

COUNCIL FOR GEOSCIENCE

**CARBON CAPTURE UTILISATION AND STORAGE (CCUS) PROJECT: 3D SEISMIC SURVEY AND
DRILLING, LEANDRA, MPUMALANGA PROVINCE**

HERITAGE IMPACT ASSESSMENT

26 APRIL 2023



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The heritage impact assessment report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below.

Requirements of Appendix 6 – GN R326 EIAs Regulations (2014, amended 2017)	Relevant section in report
1.(1) (a) (i) Details of the specialist who prepared the report	Section 1.1.3 of Report
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.1.3 and of Report and Appendix 2
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page iii of the report
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 1.1
(cA) An indication of the quality and age of base data used for the specialist report	N/A
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 5
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 6
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 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 5.4 and 5.5, Section 6
(g) An identification of any areas to be avoided, including buffers	Section 6
(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;	Appendix 1
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3
(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	Sections 6, 11
(k) Any mitigation measures for inclusion in the EMPr	Section 8, 11
(l) Any conditions for inclusion in the environmental authorisation	N/A
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	N/A
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 13
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and	
(n)(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	Section 8, 12
(o) A description of any consultation process that was undertaken during the course of carrying out the study	Not applicable. A public consultation process will be handled as part of the SEIA and EMPr process.

Requirements of Appendix 6 – GN R326 EIAs Regulations (2014, amended 2017)	Relevant section in report
(p) A summary and copies if any comments that were received during any consultation process	Not applicable. To date no comments have been raised regarding heritage resources that require input from a specialist.
(q) Any other information requested by the competent authority.	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 38(3) of the NHRA

Declaration of Independence

The report has been compiled by Nitai Consulting (Pty) Ltd, an appointed Heritage Specialist for Nemai Consulting for the Proposed CCUS Seismic Survey & Drilling Project, Leandra, Mpumalanga Province. The views contained in this report are purely objective and no other interests are displayed during the Heritage Impact Assessment Process.

I, Jennifer Kitto, declare that –

General declaration:

- I act as the independent heritage specialist*
- I will perform the work in an objective manner, even if this results in views and findings that are not favourable to the project;*
- I declare that there are no circumstances that may compromise my objectivity in performing such work;*
- I have expertise in conducting heritage impact assessments, including knowledge of the National Heritage Resources Act, No 25 of 1999 (NHRA), associated Regulations and any guidelines that have relevance to the proposed activity;*
- I will comply with the NHRA, associated Regulations and all other applicable legislation, specifically the National Environmental Management Act, No 107 of 1998 (NEMA);*
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA;*
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;*
- I undertake to disclose to the project proponent 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;*
- I will ensure that information containing all relevant facts in respect of the project is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;*
- I will provide the competent authority with access to all information at my disposal regarding the project, whether such information is favourable to the project or not*
- All the particulars furnished by me in this form are true and correct;*
- I will perform all other obligations as expected of a heritage specialist in terms of the NHRA and NEMA, associated Regulations, the constitutions of my affiliated professional bodies; and*
- I realise that a false declaration is an offence in terms of regulation 71 of the NEMA Regulations and is punishable in terms of section 24F of the NEMA.*

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the NEMA Regulations;

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PRINCIPAL HERITAGE PRACTITIONER – Jennifer Kitto

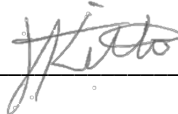
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Executive Summary

South Africa (SA) has a coal-based energy economy and emits carbon dioxide (CO₂) into the atmosphere at approximately 400 million tonnes per year. In recognising its contribution to climate change, the country has committed itself to undertake steps to minimise such emissions. Carbon Capture Utilisation & Storage (CCUS) has been acknowledged by SA as one of the technologies to mitigate the emissions of CO₂ into the atmosphere and forms one of the Nationally Appropriate Mitigation Actions (NAMA). It is also one of the national flagship projects. CCUS forms part of a just transition to a future low-carbon energy economy.

The Council for Geoscience (CGS) is undertaking a geoscientific research project for the piloting of CCUS in Leandra in Mpumalanga, where it is proposed to inject CO₂ into deep suitable geological formations, approximately 1km below the surface. The Government of SA has received funding from the World Bank's (WB) International Bank for Reconstruction and Development to finance the CCUS Project and intends to apply part of the proceeds for conducting Geological Characterisation comprising, amongst others, of drilling exploration boreholes and undertaking a high-resolution 3D seismic survey at the proposed injection site. This document only focuses on the Geological Characterisation component of the overall CCUS (i.e., the proposed 3D seismic survey and sampling drilling).

Methodology/ Significance Assessment

A literature review / historical desktop study was undertaken which has shown that various archaeological and historical resources could be expected to occur in the project area. The examination of the earliest edition (1965) of the 1:50 000 topographical maps produced by overlying the maps with satellite Imagery (Google Earth) has shown that a large number of heritage features are depicted within the project footprint, many being structures comprising the town of Leslie/Leandra.

The subsequent site survey fieldwork undertaken confirmed the findings of the desktop study as 36 heritage resources were identified as occurring within the greater project area footprint (seismic survey area).

NOTE: subsequent to this HIA report being compiled, the footprint area for the 3D seismic survey was reduced substantially from the footprint that was provided originally and which was assessed at the desktop and field- survey level. Therefore, the number of heritage resources affected by the proposed Geological Characterisation is now less and the impact of the proposed project on the identified heritage resources has been adjusted accordingly.

Identification of Activities, Aspect and Impacts

The project area that will be impacted by the proposed Carbon Capture Underground Storage project – Geological Characterisation component is situated over various portions of two farms: Farm

Goedehoop 308IR (Portions 2, 6, 12, 13, 25, 29, 31, 35, 42 and RE/9), and Farm Grootlaagte 311IR (Portions RE/3 and 25). As noted above, the area earmarked initially for the 3D seismic survey encompassed most of the town of Leandra, as well as rural areas to the east and north-east and the south-west; however, this footprint area has since been reduced substantially. The proposed drilling sampling site is located outside (to the east) of the town, between the R29 road from Leandra to Kinross and the railway line from Secunda to Springs.

Subsequent to the reduction of the footprint area for the 3D seismic survey, only a few of the heritage resources identified initially will now be affected and the impact of the proposed seismic survey and drilling sampling on the heritage resources has been adjusted accordingly.

The impact of the proposed project on protected historical structures has been reduced from medium-high to low as the reduced project footprint now excludes the town of Leandra where most of the identified historical structures or structure remains are located. Therefore, only the two historical stone railway culverts (CCUS 03 and CCUS 33), three structure or homestead remains (CCUS 06 to CCUS 07 and CCUS 30), three possible but not certain structure or homestead remains (CCUS 01, CCUS 04 and CCUS 08) as well as a potential grave (CCUS 02).

As noted above, the impact significance of the project on graves and cemeteries has been reduced from medium to low as the three community cemeteries (one being Muslim) and one farmworker graveyard identified initially now fall outside the reduced project footprint. However, the potential grave (CCUS-02) identified within the drill site footprint could still be affected.

The impact significance of the project on intangible and living heritage resources remains low as the informal church site identified is located within the Lebohang township and well outside the reduced seismic survey footprint area.

The impact significance of the proposed project on archaeological resources is low as no archaeological sites or material were identified.

Mitigation Measures

As noted above, the HIA study for the proposed CCUS seismic survey and drilling project initially identified a large number of heritage resources (36 in total) within or immediately adjacent to the originally provided project footprint. However, subsequent to undertaking the field survey, the footprint area for the 3D seismic survey was reduced substantially. Therefore, the impact on heritage resources is reduced as only nine heritage resources are located within the reduced footprint area.

The recommendations below are provided to mitigate the potential impact of the proposed project on the nine identified heritage resources:

Historical structures and demolished structures

- **The two Historical Railway Culverts (CCUS 03 and CCUS 33)** are protected by section 34 of the NHRA and must be demarcated and avoided as “no-go” areas with a 30m buffer.

- **The demolished structure remains (CCUS 06 to CCUS 07) and possible homestead (CCUS 30)** are protected by section 34 of the NHRA. If any negative impact is anticipated on either of these resources,, a permit will be required for the destruction/clearance of these resources (from MPHRA or SAHRA).
- The three possible but not certain structure or homestead remains (CCUS 01, CCUS 04 and CCUS 08) are not protected or considered to be conservation worthy and therefore no mitigation is required.

Graves and Cemeteries

- **The potential grave at CCUS-02**, that may be located within or on the south-eastern boundary of the proposed drilling site, is protected by section 36 of the NHRA. Therefore, any site clearance activities for the proposed drilling site within 30m of the approximate location, should be monitored by a heritage specialist/archaeologist. If a burial or human remains are uncovered during site clearance or construction activities, a buffer of at least 30m must be placed around the site to ensure that, the burial/human remains are not damaged. In addition, all site clearance or construction activities in the immediate vicinity of the burial/human remains must be suspended. The heritage specialist/archaeologist will then need to apply for a permit for a rescue exhumation of the burial/human remains, in compliance with section 36 of the NHRA.

Living / Intangible Heritage

- As noted above, the **informal community church site (CCUS-11)** would not be affected as it is situated outside the reduced footprint for the seismic survey. *Palaeontological Heritage*

Palaeontological Heritage

- A palaeontological assessment is not expected to be required by SAHRA for the seismic survey component as this is anticipated to impact only the ground surface and not the underlying geology of the project area footprint which is indicated as of Insignificant to Zero fossil sensitivity on the SAHRIS Palaeontological Sensitivity Map.
- However, as the drilling site is intended to sample the underlying geology, and as SAHRA has required such studies for past HIAs for the surrounding area, it is recommended that at least a desktop palaeontological assessment of the drill site footprint must be undertaken and submitted to SAHRA for comment.

Conclusion

Taking all of the above into account, the considered opinion of the heritage specialist is that no fatal flaws with respect to heritage resources have been identified during this HIA study. Therefore, there are no objections from a heritage perspective provided that the recommendations and mitigation measures contained in this report and in the recommended palaeontological assessment are implemented where necessary.

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List of Abbreviations

APHP	Association of Professional Heritage Practitioners
ASAPA	Association of Southern African Professional Archaeologists
BGG	Burial Grounds and Graves
CGS	Council for Geoscience
CRM	Cultural Resources Management
CCUS	Carbon Capture Utilisation & Storage
DALRRD	Department of Agriculture, Land Reform & Rural Development
DFFE	Department of Fisheries Forestry and Environment
EHS	Environmental, Health and Safety
EAP	Environmental Assessment Practitioner
EIA	Early Iron Age
EMPr	Environmental Management Programme
ESA	Early Stone Age
ESIA	Environmental and Social Impact Assessment
GIS	Geographic Information System
ha	Hectare
HIA	Heritage Impact Assessment
IAIAsa	International Association for Impact Assessment South Africa
IBRD	International Bank for Reconstruction and Development
IFC	International Finance Corporation
km	Kilometre (1 000m)
LIA	Late Iron Age
LSA	Later Stone Age
MPHRA	Mpumalanga Provincial Heritage Resources Authority
MSA	Middle Stone Age
NAMA	Nationally Appropriate Mitigation Actions
NEMA	National Environmental Management Act (No. 107 of 1998)
NHA	National Health Act, (No. 61 of 2003)
NHRA	National Heritage Resources Act (No 25 of 1999)
PCSP	Pilot CO ₂ Storage Project
PHRA	Provincial Heritage Resources Authority
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION

South Africa (SA) has a coal-based energy economy and emits carbon dioxide (CO₂) into the atmosphere at approximately 400 million tonnes per year. In recognising its contribution to climate change, the country has committed itself to undertake steps to minimise such emissions. Carbon Capture Utilisation & Storage (CCUS) has been acknowledged by SA as one of the technologies to mitigate the emissions of CO₂ into the atmosphere and forms one of the Nationally Appropriate Mitigation Actions (NAMA). It is also one of the national flagship projects. CCUS forms part of a just transition to a future low-carbon energy economy.

The Council for Geoscience (CGS) is undertaking a geoscientific research project for the piloting of CCUS in Leandra in Mpumalanga, where it is proposed to inject CO₂ into deep suitable geological formations, approximately 1km below the surface. The Government of SA has received funding from the World Bank's (WB) International Bank for Reconstruction and Development to finance the CCUS Project and intends to apply part of the proceeds for conducting Geological Characterisation comprising, amongst others, of drilling exploration boreholes and undertaking high-resolution 3D seismic survey at the proposed injection site. This document forms the Heritage Impact Assessment (HIA) component of the Environmental and Social Impact Assessment for the project (ESIA) and only focuses on the Geological Characterisation component of the overall CCUS.

1.1 Scope & Terms of Reference for the HIA report

1.1.1 Summary of Key Issues & Triggers Identified

In terms of the National Heritage Resources Act, No 25 of 1999 (NHRA), the following proposed activities trigger the need for a Heritage Impact Assessment (HIA):

- Potential occurrence of heritage resources, graves and structures older than 60 years within the Project's footprint.
- Proposed development that is more than 5000m².
- Proposed development where an impact assessment is triggered in terms of National Environmental Management Act, No 107 of 1998 (NEMA).

1.1.2 Approach

- Undertake a Heritage Impact Assessment in accordance with the NHRA.
- Identify and map all heritage resources in the area affected, as defined in Section 2 of the NHRA, including archaeological sites on or near (within 100m of) the proposed developments.
- Assess the significance of such resources in terms of the heritage assessment criteria as set out in the regulations.
- Assess the impacts of the Project on such heritage resources.
- Prepare a heritage sensitivity map (GIS-based), based on the findings of the study.

- Identify heritage resources to be monitored.
- Comply with specific requirements and guidelines of Mpumalanga Provincial Heritage Resources Authority (MPHRA) and SAHRA.
- Comply with specific requirements and guidelines of the World Bank (WB).

1.1.3 Nominated Specialist Details

Organisation:	Nitai Consulting
Name:	Jennifer Kitto
Qualifications:	BA Archaeology and Social Anthropology; BA (Hons) Social Anthropology
No. of years' experience:	24
Affiliation (if applicable):	Association of Southern African Professional Archaeologists (ASAPA) - Technical member No.444 International Association for Impact Assessment (IAIAsa) – Member No. 7151

1.2 Project Description

The northern portion of the Highveld coalfields presents unique geology, which affords the potential storage of CO₂. The proposed site for the piloting of CCUS project is situated near Leandra in the Govan Mbeki Local Municipality, which falls within the Mpumalanga Province of SA. The R29 runs through the central part of the overall project area (see Figure 1 below).

The proposed drilling site is located along the R29 from Leandra to Kinross and is bounded to the south by the railway line from Secunda to Springs. The area earmarked for the 3D seismic survey footprint originally encompassed most of the town of Leandra, as well as rural areas to the east and north-east. However, this footprint was subsequently reduced substantially. Refer to the map contained in **Figure 2** below.

2 LEGISLATION

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by various pieces of legislation, including the National Heritage Resources Act, 25 of 1999 (NHRA) and associated Regulations, National Environmental Management Act, Act 107 of 1998 (NEMA) and associated Regulations (as amended) as well as the National Health Act, Act No. 61 of 2003 (NHA), and associated specific Regulations governing human remains.

However, since the finance for the CCUS project was received from the World Bank's International Bank for Reconstruction and Development (IBRD), the project must also comply with the requirements of World Bank's Policies as well as the International Finance Corporation (IFC) Performance Standards observed by most large international financial institutions.

2.1 South African Legislation

2.1.1 National Heritage Resources Act (Act No 25 of 1999; NHRA)

The NHRA is the legislation that defines cultural heritage resources (section 3), provides protection to specific types of heritage resources (sections 34, 35, 36) and also requires an impact assessment of such resources for specific development activities (section 38(1)). Section 38(8) further allows for cooperation and integration of the management of such impact assessment between the national South African Heritage Resources Agency (SAHRA) or provincial heritage resources authority (SAHRA or a PHRA) and the national Department of Forestry, Fisheries and Environment (DFFE).

In terms of section 38(1)(a) of the NHRA, the specific types of development activity that may require a Heritage Impact Assessment (HIA) include: the construction of a road, wall, powerline, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length. As the proposed project area is larger than 5000m², this study falls under s38(8) and requires comment from the relevant heritage resources authority. (SAHRA and/or the Mpumalanga Provincial Heritage Authority - MPHRA).

Sections 34-36 of the NHRA further stipulate the protections afforded to specific types of heritage resources, *i.e.*, structures older than 60 years (s34); archaeological, palaeontological, meteorites (s35); graves and burial grounds (s36)), as well as the mitigation process to be followed if these resources need to be disturbed. The operation of the 3D seismic survey component and the undertaking of the drilling activities for the CCUS project may result in impacts to any of these types of heritage resources.

2.1.2 National Environmental Management Act (Act 107 of 1998; NEMA)

NEMA states that Environmental Management Programme (EMPr) should, (23 -2 (b)) "...identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage". In addition, the NEMA and associated Regulations GNR 982 (Government Gazette 38282, 14 December 2014, amended 2017) state that, "the objective of an environmental impact assessment process is to, ... identify the location of the development footprint within the preferred site ... focussing on the geographical, physical, biological, social, economic, *cultural and heritage aspects* of the environment" (GNR 982, Appendix 3(2)(c), emphasis added).

The EIA Regulations, 2014 (as amended), published in GNR 982 (Government Gazette 38282, 14 December 2014, amended 2017) promulgated under the NEMA contain specific requirements to be addressed in the different types of impact assessment reports (Regulations 19, 21 and 23) as well as requirements for Specialist Reports (Appendix 6).

2.1.3 The National Health Act (Act No. 61 of 2003; NHA) and associated Regulations (2013)

In the case of graves and/or burial grounds that could be impacted by a proposed development, and which are identified through an impact assessment, specific Regulations relating to the Management of Human Remains (GNR 363 of 2013 in Government Gazette 36473) address the exhumation and reburial of human remains: Regulations 26, 27 and 28.

2.1.4 Mineral and Petroleum Resources Development Act (Act No. 28 of 2002; MPRDA)

This MPRDA 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.

2.2 International Requirements

The regulatory aspects dealt with above relate solely to the South African laws and regulations and would usually be the only requirements for an Environmental and Social Impact Assessment (ESIA). However, since the finance for the CCUS project was received from the World Bank's IBRD, the project must comply with the requirements of World Bank Policies & Environmental, Health and Safety (EHS) Guidelines as well as the International Finance Corporation (IFC) Performance Standards observed by most large international financial institutions. Summaries of these requirements are set out below.

2.2.1 World Bank Policies & Environmental, Health and Safety Guidelines

In addition to the above IFP requirements, the World Bank's Safeguard Policies and Environmental, Health and Safety (EHS) Guidelines were put in place to prevent or mitigate adverse impacts of its projects on people and the environment. As the proposed project is considered a Category A project but was onboarded prior to 2018 it is thus subject to the Safeguards Policies (OPs), specifically with regard to cultural heritage OP/BP 4.11 - Physical Cultural Resources. This Operating Policy specifically requires that the physical cultural resources component of the Environmental Assessment includes (a) an investigation and inventory of

physical cultural resources likely to be affected by the project; (b) documentation of the significance of such physical cultural resources; and (c) assessment of the nature and extent of potential impacts on these resources. This OP also requires that when the project may have adverse impacts on physical cultural resources, the ESIA includes appropriate measures for avoiding or mitigating these impacts.

2.2.2 The International Finance Corporation

The IFC Performance Standards (PS) are an international benchmark for identifying and managing environmental and social risk and have been adopted by many organizations as a key component of their environmental and social risk management. The IFC's Environmental, Health, and Safety (EHS) Guidelines provide technical guidelines with general and industry-specific examples of good international industry practice to meet the IFC's PS.

In many countries, the scope and intent of the IFC PS are addressed or partially addressed in the country's environmental and social regulatory framework. The IFC PS encompass eight topics of which PS 7 and PS 8 have direct relevance to heritage resources. PS 7 and PS 8 relate to Indigenous Peoples and Cultural Heritage respectively.

Standard (PS) 8 – Paragraph 9 (Consultation) (2012) refers to the need for consultation with affected communities to identify cultural heritage of importance and involve affected communities and the relevant national or local regulatory authorities in the decision-making processes.

Standard (PS) 8 – Paragraph 12 (Removal of Non-Replicable Cultural Heritage) (2012) states that the removal of cultural heritage must only be considered when no other alternative is available.

3 ASSUMPTIONS AND CONSTRAINTS

This assessment assumes that all the information provided by the client and the Environmental Assessment Practitioner (EAP) regarding the project footprint is correct and current.

The large area of the project footprint provided originally meant that it was not feasible to undertake a pedestrian survey of the whole area and the fieldwork, therefore, comprised a combination of vehicle and pedestrian investigation. 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 have not been identified, specifically, informal graves or burial sites and demolished building remains.

4 PROJECT DESCRIPTION

4.1 Location

The project site is situated near the town of Leandra in the Mpumalanga Province of South Africa (SA). The R29 runs through the central part of the overall project area. The project site falls in the Gert Sibande District Municipality (GSDM) and is located within Wards 1, 2, 3 and 6 of the Govan Mbeki Local Municipality (GMLM).

The R29 runs through the central part of the overall project area. Leandra town is situated adjacent to the major gold and coal mining areas of Evander and Secunda respectively, about 120 km to the east of Johannesburg (see Figure 1 below).

The proposed drilling 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 area earmarked for the 3D seismic survey originally encompassed most of the town of Lebohang, as well as rural areas to the east and north-east. However, this footprint has since been reduced substantially and is now located outside the town of Leandra. A gravel access road leading to the drilling site would be available for use by the contractor. Refer to the map contained in **Figure 2** below.

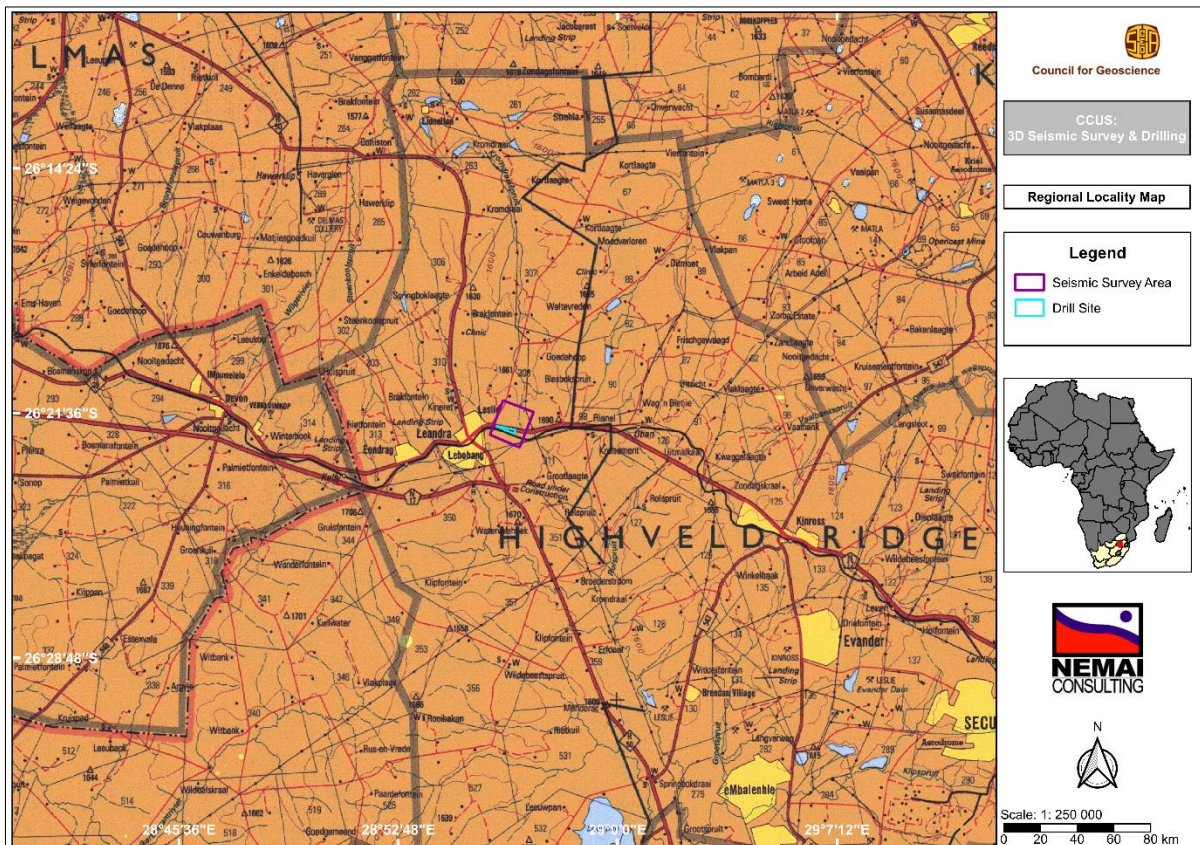


Figure 1: Regional Locality (purple polygon)

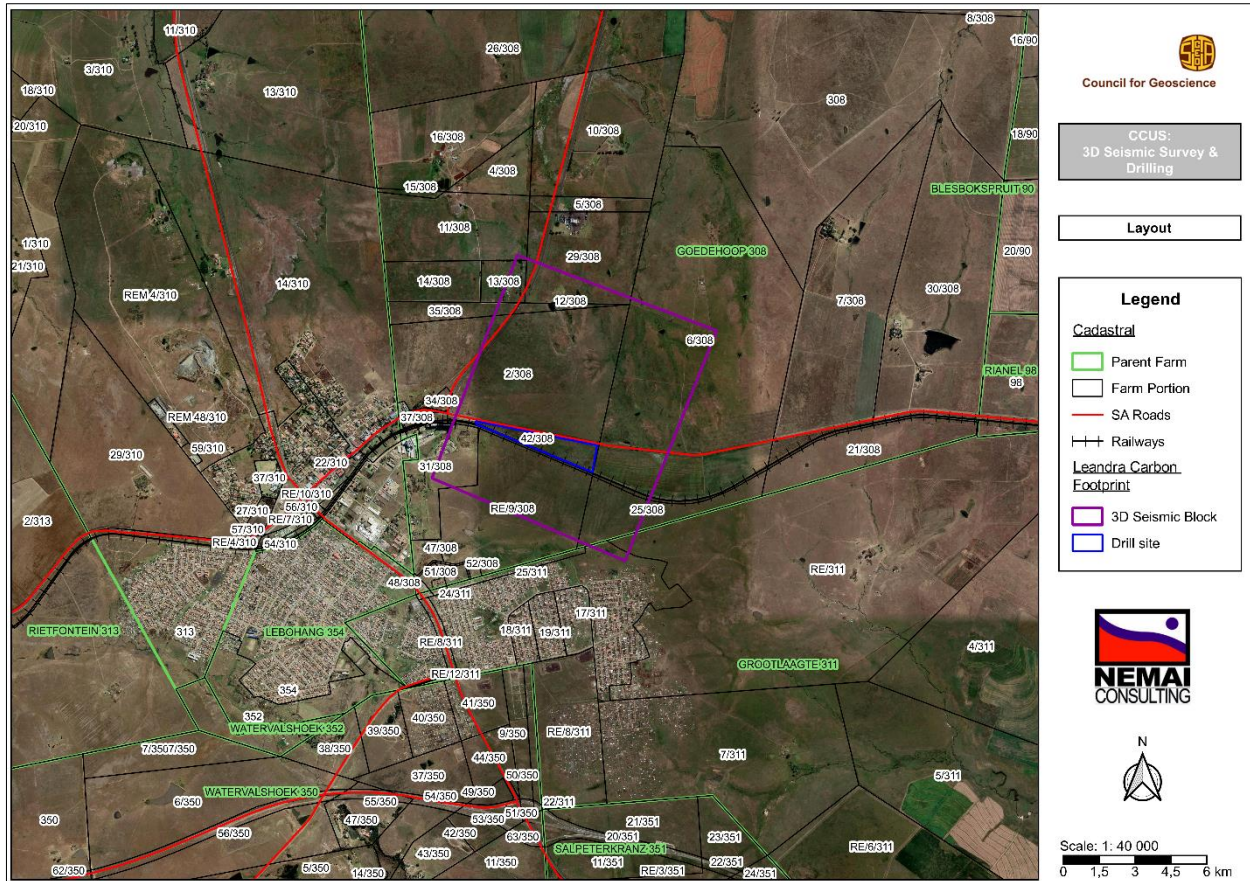


Figure 2: Layout of Proposed Seismic Survey Area and Drill Site

4.2 Project Technical Details

4.2.1 Carbon Capture Utilisation & Storage (CCUS)

CCUS reduces the release of anthropogenic CO₂ emissions into the atmosphere by capturing CO₂ at the source (e.g., point-source emitters such as coal-fired plants) and transporting and storing the captured CO₂ in suitable deep geological formations. Some of the captured CO₂ may then be used in additional downstream industries.

Basaltic rocks, which are rocks rich in iron, calcium, magnesium, and aluminium silicate minerals, are regarded as very promising CO₂ 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 (Nemai 2023).

An assessment of available geological data undertaken by the CGS identified the availability of deep coal seams and potential CO₂ storage reservoirs that can support CCUS development in the Mpumalanga Province (Nemai 2023).

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:* Pilot CO₂ Storage Project (PCSP) for the investigation and characterization of a suitable CO₂ storage site and the subsequent injection, storage and monitoring of between 10,000 and 50,000 tonnes of CO₂ into deep suitable geological formations.
- *Component 2:* A CO₂ 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.

Note that the scope of this HIA is the Geological Characterisation under of the PCSP (part of component 1 above) comprising, amongst others, of drilling a stratigraphic borehole and undertaking high-resolution 3D seismic survey at the proposed injection site.

4.2.2 Proposed Drilling Activities

4.2.2.1 Overview

The drilling and associated borehole construction of a 2,000m deep narrow hole is proposed for geological characterisation and to support the pilot CO₂ injection and monitoring project. The proposed drill site is located along the R29 from Leandra to Kinross and is bounded to the south by the 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 3** below. A schematic of the proposed drill site is provided in **Figure 4** below.

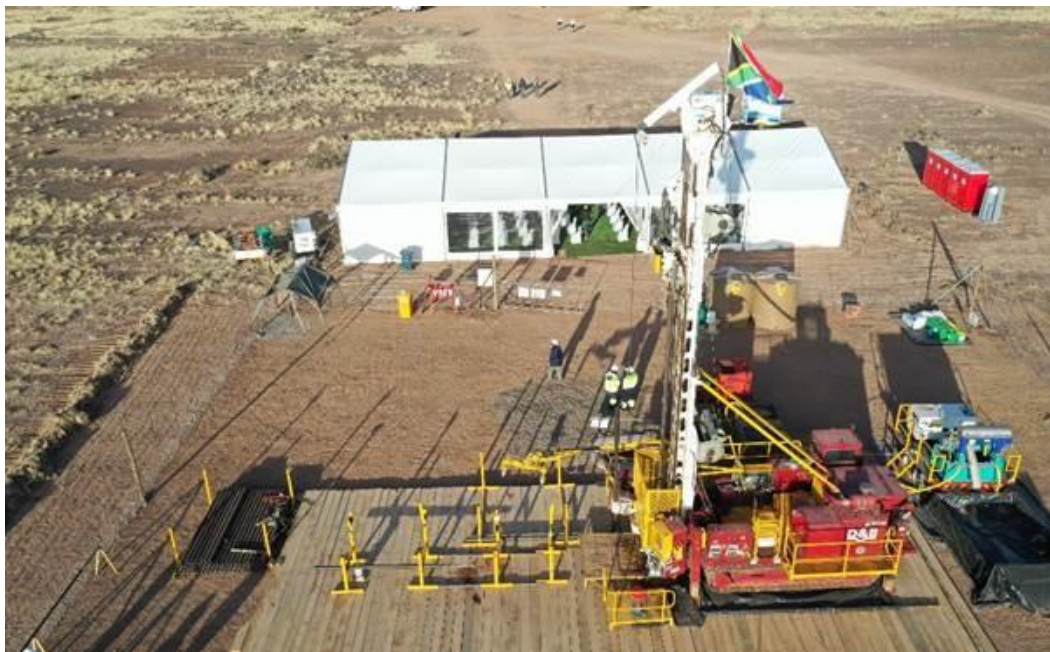


Figure 3: Photograph of a typical drill site (Nemai, 2023)



Figure 4: Schematic of proposed drill site (Nemaï, 2023)

The boreholes will be cored from the top of the bedrock to total depth with a minimum hole diameter of c. 95mm. 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 these slim holes will be to acquire core and wireline logs to assist in undertaking high-resolution geological characterisation.

4.2.2.2 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.

4.2.2.3 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.

4.2.3 3D Seismic Survey

4.2.3.1 Overview

The area earmarked for the 3D seismic survey originally encompassed most of the town of Leandra, as well as rural areas to the east and north-east. However, this has been reduced subsequently and the total area of the survey now is approximately 360 hectares in extent with the perimeter close to 7.60km.

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 survey for the CCUS Project is to map the structures, reservoir and seal rocks in detail over the identified potential injection site. The 3D survey will also establish the baseline for future time-lapse CO₂ 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 5** 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 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 6** below).



Figure 5: Example of a Vibroseis truck (Nemai, 2023)

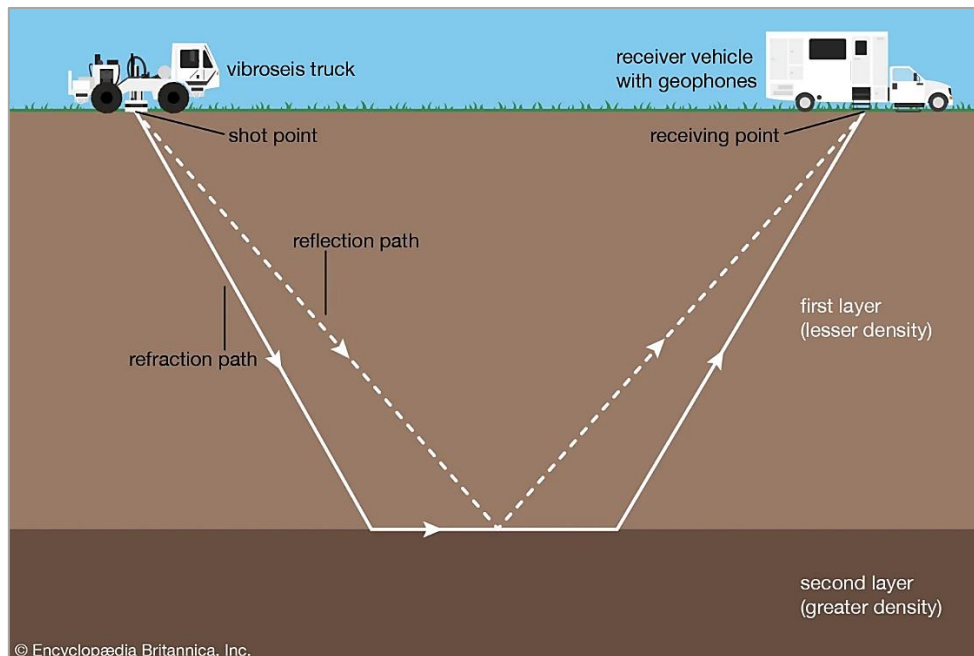


Figure 6: Simplified diagram of seismic data acquisition (<https://www.britannica.com/science/seismic-survey#/media/1/532921/61754>)

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 7** 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 20 m receiver and source line spacing and 5 m receiver and source spacing. The survey needs to provide high resolution from shallower depth of 100m to a maximum depth of 2km.

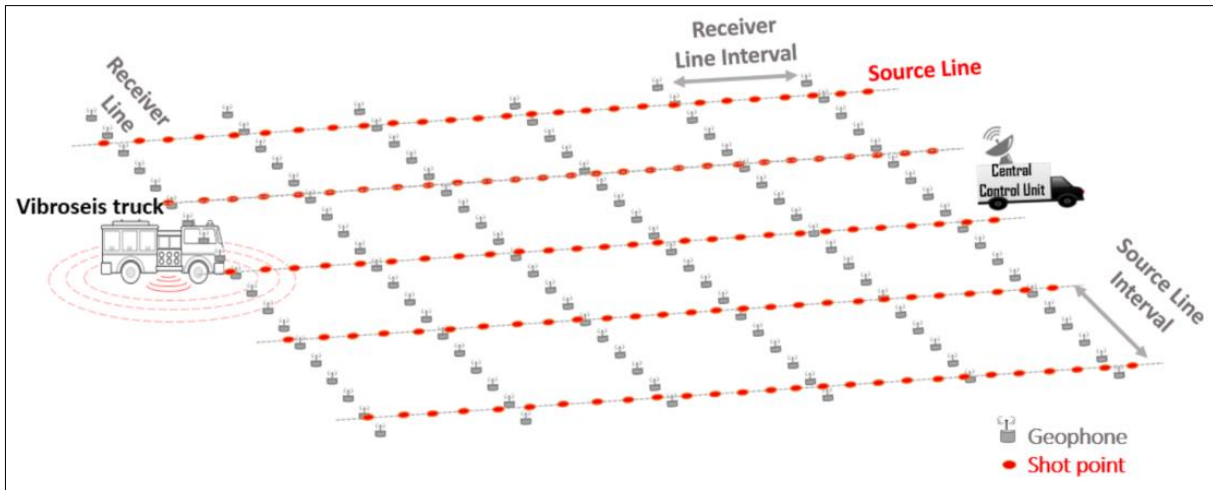


Figure 7: Wireless geophone network orthogonal geometry (Nemai 2023)

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.

4.2.3.2 Survey Parameters

Additional parameters for the CCUS 3D seismic survey are provided in Table 1 below.

Table 1: 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

Survey area	360 hectares
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

4.2.3.3 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.

4.2.3.4 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 4.2.2.2 above).

4.2.3.5 Temporary Facilities

A site camp (approximately 50m x 50m) and parking area (approximately 60m x 10m) (see Figure 4 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 Environmental and Social Management Plan (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.

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 reused, 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.

5 STATUS QUO ANALYSIS

5.1 General Existing Condition of Receiving Environment

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

The general project area terrain is situated over various portions of two farms: Farm Goedehoop 308IR (Portions 2, 6, 12, 13, 25, 29, 31, 35, 42 and RE/9), and Farm Grootlaagte 311IR (Portions RE/3 and 25).

It should be noted that although the original footprint for the 3D seismic survey included the whole town of Leandra and the township of Lebohang (which together contain a large number of historical residential and other buildings) this footprint has been reduced. The reduced footprint is planned over mainly semi-rural areas located just outside Leandra town to the north-east that are vacant or used for agricultural purposes. The areas surrounding the town are characterised by terrain that varies from relatively flat to undulating.

The proposed drill site is currently vacant land, except for the railway that bounds it to the south. The drill site will be fenced for safety and security purposes.

Although the town of Leandra is now not included in the reduced seismic survey footprint, some photographs of the historical structures situated in the town have been included below as a matter of interest.



Figure 8: View of the drill site footprint area, showing the long dense grass, and the recently graded road



Figure 9: General View of the Southern section of the seismic survey area, looking south from the drill site



Figure 10: View over the southern seismic survey area looking west to the town of Leandra from the drill site



Figure 11; View of the south-east section of the seismic survey area, looking east



Figure 12: View of the Northern section of the seismic survey area, looking southwest to Leandra town

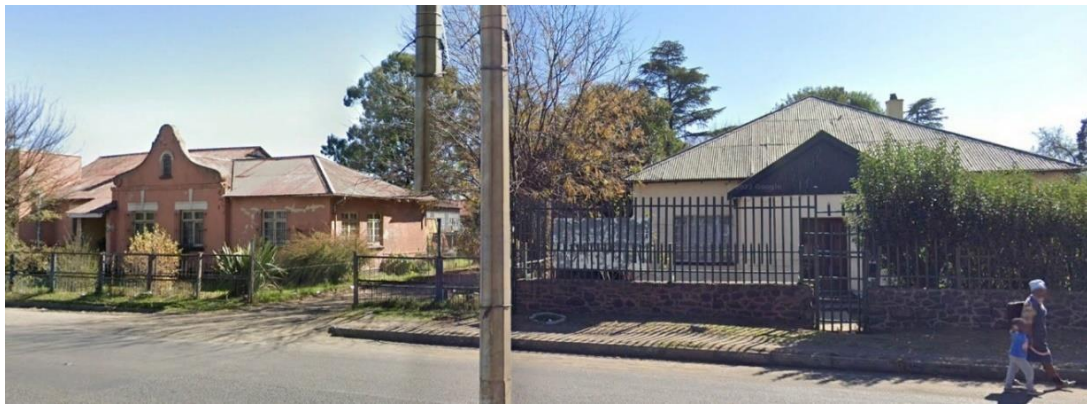


Figure 13: View of two historical houses on the north side of the Leandra Main road/R29 (Google earth Streetview)



Figure 14: View of historical police station building on north side of Leandra Main Road/R29 (R29 (Google earth Streetview)



Figure 15: View of historical police station building on north side of Leandra Main Road/R29 (R29 (Google earth Streetview))

5.2 Cultural-Heritage Receiving Environment

5.2.1 DFFE Screening Tool

The DFFE National Web Based Environmental Screening Tool was accessed for information on the cultural-heritage sensitivity of the general region. The following is noted in terms of the sensitivity of the project area:

- The archaeological and cultural heritage combined sensitivity is low (for both the original and reduced seismic survey footprints - **Figure 16** and **Figure 17**); and
- The palaeontology combined sensitivity for the project area is mainly medium, apart from a small area in the north of the original seismic survey footprint (**Figure 18**) where features with a Very High paleontological sensitivity may occur. However, this northern area is excluded from the reduced footprint of the seismic survey area (see **Figure 19**).

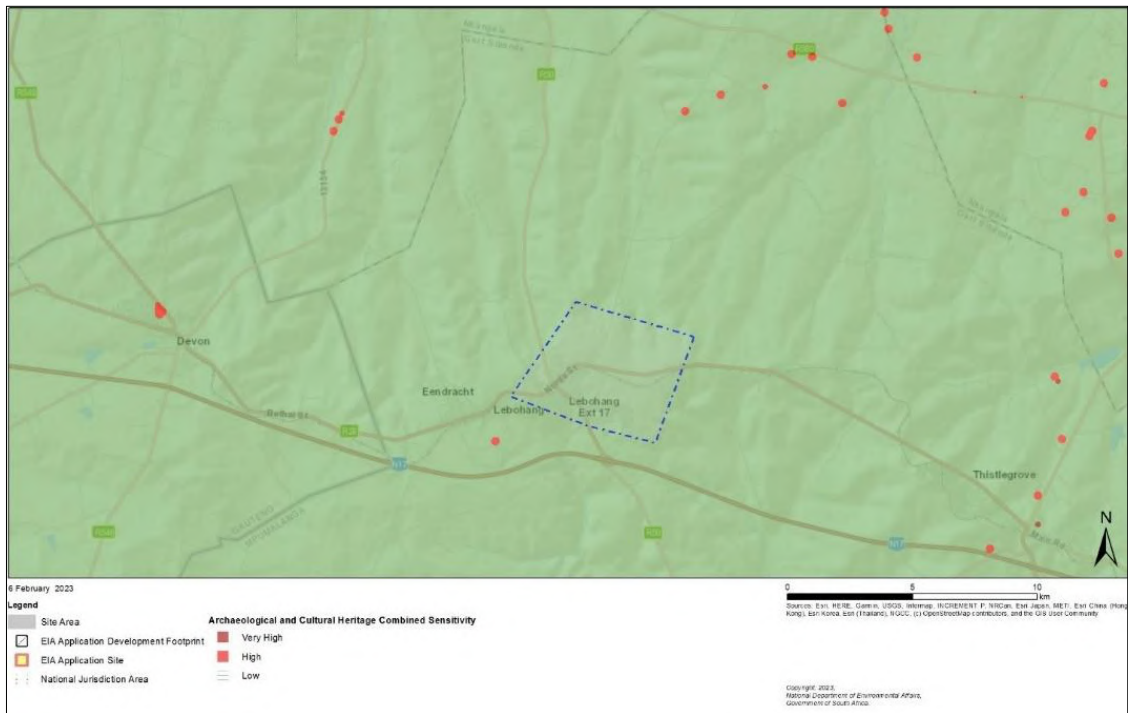


Figure 16: Map of relative Archaeological and Cultural heritage sensitivity for the original seismic survey footprint (DFFE Screening Tool, 2023)



Figure 17: Map of relative Archaeological and Cultural heritage sensitivity for the reduced seismic survey footprint (DFFE Screening Tool, 2023)

5.2.2 Historical Background of Surrounding Region (archaeological and historical literature survey)

The archaeological history of the area can broadly be divided into a Stone Age, Iron Age and Historic or Colonial Period. An archaeological and historical overview of the general region is presented below.

The Stone Age

In South Africa the oldest archaeological period is referred to by archaeologists as the Earlier Stone Age (ESA). The ESA dates from about 2 million to 250 000 years ago. The ESA comprises two technological phases. The earliest of these is known as Oldowan, after Olduvai Gorge in Tanzania where the stone tools were first recognised in the 1960s (Esterhuysen and Smith, 2007). This phase is associated with simple flakes and hammer stones. It dates to approximately 2 million years ago. The second technological phase is the Acheulian (named after a site in France where they were first discovered in the 1800s), which comprises more specialised stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates to approximately 1.5 million years ago.

The Middle Stone Age (MSA) is associated with a definite change in the technique used to produce stone tools from *circa* 250 000 years ago. The new technique produced flakes, points and blades from a prepared core. The attaching of stone tools onto bone or wood shafts to produce spears, knives or axes is also associated with the MSA (Esterhuysen and Smith, 2007). This phase is also associated with modern humans and complex cognition (Wadley, 2013). Although not much research has been undertaken on the MSA in Mpumalanga, the Bushman Rock Shelter (BRS) on the farm Klipfonteinhoek in the Ohrigstad District is a well-known site with occupation layers dated to between c.40 000 years ago to c.27 000BP (Esterhuysen and Smith, 2007). No Early Stone Age sites are known in the direct vicinity of the study area.

The Later Stone Age (LSA) is the third archaeological phase, which occurred from about 20 000 years ago, and is marked by further technological changes and social transformations. The technological changes include the production of very small stone tools called microliths; the bow and the link-shaft arrow; stones with holes bored through the middle which were used as digging-stick weights; polished and decorated bone tools; ostrich eggshell beads and the production of rock paintings and engravings. Evidence of ritual practices and complex societies is also significant (Deacon & Deacon 1999). This period is associated with both hunter-gatherers (San) and early pastoralists (Khoekhoe). It continued until the arrival of Iron Age farming groups and European settlers (including a period of interaction). Two LSA sites are known on the farm Honingklip near Badplaas in the Carolina District. They are located on opposite sides of a bend in the Nhlazatshe River, in the foothills of the Drakensberg (Esterhuysen and Smith, 2007; Delius (ed) 2006). No Middle Stone Age sites are known in the direct vicinity of the study area.

Rock Art

Several rock painting sites are known from the greater region: including Carolina (10), Ermelo (8), Middleburg (1) and Witbank (4). No engraving sites are known (Smith and Zubieta, 2007). A recent research study by Maseko (2020) has identified 31 rock painting sites in the area around the towns of Hendrina, Breyten, Lake Chrissie and Carolina.

The Iron Age

The Early Iron Age (EIA) in South Africa begins from c.AD 500 until c.AD1100. This period is associated with the migration of Bantu-speaking farming communities into the Mpumalanga region and the continued movement of such communities between the Lowveld and Highveld of Mpumalanga until the 12th century (Esterhuysen and Smith, 2007). These people practised a mixed farming economy and had the technology to work metals like iron and copper.

The Late Iron Age in South Africa (AD 1600 – AD 1840) is associated with pre-colonial farming communities (both agricultural and pastoralist), who lived in distinctive and often extensive stone-walled settlements (to which Huffman has given the label, 'Central Cattle Pattern') (Delius 2006; Huffman, 2007). The general area between Carolina and Lydenburg contains a large number of LIA settlements which indicates a substantial increase in population or movement of people into the area from the 15th century (Esterhuysen and Smith 2007).

Two main groups or periods (distinguished by ceramic styles) have been identified by Huffman (2007) as occurring in the general region: Uitkomst and Buispoort. The Uitkomst subgroup (facies) of the Blackburn Branch of the Urewe Ceramic Tradition represents the first Iron Age period to be identified in this general area. The decoration on the ceramics seems to be combine characteristics associated with both Nguni-speaking and Sotho-speaking groups. This subgroup is thought to date between AD 1650 and AD 1820. The Buispoort facies of the Moloko branch of the Urewe Ceramic Tradition is the next phase that has been identified in this area. It is thought to date between AD 1700 and AD 1840. (Huffman, 2007). However, no sites associated with either ceramic style is known from the study area.

Historical/ Colonial period

Esterhuysen (2008) and Skhosana (2010) both note that according to the earliest researchers (Van Warmelo and Jackson) the Transvaal Ndebele were understood as descended from an Nguni group that originated in what is now KwaZulu-Natal where they formed part of the Hlubi people. The group that became known as the Transvaal Ndebele was formed from the descendants of the same ancestral chief, commonly known as Musi or Msi. Some branches of the main group moved away sometime during the period 1650 to 1700 and subsequently settled in the area north of present-day Pretoria, in the vicinity of Bon Accord. Skhosana (2010) states that a subsequent succession struggle between Musi's five or six sons around the turn of the 19th century resulted in the original group splitting into two main groups, known as the Northern Ndebele and the Southern Ndebele, respectively, which then fragmented further. Nzunza and his brother Mthombeni, together with their followers, moved eastwards before settling in an area in the vicinity of the present-day town of Belfast, in the then Transvaal. Mthombeni and his followers subsequently moved northwards towards Zebediela where they eventually settled. Another son, Manala and his group occupied the land northeast of Pretoria which is now known as Wallmansthal.

During the 18th and 19th century the existing groups in the general region were disrupted by the expansion of the Zulu Kingdom and subsequent displacement of the population, which became known as the Difaqane/Mfecane (Makhura, 2007). In the north-eastern area, the Pedi under King Thulane, became

dominant, until they were defeated by the Ndebele group of Mzilikazi. This resulted in the existing Sotho tribes moving out of the area (Kitto, 2015).

Historical/Colonial Period

The vacuum resulting from the Difaqane/Mfecane was subsequently filled by Swazi groups under the reign of King, Sobhuza, who established various small chiefdoms in the Mpumalanga area (Bonner, 1983; Makhura, 2007).

The earliest traveller who came to the area was Robert Scoon in 1836; while the earliest Voortrekker party to cross over the Vaal River was the one under the leadership of Louis Trichardt and Johannes Jacobus Janse van Rensburg. Between 1841-1850, there was an increasing presence of Voortrekkers in the general vicinity of the study area (Bergh, 1999). This resulted in Mswati II of the Swazi/Swati people ceding the southern Transvaal to the colonial system (Bonner 1983).

In 1845, both the district and town of Lydenburg were established (Bergh, 1999). The district of Lydenburg was extremely large and it seems that the study area fell just within this district.

The South African War (1899 – 1902) was fought between the Boer Republics of the Transvaal and Free State on the one side and Great Britain on the other, but the victims and participants of the war were not limited to British or Boer citizens alone. No events or activities during the war can be associated with the Leandra area. However, at least one battle from the surrounding landscape is known. This was an engagement between a British force under the command Lieutenant-General J.D.P. French and a Boer commando of some 1 000 men on 23 July 1900. The main component of this engagement occurred a short distance to the east and south-east of the present-day town of Delmas, which is located some 35km northwest of Leandra (Changuion, 2001). The local Boer families in the area, as well as the African population, were also affected by the policy of the British which resulted in their removal from their farms to one of the two concentration camps establishment at Middelburg and Standerton (<https://www2.lib.uct.ac.za/mss/bccd/>).

The present-day town of Leandra/Lebohang was formed from the amalgamation of the former villages of Eendrag and Leslie. The name is a combination of Leslie and Eendrag (Raper 2014; Erasmus 2014). The village of Leslie was originally laid out on the farm Brakkefontein and proclaimed in December 1939. A later extension was proclaimed in December 1957. Raper states that the name is thought to be taken from a town called Leslie in Scotland, UK. The small village of Eendrag, was formerly called by the Dutch/Afrikaans name Eendracht, which means 'unity' and apparently relates to the motto, "Eendrag maak mag" or "Unity is strength"(Raper 2014).

Recent/ Modern History

The Manala and Nzunza Ndebele groups, lived separately until the late 1970s, when the so-called "bantustan" of KwaNdebele was created under the "homeland system" of the apartheid government. This caused extreme disruption to the local African communities in the area (Skhosana 2010; SA History online).

During the 1980s, Leandra became a symbol of defiance against the forced removals policies of the previous *apartheid* administration. Since the 1970s, there had been many attempts to forcibly move the residents of

Leandra to the so-called “independent homeland” of KwaNdebele. Although the attempt in the early 1980s was to move a portion of its residents, the majority of the people of Leandra stood up to halt these forced removals. Under the leadership of the Leandra Action Committee (LAC), the community demanded that the entire population be allowed to remain. On 7 June 1984, the Leandra Community and LAC received a letter through their lawyers from the Ministry of Co-operation and Development which stated that the 116 families who had been threatened with removal would be reprieved and would not be expected to move to KwaNdebele. (TRAC 1985).

5.2.3 Cartographic findings

An assessment of available historical topographical maps was undertaken to establish a historic layering for the study area. Overlays of the maps were made on Google Earth. These historic maps are valuable resources in identifying possible heritage sites and features located within the study area. It should be noted that the earliest edition of the map sheets for this area dates to the 1960s (see **Figure 20** below). As the first edition of this sheet dates to 1965, it was not considered necessary to examine the later edition map sheets. Any heritage resources that are 60 years or older would be depicted on the 1965 edition sheet. The topographical maps were obtained from the Department of Agriculture Land Reform and Rural Development (DALRRD) in Cape Town.

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 South Africa from aerial photographs taken in 1948.

As can be seen in **Figure 20**, the 2628BD Ed 1 1965 map sheet depicts a large number of heritage features within the original larger CCUS seismic survey footprint (pink polygon). Most of these features are buildings or structures, including two prisons and a mill. Several homestead clusters or single homesteads are depicted in the area to the east of the town, as well as two grave sites (red circles). One of these grave sites is depicted within the drill site (orange polygon).

However, **Figure 21** shows that fewer heritage features (red circles) are depicted within the reduced seismic survey footprint. Most of these features are single homesteads (huts). But it should be noted that the grave depicted at the eastern boundary of the original drill site footprint on the previous figure is still depicted as located within the updated drill site (pink polygon).

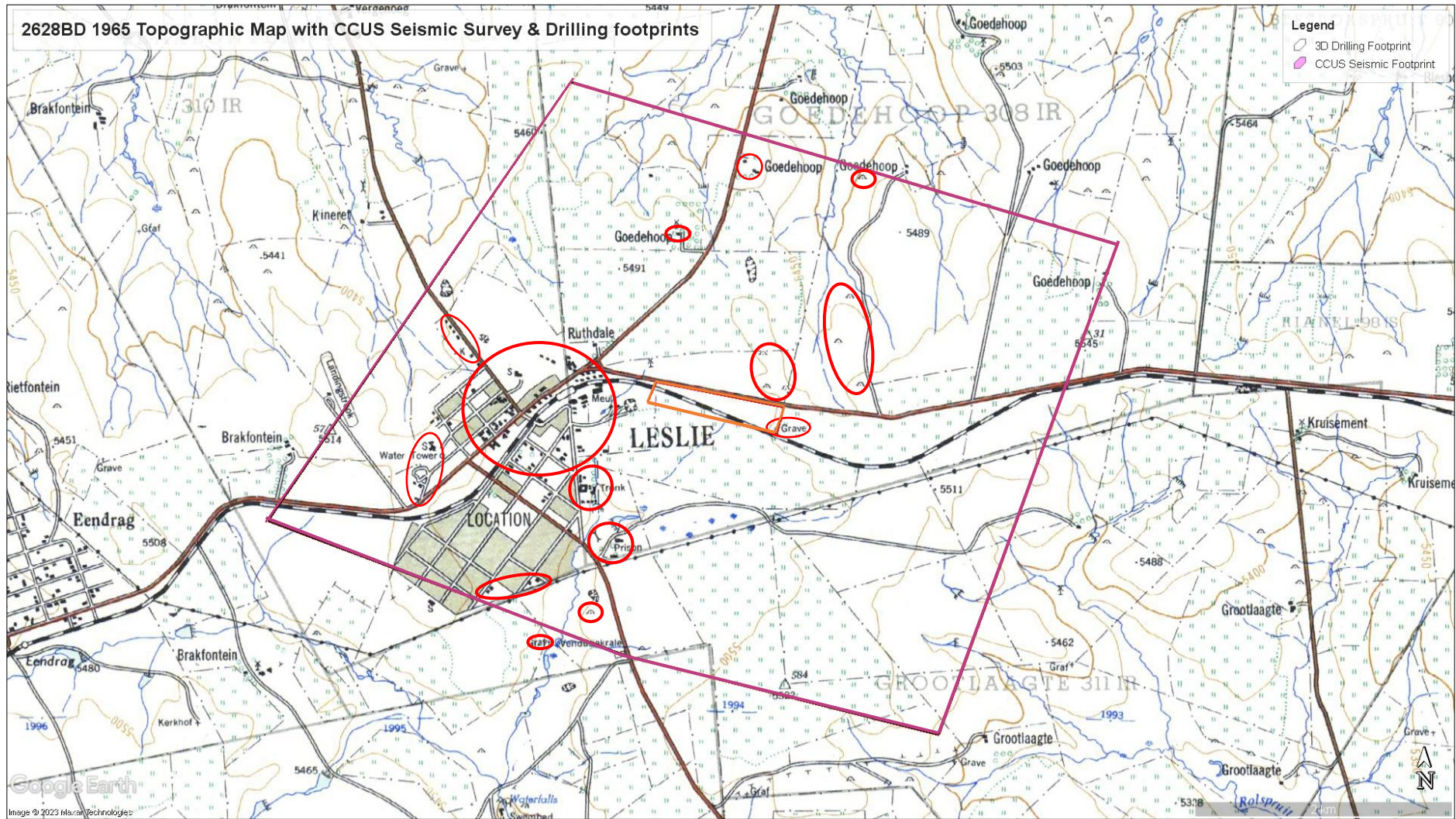


Figure 20: Enlarged view of topographic map 2628BD Ed 1 1965, depicting a large number of heritage features within the original CCUS seismic survey footprint (pink polygon). Most of these features are buildings or structures, including two prisons and a mill. Several homestead clusters or single homesteads are depicted in the area to the east of the town as well as two grave sites (red circles). One of these grave sites is depicted within the drill site (orange polygon)

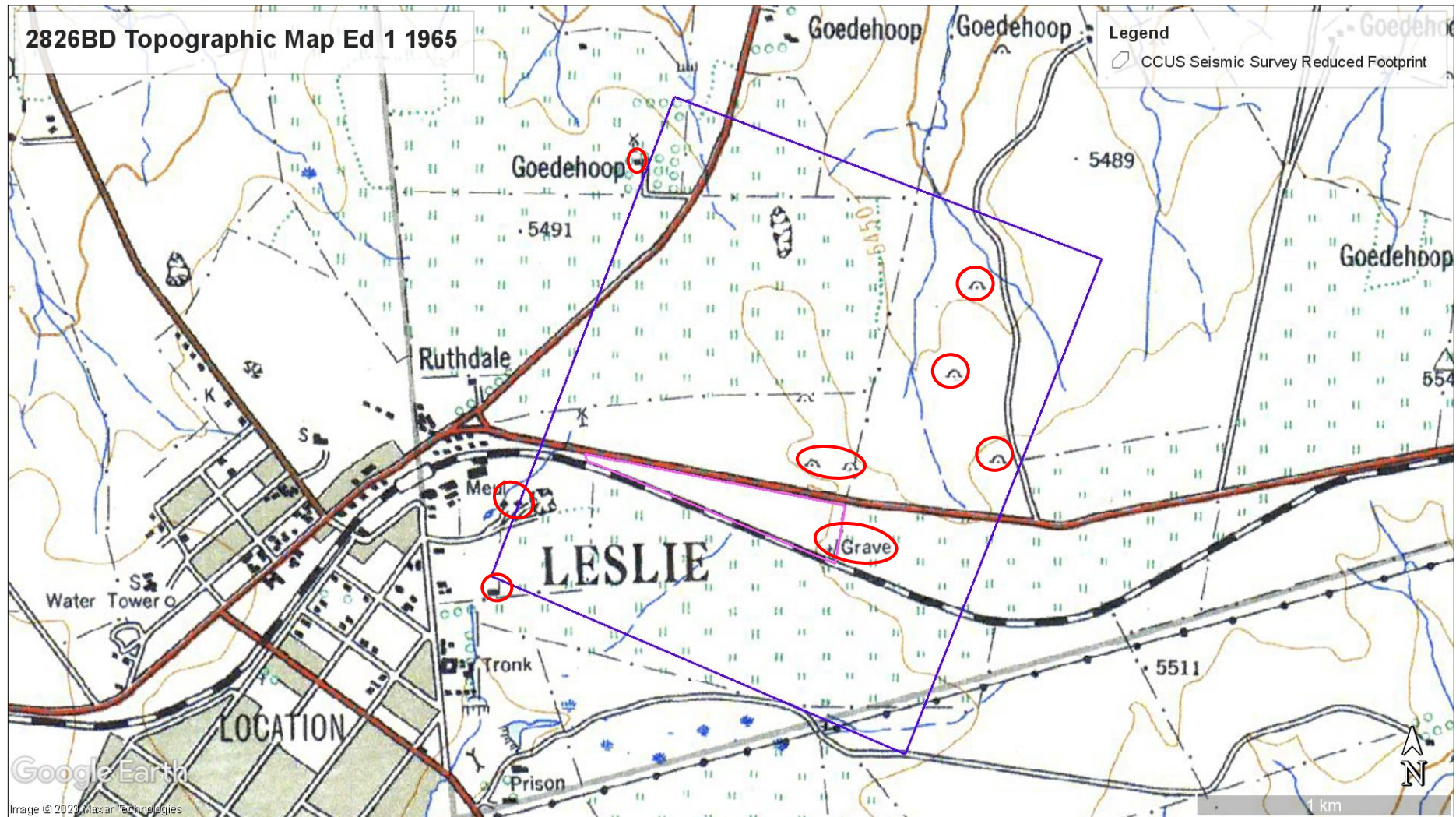


Figure 21: Enlarged view of topographic map 2628BD Ed 1 1965, depicting several heritage features (red circles) within the reduced CCUS seismic survey footprint (purple polygon). Most of these features are single homesteads (huts). Note that the grave depicted on the previous figure is still depicted as located within the updated drill site (pink polygon)

5.3 Previous HIA reports in the area

A search on the South African Heritage Resources Information System (SAHRIS) has identified several Heritage Impact Assessments conducted in and around the study area. The project area of three of these reports covered areas in the immediate vicinity of the town of Leandra: Kusel 2011, Pistorius 2016 and Smeyatsky & Fourie 2018. Other HIA reports contained information on the general surrounding region.

Kusel, U. 2011. *Cultural Heritage Resources Impact Assessment For Portion 29 of the Farm Goedehoop 308IR Govan Mbeki Local Municipality Mpumalanga Province*. The HIA study was for the proposed development of a truck yard. The survey did not identify any heritage resources on the property. A modern farmhouse and new infrastructure for large trucks, workshops and offices as well as a diesel depot had been constructed.-

Pistorius, JCC. 2016. *A Phase I Heritage Impact Assessment (HIA) Study for Anglo Operations (Pty) Ltd.'s Proposed Leslie 2 Project (near Leandra) in the Gauteng Province*. The survey identified two historical farmstead complexes and six informal graveyards (each containing approx. 20 -40 graves), as well as one possible grave.

Smeyatsky I and W Fourie, 2018. *Heritage Impact Assessment: Proposed Leslie Coal Mine near Leandra, Mpumalanga Province*. The HIA study identified 31 sites consisting of 22 burial sites (with a total of approximately 315 graves), one (1) living heritage (initiation) site and eight (8) historical structures.

Van der Walt, J. 2021. *Heritage Impact Assessment (Required under Section 38(8) Of The NHRA (No. 25 of 1999) for the Proposed Leandra Gravel Mine on a Portion of Portion 4 of the Remaining Extent of the Farm Brakfontein, Mpumalanga Province*. The study found no heritage features of significance (archaeological, built environment or graves).

Pistorius, J. 2020. *A Phase I Heritage Impact Assessment Study for the Shondoni and Middelbult Mining Areas near Secunda in the Mpumalanga Province*. The Sasol Project Area stretches from Leandra in the northeast towards Secunda and Trichardt and in the south-east incorporating the Sasol petro-chemical complex near eMmbalenhle. This study found a large number of historical remains consisting of farmstead complexes, houses and other historical structures, graveyards, and commemorative beacons.

Pistorius, J.2013. *A Phase I Heritage Impact Assessment (HIA) Study for a Proposed Raw Water Supply Pipeline For Kipower (Pty) Ltd Near Delmas on the Highveld and Eastern Highveld in the Gauteng and Mpumalanga Provinces of South Africa*. This study investigated the proposed pipeline between Delmas Coal to the south of the R50 on the farm Haverklip 256IR and Eendrag, close to Leandra. The study identified four graveyards and an historical house that dated to the 1940s

5.4 Palaeontological sensitivity

Note that this section was compiled by the author and not by a palaeontological specialist. A basic palaeontological sensitivity was determined using the SAHRIS database South African Fossil Sensitivity Map (<http://www.sahra.org.za/sahris/map/palaeo>). This map indicates that the original larger seismic survey footprint (pink polygon) falls within an area where the underlying geology has mainly Insignificant to Zero fossil sensitivity (grey), with a small area of High sensitivity (see **Figure 22** below). It should be noted that the reduced footprint for the seismic survey (purple polygon) falls completely within the area shown as grey. This should indicate that SAHRA would not require a palaeontological assessment for the seismic survey footprint area.

However, during the SAHRIS database search it was noted that SAHRA had requested either a desktop or a field Palaeontological assessment for several previous projects proposed for the surrounding region. Since this component of the project will involve drilling test holes to sample the underlying geology for suitability regarding the future injection of CO₂ into the existing bedrock, it is recommended that a desktop palaeontological study should be undertaken for the drilling site specifically (small pink polygon).

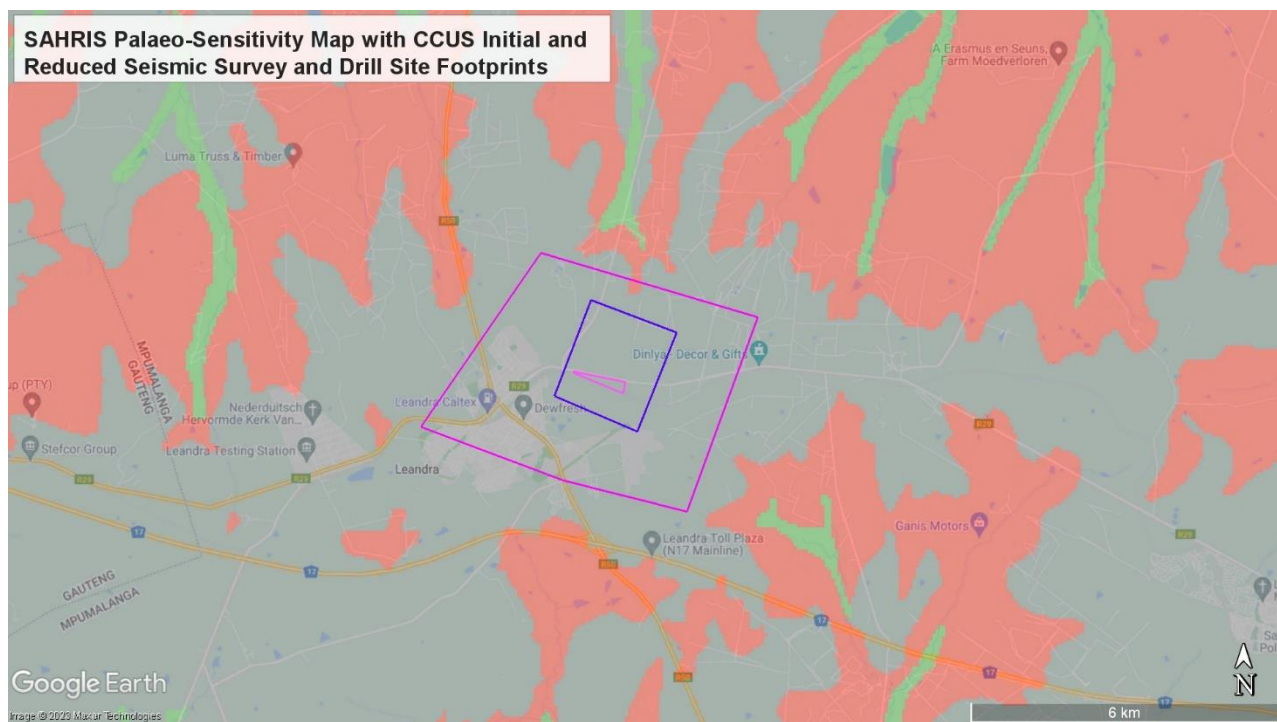


Figure 22: SAHRIS Palaeo sensitivity map overlain on the original (pink polygon) and reduced project footprint (purple polygon). The underlying geology is shown as mostly of Insignificant to Zero fossil sensitivity (grey). A very small section of High sensitivity is shown on the northern boundary of the original footprint

Table 2: 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.

5.5 Findings of the Historical Desktop Study

The general overview from the historical desktop study has shown that various archaeological and historical resources can be expected to occur in the seismic survey footprint area. The examination of the earliest edition (1965) of the 1:50 000 topographical maps produced by overlying the maps with satellite Imagery (Google Earth) has shown that a large number of heritage features are depicted within the original seismic survey footprint, many being historical structures comprising the town of Leslie/Leandra.

The Site Survey fieldwork confirmed the findings of the desktop study as it identified 36 heritage resources occurring within the original footprint (seismic survey area). As noted, above, this original footprint has been reduced substantially with a corresponding reduction in the number of heritage resources affected.

6 SITE SURVEY/FIELDWORK RESULTS

The field survey of the CCUS seismic survey original larger footprint (and original drill site footprint) took place over four separate days (9 and 22 February; 6 and 27 March 2023) by the author (heritage specialist) in association with other specialists and occasionally with an assistant. A vehicle was used to access the footprint area and the survey was conducted by both vehicle and on foot (at selected areas). The survey covered as much of the project footprint area as was feasibly accessible, given the long and dense grass and other vegetation covering several areas, as well as the fact that most of the existing town of Leandra was included in the original larger footprint area. It should be noted that sections of the originally provided seismic survey footprint area are located on private farm property and access was restricted on some of these farms.

The author used a Global Positioning System (GPS) application to navigate access roads in the study area and for recording the tracklog of the survey and waypoints of the identified heritage resources. The camera on a Samsung mobile phone was used for photographic recording of identified heritage resources and general images of the project study area.

The survey 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. The inspection of the area that was surveyed identified a total of 36 heritage resources within the original larger seismic survey footprint (**Figure 117**). It should be noted that all heritage resources identified have been retained in this HIA report for information purposes and for future reference. However, within the reduced seismic survey area, a total of nine heritage resources was identified: two historical stone railway culverts (CCUS 03 and CCUS 33), three structure or homestead remains (CCUS 06, CCUS 07 and CCUS 30) and three possible but not certain structure or homestead remains (CCUS 01, CCUS 04 and CCUS 08). This includes a potential grave (CCUS-02) depicted on the 1965 historical topographical map sheet that was not identified during the field survey but which could be located within the drill site footprint (**Figure 118** and **Figure 119**).

It should also be noted that the heritage resources identified within the proposed drilling site have been listed separately from those heritage resources identified within the original seismic survey footprint area.

Identified Heritage Sites – Proposed Drilling Site

Site Name	CCUS-01
GPS Coordinates	26°22'13.09"S ; 28°56'34.33"E
Site Description	Possible homestead?
Approximate Age	Unknown. Nothing is marked at this location on the maps from 1965, up to 2010
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	The site comprises a clear, open area with much shorter grass and vegetation and contains various scattered clusters of stones. It is located immediately south of the railway line which forms the southern boundary of the proposed drilling site, approx. 27m away from the railway line.
Site Density	Unclear
Uniqueness	Low
Heritage Significance	Low- GP.C/ NCW
Mitigation	No mitigation is required.



Figure 23: CCUS-01, open area that could indicate a past homestead

Site Name	CCUS-02
GPS Coordinates	26°22'11.10"S ; 28°56'36.14"E
Site Description	Grave depicted on 1965 map in a location just north of the railway line.
Approximate Age	If still extant, at least 58 years or older
NHRA, No. 25	Section 36
Field Grading and Ratings	
Site context and description	No signs of a grave were visible on the ground surface in the approximate location of the grave, except for an isolated stone. However, it was observed that a road had been graded immediately adjacent to the eastern boundary of the drilling site which may have obscured any signs of a grave in this location. The potential grave is located within the adjusted drill site footprint.
Site Density	At least one grave could be present, below the ground surface.
Uniqueness	Low
Heritage Significance	High - GP.A/ IIIA
Mitigation	The approximate location of the grave must be monitored during any further site clearance and preparation activities for the proposed drilling site. This is important as the Drilling Site schematic provided by the client shows the drill pad is proposed to be sited in the approximate position of the possible grave.



Figure 24: CCUS-02, View of the ground surface in the approximate location of the possible grave

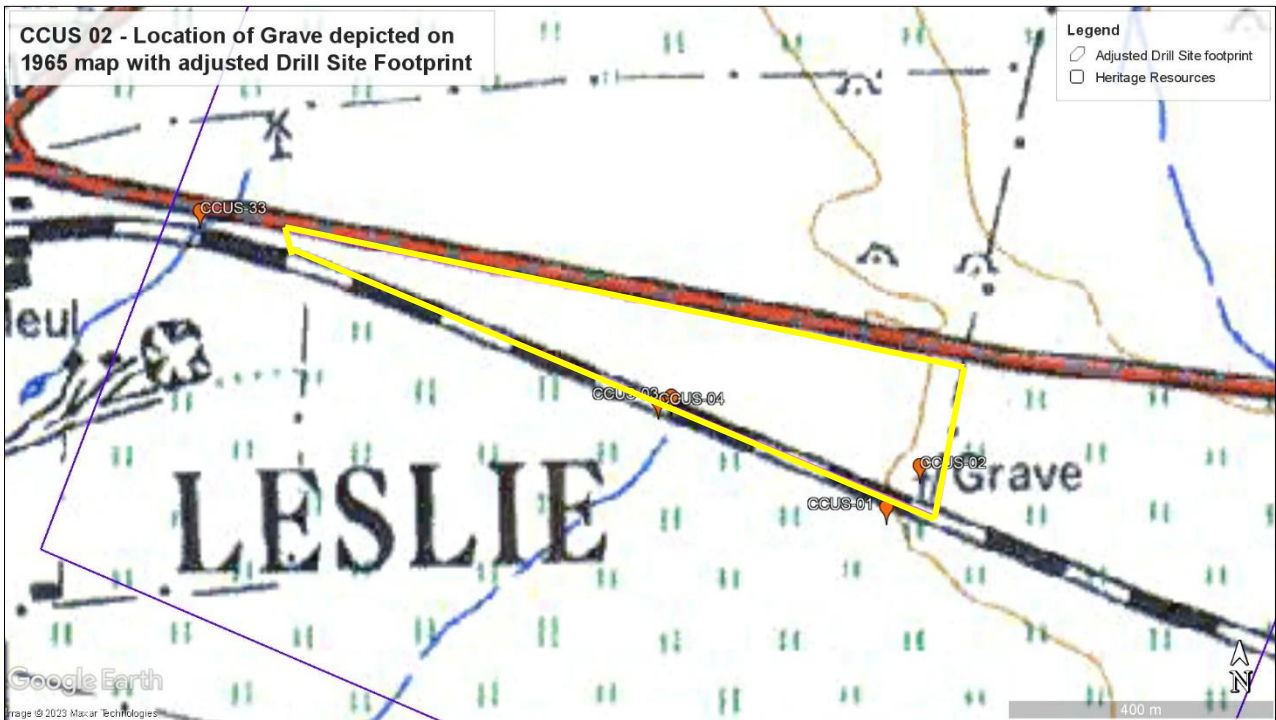


Figure 25: Enlarged view of Map sheet 2628BD Ed 1 1965, showing grave depicted at CCUS-02 and adjusted drill site footprint (yellow polygon)



Figure 26: Proposed Drilling Site updated Schematic showing position of drill pad close to the approximate location of the possible grave CCUS-02

Site Name	CCUS-03
GPS Coordinates	26°22'7.76"S ; 28°56'22.71"E
Site Description	Stone culvert under railway line
Approximate Age	At least 58 years or older, the railway is depicted on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The site is a stone drainage culvert located under the railway line. The culvert is located just outside the adjusted drill site. It is visible on satellite imagery as well as on the ground.
Site Density	One
Uniqueness	Rare
Heritage Significance	High – Such structures have been rated as Grade II of Provincial Heritage Significance in Fisher and Clarke’s (2016) extensive survey of extant NZASM structures.
Mitigation	Structure to be avoided with a buffer of at least 10-20m, especially on the northern side of the railway, where the adjusted drill site is proposed to be located.



Figure 27: Satellite imagery showing location of CCUS-03 historical railway culvert just outside the adjusted drill site



Figure 28: View of the stone culvert under the railway line at CCUS-03. This seems to be an example of a flat lintel or box culvert.



Figure 29: Close-up satellite view of the location of CCUS-03

Site Name	CCUS-04
GPS Coordinates	26°22'8.01"S ; 28°56'22.01"E
Site Description	Possible remains of structure.
Approximate Age	Unknown. No structure is depicted on the 1965 map
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	The site is the possible remains of a structure and consists of scattered building rubble with an old cement post.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 30: View of the building rubble at CCUS-04

Site Name	CCUS-05
GPS Coordinates	26°22'40.07"S ; 28°56'28.63"E
Site Description	Old stone wall around recent structure
Approximate Age	Unknown, no wall is marked on the 1965 map or later sheets
NHRA, No. 25	Possibly section 34
Field Grading and Ratings	
Site context and description	An old stone wall surrounding a more recent structure/s, situated on the eastern edge of the township of Lebohang. The wall seems to have been constructed in two phases, with later additions added to an original lower section.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C / IIIC
Mitigation	If 60 years or older it is protected from damage under section 34 of the NHRA. It should be avoided with at least a 10-20m buffer.



Figure 31: View of the old stone wall enclosing modern/recent structures

Site Name	CCUS-06
GPS Coordinates	26°22'35.45"S ; 28°56'31.07"E
Site Description	Possible structure remains.
Approximate Age	Unknown. No structures are depicted on the 1965 map
NHRA, No. 25	Possibly Section 34
Field Grading and Ratings	
Site context and description	Possible structure remains comprised of a cluster of large rocks and smaller stones. There is also a possible midden nearby. The whole site is extremely overgrown with dense grass and thorny shrubs. The remains are located just outside the reduced seismic survey footprint.
Site Density	Unknown
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	The remains could be 60 years or older and may require a permit if any impact is anticipated by the proposed seismic survey. No other mitigation is required.



Figure 32: View of stone cluster at CCUS-06



Figure 33: View of another group of stones at CCUS-06

Site Name	CCUS-07
GPS Coordinates	26°22'32.89"S ; 28°56'34.90"E ; 26°22'32.72"S , 28°56'40.72"E
Site Description	Structure Remains
Approximate Age	Unknown. Not marked on 1965 map or later editions. However, the stone pillar may indicate a date of around 60 years or older.
NHRA, No. 25	Section 34 may be applicable
Field Grading and Ratings	
Site context and description	The site consists of several stone clusters, some forming square or rectangular lines. There is also a circular shaped stone pillar located in the immediate vicinity, as well as a water trough. Several sections of concrete pipes were also identified in the area. The extent covered by these remains is approx. 0.84ha. It should be noted that the satellite view of the site shows several walls that were not visible on the survey, due to the very dense and long grass and other vegetation cover. The remains are located within the reduced seismic survey area.
Site Density	Unknown
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	The remains could be 60 years or older and may require a permit if any impact is anticipated by the proposed seismic survey. No other mitigation is required.



Figure 34: View of one of the stone clusters forming lines



Figure 35: View of another cluster of large stones/rocks



Figure 36: View of stone pillar situated among the stone clusters



Figure 37: View of large trough, covered in cement



Figure 38: View of one of several concrete pipe sections noted at CCIS-07



Figure 39: Satellite view of area around CCUS-07 showing other structures not visible on the ground (red arrows)

Site Name	CCUS-08
GPS Coordinates	26°22'34.95"S ; 28°56'43.45"E
Site Description	Two to three piles of rocks and soil
Approximate Age	Unknown
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Two to three piles of rocks and soil are located on the edge of an existing dam/pond. They could comprise rubble from demolished structures. The site is located a short distance from CCUS-07 and may be associated with those structure remains. It is located within the reduced seismic survey footprint.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 40: View of pile of building material situated next to farm dam

Site Name	CCUS-09
GPS Coordinates	26°22'44.27"S ; 28°57'28.92"E (09.1); 26°22'46.76"S; 28°57'28.53"E (09.2)
Site Description	Possible homestead.
Approximate Age	Unknown.
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Large open area with sandstone outcrops but also sandstone structure remains. This is a possible homestead. A similar open area with stone scatters was noted a short distance away.
Site Density	Two possible homestead areas. Unknown number of structure remains
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 41: View of Stone cluster from CCUS-09



Figure 42: General view of possible homestead area



Figure 43: view of the second possible homestead area at CCUS-09

Site Name	CCUS-10
GPS Coordinates	26°22'51.60"S; 28°57'28.69"E
Site Description	Old dam wall / weir structure
Approximate Age	At least 58 years, as a dam is marked on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	An old stone dam wall/weir structure situated at the inlet/outlet channel to an existing dam
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 44: View of the stone dam wall/weir structure

Site Name	CCUS-11
GPS Coordinates	26°23'0.51"S ; 28°56'31.22"E
Site Description	Open air church
Approximate Age	Unknown. Probably recent/modern. An open area in this location is marked on the 2010 map.
NHRA, No. 25	Section 3(2)(b) and 3(3)(g) - Living heritage – spiritual importance
Field Grading and Ratings	
Site context and description	Open air church area formed by square arrangement of white painted stones in an open area in Lebohang township. The site is fenced off and looks well-used.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Medium -High- GP.B / IIIB Intangible/living heritage site
Mitigation	The site must be avoided with a 20-30m buffer and the community consulted on mitigation measures if any impact is anticipated.



Figure 45: View of the informal church site at CCUS-11



Figure 46: Satellite view of CCUS-11

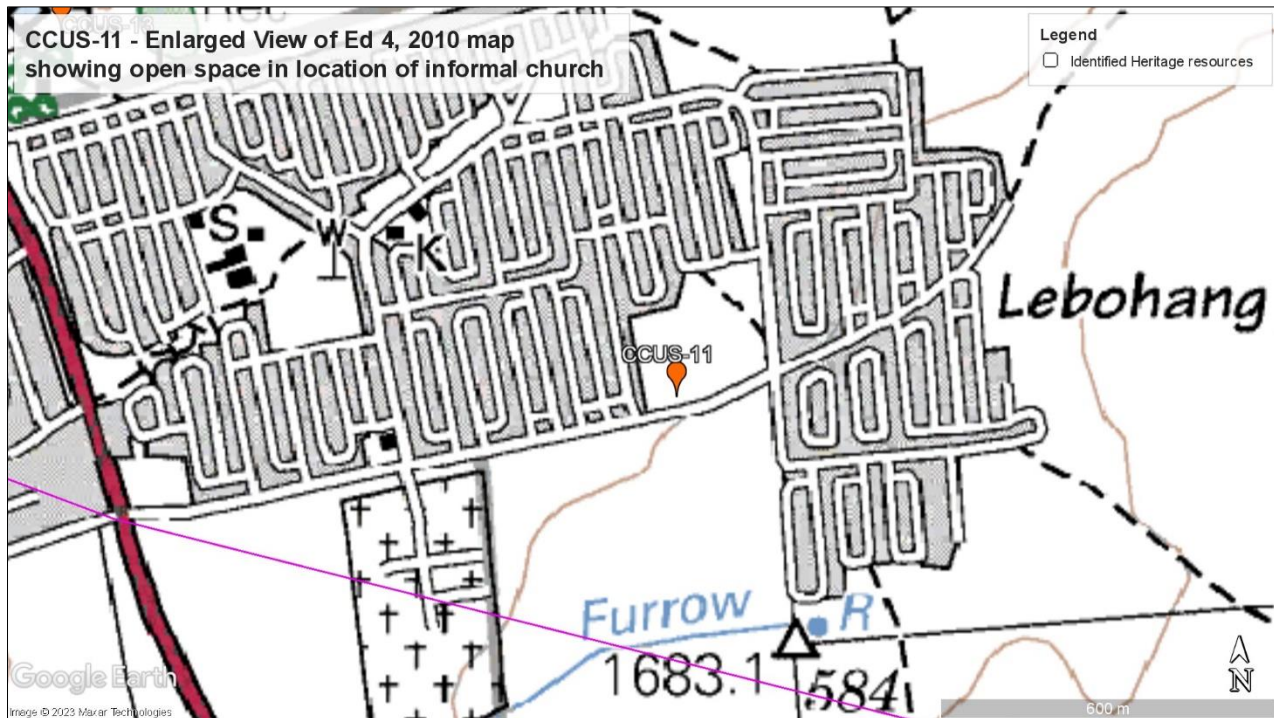


Figure 47: Enlarged view of 2020 Ed 4 map, showing an open area in the location of CCUS-11

Site Name	CCUS-12
GPS Coordinates	26°23'4.96"S; 28°56'14.04"E
Site Description	Large community cemetery
Approximate Age	Less than 60 years. Appears on 2010 map but not on earlier maps
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Large community cemetery, situated on the southern boundary of Lebohang township. The southern boundary of the original seismic survey footprint cuts through the cemetery diagonally.
Site Density	Probably several hundred graves
Uniqueness	Low
Heritage Significance	High - GP.A/ IIIA
Mitigation	The Cemetery must be avoided with a buffer of 20-30m and the community must be consulted about mitigation measures if any impact is anticipated.



Figure 48: Satellite view of the cemetery situated at CCUS-12, showing the southern boundary of the original seismic survey area (Pink line)



Figure 49: View of the cemetery from the gravel road

Site Name	CCUS-13
GPS Coordinates	26°22'39.52"S; 28°55'51.73"E
Site Description	Historical sandstone "prison" buildings
Approximate Age	60 years or older. Structures depicted on 1965 map as "Prison"
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The dilapidated remains of three historical building constructed of sandstone and/or dolerite. The structures are situated in the approximate location of structures labelled as a "Tronk" (prison) on the 1965 map. The buildings have been fenced. The buildings are of different sizes. One is constructed of sandstone, one is constructed of dolerite with sandstone detailing (quoins) and one is constructed of both sandstone and dolerite. This may indicate an extension to the original building. Some demolished material was also noted.
Site Density	Three buildings
Uniqueness	Medium
Heritage Significance	Medium - GP.B/ IIIB
Mitigation	To be avoided with a buffer of 20-30m.



Figure 50: General View of the three buildings at CCUS-13



Figure 51: View of the smaller sandstone building



Figure 52: The building built with dolerite stone and sandstone details at the corners and windows, note the demolished material in the foreground



Figure 53: View of the larger building, one section of which is constructed sandstone



Figure 54: View of the other section of the larger building, which is partially constructed of dolerite

Site Name	CCUS-14
GPS Coordinates	26°22'42.87"S; 28°55'49.70"E
Site Description	Sandstone house with date of 1933
Approximate Age	Older than 60 years (Date of 1933 = 90 years old)
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Sandstone house with a date of 1933 now used as creche. Exterior in very good condition. Surrounded by a dolerite stone wall constructed with pillars in the same/similar style as the pillars at sites CCUS-07 and CCUS-15. Both the main house and the associated outhouse have unusual circular features constructed at the sides (also of dolerite).
Site Density	Main house, outbuilding and surrounding wall.
Uniqueness	Medium
Heritage Significance	Medium – GP.B/ IIIB
Mitigation	To be avoided with a buffer of 20-30m.



Figure 55: Close-up view of the main entrance, showing the date of 1933



Figure 56: View of the historical sandstone house at CCUS-13, showing the north and west elevations



Figure 57: View of the front (west) elevation of the house, note the associated outbuilding visible on the south side.



Figure 58: View of the south elevation of the house, showing the sandstone outbuilding on the south side



Figure 59: Closer view of the Sandstone outbuilding, showing two circular features next to the west and east ends of the building



Figure 60: View of the surrounding wall, built from dolerite stone, showing one of the circular pillars



Figure 61: View of the entrance in the surrounding wall with the circular pillars

Site Name	CCUS-15
GPS Coordinates	26°22'39.89"S ; 28°55'42.73"E
Site Description	Remains of old stone bridge and stone pillar
Approximate Age	At least 58 years . Marked on 1965 map.
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The remains of an old stone bridge over the river with an associated stone pillar similar to the ones noted at CCUS-14 and CCUS-07. The bridge remains are situated next to the tar road that runs parallel to the R50 road.
Site Density	Bridge remains (3 sections) and circular pillar
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	The remains are likely to be 60 years or older and may require a permit if any impact is anticipated by the proposed seismic survey. No other mitigation is required.



Figure 62: View of the remains of the historical stone bridge at CCUS-15



Figure 63: View of the circular pillar associated with the bridge remains

Site Name	CCU-16
GPS Coordinates	26°22'4.32"S ; 28°55'30.73"E
Site Description	Demolished remains of railway houses
Approximate Age	At least 58 years. Five structures are depicted in this location on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The site contains the demolished remains of at least five houses and associated outbuildings, situated immediately north of the railway line. These were likely to have been railway houses. The surviving construction materials include both red bricks and yellow and blue/purple bricks which are typical of such houses that were built c.1930s-1920s and c1940s-1950s. One of the remains was constructed with stone walls.
Site Density	The remains of at least five houses with associated outbuildings.
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	If any impact is anticipated that would require the remains to be completely demolished then a permit is required to be obtained from the MPHRA. No further mitigation is required.



Figure 64: View of the foundation remains of one house built from red brick at CCUS-16



Figure 65: View of the foundation remains of another house with a piece of stone wall surviving



Figure 66: View of the foundation remains of another house with a piece of brick wall surviving



Figure 67: View of another of the demolished houses with a piece of brick wall remaining



Figure 68: View of one of the foundations with piece of wall in red brick



Figure 69: Example of red brick with partial inscription



Figure 71: Example of blue-purple bricks in situ



Figure 70: Example of yellow bricks

Site Name	CCUS-17
GPS Coordinates	26°21'53.25"S ; 28°55'42.55"E
Site Description	Two old and dilapidated buildings
Approximate Age	Possibly 60 years or older, structures are depicted in this location on the 1965 maps and later editions.
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Two dilapidated buildings: one long, rectangular building and one small square one. The rectangular building could have been a school. They are situated to the north of the N17 road.
Site Density	Two buildings
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	If any impact is anticipated that would require the remains to be completely demolished then a permit is required to be obtained from the MPHRA. No further mitigation is required.



Figure 72: View of the two old and dilapidated buildings at CCUS-17



Figure 73: View of the long rectangular structure, showing a brick cistern or cellar in the foreground



Figure 74: View of the small square structure

Site Name	CCUS-18
GPS Coordinates	26°22'28.49"S ; 28°55'11.48"E
Site Description	Old stone water channel
Approximate Age	Likely to be 60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	This is an old stone-built water channel running along and parallel to the railway line in the north-western section of Lebohang township. The approx. length is 61m (from Satellite imagery)
Site Density	N/A
Uniqueness	Medium
Heritage Significance	Low - GP.C/ NCW
Mitigation	If any impact is anticipated that would result in damage to the water channel, then a permit is required to be obtained from the MPHRA. No further mitigation is required



Figure 75: View along the stone water channel at CCUS-18

Site Name	CCUDS-19
GPS Coordinates	26°22'31.70"S ; 28°54'29.87"E
Site Description	Old railway arched culvert
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Old sandstone double arched culvert under the railway line. Situated close to a large community cemetery at CCUS-20.
Site Density	N/A
Uniqueness	Medium
Heritage Significance	High - Such structures have been rated as Grade II of Provincial Heritage Significance in Fisher and Clarke's (2016) extensive survey of extant NZASM structures
Mitigation	Structure to be avoided with a buffer of at least 10-20m.



Figure 76: View of the double-arched railway culvert at CCUS-19

Site Name	CCUS-20
GPS Coordinates	26°22'32.10"S ; 28°54'29.04"E
Site Description	Community cemetery
Approximate Age	Recent/modern
NHRA, No. 25	Section 36
Field Grading and Ratings	
Site context and description	Large community cemetery located at the north-west corner of Lebohang township and within the south-west section of the seismic survey footprint. There was no access due to bad road conditions.
Site Density	Unknown but likely to be several hundred
Uniqueness	Low
Heritage Significance	High- GP.A / IIIA
Mitigation	The Cemetery must be avoided with a buffer of 20-30m and the community must be consulted about mitigation measures if any impact is anticipated.



Figure 77: Satellite view of the cemetery at CCUS-20, showing its location within the south-west corner of the original Seismic Survey footprint

Site Name	CCUS-21
GPS Coordinates	26°22'27.11"S ; 28°55'24.58"E
Site Description	Ruins of at least two structures
Approximate Age	Unknown
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	The site consists of the ruins of two-three structures.
Site Density	At least two ruined structures
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 78: View of the ruined structures at CCUS-21



Figure 79: Another view of the ruined structures

Site Name	CCUS-22
GPS Coordinates	26°22'22.28"S ; 28°55'28.73"E
Site Description	Historical house, occupied
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The site is an historical house, located in the residential area north of the R50 road.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C
Mitigation	Structure to be avoided with a buffer of at least 10-20m.



Figure 80: View of historical house at CCUS-22

Site Name	CCUS-23
GPS Coordinates	26°22'11.62"S ; 28°55'37.42"E
Site Description	Dilapidated remains of historical mill buildings
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The extremely ruined, half demolished remains of the Godrich Flour Mills and van der Walt Se Meule mill buildings. The remains are situated south of the railway line and west of the existing modern Pride Mills complex.
Site Density	At least three extremely dilapidated large buildings and three foundations.
Uniqueness	Medium
Heritage Significance	Low - GP.C/ NCW
Mitigation	To be avoided with a buffer of 20-30m.



Figure 81: View of the remains of one of the historical mill buildings, showing the names of Godrich Flour Mills and Van Der Walt se Meules, looking south from the railway line



Figure 82: View of the remains of one of the mill buildings



Figure 83: View of another of the dilapidated historical mill buildings



Figure 84: View of a third historical mill building, with foundations in the foreground



Figure 85: View of the foundations with the remains of the mill buildings in the background

Site Name	CCUS-24
GPS Coordinates	26°22'15.95"S; 28°55'41.05"E
Site Description	Historical house
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Historical house, which seems to have been altered in the past. Currently used as a creche. It located in the residential area north of the R50 road.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C
Mitigation	To be avoided with a buffer of 20-30m. No additional mitigation is required.



Figure 86: View of house at CCUS-24, taken from the road

Site Name	CCUS-25
GPS Coordinates	26°22'18.65"S ; 28°55'40.67"E
Site Description	Historical house
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	An historical house located in the residential area north of the R50. It is constructed of yellow brick with detailing in blue/purple brick which dates it to c.1940s-1950s. The house is occupied.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	To be avoided with a buffer of 20-30m. No additional mitigation is required.



Figure 87: View of historical house at CCUS-25

Site Name	CCUS-26
GPS Coordinates	26°22'22.36"S; 28°55'41.12"E
Site Description	Two historical stone buildings and a corrugated iron shack.
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Two buildings constructed of stone located in the approximate position depicted as a “prison” on the 1965 map. The larger building has very small windows located at the top of the walls. A circular feature similar to the ones noted at the 1933 building is also present. The buildings are situated in the residential area north of the R50 road.
Site Density	2 buildings and a corrugated iron structure
Uniqueness	Medium
Heritage Significance	Medium - GP.B/ IIIB
Mitigation	To be avoided with a buffer of 20-30m. No additional mitigation is required.



Figure 88: View of the two stone buildings at CCUS-26, note the circular feature at the side



Figure 89: Closer view of the larger stone building, showing the very small window at the top of the walls

Site Name	CCUS-27
GPS Coordinates	26°22'25.14"S ; 28°55'41.42"E
Site Description	Two historical houses, c.1950s and three other buildings, also c. 1950s
Approximate Age	60 years or older
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Two historical houses, and three other buildings, all situated in the residential area north of the R50. They are all built of yellow brick in the style of the c.1950s, with detailing in blue/purple brick. They are all occupied.
Site Density	At least 5 buildings
Uniqueness	Low
Heritage Significance	Low - GP.C / IIIC
Mitigation	To be avoided with a buffer of 20-30m. No additional mitigation is required.



Figure 90:View of the one of the two historical houses at CCUS-27



Figure 91: View of the other historical houses



Figure 92: View of one of the three other buildings at CCUS-27, showing the blue/purple brick detailing



Figure 93: View of the second building



Figure 94: View of the third building

Site Name	CCUS -28
GPS Coordinates	26°22'28.60"S ; 28°54'51.96"E
Site Description	Demolished building
Approximate Age	Modern/recent. A structure is depicted in this location on the 2010 map.
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Demolished remains of single building, mainly concrete. Situated in the open area in the south-west corner of the original seismic survey footprint.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 95: View of demolished remains of building at CCUS-29



Figure 96: Another view of the demolished remains

Site Name	CCUS-29
GPS Coordinates	26°22'29.65"S ; 28°54'50.42"E
Site Description	Two demolished buildings
Approximate Age	Unknown. Nothing is indicated on the 1965 map or later editions.
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	The foundation remains of two demolished buildings, rectangular and constructed from concrete and brick. Situated in the same area as CCUS-28.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No mitigation is required.



Figure 97: View of one of the foundation remains at CCUS-29



Figure 98: View of the other foundation

Site Name	CCUS-30
GPS Coordinates	26°21'25.94"S, 28°56'29.58"E; 26°21'22.72"S, 28°56'28.30"E
Site Description	Possible homestead
Approximate Age	Unknown
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Large open area with scattered stones and pieces of brick. Two lower grindstone rocks were noted in this area. The site is located within the northwest corner of the reduced seismic survey footprint.
Site Density	Unknown
Uniqueness	Low
Heritage Significance	Low - GP.C/ IIIC
Mitigation	No mitigation is required.



Figure 99: View of one of the lower grindstones



Figure 100: View of the second lower grindstone



Figure 101: View of the homestead area at CCUS-30



Figure 102: View of one of the stone clusters

Site Name	CCUS-31
GPS Coordinates	26°20'55.94"S , 28°56'16.87"E
Site Description	Informal Graveyard
Approximate Age	Unknown
NHRA, No. 25	Section 36
Field Grading and Ratings	
Site context and description	This is a graveyard, probably of African farmworkers. Approx. 32 graves are visible, mainly stone packed. A few have headstones, but only one has a legible name and date, (Name: Mbonani, Date of death: 2010). The graves occur both inside and outside of a fenced area. The graveyard is located just inside the northern boundary of the original seismic survey footprint.
Site Density	Approx. 32 graves are visible
Uniqueness	Low
Heritage Significance	High - GP.A/ IIIA
Mitigation	The graveyard must be avoided and the community must be consulted about mitigation measures if any impact is anticipated.



Figure 103: General view of the graveyard at CCUS-31



Figure 104: View of the only headstone with a legible name and dates



Figure 105: View showing some of the informal stone graves outside the fenced area

Site Name	CCUS-32
GPS Coordinates	26°21'8.68" , 28°56'1.19"E
Site Description	Ruins of several demolished buildings
Approximate Age	60 years or older. A ruin is depicted in this location on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Ruins of several demolished buildings and metal structure. One large brick and cement and stone. Others of smaller stones and yellow and blue bricks. Situated in the northern section of the original seismic survey footprint.
Site Density	Unknown
Uniqueness	Low
Heritage Significance	Low - GP.C/ IIIC
Mitigation	If any impact is anticipated that would require the remains to be completely demolished then a permit is required to be obtained from the MPHRA. No further mitigation is required.



Figure 106: General view showing metal structure and building remains at CCUS-32



Figure 107: View of building remains



Figure 108: View of metal structure

Site Name	CCUS-33
GPS Coordinates	26°21'58.78"S, 28°55'57.26"E
Site Description	Historical stone railway culvert
Approximate Age	At least 58 years or older, the railway is depicted on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	The site is a stone drainage culvert located under the railway line. This seems to be an example of a flat lintel or box culvert. The culvert is located within the reduced seismic survey footprint. It is visible on satellite imagery as well as on the ground.
Site Density	N/A
Uniqueness	Rare
Heritage Significance	High - Such structures have been rated as Grade II of Provincial Heritage Significance in Fisher and Clarke's (2016) extensive survey of extant NZASM structures.
Mitigation	Structure to be avoided with a buffer of 20-30m.



Figure 109: View of historical stone culvert under railway line at CCUS-33



Figure 110: closer view of the stone culvert

Site Name	CCUS-34
GPS Coordinates	26°21'37.33"S, 28°55'27.41"E; 26°21'34.49"S, 28°55'21.56"E
Site Description	Homestead area
Approximate Age	Unknown
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	Large clump of Sisal plants over cairn of stones and bricks. Large open area on top of plateau, with several clusters of stones and a long linear feature comprised of stones and earth (possible boundary). Located in the northern section of the original seismic survey footprint.
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C / IIC
Mitigation	No mitigation is required.



Figure 111: General view of the homestead area at CCUS-34



Figure 112: View of the linear feature that seems to define the edge of the homestead area

Site Name	CCUS-35
GPS Coordinates	26°21'6.58"S , 28°57'13.40"E
Site Description	Ruined building
Approximate Age	60 years or older. Marked on the 1965 map
NHRA, No. 25	Section 34
Field Grading and Ratings	
Site context and description	Ruined remains of multi-room building, constructed with stone, brick and cement. This is located outside the northern boundary of the original seismic survey footprint
Site Density	N/A
Uniqueness	Low
Heritage Significance	Low - GP.C/ NCW
Mitigation	No impact is anticipated and no mitigation is required.



Figure 113: View of the foundation remains of the historical house at CCUS-35



Figure 114: Closer view of the building materials

Site Name	CCUS-36
GPS Coordinates	26°22'31.55"S , 28°54'56.00"E
Site Description	Muslim cemetery
Approximate Age	Modern/recent
NHRA, No. 25	N/A
Field Grading and Ratings	
Site context and description	This is a Muslim cemetery located immediately south of the R29 road and north of the railway line. It is assumed that it serves the Lebohang community. It is located within the original seismic survey footprint.
Site Density	Unknown, possibly 100+ graves
Uniqueness	Low
Heritage Significance	High– GP.A/ IIIA
Mitigation	The Cemetery must be avoided with a buffer of 20-30m and the community must be consulted about mitigation measures if any impact is anticipated.



Figure 115: General view of the Muslim Cemetery at Lebohang (CCUS-36)



Figure 116; View of the entrance to the Muslim cemetery with a sign written in Arabic

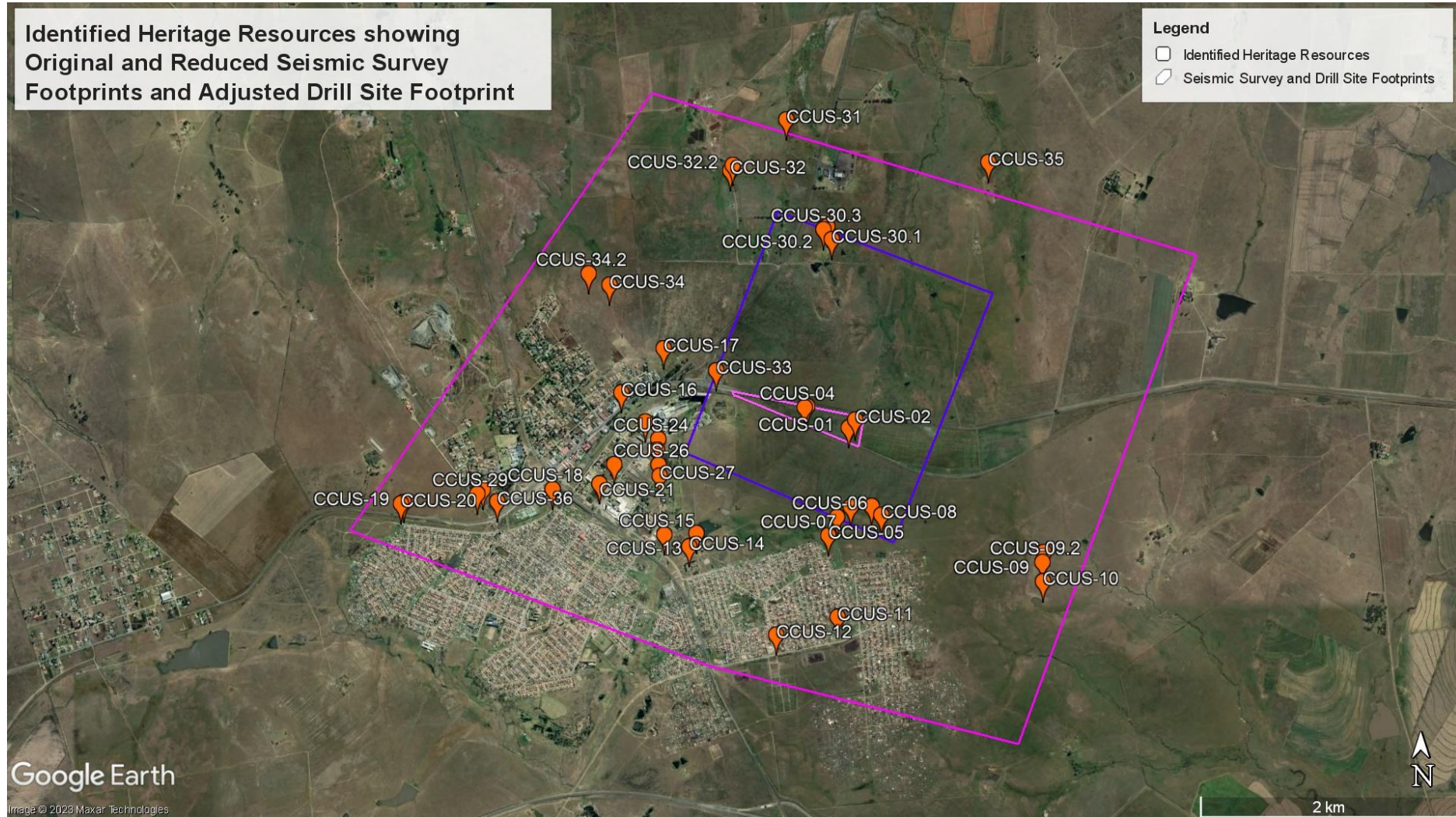


Figure 117: Identified Heritage Sites overlaid on satellite imagery showing the CCUS Seismic Survey Original and Reduced Footprints. The survey identified 36 heritage resource sites within the Original Survey footprint. The original footprint is pink, the reduced footprint is purple and the adjusted drill site footprint is pink. The orange icons indicate the identified heritage resources.

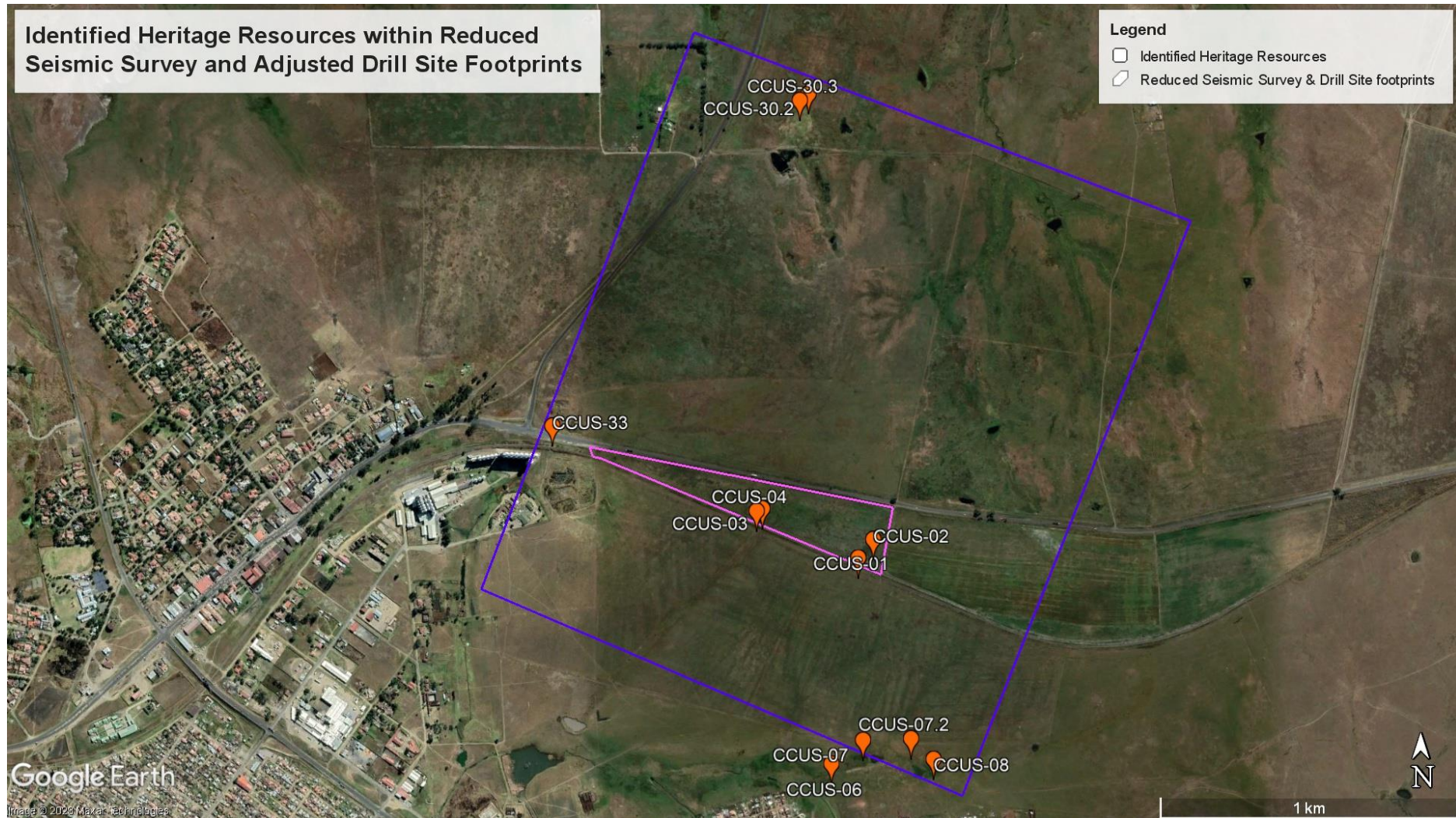


Figure 118: Identified Heritage Sites overlaid on satellite imagery showing the CCUS Seismic Survey Reduced Footprint (purple polygon). Nine heritage resource were identified within the Reduced footprint. The adjusted drill site footprint is pink. The orange icons indicate the identified heritage resources.



Figure 119: Enlarged satellite view of the proposed Reduced Drill Site footprint (pink polygon) with Identified Heritage Resources (orange icons)

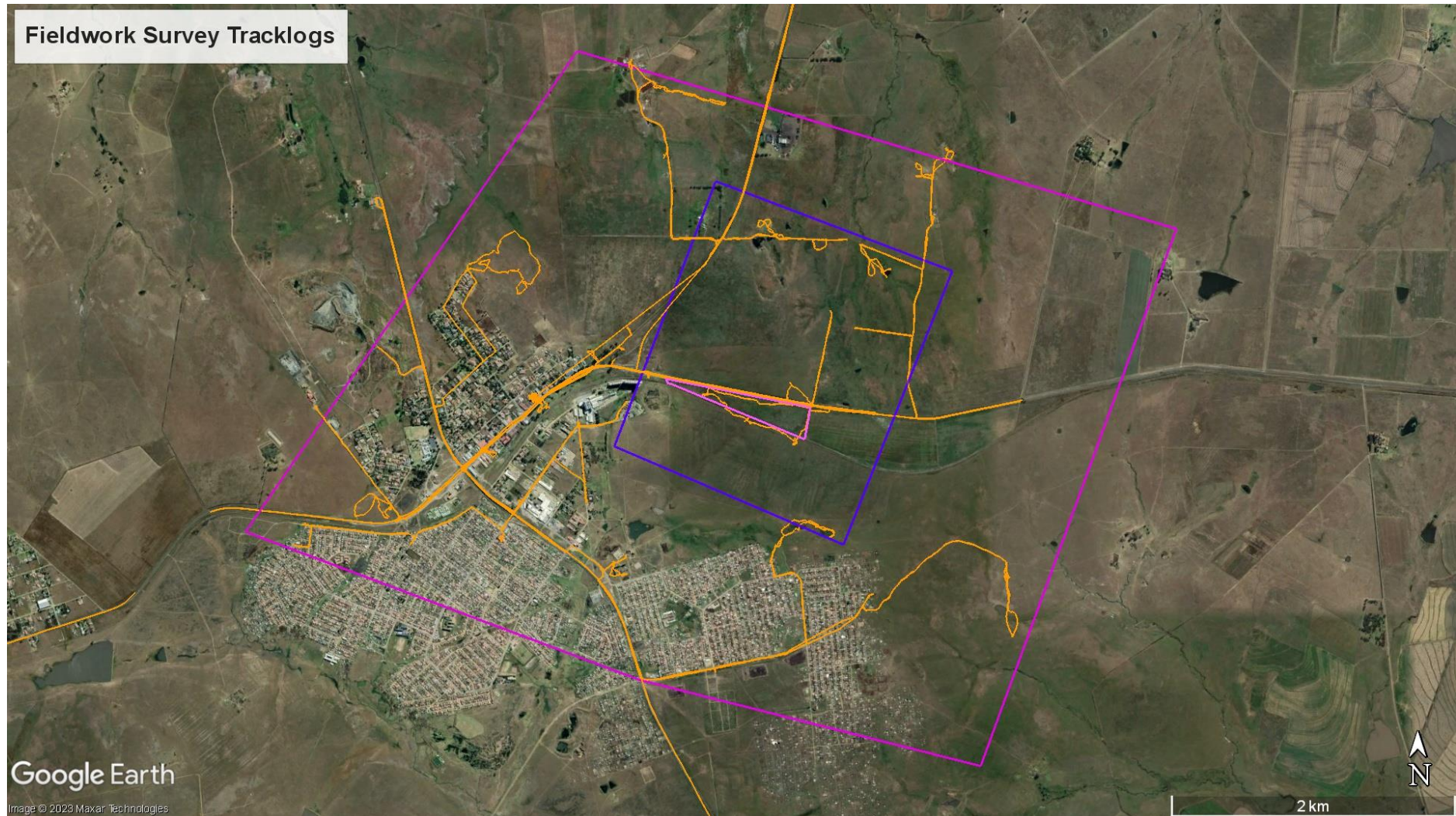


Figure 120: Site Survey Tracklogs (orange lines) overlaid on the CCSU Seismic Survey Original and Reduced footprints.

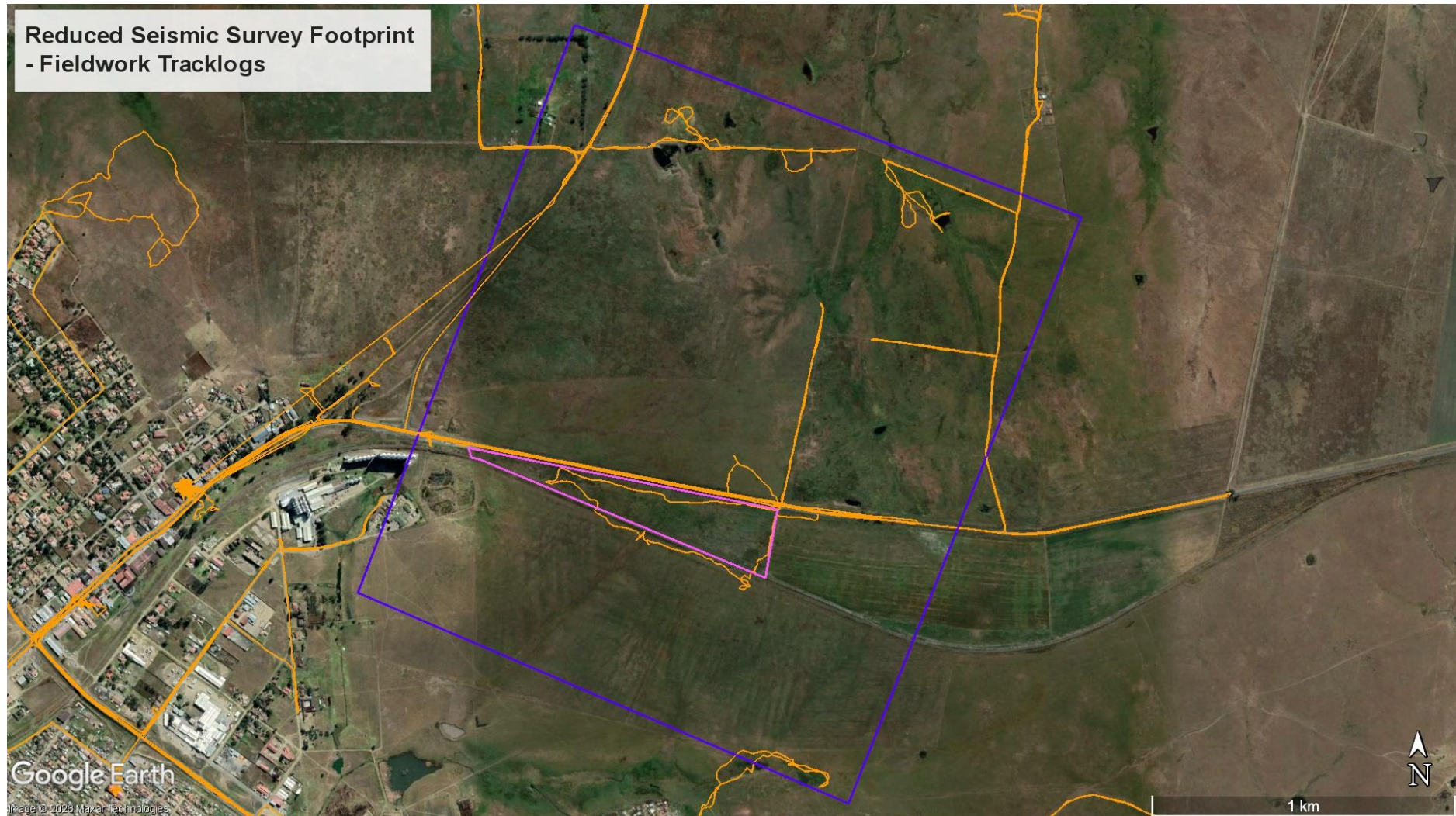


Figure 121: Site Survey Tracklogs (orange lines) overlaid on the CCSU Seismic Survey Original and Reduced footprints

7 SIGNIFICANCE ASSESSMENT

Methodology for Assessing Heritage Site Significance

The applicable maps, tables and figures are included, as stipulated in NHRA and NEMA. The HIA process consists of three steps:

Literature Review

The desktop literature review provided information on the Heritage Background of the general region and project area. This included investigating published and unpublished sources as well as past HIA studies conducted for the project area and surrounding region. An examination of historical 1:50 000 topographical maps and/or archival maps (if available) was also undertaken. The relevant early editions of the 2628BD topographical map sheets were obtained from the Department of Agriculture, Land Reform & Rural Development (DALRRD), Cape Town. A number of internet sites were also accessed for information.

Literature resources accessed are listed in Table 3.

Table 3: Literature sources accessed

Source	Information
Background Information Document - Nemaï	Project location and description details
Literature Review of Published and Unpublished Sources and Past HIAs	Historical and archaeological background on Mpumalanga and Leandra/Leslie as well as surrounding region
Directorate: National Geo-spatial Information of the Department of Agriculture, Land Reform & Rural Development, Cape Town	Historical topographic maps, 1:50 000 2628BD Leslie Edition 1 1965

Field Survey

A physical Site Inspection or Field Survey was conducted, predominantly by vehicle with selected areas traversed on foot, through the project area by an experienced heritage specialist, sometimes with an assistant. This focussed on identifying and documenting heritage resources situated within and immediately adjacent to the proposed project area footprint, such as graves, historical structures or remains and archaeological sites or material.

HIA Report

The final step involved the recording and documentation of the identified heritage resources, the assessment of such resources in terms of heritage significance and impact assessment criteria,

producing a heritage sensitivity map and compiling the heritage impact assessment report with constructive recommendations for mitigation, if required.

Impacts on these sites by the development will be evaluated as follows:

Site Significance

Site significance classification standards use is based on the heritage classification of s3 in the NHRA and developed for implementation keeping in mind the grading system approved by SAHRA for archaeological impact assessments. The update classification and rating system as developed by Heritage Western Cape (2021) is implemented in this report.

Site significance classification standards prescribed by the Heritage Western Cape Guideline (2016), were used for the purpose of this report **Table 4** and **Table 5**).

Table 4: Rating system for archaeological resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Langebaanweg (West Coast Fossil Park), Cradle of Humankind	May be declared as a National Heritage Site managed by SAHRA. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Highest Significance
II	Heritage resources with special qualities which make them significant, but do not fulfil the criteria for Grade I status. Current examples: Blombos, Paternoster Midden.	May be declared as a Provincial Heritage Site managed by Provincial Heritage Authority. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	Exceptionally High Significance
III	Heritage resources that contribute to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare. Current examples: Varschedrift; Peers Cave; Brobartia Road Midden at Bettys Bay	Resource must be retained. Specific mitigation and scientific investigation can be permitted in certain circumstances with sufficient motivation.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree.	Resource must be retained where possible where not possible it must be fully investigated and/or mitigated.	Medium Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
IIC	Such a resource is of contributing significance.	Resource must be satisfactorily studied before impact. If the recording already done (such as in an HIA or permit application) is not sufficient, further recording or even mitigation may be required.	Low Significance
NCW	A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.	No further actions under the NHRA are required. This must be motivated by the applicant or the consultant and approved by the authority.	No research potential or other cultural significance

Table 5: Rating system for built environment resources

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
I	Heritage resources with qualities so exceptional that they are of special national significance. Current examples: Robben Island	May be declared as a National Heritage Site managed by SAHRA.	Highest Significance
II	Heritage resources with special qualities which make them significant in the context of a province or region, but do not fulfil the criteria for Grade I status. Current examples: St George's Cathedral, Community House	May be declared as a Provincial Heritage Site managed by Provincial Heritage Authority.	Exceptionally High Significance
II	Such a resource contributes to the environmental quality or cultural significance of a larger area and fulfils one of the criteria set out in section 3(3) of the Act but that does not fulfil the criteria for Grade II status. Grade III sites may be formally protected by placement on the Heritage Register.		
IIIA	Such a resource must be an excellent example of its kind or must be sufficiently rare.	This grading is applied to buildings and sites that have sufficient intrinsic significance to be regarded as local heritage resources; and are significant enough to warrant that	High Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
	<p>These are heritage resources which are significant in the context of an area.</p>	<p>any alteration, both internal and external, is regulated. Such buildings and sites may be representative, being excellent examples of their kind, or may be rare. In either case, they should receive maximum protection at local level.</p>	
<p>IIIB</p>	<p>Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree.</p> <p>These are heritage resources which are significant in the context of a townscape, neighbourhood, settlement or community.</p>	<p>Like Grade IIIA buildings and sites, such buildings and sites may be representative, being excellent examples of their kind, or may be rare, but less so than Grade IIIA examples. They would receive less stringent protection than Grade IIIA buildings and sites at local level.</p>	<p>Medium Significance</p>
<p>IIIC</p>	<p>Such a resource is of contributing significance to the environs</p> <p>These are heritage resources which are significant in the context of a streetscape or direct neighbourhood.</p>	<p>This grading is applied to buildings and/or sites whose significance is contextual, i.e., in large part due to its contribution to the character or significance of the environs.</p> <p>These buildings and sites should, as a consequence, only be regulated if the significance of the environs is sufficient to warrant protective measures, regardless of whether the site falls within a Conservation or Heritage Area. Internal alterations should not necessarily be regulated.</p>	<p>Low Significance</p>
<p>NCW</p>	<p>A resource that, after appropriate investigation, has been determined to not have enough heritage significance to be retained as part of the National Estate.</p>	<p>No further actions under the NHRA are required. This must be motivated by the applicant and approved by the authority. Section 34 can even be lifted by the PHRA for structures in this category if they are older than 60 years.</p>	<p>Not Conservation worthy – no research potential or other cultural significance</p>

Table 6: Site significance classification standards as prescribed by SAHRA.

FIELD RATING	GRADE	SIGNIFICANCE	RECOMMENDED MITIGATION
National Significance (NS)	Grade 1	Very High - of National Significance	Conservation; National Site nomination
Provincial Significance (PS)	Grade 2	Very High – of Provincial Significance	Conservation; Provincial Site nomination
Local Significance (LS)	Grade 3A	High Significance	Conservation; Mitigation not advised
Local Significance (LS)	Grade 3B	High Significance	Mitigation (Part of site should be retained)
Generally Protected A (GP.A)		High / Medium Significance	Mitigation before destruction
Generally Protected B (GP.B)		Medium Significance	Recording before destruction
Generally Protected C (GP.A)		Low Significance	Destruction

8 IDENTIFICATION OF IMPACTS

8.1 Impacts and Mitigation Framework

All impacts are analysed in the section to follow with regard to their nature, extent, magnitude, duration, probability and significance.

ISO 14001-2004 defines impacts as “any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization’s environmental aspects”.

When considering an assessment of the impacts and their mitigation, the following definitions as per Table 7 apply.

Table 7: Impact and Mitigation Quantification Framework

Nature	The project could have a positive, negative or neutral impact on the environment.
Extent	<p>Local – extend to the site and its immediate surroundings.</p> <p>Regional – impact on the region but within the province.</p> <p>National – impact on an interprovincial scale.</p> <p>International – impact outside of South Africa.</p>

Magnitude	<p>Degree to which impact may cause irreplaceable loss of resources:</p> <p>Low – natural and socio-economic functions and processes are not affected or minimally affected.</p> <p>Medium – affected environment is notably altered; natural and socio-economic functions and processes continue albeit in a modified way.</p> <p>High – natural or socio-economic functions or processes could be substantially affected or altered to the extent that they could temporarily or permanently cease.</p>
Duration	<p>Short term – 0-5 years.</p> <p>Medium term – 5-11 years.</p> <p>Long term – impact ceases after the operational life cycle of the activity either because of natural processes or by human intervention.</p> <p>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.</p>
Probability	<p>Almost certain – the event is expected to occur in most circumstances.</p> <p>Likely – the event will probably occur in most circumstances.</p> <p>Moderate – the event should occur at some time.</p> <p>Unlikely – the event could occur at some time.</p> <p>Rare/Remote – the event may occur only in exceptional circumstances.</p>
Significance	<p>Provides an overall impression of an impact’s importance, and the degree to which it can be mitigated. The range for significance ratings is as follows-</p> <p>0 – Impact will not affect the environment. No mitigation necessary.</p> <p>1 – No impact after mitigation.</p> <p>2 – Residual impact after mitigation.</p> <p>3 – Impact cannot be mitigated.</p>
Mitigation	<p>Information on the impacts together with literature from socio-economic science journals, case studies and field work will be used to provide mitigation recommendations to ensure that any negative impacts are decreased and positive benefits are enhanced.</p>
Monitoring	<p>Monitoring usually involves developing and implementing a monitoring programme to identify deviations from the proposed action and to manage any negative impacts. The recommended mitigation measures will also include monitoring measures.</p>

Table 8: Impact Methodology Table

Nature			
Negative		Neutral	Positive
-1		0	+1
Extent			
Local	Regional	National	International
1	2	3	4
Magnitude			
Low		Medium	High
1		2	3
Duration			
Short Term (0-5yrs)	Medium Term (5-11yrs)	Long Term	Permanent
1	2	3	4

Probability				
Rare/Remote	Unlikely	Moderate	Likely	Almost Certain
1	2	3	4	5
Significance				
No Impact/None	No Impact After Mitigation/Low	Residual Impact After Mitigation/Medium	Impact Cannot be Mitigated/High	
0	1	2	3	

8.2 Identification of Activities and Aspects

An “Activity” is defined as a distinct process or risks undertaken by an organisation for which a responsibility can be assigned. Activities also include facilities or pieces of infrastructure that are possessed by an organisation (International Organization for Standardization, 2011).

An aspect is defined as elements of an organisation’s activities or products or services that can interact with the environment.

In order to capture the impacts associated with the proposed infrastructure, an activity – aspect – impact table was created refer to 9 below.

Table 9: Activity, Aspects and Impacts of the Project

Activity	Aspect	Potential Positive Impact	Potential Impact – Negative
Drilling Site clearance/ construction camp			Damage to potential / unidentified grave/s
Drilling Site Construction / Operation			Damage to possible fossils in the bedrock
3D Seismic Survey			Damage to remains of historical structures

8.3 Impact and Mitigation Assessment

The impact of the proposed project on protected historical structures has been reduced from medium-high to low as the reduced project footprint now excludes the town of Leandra where most of the identified historical structures or structure remains are located. Therefore, the only significant heritage resources affected are the two historical stone railway culverts (CCUS 03 and CCUS 33) and three structure or homestead remains (CCUS 06 to CCUS 07 and CCUS 30).

As noted above, the impact significance of the project on graves and cemeteries has been reduced from medium to low as the three community cemeteries (one being Muslim) and one farmworker graveyard identified previously now fall outside the reduced seismic survey footprint. However, the potential grave (CCUS-02) identified within the drill site footprint could still be affected.

The impact significance of the project on intangible and living heritage resources remains low as the informal church site identified is located within the Lebohang township and well outside the reduced seismic survey footprint area.

The impact significance of the proposed project on archaeological resources is low as no archaeological sites or material were identified.

8.4 Impacts During the Planning, Construction and Operation Phase

As a result of the analysis above, **Error! Reference source not found.** the following impact/mitigation table has been generated.

Table 10: Heritage Resources – Historical Structures Mitigation Table

Environmental Feature	Heritage resources – Historical structures					
Project life cycle	3D Seismic Survey – Planning and Operation					
Potential Impact	Proposed Management Objectives / Mitigation Measures					
Possible damage to or destruction of extant historical structures	N/A to the reduced seismic survey footprint area					
Possible destruction of demolished remains of historical structures	If any negative impact is anticipated on any of these resources, a permit will be required for the destruction/clearance of these resources (from MPHRA or SAHRA)					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	Medium	Permanent	High	3
After Mitigation	Negative	Local	Low	Short-term	Low	2
Significance of Impact and Preferred Alternatives	N/A. This is a pilot project and the purpose of the seismic survey is to confirm the suitability of the underlying geology for the proposed Carbon Capture Underground Storage project.					

Table 11: Heritage Resources – Historical Graves and Unidentified Graves Mitigation Table

Environmental Feature	Heritage resources – Graves and burial grounds (CCUS-02)
Project life cycle	3D Seismic survey and Drilling Site – Planning and Operation
Potential Impact	Proposed Management Objectives / Mitigation Measures

Possible damage to or destruction of identified historical graves	N/A to the reduced seismic survey footprint area					
Potential unidentified graves (CCUS-02)	<ul style="list-style-type: none"> At the onset of any site clearance activities for the proposed drill site construction, a walk-down of the area must be undertaken by a heritage specialist to monitor any unidentified grave sites If an unidentified grave site is uncovered during site clearance or construction activities, a buffer of at least 30m must be placed around the site to ensure that during construction, the grave/s are not damaged 					
	Nature	Extent	Magnitude	Duration	Probability	Significance
Before Mitigation	Negative	Local	High	Permanent	Moderate	4
After Mitigation	Negative	Local	Medium	Long- term	Unlikely	2
Significance of Impact and Preferred Alternatives	The possible grave at CCS-02 requires that any site clearance activities for the proposed drill site construction, should be monitored by a heritage specialist. If human remains are uncovered, then a grave relocation process may be considered, in compliance with the requirements of SAHRA					

8.5 Cumulative impacts

The project area and surrounding region has been affected by impacts of activities occurring in the past, current activities and proposed future developments. These will be discussed below.

Past impacts: several development and other activities in the past would have disturbed the heritage resources which occur in the area. This includes the initial establishment and development of the town of Leslie/Leandra and the associated township of Lebohang, the construction of the railway and R29 regional road and the R50 road, as well as historical agricultural activities. The past HIA reports recovered from the SAHRIS database also indicate that the CCUS project footprint and surrounding region has been affected by. These include coal, gold and gravel mining activities as well as the development of the existing quarry and golf course.

Current impacts: the immediate area of the project footprint is affected by existing residential and business/commercial built environment as well as farming activities.

The baseline impacts for the project area are considered to be moderate to high for Heritage resources, and additional project impacts (if no mitigation measures are implemented) will not increase the significance of the existing baseline impacts, where the cumulative unmitigated impact will probably be of a moderate significance. The impact is going to happen and will be short-term in nature, therefore the impact risk class will be Low to Moderate. However, with the implementation

of the recommended management and mitigation measures this risk class can be minimized to a Low rating.

9 ANALYSIS OF ALTERNATIVES

This project is intended to be a research project for the piloting of CCUS in South Africa and the study area was identified specifically due to the suitability of the geological formations that exist in the Leandra area. Therefore, no site alternatives are proposed.

10 ALTERNATIVES

10.1 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 a project.

10.2 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 combine a deep and thick, porous and permeable rock layer confined between two impermeable, non-porous layers (to restrict the movement and possible escape of the injected CO₂). 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 highly suitable as it was the only state-owned, un-zoned piece of land, and it could thus be secured for long-term research.

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

10.3 Layout / Design Alternatives

No information on layout/design alternatives was provided. However, the original planned seismic survey footprint has been reduced to exclude the town of Leandra.

10.4 Technology Alternatives

10.4.1 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 CO₂ to be adequately mapped and accounted for.

10.4.2 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.

10.4.3 Seismic Data Recording Equipment

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 (Nemai 2023).

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;

10.5 Drilling Fluid System Alternatives

10.5.1 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.

10.5.2 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 and storage tanks. The drilling fluids are then recirculated downhole leaving the cuttings behind for disposal.

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.

10.6 No-Go 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 HIA 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 be 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 HIA Report and ESMP.

11 STATEMENT OF IMPACT SIGNIFICANCE

The project area that will be impacted by the proposed Carbon Capture Underground Storage project – Geological Characterisation component is situated over various portions of two farms: Farm Goedehoop 308IR (Portions 2, 6, 12, 13, 25, 29, 31, 35, 42 and RE/9), and Farm Grootlaagte 311IR (Portions RE/3 and 25). As noted above, the area earmarked originally for the 3D seismic survey encompassed most of the town of Leandra, as well as rural areas to the east and north-east and possibly the south-west; however, this footprint area has since been reduced substantially. The proposed drilling sampling site is located outside (to the east) of the town, between the R29 road from Leandra to Kinross and the railway line from Secunda to Springs.

Subsequent to the reduction of the footprint area for the 3D seismic survey, only a few of the heritage resources identified initially will now be affected and the impact of the proposed seismic survey and drilling sampling on the identified heritage resources has been adjusted accordingly.

The impact of the proposed project on protected historical structures has been reduced from medium-high to low as the reduced seismic survey footprint now excludes the town of Leandra where most of the identified historical structures or structure remains are located. Therefore, the only significant heritage resources affected are two historical stone railway culverts (CCUS 03 and CCUS 33) and three structure or homestead remains (CCUS 06 to CCUS 07 and CCUS 30) and a potential grave located within the adjusted drilling site (CCUS 02). In addition, three possible but not certain structure or homestead remains (CCUS 01, CCUS 04 and CCUS 08) will be affected. These are considered to be Not Conservation worthy.

As noted above, the impact significance of the project on graves and cemeteries has been reduced from medium to low as the three community cemeteries (one being Muslim) and one farmworker graveyard identified previously now fall outside the reduced project footprint. However, the potential grave (CCUS-02) identified within the drill site footprint could still be affected.

The impact significance of the project on intangible and living heritage resources remains low as the informal church site identified is located within the Lebohang township and well outside the reduced footprint area.

The impact significance of the proposed project on archaeological resources is low as no archaeological sites or material were identified.

12 HERITAGE MANAGEMENT GUIDELINES

12.1 General Management Guidelines

1. The National Heritage Resources Act (Act 25 of 1999) states that, any person who intends to undertake a development categorised as-
 - a) the construction of a road, wall, transmission line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
 - b) the construction of a bridge or similar structure exceeding 50m in length;
 - c) any development or other activity which will change the character of a site-
 - d) exceeding 5 000 m² in extent; or
 - e) involving three or more existing erven or subdivisions thereof; or
 - f) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
 - g) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
 - h) the re-zoning of a site exceeding 10 000 m² in extent; or
 - i) any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority, must at the very earliest stages of initiating such a development, notify the responsible heritage resources authority and furnish it with details regarding the location, nature and extent of the proposed development.

In the event that an area previously not included in an archaeological or cultural resources survey is to be disturbed, the SAHRA needs to be contacted. An enquiry must be lodged with them into the necessity for a Heritage Impact Assessment.

2. In the event that a further heritage assessment is required it is advisable to utilise a qualified heritage practitioner, preferably registered with the Cultural Resources Management Section (CRM) of the Association of Southern African Professional Archaeologists (ASAPA).

This survey and evaluation must include:

- a) The identification and mapping of all heritage resources in the area affected;
- b) An assessment of the significance of such resources in terms of the heritage assessment criteria set out in section 6 (2) or prescribed under section 7 of the National Heritage Resources Act;
- c) An assessment of the impact of the development on such heritage resources;
- d) An evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
- e) The results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;

- f) If heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
 - g) Plans for mitigation of any adverse effects during and after the completion of the proposed development.
3. It is advisable that an information section on cultural resources be included in the SHEQ training given to contractors involved in surface earthmoving activities. These sections must include basic information on:
- a. Heritage;
 - b. Graves;
 - c. Archaeological finds; and
 - d. Historical Structure remains and Homestead remains

This module must be tailor made to include all possible finds that could be expected in that area of construction. Possible finds include:

- a. Unidentified graves
 - b. Historical /archaeological artefacts or material
 - c. Remains of historical structures and homestead remains
 - d. Palaeontological deposits
4. In the event that a possible find is discovered during construction, all activities must be halted in the area of the discovery and a qualified heritage specialist/archaeologist contacted.
5. The heritage specialist/archaeologist needs to evaluate the finds on site and make recommendations towards possible mitigation measures.
6. If mitigation is necessary, an application for a rescue permit must be lodged with SAHRA/MPHRA.
7. After mitigation, an application must be lodged with SAHRA/MPHRA 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.
8. 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/heritage specialist.
9. In the event that human remains are uncovered, or previously unknown graves are discovered, a specialised archaeologist (forensic archaeology/ human remains) needs to be contacted to conduct an evaluation of the finds.
10. If the remains are to be exhumed and relocated, the relocation procedures required by SAHRA need to be followed. This includes an extensive social consultation process.

13 RECOMMENDATIONS AND CONCLUSION

As noted above, the HIA study for the proposed CCUS seismic survey and drilling project identified a large number of heritage resources (36 in total) within or immediately adjacent to the originally provided project footprint. However, subsequent to undertaking the field survey, the footprint area for the 3D seismic survey was reduced substantially. Therefore, the impact on heritage resources is reduced as only nine heritage resources are located within the reduced footprint area.

The recommendations below are provided to mitigate the potential impact of the proposed project on the nine identified heritage resources:

Historical structures and demolished structures

- **The two Historical Railway Culverts (CCUS 03 and CCUS 33)** are protected by section 34 of the NHRA and must be demarcated and avoided as “no-go” areas with a 30m buffer.
- **The demolished structure remains (CCUS 06 to CCUS 07) and possible homestead (CCUS 30)** are protected by section 34 of the NHRA. If any negative impact is anticipated on either of these resources, a permit will be required for the destruction/clearance of these resources (from MPHRA or SAHRA) .
- The three possible but not certain structure or homestead remains (CCUS 01, CCUS 04 and CCUS 08) are not protected or considered to be conservation worthy and therefore no mitigation is required.

Graves and Cemeteries

- **The potential grave at CCUS-02**, that may be located within or on the south-eastern boundary of the proposed drilling site, is protected by section 36 of the NHRA. Therefore, any site clearance activities for the proposed drilling site within 30m of the approximate location, should be monitored by a heritage specialist/archaeologist. If a burial or human remains are uncovered during site clearance or construction activities, a buffer of at least 30m must be placed around the site to ensure that, the burial/human remains are not damaged. In addition, all site clearance or construction activities in the immediate vicinity of the burial/human remains must be suspended. The heritage specialist/archaeologist will then need to apply for a permit for a rescue exhumation of the burial/human remains, in compliance with section 36 of the NHRA.

Living / Intangible Heritage

- As noted above, the **informal community church site (CCUS-11)** would not be affected as it is situated outside the reduced footprint for the seismic survey. *Palaeontological Heritage*

Palaeontological Heritage

- A palaeontological assessment is not expected to be required by SAHRA for the seismic survey component as this is anticipated to impact only the ground surface and not the underlying geology of the project area footprint which is indicated as of Insignificant to Zero fossil sensitivity on the SAHRIS Palaeontological Sensitivity Map.
- However, as the drilling site is intended to sample the underlying geology, and as SAHRA has required such studies for past HIAs for the surrounding area, it is recommended that at least a desktop palaeontological assessment of the drill site footprint must be undertaken and submitted to SAHRA for comment.

Conclusion

Taking all of the above into account, the considered opinion of the heritage specialist is that no fatal flaws with respect to heritage resources have been identified during this HIA study. Therefore, there are no objections from a heritage perspective provided that the recommendations and mitigation measures contained in this report and in the recommended palaeontological assessment are implemented where necessary.

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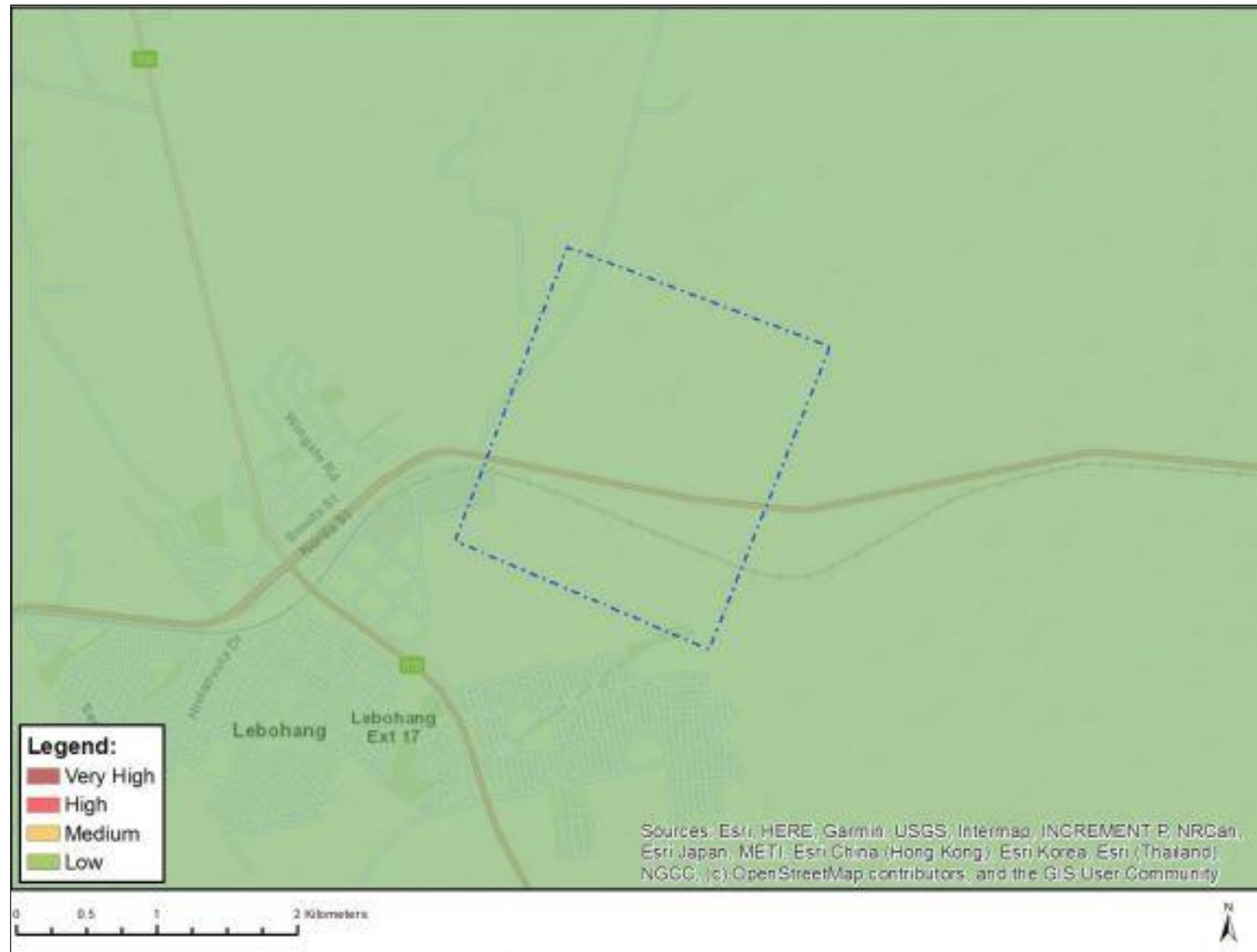
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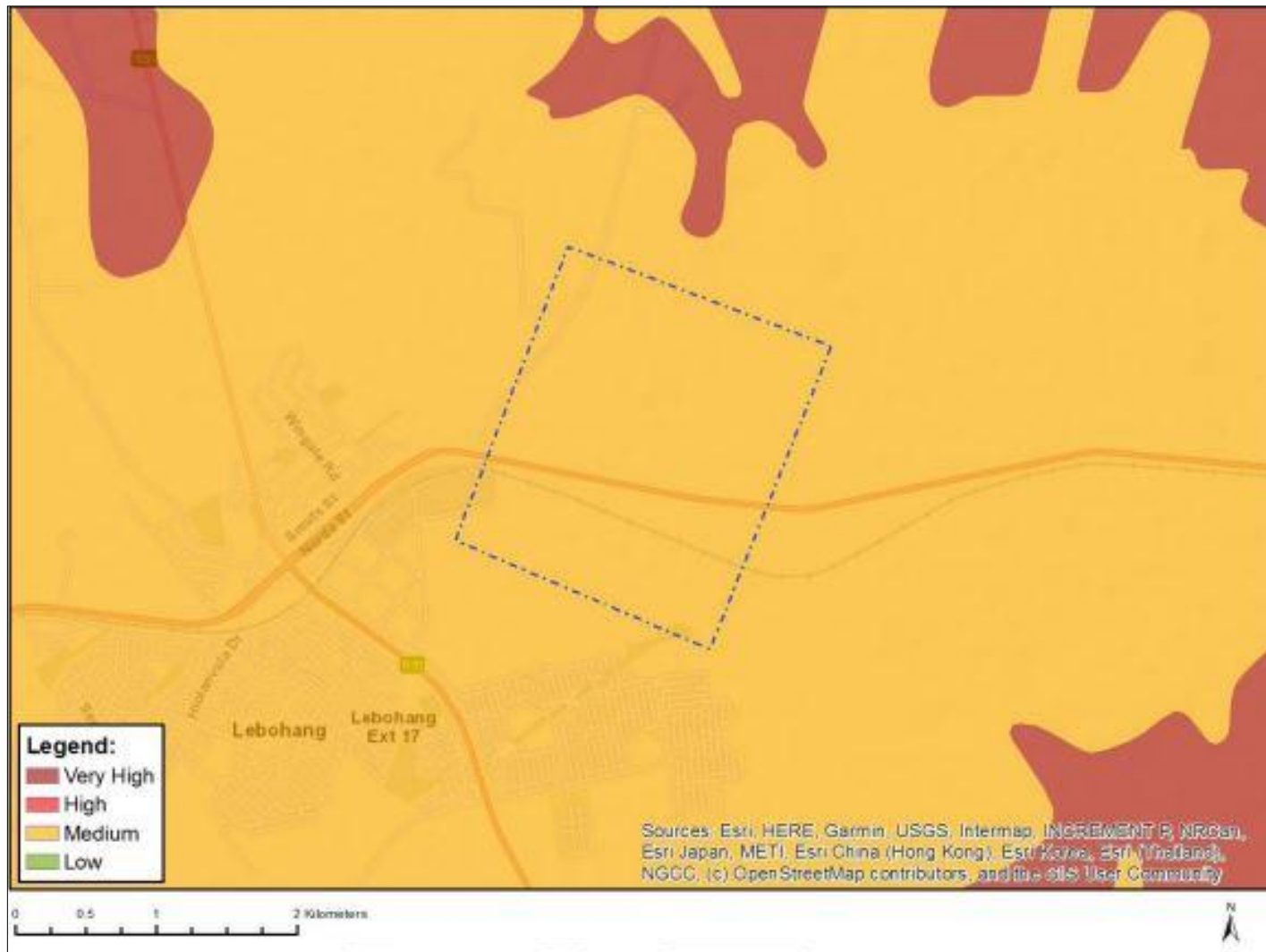
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APPENDIX 1: HERITAGE SENSITIVITY MAP/S

1. Cultural Heritage Sensitivity map from DFFE screening tool – Reduced Seismic Survey Footprint

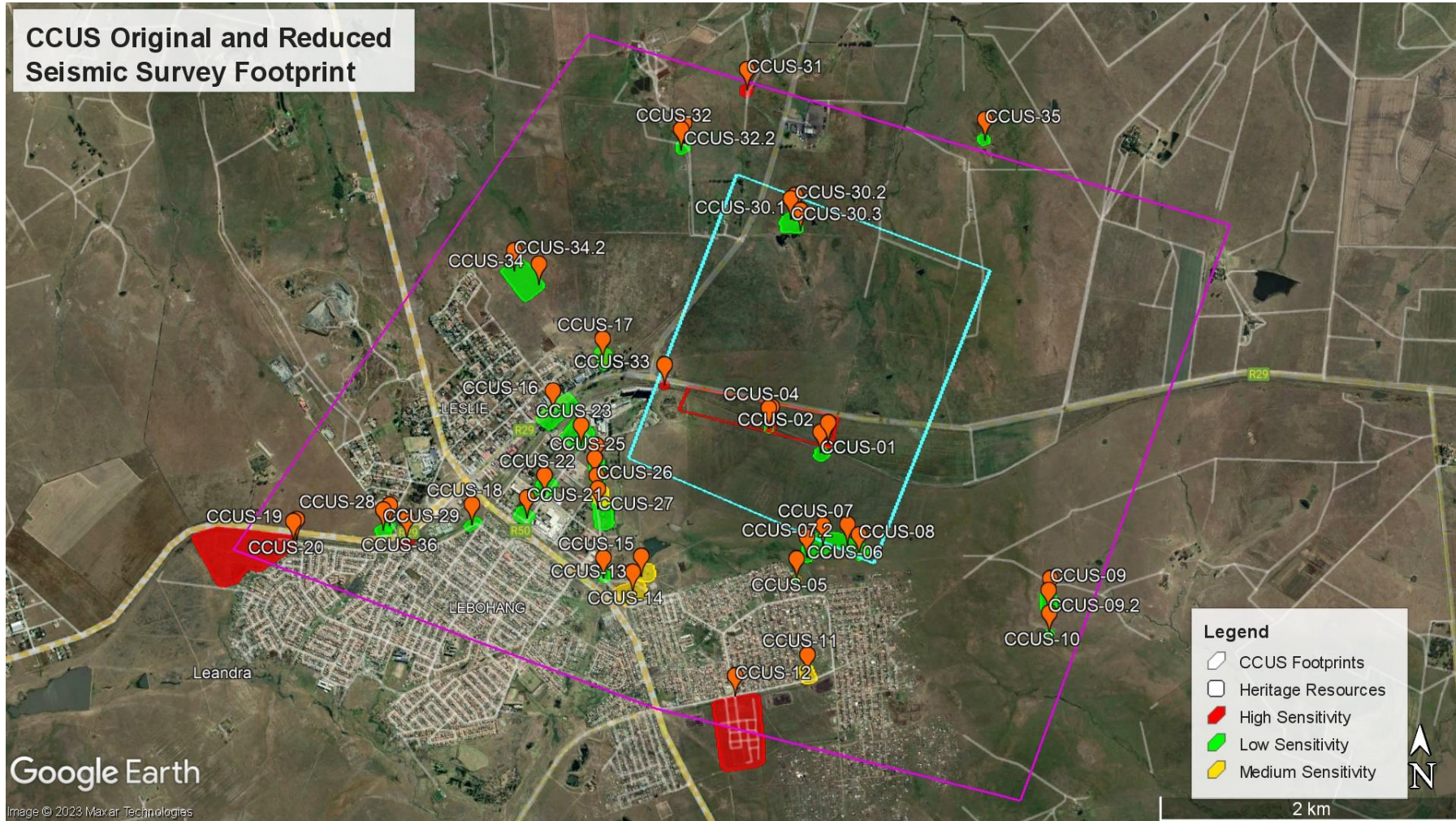


2. Palaeontological Sensitivity map from DFFE screening tool – Reduced Seismic Survey Footprint

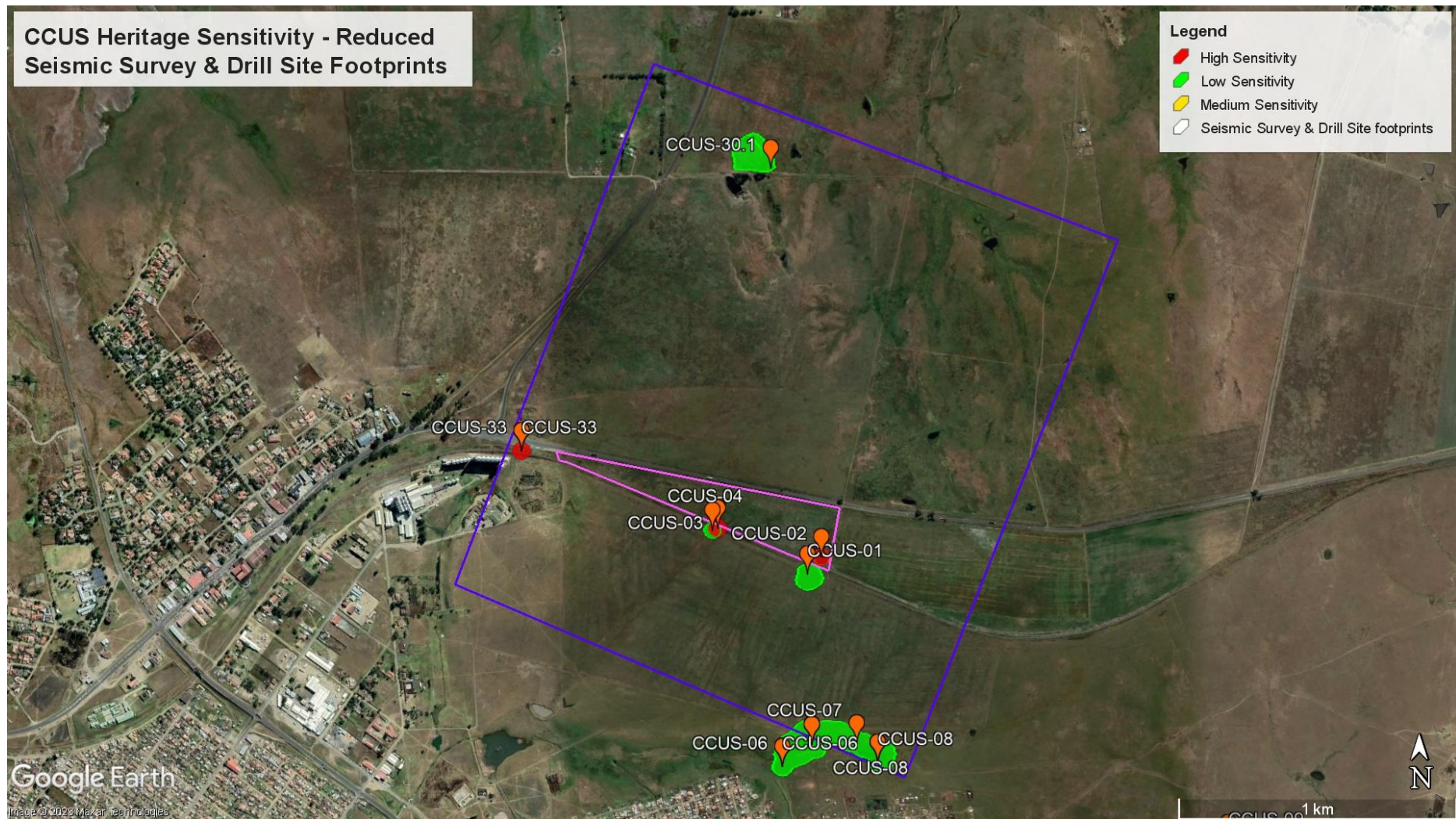


3. Heritage Sensitivity Map based on the Site Inspection / Field survey

3.1 Sensitivity Map showing Original (pink polygon) and Reduced (blue polygon) Seismic Survey Footprints



3.2 Sensitivity Map showing Reduced Seismic Survey Footprint (purple) and Adjusted Drill Site Footprint (pink)



3.3 Sensitivity Map showing Adjusted Drill Site Footprint (pink polygon)



APPENDIX 2: CURRICULUM VITAE OF HERITAGE SPECIALIST

1 Personal Particulars

Profession:	Heritage Specialist
Date of Birth:	11 September 1966
Name of Firm:	Nitai Consulting
Name of Staff:	Jennifer Kitto
Nationality:	RSA
Membership of Professional Societies	Association of Southern African Professional Archaeologists - ASAPA (444); International Association for Impact Assessment - IAIAAsa (7151)

2 Education:

BA Hons Social Anthropology, WITS, South Africa, 1994

BA. Archaeology and Social Anthropology, WITS, South Africa, 1993

Higher National Diploma, Practical Archaeology, Dorset Institute for Higher Education (now Bournemouth University), UK, 1989

3 Employment Record:

2022 – Present *Heritage Specialist, Nitai Consulting*

Conduct Heritage Impact Assessments;

2012 – 2021 *Heritage Specialist, PGS Heritage (Pty) Ltd*

Conduct Heritage Impact Assessments

Compile Desktop Historical Research

Compile Heritage Audit and Management Plans

Compile and submit permit applications to National and Provincial Heritage Authorities for Section 34 building alterations and demolitions (under National Heritage Resources Act, 25 of 1999)

Compile and submit permit applications to Provincial and Municipal Health Authorities for Section 36 relocations of graves and burial grounds (under National Heritage Resources Act, 25 of 1999 and National Health Act, No 61 of 2003)

2008 – 2011 *Cultural Heritage Officer (National), Burial Grounds and Graves Unit: South African Heritage Resources Agency (SAHRA)*

Review and assessing permit applications for relocation of historical graves and burial grounds.

1998 – 2008 *Cultural Heritage Officer (Provincial), Provincial Office – Gauteng: SAHRA*

Review and comment on heritage and archaeological impact reports

Research for the nomination and grading process for related to the declaration of specific heritage resources as National Heritage Sites

Monitoring of certain archaeological and built environment National Heritage Sites (e.g., The Cradle of Humankind World Heritage Site)

4 Selected Consultancies

4.1 GDID East Corridor, OHS Implementation, Tambo Memorial Regional Hospital (as sub-contractor to PGS Heritage (Pty) Ltd

2022 Independent Heritage Specialist, Compile Historical Archival Report of Tambo Hospital Boksburg, Gauteng for PGS Heritage (Pty) Ltd, Finalise HIA Report and submit HIA report to Gauteng Provincial Heritage Resources Authority

4.2 GDID East Corridor, OHS Implementation, Tembisa Regional Hospital (as sub-contractor to PGS Heritage (Pty) Ltd

2022 Independent Heritage Specialist, Compile Historical Archival Report of Tembisa Hospital, Ekurhuleni, Gauteng for PGS Heritage (Pty) Ltd, Finalise HIA Report and submit HIA report to Gauteng Provincial Heritage Resources Authority.

4.3 Kroonstad Solar PV Facilities

2022/2023 Heritage Specialist, Development of three Solar PV facilities near Kroonstad, Free State Province, South Africa, Identify, assess and map all heritage resources associated with the three solar PV facilities

4.4 Kroonstad South Solar PV Facilities

2022/2023 Heritage Specialist, Development of five Solar PV facilities near Kroonstad, Free State Province, South Africa, Undertake Heritage Impact Assessment of all heritage resources associated with the five solar PV facilities

4.5 Rustenburg Solar PV Facilities

2022/2023 Heritage Specialist, Development of three Solar PV facilities near Rustenburg, North-West Province, South Africa, Undertake Heritage Impact Assessment all heritage resources associated with the three solar PV facilities.

4.6 Seelo Solar PV Facilities

2022/2023 Heritage Specialist, Development of three Solar PV facilities near Carletonville, North-West Province, South Africa, Undertake Heritage Impact Assessment all heritage resources associated with the three solar PV facilities.

4.7 Decommissioning of Komati Power Station

2023, Heritage Specialist, Proposed Decommissioning of the Komati Power Station, Middelburg, Mpumalanga, Undertake Heritage Impact Assessment of all heritage structures within the power station

5 Languages:

English - excellent speaking, reading, and writing

Afrikaans –fair speaking, reading and writing