure 19).

Table 8: Ecological Importance and Sensitivity of the two HGM units south of the drill site

HGM Unit	Ecological Importance and Sensitivity
Seeps	Moderate (1.29)
Depressions	Moderate (1.64)

Table 9: Ecological Importance and Sensitivity of the three HGM units north of the drill site

HGM Unit	Ecological Importance and Sensitivity
Channelled Valley-Bottoms	Moderate (1.34)
Seeps	Moderate (1.29)
Depressions	Moderate (1.51)

6.3.8 Wetland Ecosystems Services

The wetland ecosystem services (Kotze *et al*., 2020) for all the wetlands identified during the site visit are shown in Table 10, and Table 11 below (see Table 12 for description of impact category ratings). The two wetlands south of the drill site are particularly moderately and highly valuable for biodiversity maintenance. This is due to the wetlands being situated in an ESA and with vegetation that are critically endangered. Furthermore, both wetlands are moderately valuable for agriculture as food for livestock (Table 10). North of the drill site, the wetlands also hold high value for Biodiversity Maintenance and are moderately valuable for agriculture (food for livestock and cultivation) (Table 11).

Table 10: Wetland Ecosystem Services calculated for all two HGM units south of the drill site

Ecosystem Services		Score	
		Depressions	Seeps
Regulating and Supporting Services	Flood attenuation	0.0	0.0
	Stream flow regulation	0.0	0.0
	Sediment trapping	1.5	0.9
	Erosion control	0.2	0.1
	Phosphate assimilation	1.6	0.9
	Nitrate assimilation	1.3	0.6
	Toxicant assimilation	2.1	1.4
	Carbon storage	0.0	0.0
	Biodiversity maintenance	2.2	2.7
Provisioning services	Water for human use	1.4	0.0
	Harvestable resources	0.8	0.7
	Food for livestock	0.8	0.8
	Cultivated foods	1.7	2.0
Cultural Services	Tourism and Recreation	0.0	0.0
	Education and Research	0.0	0.0
	Cultural and Spiritual	0.5	0.5

Table 11: Wetland Ecosystem Services calculated for all three HGM units north of the drill site

Ecosystem Services		Score		
		Channelled Valley-Bottom wetlands	Depressions	Seeps
Regulating and Supporting Services	Flood attenuation	0.0	0.0	0.0
	Stream flow regulation	0.5	0.8	0.0
	Sediment trapping	1.6	1.6	0.1
	Erosion control	0.0	0.0	0.2
	Phosphate assimilation	1.6	1.5	0.1
	Nitrate assimilation	1.4	1.4	0.1
	Toxicant assimilation	1.6	1.0	0.1
	Carbon storage	0.0	0.0	0.0
	Biodiversity maintenance	1.5	1.5	1.4
Provisioning services	Water for human use	0.3	0.2	0.2
	Harvestable resources	0.5	1.0	0.7
	Food for livestock	1.0	2.0	1.7
	Cultivated foods	1.8	1.8	1.7
Cultural Services	Tourism and Recreation	0.0	0.0	0.0
	Education and Research	0.3	0.3	0.0
	Cultural and Spiritual	2.5	0.5	0.0

Table 12: Importance Category ratings

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

6.4 Site sensitivity and buffer zones

6.4.1 Desktop sensitivity assessment (DFFE Screening Tool)

During the Desktop study for the CCUS drilling and seismic survey an Environmental Screening tool from Department of Forestry, Fisheries & the Environment (DFFE) were queried. The Screening Tool allows for the generation of a Screening Report referred to in Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended, whereby a Screening Report is required to accompany any application for Environmental Authorisation.

The DFFE Screening Tool Report has identified that Aquatic Biodiversity Theme for the study area is of very high sensitivity together with low sensitivity (Figure 30). The very high sensitivity is due to watercourses situated within the seismic survey while the southern section of the seismic survey is a SWSA surface water. Due to the nature of the proposed works, it is of the opinion that the proposed activities do not pose significant risks to aquatic features given that the recommendation and mitigation measures are followed.

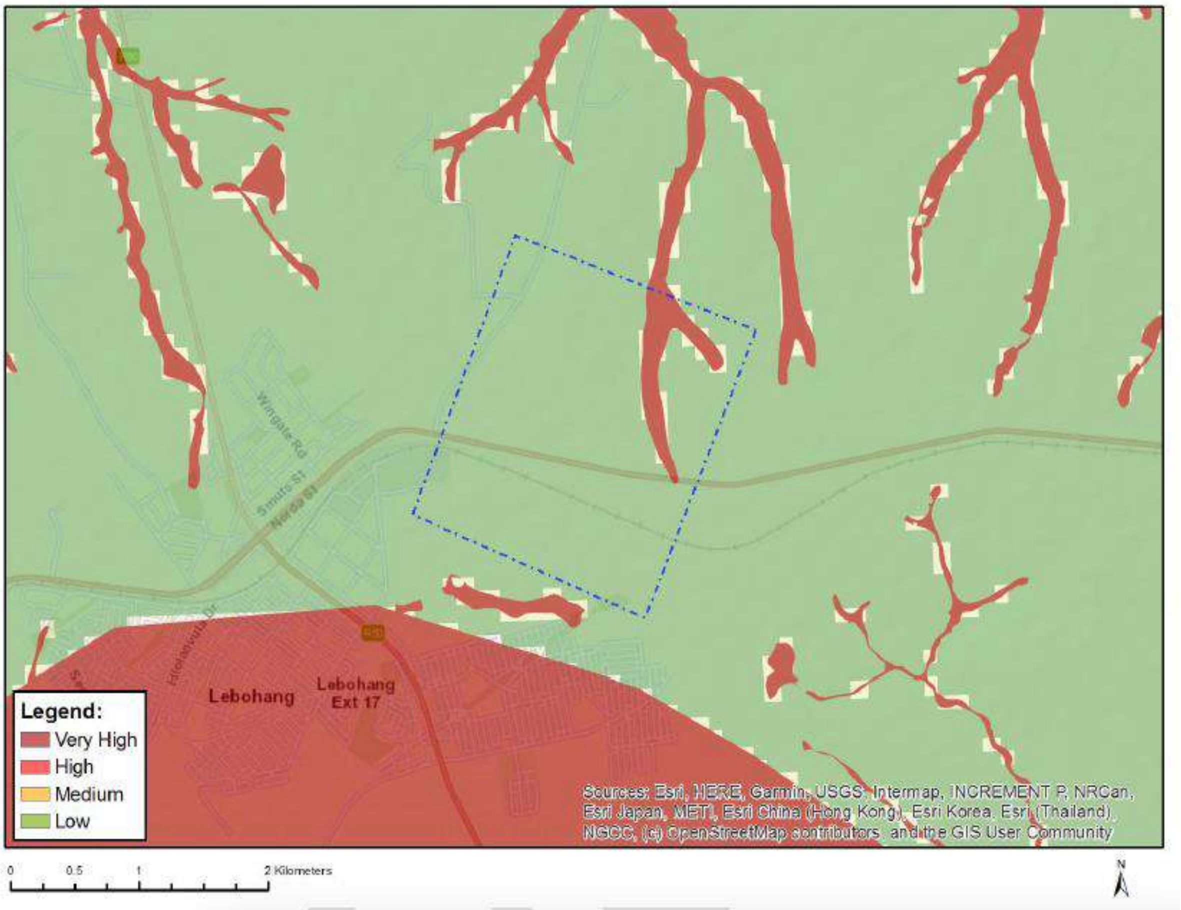

Figure 30: Aquatic Biodiversity Sensitivity Theme from the Department of Forestry, Fisheries & the Environment Screening Tool

6.4.2 Ground truthing and buffer zones

Buffer zones for all watercourses (wetlands, rivers, and drainage lines) were determined based on the current condition and protection level of these watercourses. In addition, these buffer zones does not necessarily indicate no-go areas since the proposed works will be of low impact due to only driving within the seismic survey footprint. However, the buffer zones do indicate that, no activity such as the stopping of the truck or refuelling can take place within the wetland and its associated buffer zone.

The buffer zones determined for each wetlands were based on the Macfarlane and Bredin (2017) guidelines. As such, the minimum buffer zones were determined as 32 m (Figure 31).

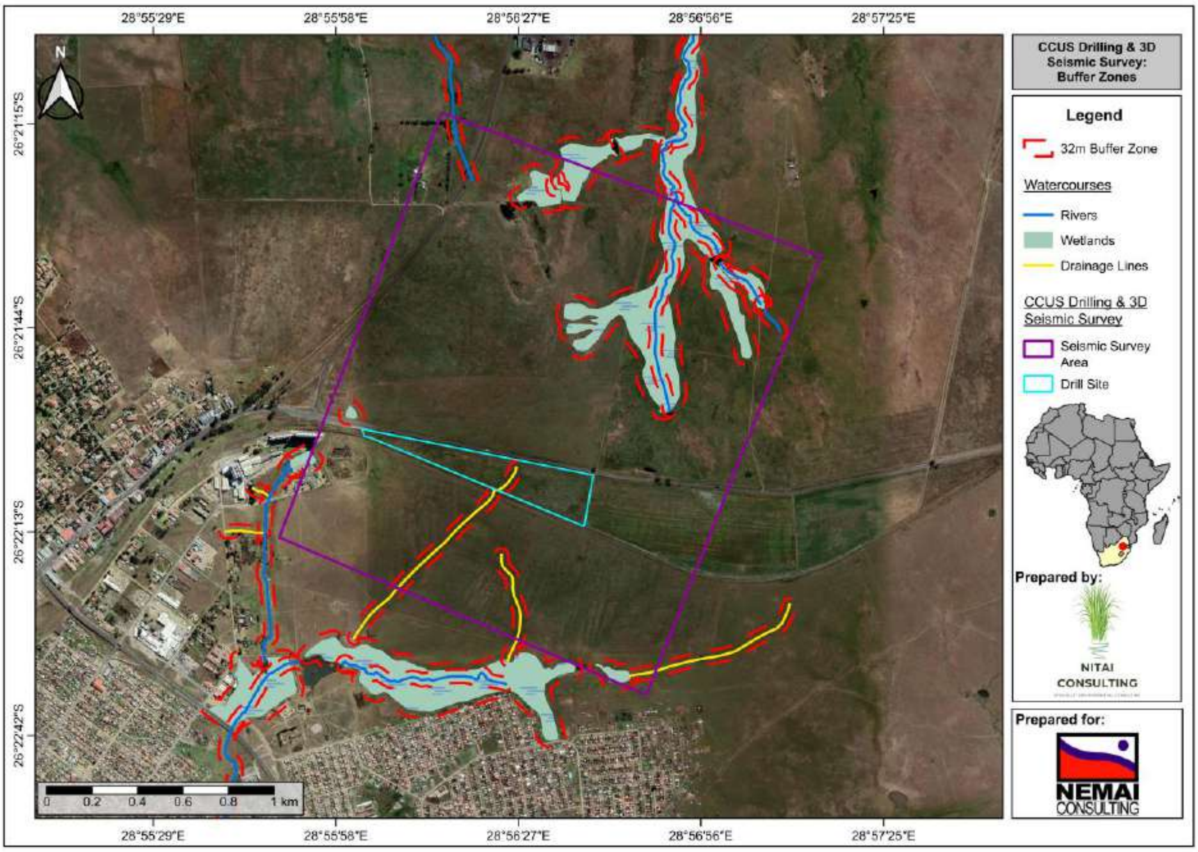

Figure 31: Buffer zones determined for all watercourses associated with the study area

7 Risk-based Impact Assessment

7.1 Impacts and Mitigation Framework

Since watercourses have been identified within the footprint of the study area that could be potentially significantly affected by the CCUS drilling and seismic survey, a Risk-based Impact Assessment were conducted.

All impacts are analysed in the section to follow with regard to their nature, probability, duration, extent, magnitude, likelihood and significance.

The following criteria for nature, probability, duration, extent, magnitude and significance were used:

Table 13: Probability descriptors, definitions and rating scores

Descriptors	Definitions	Score
Rare/Remote	May occur only in exceptional circumstances.	**1**

Descriptors	Definitions	Score
Unlikely	Could occur at some time.	**2**
Moderate	Should occur at some time.	**3**
Likely	Will probably occur in most circumstances.	**4**
Almost certain	Expected to occur in most circumstances.	**5**

Table 14: Duration descriptors, definitions and rating scores

Descriptors	Definitions	Score
Temporary	Impact is only for a short period (0-1 years).	**1**
Short term	Impact is for a period of 1 – 5 years.	**2**
Medium	Impact is for a period of 5 – 15 years.	**3**
Long term	Impact ceases after operational life cycle of the activity either because of natural processes or by human intervention.	**4**
Permanent	Impact will continue indefinitely.	**5**

Table 15: Extent descriptors, definitions and rating scores

Descriptors	Definitions	Score
Site only	Impact on the extent of the site only.	**1**
Local	Impact on the immediate surroundings.	**2**
Regional	Impact on the region but within the province.	**3**
National	Impact on an interprovincial scale.	**4**
International	Impact outside South Africa.	**5**

Table 16: Magnitude descriptors, definitions and rating scores

Descriptors	Definitions	Score
Negligible	Ecosystem pattern, process and functioning are not affected, although there is a small negative impact on quality of the ecosystem.	**1**
Minor	A minor impact on the environment and processes will occur.	**2**
Low	Natural and socio-economic functions and processes are not affected or minimally affected.	**4**
Moderate	Valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way.	**6**
High	Natural or socio-economic functions or processes could be substantially affected altered to the extent that they could temporarily cease.	**8**
Very High	Natural or socio-economic functions or processes could be substantially affected altered to the extent that they could permanently cease.	**10**

The significance of impacts will be calculated through the combination of the above-mentioned criteria using the following formula:

Significance = (Extent + Duration + Magnitude) x Probability

Descriptors	Definitions	Score
Low	Perceived impact will not have a noticeable negative impact on the environment. Unlikely to require management intervention.	**0 – 19**
Low to Moderate	Perceived impact is acceptable, and application of recommended mitigation measures recommended.	**20 – 39**
Moderate	Perceived impact is likely to have negative impact on the environment, and is likely to influence decision to approve the activity. Implementing recommended mitigation measures are required as a routine monitoring to ensure effectiveness of recommended mitigation measures.	**40 – 59**

Descriptors	Definitions	Score
Moderate to High	Perceived impact will have significant impact on the environment and will likely influence the decision-making process. Strict implementation of provided mitigation measures is required. Strict monitoring and high levels of compliance and enforcement in respect of the impact are required.	**60 – 79**
High	Perceived impact on the environment will be significantly high and likely to be irreversible and therefore will result in a highly likely fatal flaw for the project. Any alternatives for the proposed activity should be considered as the impact will influence the decision-making process.	**80 – 100**

7.1.1 Impact Assessment

Table 17 and Table 18 below indicate the impact scores for the potential groundwater impacts surrounding the construction and operational phases of the CCUS Drilling and 3D Seismic Survey.

Table 17: Impacts to wetland habitat

Nature: Wetland habitat change, soil compaction, increase of runoff and erosion.		
ACTIVITY: The routes the vibroseis truck will take within wetland or buffer zones can lead to soil compaction, destruction of wetland habitat and vegetation and can cause erosion near rivers.		
	Without mitigation	**With mitigation**
Drilling and 3D Seismic Survey		
Probability	Unlikely (2)	Rare/Remote (1)
Duration	Short term (2)	Short term (2)
Extent	Regional (3)	Local (2)
Magnitude	Low (4)	Minor (2)
Significance	**18 (low)**	**6 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Medium	Very Low
Can impacts be mitigated?	Yes	

Mitigation:

- The stopping of the vibroseis trucks and refueling/maintenance of the trucks and support vehicles shall not take place within the 32m buffer zones of watercourses.
- Where possible, it is recommended that the seismic survey be undertaken within the dry season should watercourses need to be crossed by the vibroseis trucks and there are no existing crossings, to minimise the impact on the hydrology of the wetlands.
- Since seismic lines was unknown during this assessment, seismic lines should rather be strategically placed to avoid all watercourses if possible; and,

• Any disturbance to wetland vegetation and soils should be rehabilitated after the completion of the seismic survey according to the Rehabilitation Plan.
Cumulative impacts: Low to moderate
Residual Risks: Expected to be low given that vibroseis truck will remain outside the delineated sensitive areas.

Table 18: Impacts to groundwater sources

Nature: Groundwater pollution.		
ACTIVITY: Refuelling of vibroseis truck could cause spillages onto the soil leading to the potential groundwater pollution.		
	Without mitigation	**With mitigation**
Drilling and 3D Seismic Survey		
Probability	Moderate (3)	Unlikely (2)
Duration	Long term (4)	Short term (2)
Extent	Local (2)	Site-only (1)
Magnitude	Low (4)	Minor (2)
Significance	**30 (Moderate - low)**	**10 (low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Medium	Very Low
Can impacts be mitigated?	Yes	
Mitigation: • No stopping of the vibroseis truck within the buffer zone of the wetland; • Refuelling of the vibroseis truck should occur within the permanent laydown area; • All stationary construction vehicles and machinery should be equipped with a drip tray; • Ensure spill kits are readily available; • Contaminated soil should adequately as per the Environmental Monitoring Programme (EMPr);		
Cumulative impacts: Low given the limited footprint of the study area. As development occurs and continue, soils can and are contaminated with chemicals, hydrocarbons, and sediments from various sources such as the existing roads, leakage and spillage from construction activities.		
Residual Risks: Expected to be low given provided that the recommendation measures in this report are adhered to. Residual impacts could occur if leakage or spillage of chemicals occur during the construction phase, and these soils are not remediated. These soils will continue to release chemicals into the environment after construction has ended.		

8 Conclusion and Recommendations

The CCUS drilling and seismic survey is situated within the northern portion of the Highveld coalfields in the Mpumalanga Province of South Africa. Several watercourses were identified during site visits to the study area. The watercourses identified were a large CVB, S, and Dep wetlands based on soil wetness and vegetation indicators. In addition to wetlands, one perennial river (Kromdraaispruit) with several small tributaries were also identified. Several drainage lines are found across the study area with only one traversing the drill site. No wetlands were identified within the drill site, however, the drill site does fall within the 500m regulated area of two Dep and one CVB.

The area, according to spatial data, has been mostly characterised as Mayo, Arcadia, and Shortlands. During the site visits, soil was identified as either Arcadia or Mayo soils and indicated strong clay content and gleyed soils. The vegetation species recorded throughout the site are typically associated with wetlands.

Although the DFFE Screening Tool has identified the area as a very high sensitivity from an Aquatic Biodiversity Theme perspective. This is due to wetlands and rivers within the study area. However, it is of the opinion of the specialist that the activities will not have a significant impact on the associated watercourses, given the mitigation measures are followed and best practise pollution control.

It is of the opinion of the specialist that the CCUS Drilling and 3D Seismic Survey can continue as the activities will not significantly impact the associated watercourses.

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APPENDIX 1: SPECIALIST DETAILS, QUALIFICATIONS AND EXPERTISE

1 PERSONAL PARTICULARS

Profession:	Aquatic and Wetland Specialist
Date of Birth:	20 December 1993
Name of Firm:	Nitai Consulting
Name of Staff:	Divan van Rooyen
Nationality:	RSA
Membership of Professional Societies	SACNASP (Can. Sci. Nat. 151272), IAIAsa (7063)

2 EDUCATION:

- Ph.D. Environmental Science (Aquatic Ecosystem Health), NWU, South Africa, 2022
- M. Sc. Environmental Science (Ecological Remediation and Sustainable Development), NWU, South Africa, 2017
- B.Sc. Hons Environmental Science (Ecological Remediation and Sustainable Development), NWU, South Africa, 2015
- B.Sc. Tourism, Geography and Zoology, NWU, South Africa, 2014

Publications:

- Schaeffner, B.C. van Rooyen, D., Gerber, R., Scholz, T. & Smit, N.J. 2020. *Wenyonia gracilis* sp. n. (Cestoda: Caryphyllidea) from *Synodontis zambezensis* (Siluriformes: Mochokidae): the first native caryophyllidean tapeworm from southern Africa. Folia Parasitologica, 67: 035.
- van Rooyen, D., Gerber, R., Smit, N.J. & Wepener, V. 2022. An assessment of water and sediment quality of aquatic ecosystems within South Africa's largest floodplain. *African Journal of Aquatic Sciences, 474 – 488*.

3 EMPLOYMENT RECORD:

- 2022 – Present Aquatic and Wetland Specialist, Nitai Consulting

Conduct Wetland Delineations and Impact Assessments;

Conduct Aquatic Ecological Assessments;

SASS5 Assessments;

Aquatic and Wetland Monitoring Programs; and,

GIS Mapping

- March 2022 – November 2022 Environmental Consultant and Aquatic Specialist, Enviroworks

Environmental Control Officer;

Water Use Licensing;

Environmental Auditing;

Report Writing.

- January 2022 – February 2022 Environmental Intern, ABS-Africa (PTY) Ltd

Environmental Auditing;

Groundwater quality monitoring;

Data interpretation and evaluation; and

Report writing

- 2017 – 2021 Research and Field Assistant, North West University (NWU-Water Research Group)

Assisting UNISA and NWU Zoology students with module practical's;

Supervisor to 3rd year Zoology students on a Water Quality Project;

Fish specialist for a fish translocation study at Lethabo Power Station (ESKOM);

Junior Aquatic Specialist for aquatic biomonitoring at Khumba Iron Ore Mining (Joint Amanzi Aquatics and NWU-WRG);

Junior Aquatic Specialist for biomonitoring at a WWTW (Ecosphere & NWU-WRG); and

Assisted students with aquatic biomonitoring assessments (FRAI, MIRAI, FROC, Fish identification and SASS under the supervision of Dr. Wynand Malherbe).

4 SELECTED CONSULTANCIES

4.1 Fish Translocation study (NWU – WRG), Lethabo Power Station (ESKOM)

2016 - 2021 – Fish Specialist, Fish Translocation at ESKOM, South Africa, Sampling of fish species in ESKOM Cooling Towers and translocating them to the NWU.

4.2 Aquatic Biomonitoring at Khumba Iron Ore Mining (Joint with Amanzi Aquatics and NWU – WRG)

2019, Junior Aquatic Specialist, Aquatic Biomonitoring at Khumba Iron Ore Mining (Joint Amanzi Aquatics and NWU – WRG), South Africa, Undertake aquatic biomonitoring in nearby rivers surrounding Khumba Iron Ore to assess fish community structures.

4.3 Aquatic Biomonitoring at a WWTW near Greylingstad (Joint with Ecosphere and NWU – WRG)

2022, Junior Aquatic Specialist, Aquatic biomonitoring (SASS5, water and sediment quality and fish community structure), South Africa, Undertake aquatic biomonitoring in nearby rivers surrounding Khumba Iron Ore to assess fish community structures.

4.4 Kroonstad Solar PV Facilities

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Vals River.

4.5 Kroonstad South Solar PV Facilities

2022, Aquatic and Wetland Specialist, Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the five solar PV facilities as well as perform aquatic biomonitoring of the Blomspruit.

4.6 Proposed Nketoana Regional Bulk Water Scheme Project

2022, Aquatic and Wetland Specialist, Nketoana Local Municipality is experiencing severe water shortages in its towns Reitz/Petsana/ Petrus Steyn/ Mamafubedu/ Arlington/ Leratswana and Lindley. Solutions to the water shortages are the proposed Nketoana Regional Bulk Water Scheme Pipeline, South Africa, Perform aquatic biomonitoring and assessing all wetlands within a 500m radius of the bulk water scheme project.

4.7 Rustenburg Solar PV Facilities

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Rustenburg, North West Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Elands River.

4.8 Grootvlei Solar PV Facility

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all wetlands associated with the one solar PV facility.

4.9 400kV Transmission and 132kV distribution power lines for the Apollo-Lepini-Mesong Project

2023, Aquatic and Wetland Specialist, Proposed development of a 400kV transmission and 132kV power lines for the Apollo-Lepini-Mesong Project, Gauteng Province, South Africa, Undertake and Aquatic and Wetland Impact Assessment along the proposed routes for the 400kV and 132kV power lines.

4.10 CCUS 3D Seismic Survey & Drilling

2023, Wetland Specialist. Proposed 3D Seismic Survey within the Leandra area, Mpumalanga Province, South Africa, Assess and map all wetlands within the footprint of the survey area.

4.11 Paulputs 400 kV Strengthening (Transmission Line Loop in Loop Out) Project

2022, Aquatic and Wetland Specialist, Proposed Paulputs 400kv Strengthening Project (Transmission Line Loop In Loop Out From Aries – Kokerboom Transmission Line), South Africa, Assess and map all wetlands associated with the power line as well as aquatic biomonitoring.

4.12 Seelo Solar PV Facilities

2022, Aquatic and Wetland Specialist, Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Mooirivierloop.

5 LANGUAGES:

English - excellent speaking, reading, and writing

Afrikaans – excellent speaking, reading and writing

Appendix 2: Reviewers details, qualifications and expertise (Elzet Human)

1. Personal Particulars

Profession:	Biodiversity Specialist
Date of Birth:	13 March 1987
Name of Firm:	Nitai Consulting
Name of Staff:	Elzet Human
Nationality:	RSA
Membership of Professional Societies	SACNASP (Pr. Sci. Nat. 147031)

2. Education:

- M-Tech Nature Conservation, (Plant DNA Barcoding and phylogenetics), TUT, South Africa, 2021
- B-Tech Nature Conservation, (Resource Management, Vegetation ecology and rehabilitation) TUT, South Africa, 2011
- N. Dip Nature Conservation, TUT, South Africa, 2008

3. Employment Record:

- 2022 – Present Biodiversity Specialist, Nitai Consulting

  Conduct Biodiversity Impact Assessments.

  Conduct Plant Ecological Assessments.

  Conduct Animal Ecological Assessments

  Biodiversity monitoring programs; and,

  GIS Mapping

- 2013 – 2022 Lecturer: Nature Management, Centurion academy

  Lectured various subjects for undergraduate students in Nature Management:

Botany and Vegetation Ecology, Zoology, Animal Health, Conservation Development, Ecology, Game Ranch Management, Biostatistics, Research Methodology, Genetics, Soil Science

- 2009 – 2013 HOD Rangers Department, Zebula Gold Estate and Spa

  Ecological Monitoring, Reserve Maintenance, Animal Husbandry, Neonatal care of Endangered carnivore species, Zoological display, and permit compliance

- 2008 – Conservation Student, Ann van Dyk Cheetah Research Centre

  Neonatal Care of Carnivore species,

  Veterinary assistance work – vaccine, diets, Endo scoping, pregnancy tests, health monitoring, quarantine care of species, emergency c-sections, bleeding procedures on vultures

  Enclosure Maintenance

  Tracking wild cheetahs

  Rewilding cheetahs

  Anatolian Shepard project assistance

4. Selected Consultancies

4.1 Ecological assessment for Victorius Game farm, Visgat, Ellisras, Limpopo

2018, Ecologist, Ecological condition assessment and game carrying capacity for game farm. Habitat evaluation and rehibition program for problem areas

4.2 Elephant impact study on Mabula Game Reserve, Bela-Bela, Limpopo,

2019, Ecologist, Ecological impact study on Private Nature reserve to see extent of elephant utilisation and impact. Woody species analysis – structure classification and net primary production. Elephant movement patterns and carrying capacity. Identification of vulnerable habitats and management program.

4.3 Faan Meintjies Municipal Nature Reserve, Matlosana, North West

2018-2022, Ecologist, Habitat assessments, game carrying capacities, ecological condition assessments, game counts and game recommendations, ecological rehabilitation programs, white rhino monitoring, anti-poaching programs, Environmental Education programs.

4.4 Kroonstad Solar PV Facilities

2022, Biodiversity Specialist. Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the three solar PV facilities as well as perform aquatic biomonitoring of the Vals River.

4.5 Kroonstad South Solar PV Facilities

2022, Biodiversity Specialist. Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Assess and map all wetlands associated with the five solar PV facilities as well as perform aquatic biomonitoring of the Blomspruit.

4.6 Proposed Nketoana Regional Bulk Water Scheme Project

2023, Biodiversity Specialist. Nketoana Local Municipality is experiencing severe water shortages in its towns Reitz/Petsana/ Petrus Steyn/ Mamafubedu/ Arlington/ Leratswana and Lindley. Solutions to the water shortages are the proposed Nketoana Regional Bulk Water Scheme Pipeline, South Africa, Assess and map all biodiversity, plant and animal features associated within the footprint of the bulk water scheme project.

4.7 Rustenburg Solar PV Facilities

2023, Biodiversity Specialist. Development of three Solar PV facilities near Rustenburg, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the three solar PV facilities.

4.8 Grootvlei Solar PV Facility

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant and animal features associated with the one solar PV facility.

4.9 400kV Transmission and 132kV distribution power lines for the Apollo-Lepini-Mesong Project

2023, Biodiversity Specialist. Proposed development of a 400kV transmission and 132kV power lines for the Apollo-Lepini-Mesong Project, Gauteng Province, South Africa, undertake assessments and map all biodiversity, plant, and animal features along the proposed routes for the 400kV and 132kV power lines.

4.10 CCUS 3D Seismic Survey & Drilling

2023, Biodiversity Specialist. Proposed 3D Seismic Survey within the Leandra area, Mpumalanga Province, South Africa Assess and map all biodiversity, plant and animal features within the footprint of the survey area.

4.11 Paulputs 400 kV Strengthening (Transmission Line Loop in Loop Out) Project

2023, Biodiversity Specialist. Proposed Paulputs 400kv Strengthening Project (Transmission Line Loop In Loop Out From Aries – Kokerboom Transmission Line), South Africa, Assess and map all biodiversity, plant and animal features within the power line footprint as well as perform biodiversity monitoring.

4.12 Seelo Solar PV Facilities

2023, Biodiversity Specialist. Development of three Solar PV facilities near Carletonville, North West Province, South Africa, Assess and map all biodiversity, plant, and animal features within the three solar PV facilities as well as perform biodiversity monitoring.

5 LANGUAGES:

English - excellent speaking, reading, and writing

Afrikaans – excellent speaking, reading and writing

APPENDIX 2: REVIEWERS DETAILS, QUALIFICATIONS AND EXPERTISE (ANTOINETTE BOOTSMA)

1. PROFESSIONAL AFFILIATIONS

- Professional Natural Scientist (SACNASP) # 400222-09 Botany and Ecology
- South African Wetland Society # NA6RY2FP
- Grassland Society of South Africa

2. QUALIFICATIONS

- **M.SC** (Environmental Science), University of South Africa, 2017. *Awarded with distinction*. Project Title: Natural mechanisms of erosion prevention and stabilization in a Marakele peatland; implications for conservation management.

3. PUBLICATIONS

- A.A. Boostma, S. Elshehawi, A.P. Grootjans, P.L Grundling, S. Khosa, M. Butler, L. Brown, P. Schot. 2019. Anthropogenic disturbances of natural ecohydrological processes in the Matlabas mountain mire, South Africa. South African Journal of Science Volume 115| Number 5/6, May/June 2019, P1 to 8.

4. EMPLOYMENT HISTORY

- Director at Limosella Consulting (Pty) Ltd - 2009 – ongoing
- Senior Wetland Specialist at Strategic Environmental Focus – 2007 to 2009
- Technical Assistant at the Conservation Ecology Research Unit, University of Pretoria, Richards Bay field station, 2005 to 2007.

5. Summary of Key skills

- Management of projects in terms of specialist input, including quotations, planning, technical review, submission of reports and invoicing;
- Fine scale wetland delineations and functional assessments;
- Strategic wetland assessments and open space management and planning;
- General Rehabilitation, Monitoring and Mitigation assessments;
- Wetland offset strategies;
- Hydropedological investigations; and
- Implementation of wetland assessment tools including the DWS (2016) Risk Assessment, Present Ecological Status (PES) Macfarlane et al, (2020), Ecological Importance and Sensitivity (EIS) (DWAF, 1999), Recommended Ecological Category (REC) Rountree et al (2013), Riparian Vegetation Response Assessment Index (VEGRAI) (Kleynhans et al, 2007) and QHI (Quick Habitat Integrity).

6. Short summary of Experience

- Numerous external peer reviews as part of mentorship programs for companies including Galago Environmental Consultants, Lidwala Consulting Engineers, Bokamoso Environmental Consultants, Gibb, 2009 – ongoing;
- Wetland specialist input into the Kloof Mine wetland sediment interim management, remediation and rehabilitation plan, 2022;
- Wetland Assessments for the upgrade of 7 culverts and bridges in Vereeniging, Gauteng, July 2021
- Input into the Environmental Management Plan for repair to 90 bridges in the City of Johannesburg, 2020;
- Wetland specialist input into the City of Tshwane Open Space Framework, 2019;
- Wetland specialist input into the North West Environmental Outlook, 2018;
- Wetland specialist input into the Gauteng Environmental Outlook, 2017;
- Wetland specialist input into the Open Space Management Framework for Kyalami and Ruimsig, City of Johannesburg, 2016;
- Kangra Maquasa East and Maquasa West and Nooitgesien Mine, Mpumalanga Province: Rehabilitation and Monitoring Assessment. June 2018; and
- Mbuyelo Coal Welstand Reserve Amendment: Wetland assessment. June 2017.

Appendix 3: Signed Declaration Independence

I, **Divan van Rooyen**, declare that –

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

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

01/04/2023

Dr. Divan van Rooyen (Can. Sci. Nat. 151272)

Date

Aquatic and Wetland Specialist

I, **Elzet Human**, declare that –

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

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

02/04/2023

Elzet Human (Pri. Sci. Nat. 147031)
Date

Terrestrial Ecologist

I, **Antoinette Bootsma**, declare that –

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

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

ABootsma

______________________________ **06/04/2023**

Antoinette Bootsma (Pri. Sci. Nat. 400222-09) **Date**

Wetland Specialist