APPENDIX H: CULTURAL HERITAGE IMPACT ASSESSMENT

Rhino Oil and Gas Proposed Exploration Well Drilling in ER 294

Proposed Drill Holes On Various Farms within the Exploration Right Area, Free State Province

Heritage Impact Assessment

Template Number	Document Number	Revision	Date
PGS PJ REP 007 01	601HIA-001	3.0	14 April 2023

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REVISION HISTORY

Version	Issue Date	Description of Changes
001	17 February 2023	First draft
002	3 March 2023	Second draft – names of proposed well localities were revised
003	14 April 2023	Third draft – minor edits.

Declaration of Independence

- I, Nikki Mann, declare that –
- General declaration:
- I act as the independent heritage practitioner in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting heritage impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application 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 application, whether such information is favourable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected from a heritage practitioner in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realise that a false declaration is an offence in terms of regulation 71 of the 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 Regulations;

HERITAGE CONSULTANT: PGS Heritage (Pty) Ltd

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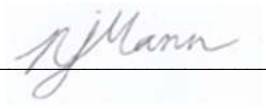
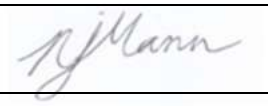
SIGNATURE: 

ACKNOWLEDGEMENT OF RECEIPT

Report Title	**Heritage Impact Assessment: Rhino Oil and Gas Proposed Exploration Well Drilling in ER 294 - Proposed Drill Holes On Various Farms within the Exploration Right Area, Free State Province.**		
Control	**Name**	**Signature**	**Designation**
Author	N Mann		Archaeologist
Reviewer	W Fourie		PGS Heritage -Project Manager/Archaeologist
Reviewed			Client

CLIENT: **SLR Consulting (Pty) Ltd**

CONTACT PERSON:

SIGNATURE: _____

The Heritage Impact Assessment Report has been compiled considering the National Environmental Management Act (Act No. 107 of 1998) (NEMA): Appendix 6 of the Environmental Impact Assessment (EIA) Regulations of 2014 (as amended, 2017) requirements for specialist reports as indicated in the table below.

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report
1.(1) (a) (i) Details of the specialist who prepared the report	Page iii of Report – Contact details and company
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 1.2 – refer to Appendix C
(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	Section 3
(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 3, 4
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3, Appendix A
(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
(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;	Section 6
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 1.3
(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	Section 4, 6, 7
(k) Any mitigation measures for inclusion in the EMPr	Section 8
(l) Any conditions for inclusion in the environmental authorization	Section 8
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorization	Section 8
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 9
(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 9
(o) A description of any consultation process that was undertaken during the course of carrying out the study	
(p) A summary and copies if any comments that were received during any consultation process	Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(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.	No protocols or minimum standards for HIAs or PIAs

EXECUTIVE SUMMARY

PGS Heritage (Pty) Ltd (PGS) was appointed by SLR Consulting (Pty) Ltd (SLR), on behalf of Rhino Oil and Gas Exploration South Africa (Pty) Ltd (ROGESA), to undertake a Heritage Impact Assessment (HIA) that forms part of the Basic Environmental Assessment (BA) for proposed exploration drilling activities at five sites within the exploration right (ER 294) area. The five proposed well sites are located within the Ngwathe and Moqhaka Local Municipalities, within the Fezile Dabi District Municipality, Free State Province.

It must be noted that one alternative well location (waypoint: 017) was proposed based on various specialist observations. This alternative well location will also be discussed within the report.

Heritage Resources Identified

A selective survey of the study area was conducted by Dr Matt Lotter between 29 November – 3 December 2022. Heritage resources are unique and non-renewable and as such any impact on such resources must be seen as significant.

During the fieldwork a total of five heritage features and resources where identified. These consist of one burial ground with approximately 27 graves (**013**), two localities with several sandstone blocks which are possibly boundary markers (**006, 009**) and two localities with historic structures (**007, 008**). See **Figure 39** and the individual site descriptions as contained in **Appendix C**.

Only one of the identified heritage resources (006) is located within proximity of the newly proposed alternative well site (017).

Historical Structures

Two (2) structures (**007, 008**), which are located further than 200m away of a proposed well, were rated as having **low heritage significance**.

Boundary Markers

Two localities with sandstone blocks (**006, 009**) were rated as having **medium heritage significance**.
One site (**009**) is located further than 200m away of a proposed well.
Site **006** is located further than 200m away from proposed well ABredell_4 but is located less than 20m from the newly proposed alternative well site (017).

Burial grounds and graves

One (1) burial ground (**013**) was rated as having **high heritage significance**; however, it is located a considerable distance (± 100m) from the proposed development area.

Mitigation measures

The calculated impact as summarised in **Section 8** of this report confirms the impact of the proposed development will be reduced with the implementation of the mitigation measures. This finding in addition to the implementation of a chance finds procedure, as part of the EMPr, will mitigate possible impacts on unidentified heritage resources. The following mitigation measures are listed in **Table 1**.

Table 1 - Heritage management recommendations.

Heritage Resources	Mitigation measures
General Area	▪ A chance finds protocol has been developed that includes the process of work stoppage, site protection, evaluation and informing SAHRA of such finds and a final process of mitigation implementation.
Burial Ground (**013**)	▪ As the burial ground is more than 100m away from proposed well sites, no impact is expected. ▪ However, the burial ground should be retained and avoided with a **buffer zone of 50m** as per SAHRA guidelines.
Historical Structures (**007, 008**)	▪ As the structures are located more than 100m away from proposed well sites, no impact is expected. Therefore, no mitigation is required.
Sandstone Boundary Markers (**006, 009**)	▪ As the boundary markers at 009 are located more than 200m away from proposed well sites, no impact is expected. Therefore, no mitigation is required. ▪ Site 006 is located further than 200m away from proposed well ABredell_4 but is located less than 20m from the newly proposed alternative well site (017). Implement a **30-meter buffer** around the boundary markers. If the markers cannot be avoided, then a permit will be required to move the marker (before any construction) to the boundary of the footprint and reinserted at a later stage. The co-ordinates of the original and new locations need to be taken and photographed.

Conclusion

It is the author's considered opinion that the overall impact on heritage resources will be **Low**. Provided that the recommended mitigation measures are implemented if chance finds are unearthed within the project area, the impact would be acceptably low or could be totally mitigated to the degree that the project could be approved from a heritage perspective. The management and mitigation measures as described in **Section 8** of this report have been developed to minimise the project impact on possible heritage resources.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Early Stone Age

The archaeology of the Stone Age between 700 000 and 2 500 000 years ago.

Fossil

Mineralised bones of animals, shellfish, plants and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Late Stone Age

The archaeology of the last 30 000 years associated with fully modern people.

Late Iron Age (Early Farming Communities)

The archaeology of the last 1000 years up to the 1800's, associated with iron-working and farming activities such as herding and agriculture.

Middle Stone Age

The archaeology of the Stone Age between 30 000-300 000 years ago, associated with early modern humans.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Abbreviations	Description
AIA	Archaeological Impact Assessment

Abbreviations	Description
ASAPA	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIMS	Environmental Impact Management Services (Pty) Ltd
EMPr	Environmental Management Programme
ESA	Earlier Stone Age
FSHRA	Free State Heritage Resources Authority
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LCTs	Large Cutting Tools
LSA	Late Stone Age
LIA	Late Iron Age
LOM	Life of Mine
MPRDA	Mineral and Petroleum Resources Development Act 28 of 2002
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act, 1998 (Act No 107 of 1998)
NHRA	National Heritage Resources Act, 1999 (Act No 25 of 1999)
PGS	PGS Heritage (Pty) Ltd
PHRA	Provincial Heritage Resources Authority
PIA	Palaeontological Impact Assessment
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

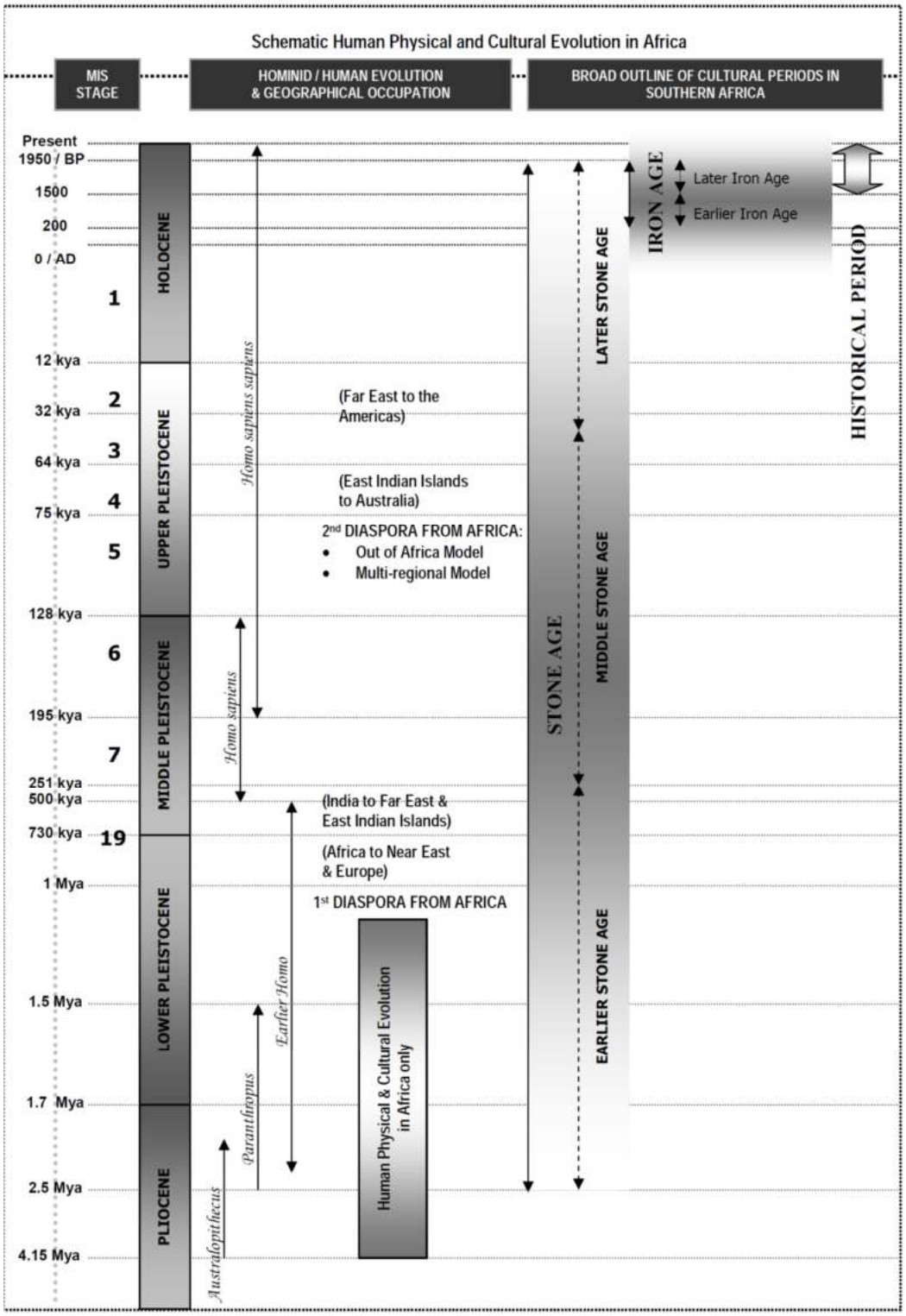


Figure 1 – Human and Cultural Timeline in Africa

1 INTRODUCTION

PGS Heritage (Pty) Ltd (PGS) was appointed by SLR Consulting (Pty) Ltd (SLR), on behalf of Rhino Oil and Gas Exploration South Africa (Pty) Ltd (ROGESA), to undertake a Heritage Impact Assessment (HIA) that forms part of the Basic Environmental Assessment (BA) for proposed exploration drilling activities at five sites within the exploration right (ER 294) area. The proposed well sites are located within the Ngwathe and Moqhaka Local Municipalities, within the Fezile Dabi District Municipality, Free State Province.

It must be noted that one alternative well location (waypoint: 017) was proposed based on various specialist observations. This alternative well location will also be discussed within the report.

1.1 Scope of the Study

The aim of the study is to identify heritage sites and finds that may occur in the proposed project area. The HIA aims to inform the BA to assist the developer in managing the discovered heritage resources in a responsible manner, in order to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act 25 of 1999) (NHRA).

1.2 Specialist Qualifications

This HIA Report was compiled by PGS Heritage (PGS).

The staff at PGS has a combined experience of nearly 90 years in the heritage consulting industry. PGS and its staff have extensive experience in managing HIA processes. PGS will only undertake heritage assessment work where they have the relevant expertise and experience to undertake that work competently.

Wouter Fourie, the Project Coordinator, is registered with the Association of Southern African Professional Archaeologists (ASAPA) as a Professional Archaeologist and is accredited as a Principal Investigator; he is further an Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).

Nikki Mann, the author of this report, is registered as a Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA). She has 5 years of experience in the heritage assessment field and holds a Master's degree (MSc) in Archaeology from the University of Cape Town.

Dr Matt Lotter, geoarchaeologist based at the University of Johannesburg, was contracted by PGS to conduct the field survey for this report.

1.3 Assumptions and Limitations

Not detracting in any way from the comprehensiveness of the fieldwork undertaken, it is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some archaeological sites and existing vegetation cover. It should be noted most of the study area was accessible for the fieldwork survey. Fieldwork was also focussed on area that was not previously ploughed or disturbed by farming activity, thus focussing on areas with the highest potential to yield heritage resources.

Therefore, should any heritage features and/or objects be located or observed outside the identified heritage sensitive areas during the construction activities, a heritage specialist must be contacted immediately. Such observed or located heritage features and/or objects may not be disturbed or removed in any way until such time that the heritage specialist has been able to make an assessment as to the significance of the site (or material) in question. This applies to graves and cemeteries as well. If any graves or burial places are located during the development, the procedures and requirements pertaining to graves and burials will apply as set out below.

1.4 Legislative Context

The identification, evaluation and assessment of any cultural heritage site, artefact or find in the South African context is required and governed by the following legislation:

- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified
- National Environmental Management Act (NEMA), Act 107 of 1998 – Appendix 6
- National Heritage Resources Act (NHRA), Act 25 of 1999

1.4.1 Notice 648 of the Government Gazette 45421

Although minimum standards for archaeological (2007) and palaeontological (2012) assessments were published by SAHRA, GN.648 requires sensitivity verification for a site selected on the national web based environmental screening tool for which no specific assessment protocol related to any theme has been identified. The requirements for this Government Notice (GN) are listed in **Table 2** and the applicable section in this report noted.

Table 2 - Reporting requirements for GN648

GN 648	Relevant section in report	Where not applicable in this report
2.2 (a) a desktop analysis, using satellite imagery;	Section 5	
2.2 (b) a preliminary on-site inspection to identify if there are any discrepancies with the current use of land and environmental status quo versus the environmental sensitivity as identified on the national web-based environmental screening tool, such as new developments, infrastructure, indigenous/pristine vegetation, etc.	Section 4	-
2.3(a) confirms or disputes the current use of the land and environmental sensitivity as identified by the national web-based environmental screening tool;	Section 4	-
2.3(b) contains motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity;	Section 4	-

An assessment of the Environmental Screening tool provides the following sensitivity ratings for archaeological and heritage resources as low (**Figure 2**) and palaeontological resources as medium to very high (**Figure 3**).

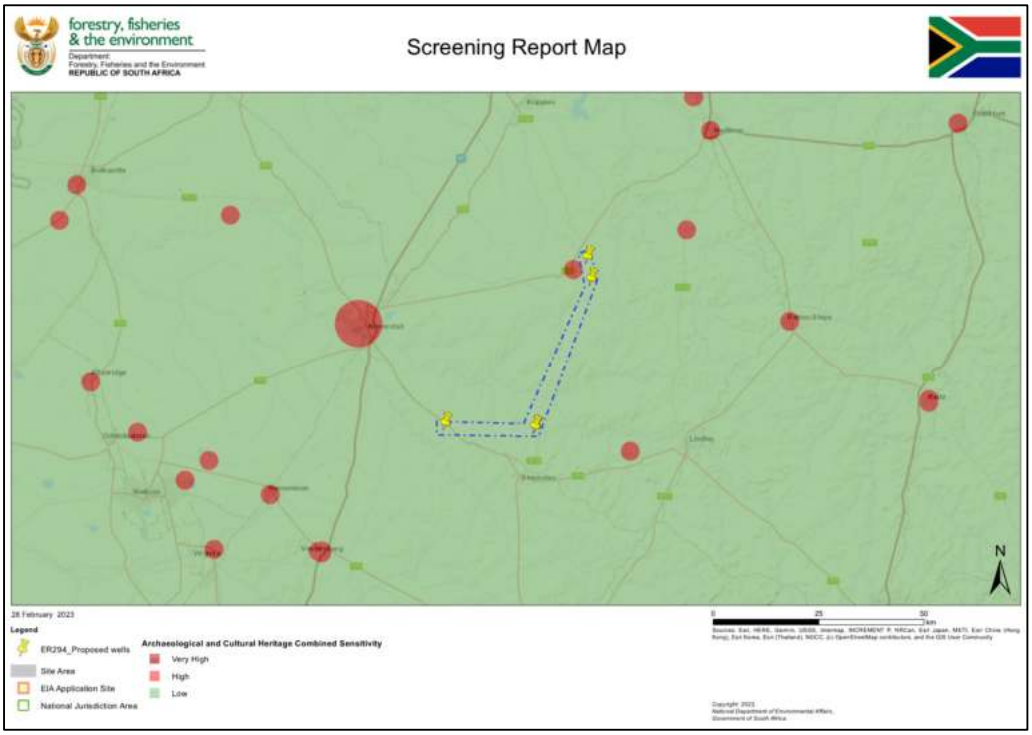


Figure 2 – Archaeology and Heritage screening map for the proposed drill sites (Source: DFFE).

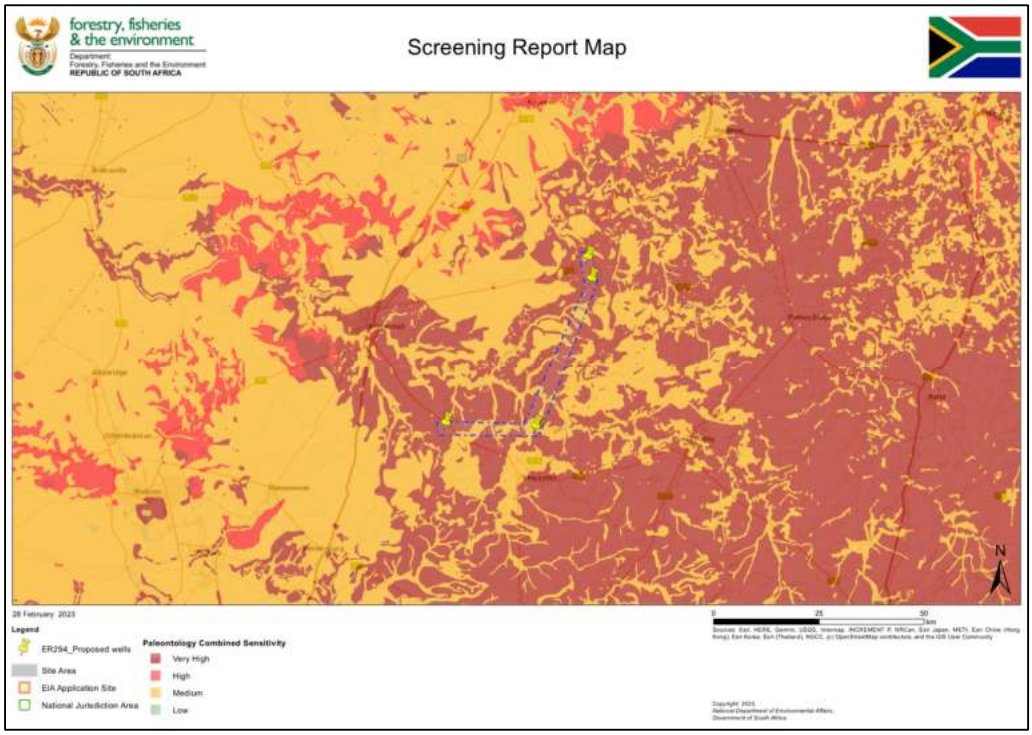


Figure 3 - Palaeontology screening map for the proposed drill sites (Source: DFFE).

1.4.2 NEMA – Appendix 6 requirements

The HIA report has been compiled considering the NEMA Appendix 6 requirements for specialist reports as indicated in the table below. For ease of reference, the table below provides cross-references to the report sections where these requirements have been addressed.

1.4.3 The National Heritage Resources Act

- National Heritage Resources Act (NHRA) Act 25 of 1999
  - Protection of Heritage Resources – Sections 34 to 36; and
  - Heritage Resources Management – Section 38

The NHRA is utilized as the basis for the identification, evaluation, and management of heritage resources and in the case of Cultural Resource Management (CRM) those resources specifically impacted on by development as stipulated in Section 38 of NHRA. This study falls under s38(8) and requires comment from the relevant heritage resources authority.

2 TECHNICAL DETAILS OF THE PROJECT

The following section contains information that was supplied by SLR.

2.1 Background

The Exploration Right (ER) for ER294 was granted in 2015. The Environmental Authorisation (EA) for non-intrusive work was done in 2019.

The ER, which was informed by an EA, permitted ROGESA to undertake an exploration work programme involving desktop studies and an aerial gradiometry gravity survey.

ROGESA undertook the studies and survey and is now proposing to drill exploration wells within two Target Areas located in the ER. Target Area 1 is located south of Petrus Steyn and Target Area 2 lies south of the R34 between Kroonstad and Edenville (refer **to Figure 4**). The specific well locations have been proposed by ROGESA based analysis of geological data and will confirmed based on landowner engagement and environmental investigations (the latter will form part of this EIA).

2.1.1 ER Location

The extent of ER 294 includes ~ 3 000 properties (farms and portions) over an area of ~ 660 000 ha.

Based on the outcome of prior exploration, ROGESA has identified two (2) Target Areas within which the updated well drilling EWP intends to focus. The Target Areas include:

- **Target Area 4** extends for an area of ~550 km^2, approximately 10 km north of Steynrus and 10 km east of Kroonstad. The Target Area 4 includes ~ 300 properties;
- **Target Area 5** of ~1 300 km^2, which is in the central part of ER294, with Petrus Steyn right in its centre. Target Areas 5 extends across ~ 1 000 properties.

Given the large number of properties included, it is not feasible to include a cadastral description of every property in this document.

The location of well drilling sites is subject to a process of geological review, landowner consent and environmental considerations. Areas that are unsuitable will be eliminated from further consideration. ROGESA is currently busy with the well site identification process.

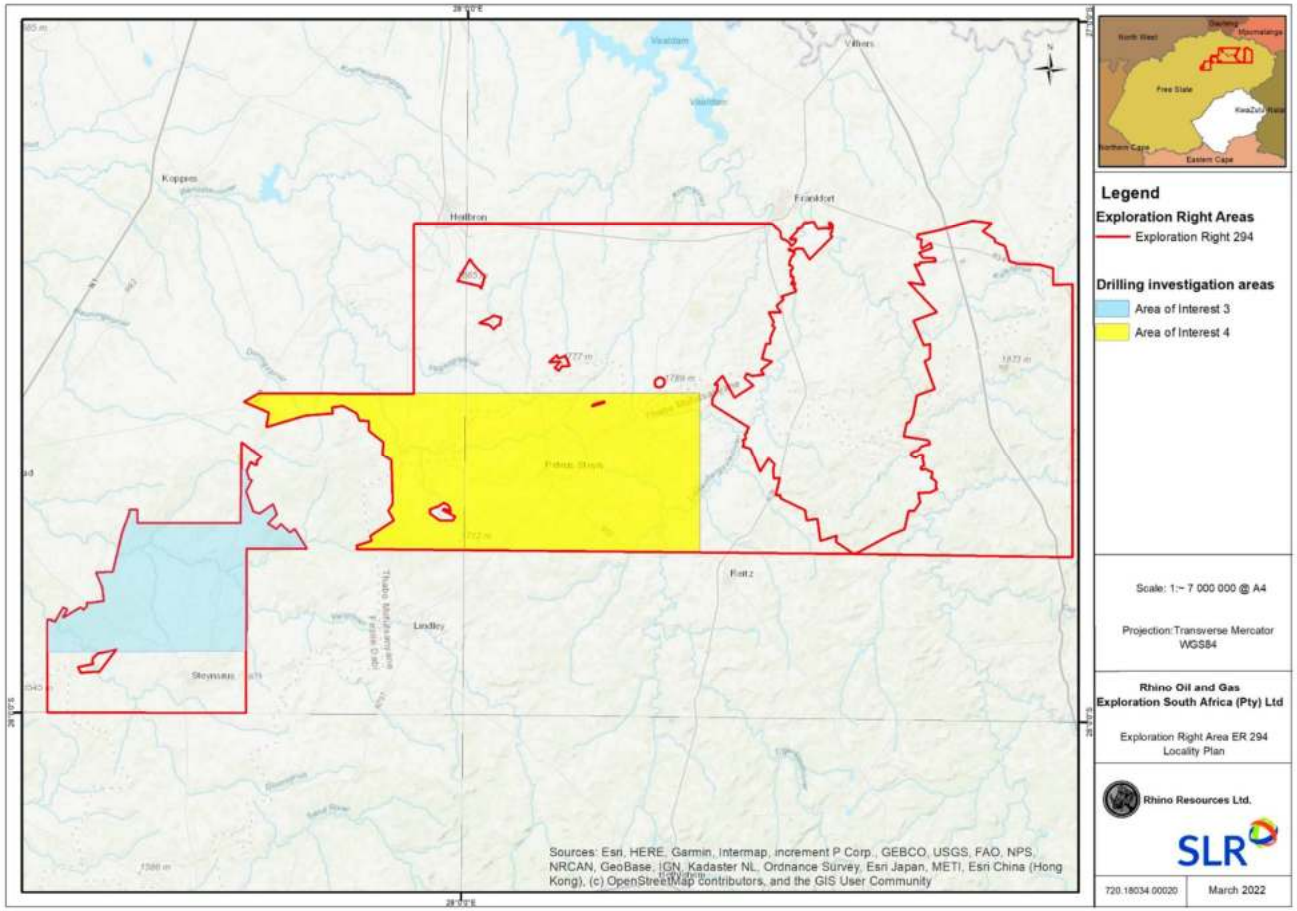


Figure 4 - Locality Map (showing ER Boundary and Target Areas)

2.2 Locality of Proposed Well Sites

In this report, the proposed exploration drilling activities at five sites, located within the ER 294, were assessed.

The proposed well sites are located within the Ngwathe and Moqhaka Local Municipalities, within the Fezile Dabi District Municipality, Free State Province.

The locations of the 5 proposed well sites are as follows (**Figure 5** - **Figure 6**):

- One proposed well site (ref: **ER294_Traget Area_5_01**) is located on the farm **Honinglaagte No 2118**, to the north-east of Edenville, Free State Province.
- One proposed well site (ref: **ER294_Traget Area_5_02**) is located is located on the farm **Cyfergat No 211** (portion 0), to the south-east of Edenville, Free State Province.
- One proposed well site (ref: **ER294_Traget Area_4_03**) is located on the farm **Benoni No 662** (portion 1), north of Steynsrus, Free State Province.
- One proposed well site (ref: **ER294_Traget Area_4_04**) is located on the farm **Benoni No 662** (portion 1), north of Steynsrus, Free State Province.
- One proposed well site (ref: **ER294_Traget Area_4_02**) is located on the farm **Welbedacht No 1913** (portion 0), north-west of Steynsrus, Free State Province.

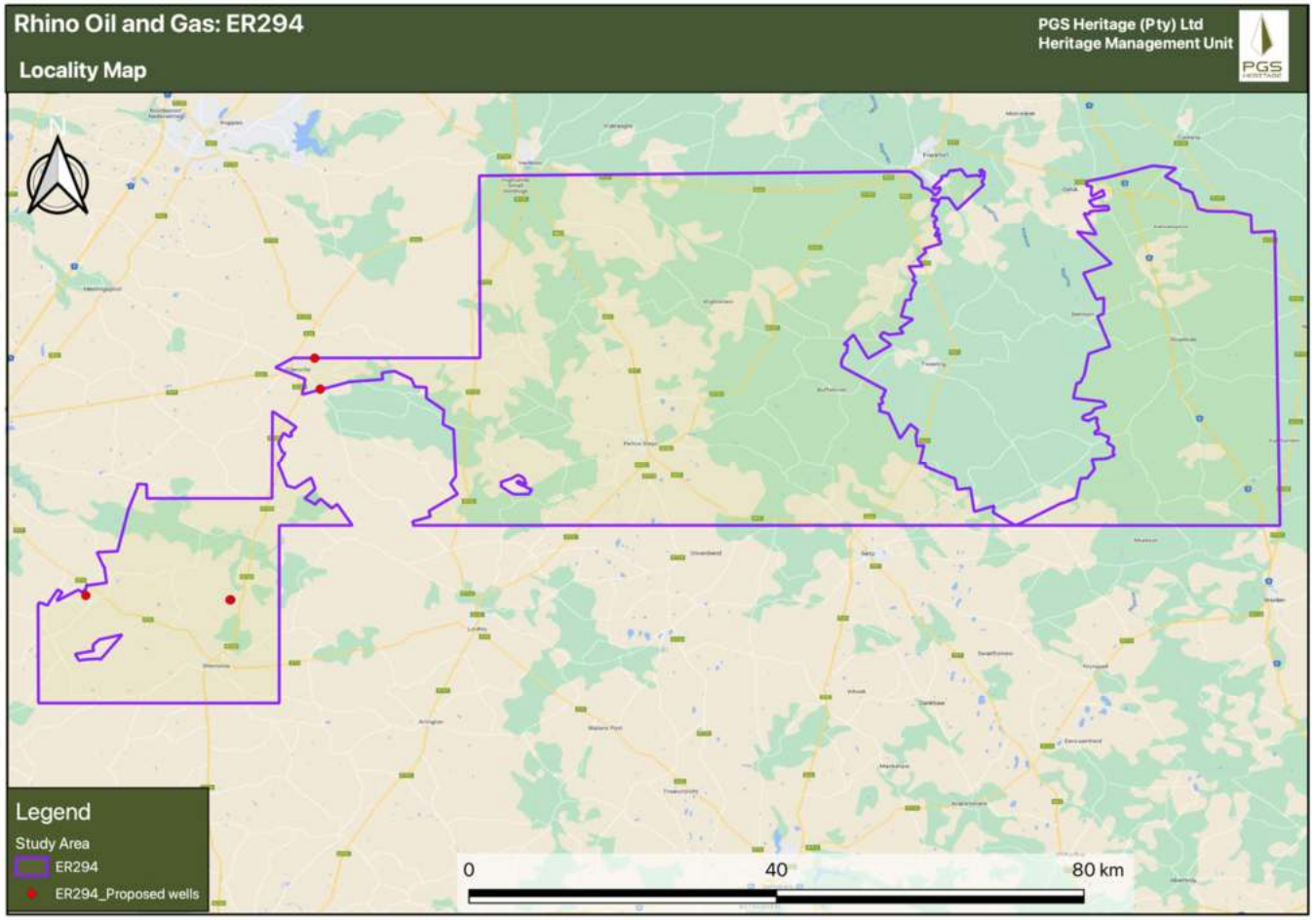


Figure 5 - Location of the proposed wells within the ER294.

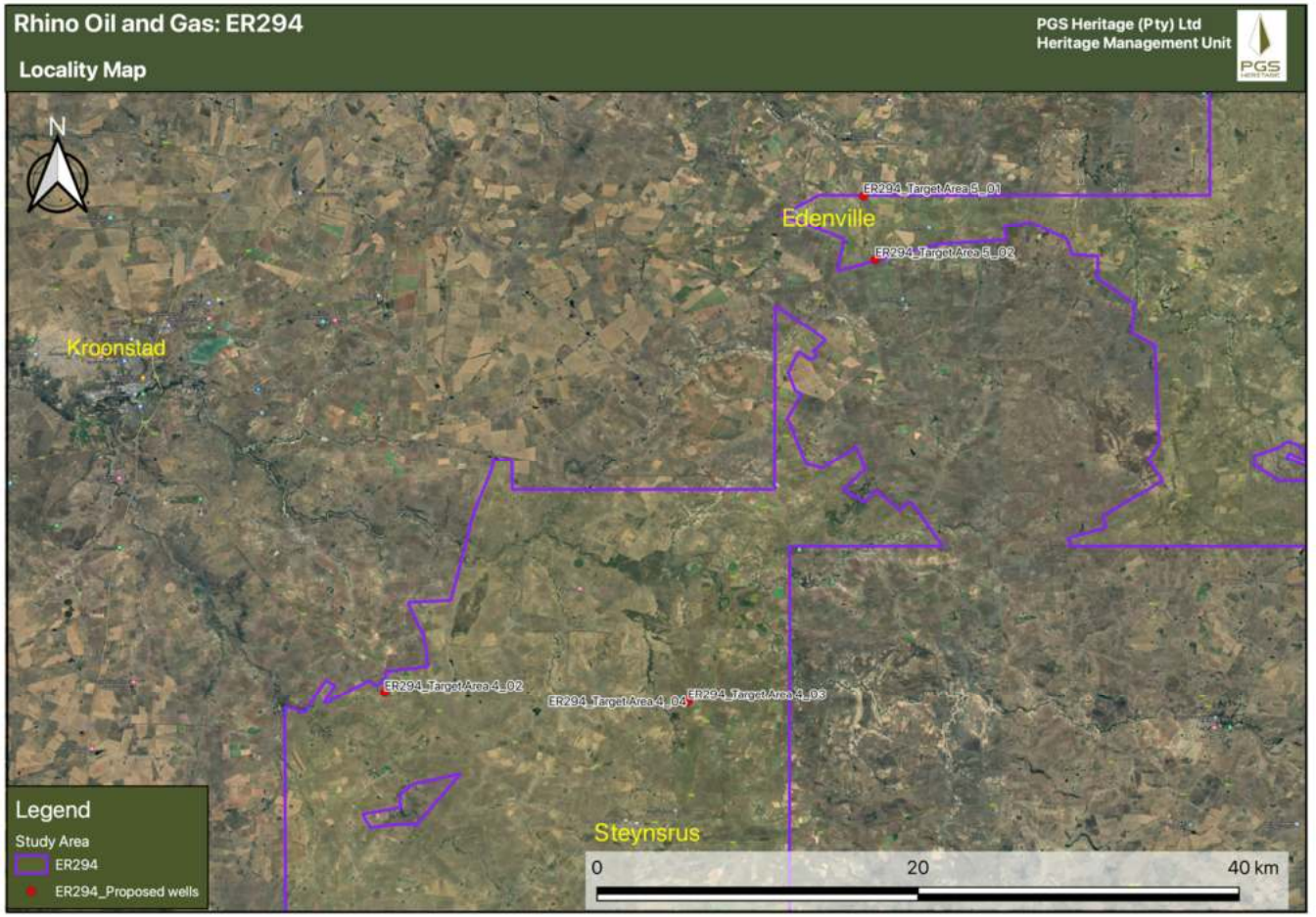


Figure 6 - Locality map illustrates the general location of the five proposed well sites.

2.3 Technical Project Details

2.3.1 Exploration Drilling Program And Project Schedule

The Drilling Program and Time Schedule proposed by Rhino Oil and Gas is to start drilling at least ten exploration wells (i.e. five in each of the ERs) within the Target Areas in 2023.

If any of the first ten exploration wells result in the identification of commercially viable commodities (hydrocarbons, helium, or hydrogen), Rhino Oil and Gas's Drilling Program and Project Schedule would be updated to include the drilling of additional exploration wells at different locations within the Target Areas.

Completed exploration wells will be tested to evaluate their commerciality. The drilling of the exploration wells will likely be undertaken as one or two campaigns. At the end of operations, unsuccessful wells will be plugged and abandoned ("decommissioned"). Successful wells will have their ability to produce preserved but be capped and secured for possible future field development (subject to a receipt of the requisite approvals including, amongst others, Environmental Authorisation by means of a separate EIA process for Production Rights (PR)).

The drilling time to complete one well is estimated to take approximately 3 to 4 weeks. The results of the first few wells drilled within the Target Areas will influence the positioning and pace of the rest of the drilling campaign based on the interpretation of the geological, geophysical, fluid sampling data. The sequencing of the drilling campaign will be dynamic and influenced by the learnings of each new well.

The drilling rig will be mobilised from within South Africa. The likely drilling service provider already operates in the vicinity on Renergen's PR007 (Virginia field) located approximately 15 km south of the ER; as such the longest mobilisation will take only a couple of days.

2.3.2 Main Project Components

This section describes the main project components, including the following:

- Onshore Drill Rig;
- Exclusion Zone;
- Local logistics base;
- Supply trucks;
- Personnel;
- Crew transfer; and
- Infrastructure and services.

2.3.2.1 Onshore Drill Rig

Various types of drilling rigs are used worldwide in onshore drilling operations, with the type of unit typically dependent on the depths to which it needs to reach and the hardness of rocks it needs to penetrate. Based

on the overall subsurface rock in each area of interest, it is anticipated that exploratory drilling will be conducted using a truck mounted drilling rig with air and mud drilling capabilities.

The truck mounted drilling rig has minimal area of disturbance due to its compact footprint (See **Figure 7** for an example of a typical drill rig). A significant benefit to using a truck mounted drilling rig is the ease of mobility as it is a self-propelled truck with the flexibility to move from location to location without the need of additional truck support.

Figure 7 - Example of a drill rig (Source: Torque Africa).

2.3.2.2 Safety Zone

During the drilling operations, there will be a fenced safety zone of about 20 to 25 m around the drill site. No traffic will be allowed to enter the safety zone for the duration of drilling operations. The purpose of the safety zone is to prevent accident with the high-powered equipment used during operations. In addition, drilling may liberate flammable gases that require a standoff distance for safe handling.

2.3.2.3 Local Logistics Base

A local logistics base will be in close vicinity of Target Areas since it will be shared with other ongoing drilling activities undertaken by the drilling contractor for Renergen, who are developing and producing the Virginia field in the Free State.

That logistics base will be on an existing brownfield site (previously developed land) most likely used by farming communities to store and maintain heavy duty machinery. A final decision will be undertaken after a logistic survey in the identified areas. This base will include the following facilities:

- An open storage area partially equipped with pipe racks for drilling tubular material storage;

- A covered warehouse for drilling material and other minor equipment;
- Temporary offices for logistic base personnel;
- Area for storage (less than 90 days per well activity) for general waste and hazardous waste at any one time.

Wastes will be transported to a licensed waste disposal facility by an appropriately permitted waste management contractor and will not be stored within the base except for the time strictly necessary for unloading from the drill site and loading on the trucks for transport to the disposal site. The following maximum potential space requirements have been identified:

- Open area/pipe yard: up to 1000 m^2; and
- Warehouse: up to 500 m^2.

Rhino Oil and Gas's drilling contractor plans to use existing infrastructure within the Free State to provide the transport, storage and bunkering facilities for the project. Based on regional experience, the drilling contractor anticipate that the drilling will be done by air drilling thus not requiring mud plant. However, for safe operations and well control backup options, a small temporary mud plant will be available at the well site.

2.3.2.4 Supply trucks

For the duration of the drilling operation, the drill site will be supported by supply trucks, which are general purpose trucks designed to carry a variety of equipment and cargo. These trucks will supply the drill site two to four times a week with cement, mud and equipment such as casing, drill pipe and tubing. They will also remove waste that must be appropriately disposed of on land. The number of supply trucks has not yet been defined but will be provided by the drilling contractor.

2.3.2.5 Personnel

The logistics base will be located within around 120 km reach and all based personnel will reside locally. The local staff employed by the South African drilling contractor is experienced local South Africans in drilling in the Free State region. Some external advisors might be internationally sourced if required by the project. Rhino Oil and Gas representatives will also be located in the Cape Town office and travel to well sites during the drilling campaign. The drilling will see around 5 to 10 personnel on site. The number of personnel on the supply trucks will vary based on the types of activities they support. The trucks will be local trucks and staff, where possible, for drilling operations service. All workers will be provided with health and safety training and Personal Protective Equipment (PPE) suitable for the types of activities by the drilling contractor.

2.3.2.6 Crew Transfers

Transportation of personnel to and from the drill site will most likely be provided by road. The drill site can operate during day and night shifts. However, if timeline permits, it is anticipated to mainly operate during day shifts only. Crews will generally work in 8 to 12 hour shifts in 2-to-4-week cycles. Crew changes will be staggered, and in combination with ad hoc personnel requirements and will be managed by Rhino Oil and Gas's drilling contractor.

2.3.2.7 Infrastructure Support and Services

2.3.2.7.1 Freshwater

The project will require water for making water-based drilling muds to be used as backup for safe measure to maintain well control and for rig cleaning. This industrial water will be sourced by Rhino Oil and Gas's drilling contractor from authorized sources. The drinking (potable) water for the personnel on the drill site will be bottled water.

2.3.2.7.2 Fuel

The estimated total fuel consumption per well during the mobilisation, drilling phase (approximately 2 days mobilisation and 25 days drilling, 1000m drilled) by all the project equipment's and truck is on average 7 to 15 m3 of gasoil.

2.3.2.7.3 Food Supplies and Local Services

The bulk of food and local services will be purchased locally near the logistics base.

2.3.3 Project Activities Per Phases

Project activities associated with drilling include the following phases, described further in the following sections:

- Mobilisation of the truck mounted rig and supply trucks from drilling contractor base located near Pretoria to the Rhino Oil and Gas Target Area in the Free State Province;
- Well drilling;
- Well execution (logging, completion) options;
- Well testing for successful well options;
- Well abandonment for unsuccessful well (Plug and Abandonment "decommissioning"); and
- Demobilisation of the drill rig, supply truck and local logistics base.

2.3.3.1 Mobilisation Phase

The drilling locations will be identified prior to mobilisation of the drill rig based on the results of the analysis of airborne geophysical data, regional geological analysis, historical data integration, land owner consultation and environmental sensitivities.

During mobilisation, the drill rig and supporting equipment will arrive directly on location from previous jobs (probably from Renergen drill sites) or from Rhino Oil and Gas's drilling contractor main yard near Pretoria.

Once on location, the well site will be prepared by drilling contractor. A typical drill site schematic is provided in **Figure 8**. Should any obstacles/sensitivities be identified at the drilling location, the well will be relocated to a nearby location where no obstacles/sensitivities are located.

These activities will be followed up with safety checks, drills, communication tests. This will take approximately 2 to 4 days to complete.

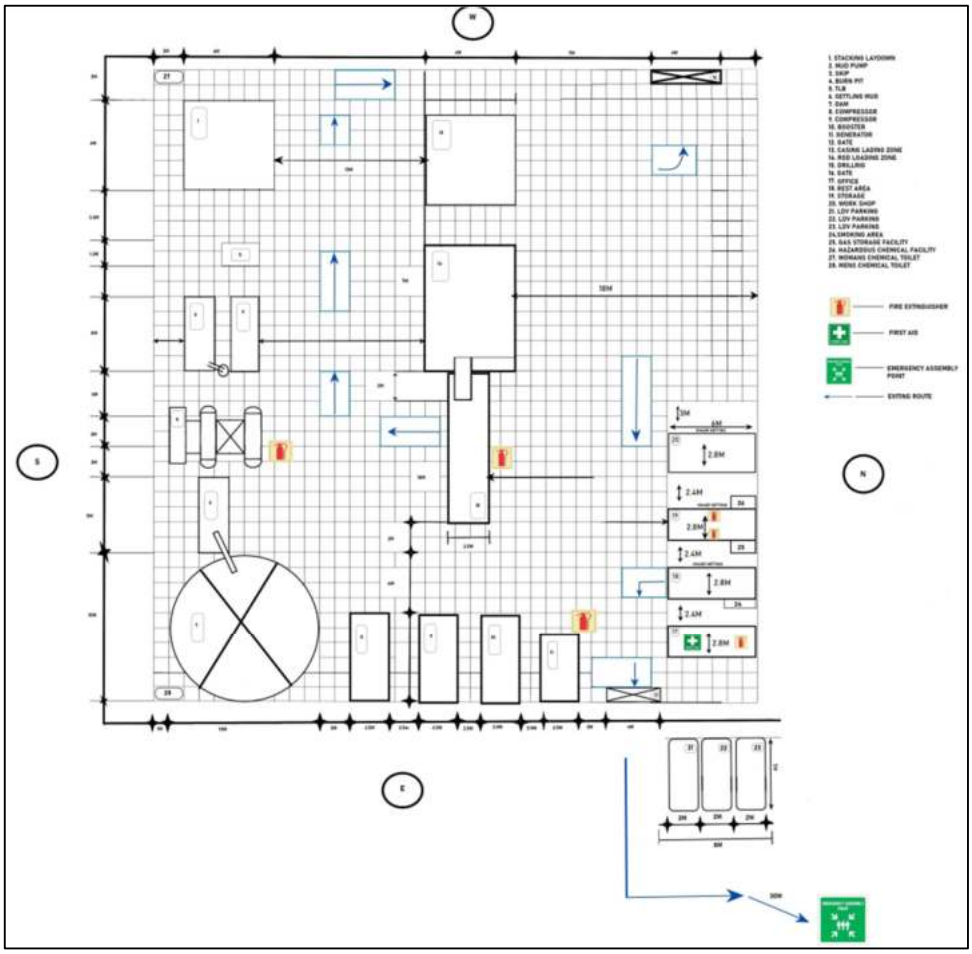


Figure 8 - Drill site layout (Source: Torque Africa).

2.3.3.2 Drilling Phase

2.3.3.2.1 Well Drilling

After mobilisation, the next phase is the drilling phase.

The drilling sequence for the exploration drilling campaign is not yet defined as it will depend on the first exploration well results. However, it is currently planned that each Target Area will have at least 1 well drilled in the initial 10 exploration wells campaign.

To evaluate and confirm the commercial viability of the reservoir, a vertical or slanted well will be drilled to a total depth of approximately 1000 m below surface. The expected valuable fluid for these wells is biogenic gas, helium or geological hydrogen. A standard well design and programme for onshore wells will be updated after the completion of seismic interpretation and stratigraphy evaluation by the geologists and petroleum engineers. The final well path will be defined according to the reservoir target and final location of the wellhead

at surface. Rhino Oil and Gas's preference for drilling exploration wells is a slanted well profile allowing maximum chance to intersect naturally occurring faults in the basement rocks.

During the drilling phase, different drilling bit sizes are used to drill a series of telescoping holes, from the surface to the total depth of the planned well. The first hole, the outer diameter, is the biggest and called the top hole, while the next inner holes are progressively smaller and smaller as the well depth increases. This continues until the final hole, which is the smallest, reaches the reservoir level.

During the drilling process, drilling fluids such as compressed air or muds are pumped down the inside of the drill pipe and exit at the drill bit to optimise drilling operations. For the first section (top hole) of the well, a conductor pipe will be installed by hammering it down to around 50 m to isolate from any ground water. In the bottom sections of the well, air drilling (i.e., with compressed air injected) will be mainly carried out. The water-based mud programme will only be deployed if high rock formation pressure encountered. The main functions of drilling fluids (air or mud) include the following:

- Removal of drilled rock cuttings from the bottom of the well and from the well bore and transportation of these cuttings to the surface;
- Control of formation pressures and managing of formation fluids (i.e., 'primary well control');
- Transmission of power to the drill bit;
- Provision of hydrostatic pressure as well as chemical stability to the rock to maintain the integrity of the hole and prevent hole collapse;
- Lubrication and cooling of the drill bit.

The drill bit is connected to surface by a string of hollow tubulars referred to as the drill string. On the rig floor, drill pipes are attached, one by one, to the top of the string as the drill bit advances into the borehole. The action of drilling (creating a hole in the rocks stratigraphy) is obtained by applying weight and percussion to the bit. The top drive, installed in the truck mounted drill rig, advances the drill string into the well, and provides the rotation/percussion and weight on bit required to drill. The drill string goes through a Rotating Control Device (RCD) to provide physical barrier with wellbore and allow flow back diversion to flare in case of hydrocarbon intersection. Once each hole section has been drilled, casing (steel tubulars) is run into the well and cemented in place to secure/seal the hole interval just drilled and to allow for the drilling of the next (smaller) hole section. The cement operation consists of pumping cement down the drill string to the bottom. The cement flows, out the bottom of the casing shoe and back up into the annular space around the casing, sealing the space between the cased tube and open hole.

Casing plus cement is a tested barrier that facilitates the drilling of the next section, allowing to reach the target final depth in the safest way. During the drilling stage, fluid (mainly air) and dust/cuttings are discharged directly on the surface in immediate proximity of the well after going through a cyclone separator. The physical and chemical properties of the drilling fluid are constantly monitored and adjusted to suit varying down-hole conditions. These conditions are, in part, due to the variation in formation pressure within the well bore at different depths. If water-based mud is in use, fluid density (or mud weight) is adjusted with mud additives. The 3 main mud additives likely to be used by the drilling contractor are AMC EzeeMix (classified non-

hazardous), AMC Aerofoam and AMC Rotafoam (classified non to moderate hazardous). The mud additives details are displayed in the EIA report or can be found on AMC website (**www.amcmud.com**).

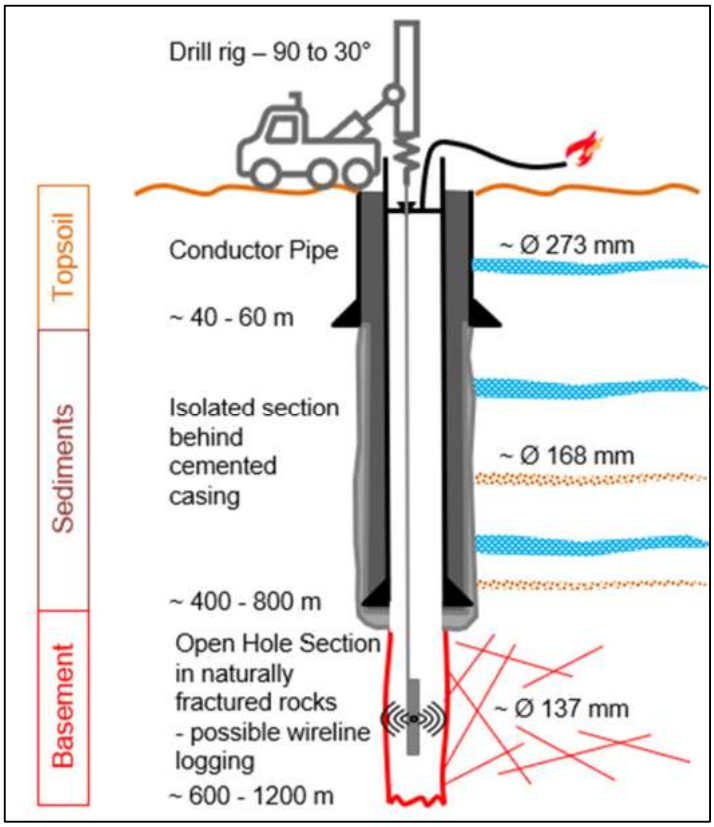


Figure 9 - Subsea Well Schematic at the End of Drilling Phase (Source: ROGESA, 2022).
Note: This drawing is not to scale, for dimension of rig vs equipment and tubulars or depths

2.3.3.3 Well Execution Options

2.3.3.3.1 Redrill

In case of any issues related to stratigraphy (e.g., permeable zones with different pressure gradient, hole instability, necessity to increase the inclination of the well to achieve the reservoir target) or problem during the drilling activities (e.g. bottom hole assembly stuck) it would be easier to redrill the well in a nearby location. The initial open hole will be cemented up and abandoned.

2.3.3.3.2 Well Logging

Different sensors are used throughout the drilling operation to measure several parameters such as quality of cement job, lithology, fluid types.

A dedicated run to measure/log the cement bond and consistency in the annuli is performed at the end of each cement job, prior to start drilling operations in the next phase.

Further detailed information is obtained on the physical properties of the rock formations and fluids (water, oil, gas) by means of an open and cased hole logging using sensors introduced down- hole with a wireline cable, or coiled tubing unit.

This operation is usually performed at the end of the drilling phase, after the bottom hole final clean up.
The logging plan is developed in accordance with standard industry best practices. In the case of unsuccessful wells, once a full log of the reservoir section might have been undertaken, the well will be plugged and abandoned. The completion phase, if confirmed in case of discovery, will be performed.

2.3.3.3.3 Well Completion

Well completion and well testing operations will be conducted during drilling of successful exploration wells.

The completion phase of a successful well takes place after the reservoir formation has been drilled and maintained open hole.

At the beginning of the completion operations, the wellbore is displaced with an industrial water, necessary to balance the downhole pressure and, at the same time, to complete the removal of dust/mud/solids from the well in order to minimise any potential damage to the rock formation.

The selection of salt and brine composition will be defined once the hydrocarbon has been discovered in the exploration well and reservoir lithology completely logged although simple industrial water is expected to be adequate considering low pressure encountered in regional analog exploration or production wells.

The successful well will be capped with well head valve connected to metering equipment with a flare stack at the end of it.

2.3.3.4 Well Testing Option for Successful Wells

As stated previously, well testing may be conducted on the successful wells if they present potential commercial quantities of hydrocarbon. A well test is a temporary completion of a well to acquire dynamic rate through time, pressure, and fluid property data. The well test often indicates how the well will perform when it is subjected to various flow conditions. An analysis is usually performed on the data to determine reservoir parameters and characteristics including pressure, volume, and temperature. Current testing practices are carried out using modern testing equipment and high-resolution pressure data acquisition system, getting the reservoir evaluation objectives depends on the behaviour of the formation fluid properties, well completion, and flow assurance situations are only known when testing is carried out.

The well test objectives are to:

1. Determine key technical factors of the reservoir (e.g., size, permeability and fluid characteristics) and values for use in future drilling.
2. Obtain representative data including reservoir pressure, production rates and sample(s).

While testing, hydrocarbons are sent to a flare boom with a burner to ensure as complete combustion of fluids (including hydrocarbons) as possible. To ensure that burning can be done safely from the drill site, a flare pit can be installed in order to prevent fire propagation.

The flow periods and rates will be limited to the minimum necessary to obtain the required reservoir information during the well test. It is anticipated that a maximum well test time for this project will be approximately 30 days.

Downhole sampling, if required, normally consists of recovering reservoir fluids via wireline or through specific tools added directly to the temporary test string. Wireline testing involves running instruments into the borehole on a cable to measure formation pressures and obtain fluid samples. Formation fluids are brought to the surface where the composition can then be analysed.

The following key well testing preventative measures will be implemented during the well testing programme:

- Monitor flare performance to maximise efficiency of flaring operations;
- Flare equipment appropriately inspected, certified and function tested prior to operations;
- Flare equipment appropriately maintained and monitored throughout well testing operations;
- The appropriate emergency stop mechanisms (Emergency Shut Down devices) are in place to halt testing in case of emergency

2.3.3.5 Well Control and Blowout Prevention

Health, safety and environmental protection are prioritised throughout the drilling process. In particular, there is a specific focus and attention during preparation and operations to avoid any potential accidental events, with related hydrocarbon release or uncontrolled flow from downhole to surface.

Well control during well operations is a routine function, with each well designed and executed to minimise risk of developing a well control incident. Down-hole conditions, such as shallow gas and high-pressure zones can cause control measures as a sudden variation in well pressure.

A well kick can occur if there is an influx of formation fluids with sufficient pressure to displace the well fluids.

The drilling will be done through a Rotative Control Device (RCD) that creates a pressure tight barrier against drilling hazards and allows safe diversion to the side flare stack (**Figure 10**). RCD must be pressure rated to the expected pressure to be encountered in the regional subsurface conditions.

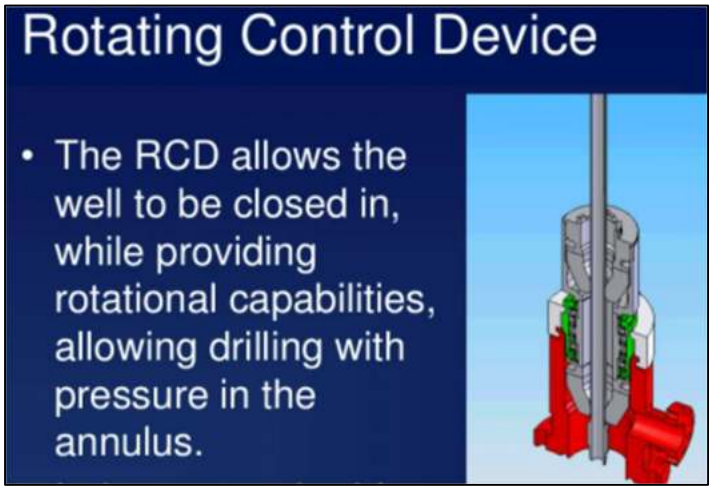


Figure 10 - Rotating Control Device (Source: Slideshare.net/SPE).

2.3.3.6 Well Abandonment (Plug and Abandonment "decommissioning")

Once drilling is completed, an unsuccessful well will be plugged and abandoned (P&A). The scope of well abandonment is to protect the environment by effectively sealing off all distinct permeable zones (i.e., the zones of potential hydrocarbons or water inflow penetrated by the well), to ensure that formation fluids are isolated, both within the wellbore and in annular spaces, and that their migration among different formations and/or up to the surface is prevented.

For unsuccessful wells, a cement plug setting job will be performed (**Figure 11**). The plugging and abandonment job will be final, in that no re-entry of the well is planned. The cement plugs are suitable to guarantee the effectiveness and integrity of the seal and are configured so that no future intervention and monitoring is required.

In the presence of a single permeable zone, the well will be isolated by means of at least one well barrier (plug). When the formation pore pressure from a permeable zone is expected to exceed the formation fracture pressure anywhere else in the open hole, two well barriers shall be present in order to prevent formation breakdown or underground blowout.

For each distinct permeable zone, two well barriers, referred to as "primary" and "secondary", shall be present in order to prevent also cross flow to surface or vice versa. As per industry best practice, the primary well barrier envelope will have a well barrier element set across or above the highest point of potential influx (top permeable zone or top perforations) or as close as reasonably possible to it. The secondary well barrier shall have a well barrier element set in such a way to guarantee the sealing of the permeable zone in case of failure of the first well barrier.

The RCD will be then retrieved, and the wellbore will be flanged capped.

The final program for well plugging and abandonment will be finalized after the end of drilling phase and log evaluation, in order to maximize the number and composition of plugs sealing in the single or multiple permeable zones discovered.

At the end of the plug and abandonment operations, the well schematic and wellhead location (including casings dimension, length, cement plug dimension and composition, pressure and inflow test results etc.) will be included in a final report submitted to PASA.

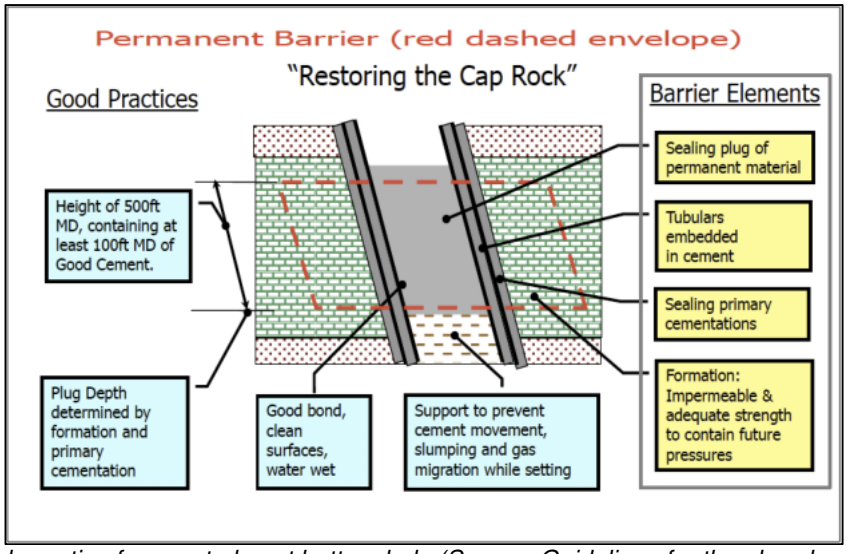


Figure 11 - Schematic of cement plug at bottom hole (Source: Guidelines for the abandonment of Wells, p12 OGUK, 2015).

2.3.3.7 Demobilisation

On completion of drilling, the drill rig and support trucks will leave the wellsite location. A final well site verification survey will be performed to check the condition of the wellsite.

2.3.4 HSE Risk Management During Operations

Rhino Oil & Gas's HSE (health, safety, environment) risk management will be implemented by the drilling contractor during operations. Rhino Oil & Gas is committed to protecting the health, safety and security of its employees and those of its contractors, to ensure that all activities are conducted in a manner that protects the environment and people who are potentially impacted by its operations.

2.3.5 Planned Emissions, Cuttings Handling And Waste Management

This section presents the main sources of emissions to air, cuttings handling and waste that will result from the planned drilling activities and associated operations.

Waste management will follow South African regulations. Appropriately licenced waste disposal sites and waste management facilities will be identified prior to commencement of drilling.

2.3.5.1 Emissions to air

The principal sources of emissions to air from the proposed drilling campaigns could be from three (3) main sources:

- Exhaust emissions from diesel fuel used to generate power on the drill site. The power will be used for operating truck mounted drill rig, air compressors, miscellaneous equipment;
- Exhaust emissions from diesel fuel used by the supply trucks. The local logistics base will be in the vicinity and will minimise commute length and emissions;
- Flaring activities during well testing. Based on regional analysis and analog wells, mainly biogenic gas (CH_4) with traces of Helium (He) and geologic hydrogen (H_2) will be encountered. This gas will burn clean emitting mainly carbon dioxide (CO_2) and water (H_2O). No other polluting contaminants are expected such as Hydrogen sulphide (H_2S) or Mercury (Hg).

The emissions from diesel fuel will essentially be carbon dioxide (CO_2), sulphur oxides (SOx), nitrogen oxides (NOx) and carbon monoxide (CO). Relative to these pollutants, smaller quantities of non-methane volatile organic compounds (VOCs), methane (CH_4) and particulate matter (PM_{10}/$PM_{2.5}$) will also be released. These emissions are released during the normal operation of a diesel engine and have the potential to result in a minor short-term localised increase in pollutant concentrations. They also contribute to regional and global atmospheric pollution.

It is estimated that approximately 7 to 15 m^3 of diesel fuel will be used during the operations of 1 well resulting in approximately 0.02 to 0.04 kt of Greenhouse Gas Emissions (GHG) emissions being emitted to the atmosphere (https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references#diesel).

The emissions from the flaring activities will essentially be carbon dioxide (CO_2), Helium (He) and water vapor (H_20). It is hard to predict a successful well flow performance ahead of a discovery. Based on regional analogues, flaring of 0.2 mmscfd of biogenic gas during 3 weeks of testing should generate approximately 0.23 kt of CO_2 GHG emitted to the atmosphere per well test. It is worth noting, that the biogenic gas (CH_4) explored in the ER area is currently leaching into the atmosphere and is up to 80 times more potent than its combusted version (CO_2). Flaring gas reflect safe operations and should be considered GHG efficient (https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-revision-history).

2.3.5.2 Cutting handling

For the first section (top hole) of the well, around 3 m^2 of topsoil will be picked up and dispersed in nearby field location. Once reaching deeper sections, the drilled rock formation will come back at surface in dust format while air drilling. Drilled rock formation if mud drilling will come back as cuttings. The overall volume is highly dependent on subsurface layering, overall depth to be drilled and the use or not of mud while drilling. In air drilling configuration, the volume of dust rock is estimated to be anywhere between 20 m^3 for 600 m deep well and to 40 m^3 to 1200 m deep well. Dust and Cuttings will be collected by Rhino Oil and Gas's

drilling contractor and then transported in adequate containers to already identified specialized landfill for hazardous materials safe disposal or as directed by South Africa regulations.

2.3.5.3 Water management

To be prepared for water/liquid management, the wellsite will be provided with lined up sumps. The sumps will be used to temporarily dispose of subsurface water or drilling mud (if any). In the sumps, the water and mud will split/decant, and the solids will fall to the bottom. The volumes of liquid will largely be recovered with sub aqueous pumps for future drilling use, the small remainder naturally evaporating over a certain period of time with the hot ambient temperatures experienced in the Free State. This efficient dehydration process allows to handle smaller residual quantities. The remaining material will then be removed and handled by a hazardous waste company already identified by Rhino Oil and Gas's drilling contractor.

If water is intersected down hole, the hole will be reamed, casing installed, and a grouting job completed to seal off the water. The water in the hole will follow the same process as above.

2.3.5.4 Waste management

A number of other types of wastes generated during the drilling activities be transported for disposal.

These wastes will be recycled or re-used if possible or transported and disposed of at an appropriate licensed municipal landfill facility or at an alternative approved site.

2.3.5.5 Noise emissions

The main sources of noise from the proposed drilling programme include noise produced by the power generator and air compressor at the drill site. The noise characteristics and level will vary between 80 and 180 dB. The particular activity being conducted changes the noise characteristics, for example, if it is at idle, or providing full power to the truck mounted drill rig.

2.3.6 Unplanned Emissions And Discharges

This section presents the main sources of emissions that will result from the unplanned/ accidental events during the drilling activities and associated operations.

2.3.6.1 Hydrocarbons and Chemical Spills

Two of the main types of unplanned/ accidental events that could occur while drilling wells that could result in a discharge of hydrocarbons or chemicals to the environment are loss of well containment and single event/batch spills.

Loss of well containment is a continuous release (in worst situation, with no control and massive release, it is called "well blowout") which could last for a measurable period of time, while a single-event spill is an instantaneous or limited duration occurrence. Rhino Oil and Gas is not expecting to find any liquid hydrocarbon (oil) but only to find dry biogenic gas (already covered in the emissions section). The downhole pressures recorded in regional analog wells do not indicate any risk for potential long-term release.

Rhino Oil and Gas is committed to minimising the release of hazardous chemical discharge into the environment and avoiding unplanned spills.

In case of unplanned/ accidental events, Rhino Oil and Gas minimises any adverse effects to the environment and plans to accomplish this goal by:

i) Incorporating chemical spill prevention into the drilling plans, and
ii) Ensuring that the necessary contingency planning has taken place to respond effectively in the event of an incident.

In addition, precautions are taken to ensure that all chemicals and petroleum products handled in a manner to minimise the potential for a spill and environmental damage in the event of an unplanned/ accidental release.

2.3.7 Project Alternatives

One of the objectives of an EIA is to investigate alternatives to the project. In relation to a proposed activity "alternatives" means different ways of meeting the general purposes and requirements of the proposed activity. Appendix 2 Section 2 (h)(i) of the EIA Regulations, 2014 (as amended), requires that all S&EIR processes must identify and describe alternatives to the proposed activity that are feasible and reasonable. Different types or categories of alternatives can be identified, e.g., location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The 'No-Go' or 'No project' alternative must also be considered.

Not all categories of alternatives are applicable to all projects. The consideration of alternatives is inherent in the detailed design and the identification of mitigation measures, and therefore, although not specifically assessed, alternatives have been and will continue to be considered in the design and EIA processes. Despite many advances in geophysical data acquisition and analysis, currently no alternatives exist to definitively establish the presence of hydrocarbon reserves other than through exploration drilling. No activity alternatives have therefore been assessed.

A summary is provided below of the alternatives considered for this application.

2.3.7.1 Site Locality Alternative

2.3.7.1.1 Drilling Location

Rhino Oil and Gas is the operator and holds Exploration Rights for ER 294.

Both aeromagnetic and gravimetric airborne surveys have been undertaken over blocks within ER 294 and possible Target Areas were identified. Based on the interpretation of the geophysical information, Rhino Oil and Gas have identified two Target Areas covering a limited area of ER 294, in which they are considering undertaking exploration drilling activities in order to determine the presence and viability of the reserve.

The selection of each drill site location will follow an iterative process based on:

- Lawful entitlement in terms of the MPRDA, namely the full extent of Rhino Oil and Gas's ER;
- Prospective geology identified as part of previous geophysical surveys;
- Desktop GIS environmental sensitivity taking into consideration hydrological, geohydrological, ecological and cultural heritage constraints and opportunities;
- Consultation with landowners to agree access to the proposed sites; and
- Micro siting by petroleum geologist and environmental specialists considering the local situation and landowner preferences.

The micro siting of proposed well drill sites will be concluded as part of this S&EIA process.

2.3.7.1.2 Logistics Base

A logistics base will be located near Welkom in vicinity to where the drilling contractor has enough momentum between its other local activities (shared facilities with Renergen). For drill sites that will be far away from that logistics base, an alternative base might be considered. This S&EIA will assess the impacts from a logistics base in Welkom.

There are no noticeable differences associated with the location of the logistic base in Welkom or more to the East towards Kroonstad.

2.3.7.2 Technology Alternative

2.3.7.2.1 Drilling Rig Alternatives

There is a range of drilling rigs available to conduct the drilling of a shallow onshore well. There are essentially 4 possible rigs to be considered:

- Coring drilling rig: usually used in mining type activities, not very efficient in handling hydrocarbons
- Percussion air drilling rig: usually used in drilling water wells, can be used in very low pressure hydrocarbons exploration but with limited ability to control well in un-expected kick situation
- Rotating mud drilling rig: usually used in traditional hydrocarbon drilling activities, can handle high pressure reservoir but totally inefficient in low pressure naturally fractured reservoir (mud circulation losses and reservoir clogging)
- Hybrid air/mud drilling rig: usually use for drilling water wells, can be used in very low pressure naturally fractured reservoir and ability to handle unexpected higher pressure with mud injection for well control

Rhino Oil and Gas's preference is to use the hybrid air/mud drilling rig provided by the local South Africa experienced drilling contractor.

2.3.7.3 Design or Layout Alternatives

2.3.7.3.1 Number of Wells

Rhino Oil and Gas proposes to drill:

1. At least 1 well within each Target Area;
2. A campaign of 10 initial wells for ER294;
3. With possible additional wells to supplement initial campaign in successful outcome

The time sequence and the number of additional wells will be dependent on the success of the first exploration well. Any additional wells will be drilled in a campaign with potentially up to 3 rig lines (parallel drilling).

2.3.7.3.2 Scheduling

The drilling of the first exploration well, is planned for 2023, dependent on drill rig availability, amongst a number of other planning requirements. The drilling of one well is estimated to take approximately 25 to 30 days to complete. The time sequence and the number of additional wells will be dependent on the results of the first exploration well and the interpretation of its results.

2.3.7.4 No-Go Option

The impact of the No-Go alternative is assessed in **Section 7** of this report, in accordance with the requirements of the EIA Regulations, 2014 (as amended). The No-Go alternative entails no change to the status quo, in other words the proposed exploration drilling activities will not be conducted in ER 294.

The option not to proceed with exploration drilling will leave the areas of the potential drilling sites in their current environmental state, with the biogenic gas, helium and geological hydrogen potential remaining unknown.

This alternative is in contravention of South Africa's overall strategic objectives with a No-Go (assuming a viable hydrocarbon source would be discovered) resulting in:

- No improved security of gas/power supply for both businesses and households;
- Not being able to make competitively priced locally produced natural gas available;
- No in-country investments in a development project with associated job creation, increased government revenues and general contribution to economic growth;
- Not being able to help with the transition to a low carbon economy to meet South Africa's Paris Agreement obligations, and
- Increased dependence on imported Liquified Natural Gas and coal for baseload power and industrial heat.

3 ASSESSMENT METHODOLOGY

The section below outlines the assessment methodologies utilised in the study.

3.1 Methodology for Assessing Heritage Site significance

This HIA report was compiled by PGS for proposed exploration drilling activities. The applicable maps, tables and figures are included, as stipulated in the NHRA (no 25 of 1999) and the National Environmental Management Act (NEMA) (No. 107 of 1998). The HIA process consists of three steps:

Step I – Literature Review and initial site analysis: The background information to the field survey relies greatly on the Heritage Background Research which was undertaken through archival research and evaluation of satellite imagery and topographical maps of the study area.

Step II – Physical Survey: A physical survey was conducted by a combination of vehicle and pedestrian access through the proposed project area by one qualified heritage specialist (29 November – 3 December 2022), aimed at locating and documenting sites falling within and adjacent to the proposed development footprint.

Step III – The final step involved the recording and documentation of relevant heritage resources identified in the physical survey, the assessment of these resources in terms of the HIA criteria and report writing, as well as mapping and constructive recommendations.

The significance of heritage sites is based on four main criteria:

- Site integrity (i.e. primary vs. secondary context),
- Amount of deposit, range of features (e.g., stonewalling, stone tools and enclosures),
- Density of scatter (dispersed scatter)
    - Low - <10/50m2
    - Medium - 10-50/50m2
    - High - >50/50m2
- Uniqueness; and
- Potential to answer present research questions.

Management actions and recommended mitigation, which will result in a reduction in the impact on the sites, will be expressed as follows:

A - No further action necessary;

B - Mapping of the site and controlled sampling required;

C - No-go or relocate development activity position;

D - Preserve site, or extensive data collection and mapping of the site; and
E - Preserve site.

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

3.1.1 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 3** and **Table 4**).

Table 3 - 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
IIIC	Such a resource is of contributing significance.	Resource must be satisfactorily studied before impact. If the	Low Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
		recording already done (such as in an HIA or permit application) is not sufficient, further recording or even mitigation may be required.	
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 4 - 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. These are heritage resources which are significant in the context of an area.	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 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.	High Significance
IIIB	Such a resource might have similar significances to those of a Grade III A resource, but to a lesser degree. These are heritage resources which are significant in the context of a townscape, neighbourhood, settlement or community.	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	Medium Significance

Grading	Description of Resource	Examples of Possible Management Strategies	Heritage Significance
		IIIA buildings and sites at local level.	
IIIC	Such a resource is of contributing significance to the environs These are heritage resources which are significant in the context of a streetscape or direct neighbourhood.	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. 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.	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 and approved by the authority. Section 34 can even be lifted by HWC for structures in this category if they are older than 60 years.	No research potential or other cultural significance

3.2 Methodology used in determining the significance of environmental impacts

The methodology used to determine the environmental impact significance was provided by SLR and is explained in **Appendix B**.

4 CURRENT STATUS QUO

A site visit was conducted by Dr Matt Lotter, a geoarchaeologist, between 29 November – 3 December 2022. The general vicinity of the proposed well sites were assessed.

The proposed exploration drilling activities are located between Steynsrus and Edenville in the Free State Province. Fieldwork focussed on areas that were not previously disturbed, thus focussing on areas with the highest potential to yield heritage resources.

The study area can be accessed via the R34, R76, R720 and informal roads. The study area is in a relatively rural area where much of the farmland is used for grazing and crop cultivation. Portions of the study area have been disturbed by activities associated with agriculture. In terms of the climate, the region experiences summers that are long and warm and winters that are short, dry, and cold.

In terms of the vegetation, the Vegetation type is classified as Central Free State Grassland (Mucina & Rutherford, 2006; Sanbi, 2022). **Central Free State Grassland** (Gh6) vegetation is characterised by "*Undulating plains supporting short grassland, in natural condition dominated by Themeda triandra while Eragrostis curvula and E. chloromelas become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with clayey soils prone to Acacia karroo encroachment.*" (Mucina & Rutherford, 2006).

In terms of geology and soils, the area is characterised by the Balfour Formation (Greenish- to bluish-grey and greyish-red mudstone, siltstone, subordinate sandstone) and the Karoo Dolerite Suite (Dolerite, minor ultrabasic rocks) (Council of Geoscience, 2022).

It must be noted that one alternative well location (waypoint: 017) was proposed based on various specialist observations. This alternative well location will also be discussed within the report.

The general site descriptions and photographs of the proposed well locations are provided as follows:

ER294_Traget Area_4_02:

Open flat grassland running alongside large powerlines. Landscape dips south towards farm storage dam and drainage line. Grazing and cropland to the south and east. Vehicle survey completed on the 'less disturbed' western portion of land under the powerlines and down towards the drainage line.

Figure 12 – View of existing powerlines.

Figure 13 – View of cattle grazing.

Figure 14 – View of the predominately flat open grassland.

Figure 15 – View of local sandstone bedrock outcrops in the area.

Alternative well location (**waypoint 017**) proposed near ER294_Traget Area_4_02:

Undulating open grassland with small bushes. Poor surface visibility due to dense grass.

Figure 16 - General images of newly proposed well location (017).

ER294_Traget Area_4_03:

Undulating open grassland. Good landscape visibility but poor surface visibility due to dense grass. Small sandstone outcrops occur across the property.

Figure 17 – Views of the open and undulating landscape.

Figure 18 - View of sandstone outcrop.

ER294_Traget Area_4_04:

This proposed well locality is located approximately 97m to the west of ER294_Traget Area_4_03 in a similar undulating open grassland setting.

ER294_Traget Area_5_01:

Undulating open grassland with good landscape visibility. Poor surface visibility due to grasses. Property slope to the SW towards a drainage line. Disturbed cropland occurs to the north. Vehicle survey done down to drainage line to see if there were archaeological deposits (none identified).

Figure 19 - General views of the area surrounding the proposed well ER294_Traget Area_4_04.

ER294_Traget Area_5_02:

Flat, open grassland dissected by two dirt roads. Good landscape visibility but poor surface visibility due to dense grasses. Cropland to the west and 'less disturbed' grasslands to the east, the latter of which were likely agricultural fields at some point.

Figure 20 - General views of the area surrounding the proposed well ER294_Traget Area_5_02.

5 BACKGROUND RESEARCH

The previous section provided a topographical description of the proposed development area. This section seeks to describe the historical origins of the receiving environment.

The examination of heritage databases, historical data and cartographic resources represents a critical additional tool for locating and identifying heritage resources and in determining the historical and cultural context of the study area. Therefore, an internet literature search was conducted, and relevant archaeological and historical texts were also consulted. Relevant topographic maps and satellite imagery were studied.

5.1 Archival and historical maps

Topographic maps (1:50 000) for various years (1959, 1960, 1963, 1970, 1975, 1978, 1986, 1997), were available for utilisation in the background study. These maps were assessed to observe the development of the area, as well as the location of possible historical structures and burial grounds. The study area was overlain on the map sheets to identify structures or graves situated within or immediately adjacent to the study area that could possibly be older than 60 years and thus protected under Section 34 and 36 of the NHRA.

The topographical maps which were relevant to this study included: 2727DC STEYNRUS, 2727CD WONDERKOP and 2727DA EDENVILLE.

The analysis of the topographical maps demonstrates that the majority of the proposed well locations have been for the most part been within and surrounded by agricultural lands through the years.

There were several structures, homesteads and farmsteads identified within the wider vicinity of some of the proposed well locations. These will be illustrated in the enlarged sections of map sheets below.

1.1.1 1: 50 000 Topographical Map 2727CD WONDERKOP- First Edition 1960

A section of the First Edition of the 2727CD Topographical Sheet is depicted in **Figure 21**. The map was compiled from aerial photography undertaken in 1951, surveyed in 1960 and drawn in 1962 by the Trigonometrical Survey Office.

Farmsteads, structures and homesteads were identified within the surroundings of the study area. All these identified sites are likely to be at least 63 years old.

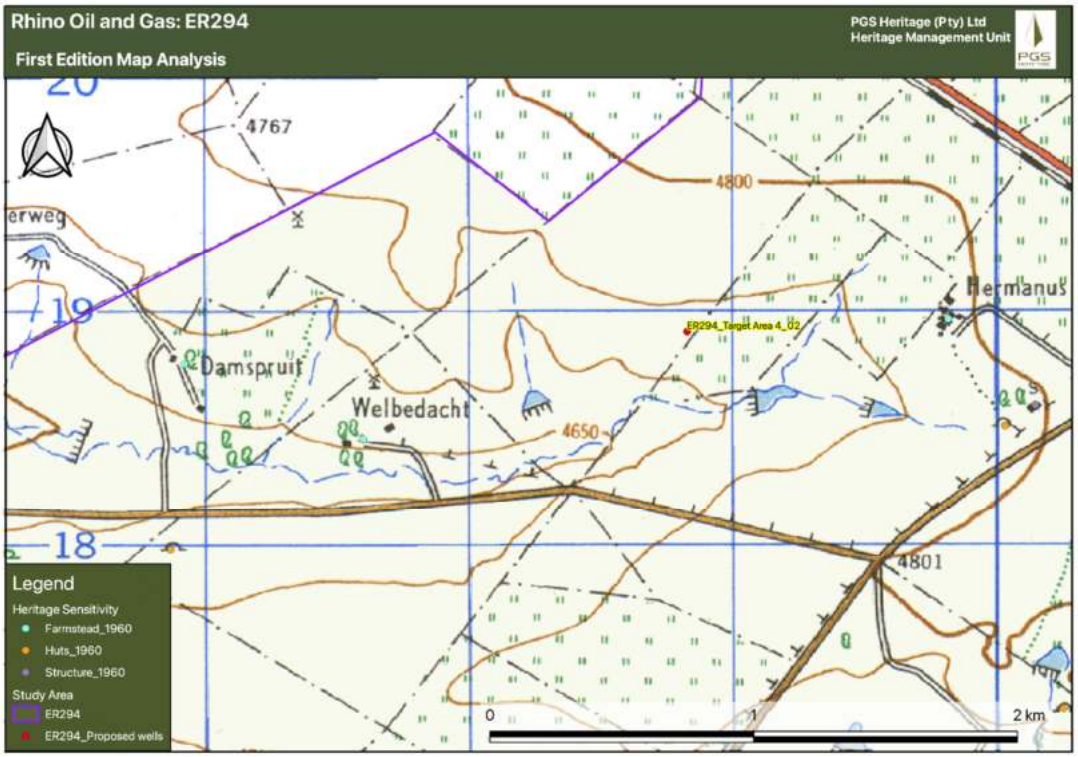


Figure 21 - Enlarged section of 2727CD Ed 1 1960 sheet, depicting homesteads (orange polygon), structures (purple polygon) and farmsteads (cyan polygon) in the distant surroundings of the proposed well ER294_Traget Area_4_02.

5.1.1 1: 50 000 Topographical Map 2727DA EDENVILLE- First Edition 1963

Two sections of the First Edition of the 2727DA Topographical Sheet are depicted in **Figure 22**. The map was compiled from aerial photography undertaken in 1959, surveyed in 1963 and drawn in 1964 by the Trigonometrical Survey Office.

Farmsteads and homesteads were identified within the surroundings of the study area. All these identified sites are likely to be at least 60 years old.

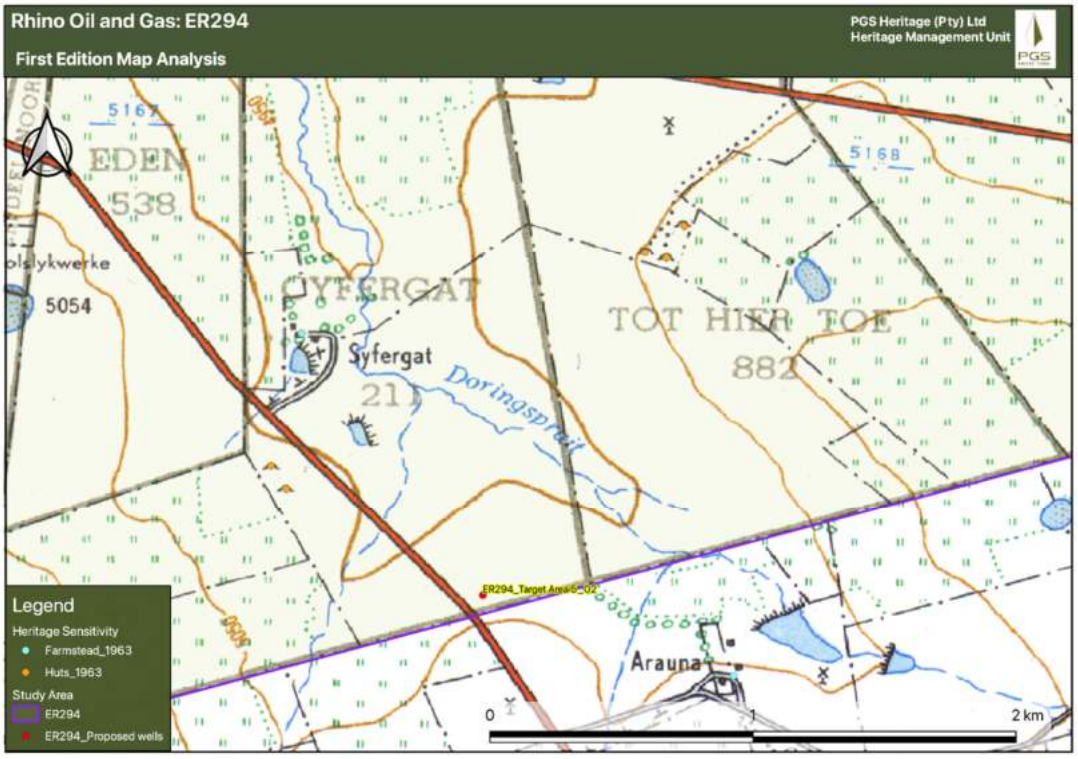


Figure 22 - Second section of 2727DA Ed 1 1963 sheet, depicting homesteads (orange polygon) and farmsteads (cyan polygon) in the distant surroundings of the proposed well BVanEeden_4.

5.2 Historical Overview of the Study Area and Surrounding Landscape

The high-level archival research focused on available information sources that were used to compile a general background history of the study area and surrounds.

The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter- gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915).

The archaeological history of the area can broadly be divided into a Stone Age, Iron Age and Historic Period. Both the Stone and Iron Ages form part of what is referred to as the Pre-Colonial Period (Prehistoric Period) whereas the Historic Period is referred to as the Colonial Period (Historic Period).

It must be noted that such an overview, which is based on available literature and archival research, would necessarily reflect a bias toward a traditional white history of the region as this would have been the focus of publications and archival documents during the last 150 years.

Table 5 - Archaeological and Historical Overview of the Study Area and Surrounding Landscape

DATE	DESCRIPTION
The Study Area during the Stone Age	
2.5 million – 250 000 years ago	The Earlier Stone Age is the first and oldest phase identified in South Africa's archaeological history and comprises two technological phases. The earliest of these is known as Oldowan and is associated with crude flakes and hammer stones. It dates to approximately 2 million years ago. The second technological phase is the Acheulian and comprises more refined and better made stone artefacts such as the cleaver and bifacial hand axe. The Acheulian dates to approximately 1.5 million years ago. *No ESA sites are known from the vicinity of the study area. Stone Age material has been identified within the vicinity of rivers such as the Doring Spruit (north of Kroonstad), the Vals River (south of Kroonstad) and the Sand River (south of Ventersburg).*
250 000 to 40 000 years ago	The Middle Stone Age is the second oldest phase identified in South Africa's archaeological history. This phase is associated with flakes, points and blades manufactured by means of the so-called 'prepared core' technique. *No MSA sites are known from the vicinity of the study area*
40 000 years ago to the historic past	The Later Stone Age (LSA) is the third archaeological phase identified and is characterised by an abundance of very small stone tools known as microliths as well many rock art sites across the country. This period is associated with hunter-gatherers (San) as well as early pastoralists (Khoekhoe) and lasted up until - and in many cases a considerable number of years after – the arrival of Iron Age and European communities. *No LSA sites are known from the vicinity of the study area*
The Study Area during the Iron Age	
The arrival of early farming communities during the first millendium, heralded in the start of the Iron Age for South Africa. The Iron Age is that period in South Africa's archaeological history associated with pre-colonial farming communities associated with agricultural and pastoralsit farming activites, metal working, cultural customs such as lobola as well as the tangible representation of the significance of cattle imprinted on their settlement layouts (known as the Central Cattle Pattern) (Huffman, 2007). LIA sites are known to occur in the region, in the vicinity of the Sandrivier and to the northwest of Ventersburg. According to the distribution map for Iron Age settlements on the Southern Highveld as published in Maggs (1976), the largest majority of such known Late Iron Age sites are located in proximity to the Sand River as well as the Erasmus Spruit. With these Late Iron Age sites located south-west of the study area, the majority comprise what is referred to as Type Z settlements, with a lesser number of Type V settlements also found. The distribution maps as published by Huffman (2007), indicate that two Iron Age facies occurred in the surroundings of the study area during roughly the same period. These two Iron Age facies, known as Thabeng and Makgwareng, will be presented here.	

AD 1700 – AD 1840	The Thabeng facies of the Moloko Branch of the Urewe Tradition is one of the facies identified within the study area. The decoration on the ceramics associated with this facies is characterised by incised triangles, coloured chevrons and arcades. The Tlhaping at Dithakong, Rolong at Platberg and the Kubung from the Free State form a Southwestern Sotho-Tswana cluster that is associated with this Thabeng facies pottery and Type Z settlement layouts (Huffman, 2007). The Type Z settlements are one of the Late Iron Age stonewalled settlement types identified by Tim Maggs during his extensive archaeological research project on the Iron Age of the southern Highveld, which includes the present study area (Maggs, 1976). These sites are characterised by large primary enclosures enclosed by a 'discontinuous ring' of characteristic bilobial dwellings. Each of these bilobial dwellings comprises a hut at its front with a semi-circular courtyard at the back. With the area in front of the hut enclosed by a low stone wall and the courtyard at the back similarly enclosed by a smaller enclosure, the layout plan of these huts comprise two lobes, one larger than the other. The huts are defined by a ring of upright stones and are usually paved with flat stones. Unlike Type V settlements (see below), corbelled hut are rarely associated with these Type Z settlements, and appear to be the result of contact with the Type V settlements located to the east. While a number of Type Z sites are located within the surroundings of the study area, one of the more prominent ones is OXF1, located a short distance north-west of the town of Ventersburg. This site was excavated by Tim Maggs during the 1970s as part of his overall research project alluded to above (Maggs, 1976). In his conclusions on the history of his entire study area, Maggs (1976:317) states that "*…the conclusion seems inescapable that the Kubung were the builders of Type Z. This conclusion could be put forward on the typological evidence alone, for the Kubung are the only known off-shoot of the Rolong to have settled in our area, and the Type Z industry was clearly the work of a group related to the Rolong*."

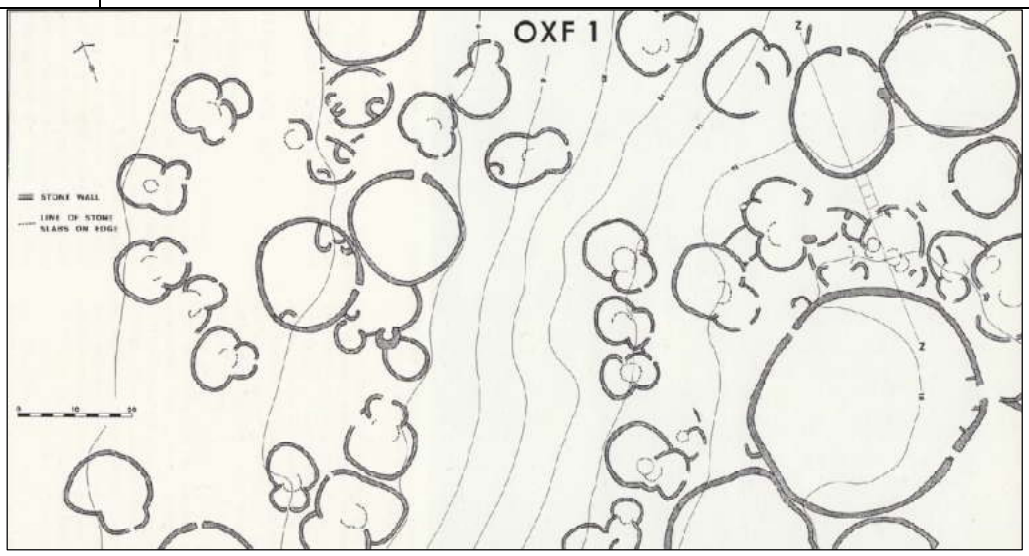


Figure 23 - This plan depicts the settlement layout of a typical Type Z site, and was recorded at site OXF 1 (Maggs, 1976:233).

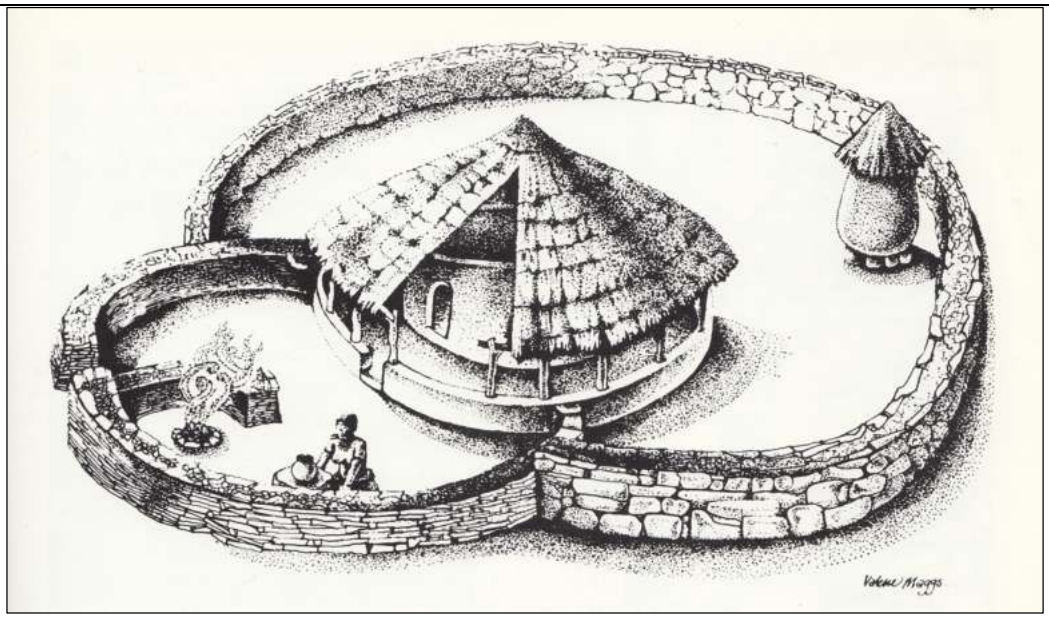


Figure 24 – Artist's impression of a bilobial dwelling at site OXF 1. These bilobial dwellings represent a characteristic element of Type Z settlements (Maggs, 1976:241).

AD 1700 – AD 1820	The Makgwareng facies of the Blackburn Branch of the Urewe Ceramic Tradition represents the next known Iron Age period within the surroundings of the study area. The decoration on the ceramics from this facies is characterised by finely stamped triangles, rim notching and appliqué (Huffman, 2007). This facies developed from Ntsuanatsatsi south of the Vaal River and can be associated with the Type V stone walling settlement type (Huffman, 2007), the name of which is derived from Vegkop (Maggs, 1976). Van Riet Lowe (1927) was one of the first to record these structures. Dreyer (1990) also conducted excavations on Type V Late Iron Age stonewalled settlements located a short distance south-west of Winburg. The Type V settlements comprise a core of cattle enclosures surrounded by beehive huts. Corbelled stone huts are associated with this walling type, and can be seen as characteristic. They are low stone huts located at the edge of the cattle enclosures and were where the boys herding the cattle often lived (Huffman 2007). As suggested by Huffman (2007), the corbelled huts were in fact beehive huts made of stone rather than grass and reeds. Furthermore, the presence of beehive huts at these sites necessarily indicates a Nguni association or origin with these settlements. Based in information presently available, the best known site of this type found within the surroundings of the study area, comprises a so-called "Early Sotho Settlement, Waterval, Sandrivierhoogte" that was originally declared a National Monument and which is now registered as a Provincial Heritage Site. The site is located 60 km south-west of the present study area. The site was proclaimed a national monument by virtue of a notice in the Government Gazette on 17 December 1982. In the declaration, the site is described as a 'Leghoya Village' comprising corbelled huts and stonewalls. The site has since been declared a Provincial Heritage Site in terms of the National Heritage Resources Act (www.sahra.org.za).

Figure 25 – Corbelled stone huts associated with a Type V settlement (Huffman, 2007:39).

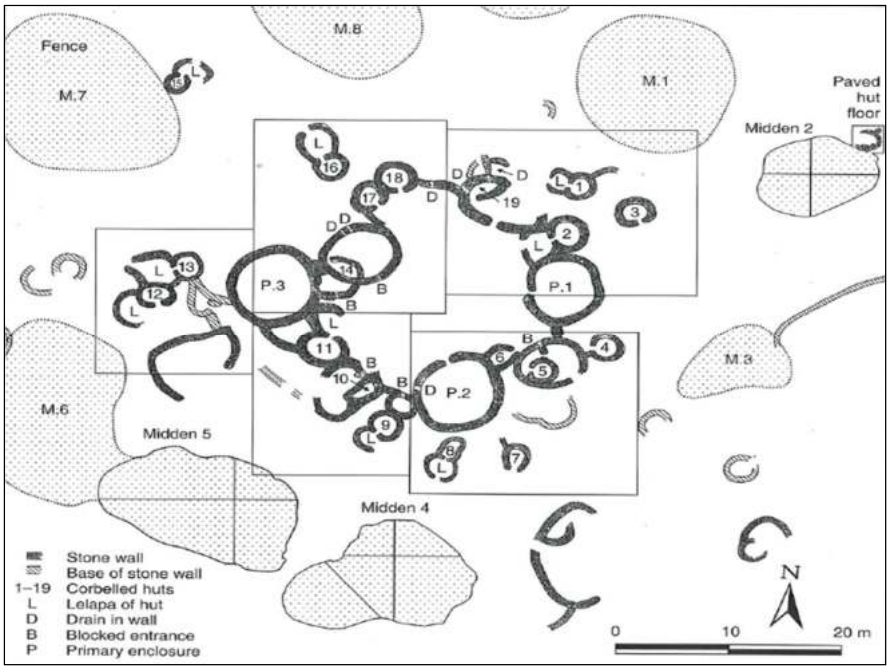


Figure 26 – Layout of a Type V Settlement (Huffman, 2007:38).

1820s	Across the Southern Highveld, this period was characterised by warfare and unrest. Known as the Mfecane, these years of upheaval originated primarily in the migration of three Nguni groups from present day Kwazulu-Natal into the present day Free State as a result of the conquests of the Zulu under King Shaka. The three Nguni groups were the Hlubi of Mpangazitha, the Ngwane of Matiwane and the Khumalo Ndebele (Matabele) of Mzilikazi. In c. 1821, the Hlubi migrated across the Drakensberg Mountains in a westerly direction (Maggs, 1976) and attacked the Tlokwa of MaNthatisi along the banks of the Wilge River. This river has its source near Harrismith and flows into the Vaal River where the Vaal Dam is located today. While it is not exactly certain where MaNthatisi's

	settlements would have been located (in all likelihood further south), the Tlokwa fled westward as a result of the Hlubi attack and in turn attacked other groups in its path. This started a period of unrest and warfare, which rippled across the Highveld on both sides of the Vaal River (Legassick, 2010) (Lye and Murray, 1980). The Ngwane followed closely on the Hlubi and further augmented the unrest and warfare along the southern Highveld (Legassick, 2010). Although the effects of the migrations of the Hlubi and Ngwane would certainly have had a profound impact on the northern Free State, this was also the case in terms of the Khumalo Ndebele who would have played a significant role in the surroundings of the study area during this time. The Khumalo Ndebele (also known as the Matabele) were also forced to leave Kwazulu-Natal and between 1823 and 1827 settled along the central Vaal River (Bergh, 1999). Mzilikazi attacked a number of Sotho-Tswana groups and settlements and incorporated them into his kingdom. As a result, his activities would have had a definite impact on the northern Free State at the time.

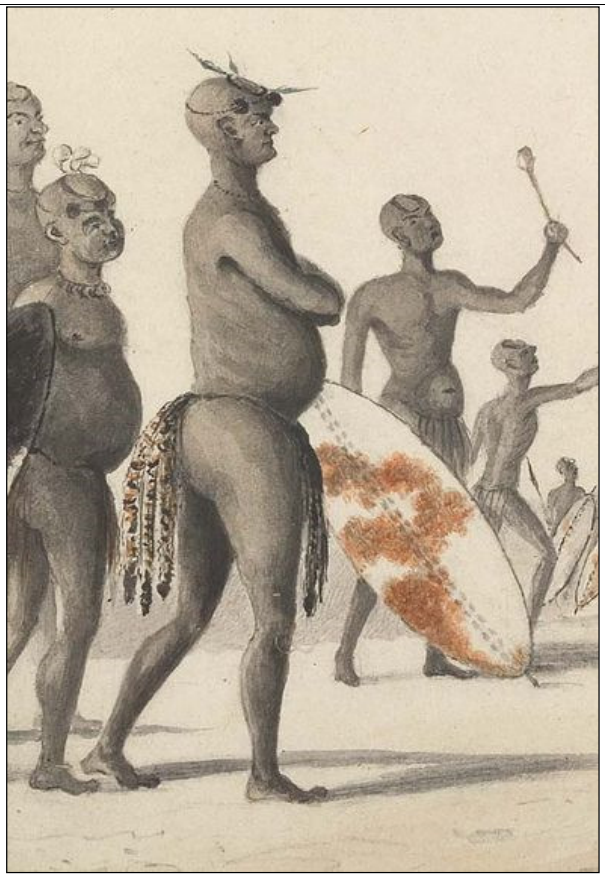


Figure 27 - King Mzilikazi of the Matabele. This illustration was made by Captain Cornwallis Harris in c. 1838 (www.sahistory.org.za).

The Early Colonial Period

The early Colonial Period within the study area and surroundings was characterised by the arrival of newcomers to the Transoraniga. The first arrivals were the Griqua followed by white Trekboers, who for the most part practiced a nomadic pastoralist way of life and were small in number. During the 1830s a mass migration of roughly 2 540 Afrikaner families (comprising approximately 12 000

individuals) from the frontier zone of the Cape Colony to the interior of Southern Africa took place. The people who took part in this Great Trek were later to be known as Voortrekkers (Visagie, 2011).	
1804	The Griqua were of European and Khoikhoi descent, and although they had been present on the Orange River for some time, they only established themselves permanently north of the river in 1804 when they settled near present-day Danielskuil (Reader's Digest, 1994).
Early 1800s	During the early 1800s, frequent droughts forced white farmers from the Cape Colony to move with their livestock across the Orange River to look for better grazing. Initially, these Trekboers first obtained permission from the Cape authorities before departing across the frontier, however with time, increasing numbers of Trekboers moved across this river into the Transorangia (as it became known) without any prior permission (Schoeman, 1980).
Early 1836	The first Voortrekker party of some 70 wagons crossed over the Orange River during early 1836. More groups followed and in terms of the surroundings of the study area, established themselves along the Vet River (Schoeman, 1980). Meintjies (1973) mentions that a Voortrekker party under Hendrik Potgieter arrived along the Vet River during this time. The grazing around the Vet River was not enough for all the livestock and animals of the Voortrekkers, so they split into smaller groups with one group establishing itself in May 1836 at Blaaudrift, on the Zand River. Apart from this historic event, the closest known tangible evidence for the Voortrekkers was a fort which they built on the northern bank of the Zand River on the farm Du Preez Leger.
1837 - 1843	In 1841 the town of Winburg was established on the banks of the Vet river. After the annexation of Natal by the British in 1843 and the subsequent dissolution of the Voortrekker Republic of Natalia, Winburg became the capital of the Voortrekkers in what is today known as the Free State (Erasmus, 2004). Winburg is located 84 km south-west of the study area. On 10 October 1968, an extensive Voortrekker Monument was opened near Winburg (www.artefacts.co.za).
 *Figure 28 – Depiction of an ox wagon crossing a river during the Great Trek (Reader's Digest, 1994:116).*	
The Mid to Late Nineteenth Century	
3 February 1848	The Orange River Sovereignty was proclaimed over the Transorangia by Great Britain and had its capital at the newly established town of Bloemfontein (www.wikipedia.org). The sovereignty came about after one-sided agreements that favoured the British Government had been reached between Great Britain on the one hand and King Moshesh of the Basotho and Adam Kok III of the Griqua on the other. Those Voortrekkers present in the Transorangia were completely by-passed by these agreements, which led to serious dismay and disappointment amongst them. In terms

	of the surroundings of the study area, the response of the Voortrekkers was to force the British magistrate at Winburg, one Thomas Biddulph, out of town and proclaim the Republic of Winburg (Reader's Digest, 1994).
16 January 1852	On 16 January 1852 the Sand River Convention was signed between the British Government and the Transvaal Boers. The British Government was represented by British Assistant Commissioners W.S. Hogge and C.M. Owen, whereas the Transvaal Boers were under the leadership of the Voortrekker hero of Blood/Ncome River, General Andries Pretorius. This convention formally recognised the existence and independence of the Boer Republic north of the Vaal River by the British Government. As a result, this agreement allowed for the creation of a Boer Republic, namely the *Zuid-Afrikaansche Republiek* (South African Republic) (Oberholster, 1972). The *Zuid-Afrikaansche Republiek* remained in existence until the end of the South African War in 1902. The site where the signing of the convention took place, was declared a monument and for many years was marked by a stone cairn and plaque (Oberholster, 1972). The present condition of the monument is not known. The site is located near the bridge where the N1 highway passes over the Sand River.
23 February 1854	The Orange River Convention was signed by representatives of Great Britain and the Boers, and resulted in the proclamation of the Boer Republic of the Orange Free State. The convention was signed at Bloemfontein (www.wikipedia.org). As with the proclamation of the Soverignty, the Orange River Convention was again one-sided and did not obtain the blessing or inputs of all the major role-players in the Free State. While the Voortrekkers were excluded in 1848, the signing of the Orange River Convention in 1854 did the same to the Basotho and Griqua. For the next 48 years, the study area fell within the boundaries of the Boer Republic of the Orange Free State. Incidentally, the Orange River Convention is sometimes referred to as the Bloemfontein Convention.
1872	The town of Ventersburg was laid out on the farm Kromfontein in 1872. Kromfontein had originally belonged to one of the early Voortrekker leaders, namely Field-Cornet P.A. Venter. After his death in 1857, his son B.G. Venter allowed church services to be held in his father's homestead. The second Gereformeerde (Dopper) church north of the Orange River was also established at Kromfontein in 1859. The use of the farm for church services led to the establishment of a town. The new town was named after Field-Cornet P.A. Venter, and formal proclamation for Ventersburg took place in 1876 (Erasmus, 2004). Ventersburg is located 42 km south-west of the present study boundaries.
1890	Erasmus (2004) states that two American engineers were responsible for the original survey of sections of the proposed railway line between Bloemfontein and Johannesburg. On the farm Merriespruit they chiselled the name 'Virginia' on a boulder, presumably in honour of the American State of Virginia. When the railway line was built a few years later, the nearby railway siding was named Virginia and some years later, in 1954, the town of Virginia was also established. The exact position of the chiselled boulder, if it still exists today, is not presently known.
Early 1890s	The railway line between Bloemfontein and Johannesburg was built during the early 1890s, and eventually reached Johannesburg during September 1891 and Pretoria in January 1892 (Schoeman, 1980). In terms of the study area, this railway line passed to its east and in this area was built from Smaldeel (present day Theunissen) to Theron, Welgelegen and Virginia.

9 November 1892 – 1899	The Driekopjes Diamond Mining Company was registered. One of the founding directors of the company was the man who would become synomynous with South African diamond mining and diamonds, Sir Thomas Major Cullinan. The "Driekopjes" in the name of the company referred to a farm of that name north-west of Kroonstad, where diamond mining was taking place. In June 1894 the Driekopjes Diamond Mining Company also acquired an interest in the farm Welgegund from the Van Rensburg Diamond Mining Syndicate. The farm Welgegund was located within the study area, and is presently known as the farm Driekoppies 422. No information could be found on this syndicate. However, the fact that the Driekopjes Company acquired an interest from the Van Rensburg syndicate, suggests that diamond prospecting and possibly mining activities had taken place within the surrounding region before this transfer took place. A large number of diamonds were subsequently recovered from Welgegund. However all mining activities came to a halt with the South African War (1899 – 1902) (Helme, 1974).
Mid 1890s	During the mid 1890s two men arrived on the farm Aandenk to undertake prospecting work. Alexander Edward King Donaldson was a prospector and his associate Herbert Hinds an engineer. They excavated an 18-meter-deep shaft and took samples from their excavations for further testing and analysis. On their return journey to England, both men died when their ship, the Drummond Castle, wrecked at Ushant off France, and with it the samples they had brought from the Free State (www.sahra.org.za) (Felstar Publishers, 1968). The activities of these two men laid the foundation for the discovery and development of the Free State Goldfields. The farm Aandenk is located immediately south of Allanridge today.
The South African War (1899 – 1902)	
The discovery of diamonds and gold in the northern provinces between 1867 and 1886 had very important consequences for South Africa. After this discovery, the British, who at the time had colonized the Cape and Natal, had intensions of expanding their territory into the northern Boer republics. This led to the Anglo-Boer War (Du Preez 1977). The South African War was fought between the Boer Republics of the Transvaal and Free State on the one side and Great Britain on the other, but is referred to as the South African War as the victims and participants of the war were not excluded to Britain or Boer alone. As will be discussed in more detail below, the march of Lord Roberts from Bloemfontein to Pretoria in May and June 1900 was especially significant in terms of the study area. In particular, the so-called Battle of Zand River (7 – 10 May 1900) was fought in the surroundings of the study area.	
13 March 1900 – 6 May 1900	Bloemfontein, the capital of the Boer Republic of the Orange Free, was occupied by the British Army under Lord Roberts on 13 March 1900. The Boer Republic of the Orange Free State was renamed the Orange River Colony. President M. T. Steyn declared Kroonstad the new capital of the Free State government. It simultaneously became the organizing center for retreating Boer commandos. With the Republican forces of the Transvaal and Free State retreating northwards from Bloemfontein, Lord Roberts's eyes drifted further north, where the greatest prize of the war lay waiting, Pretoria. Lord Roberts and his staff strongly believed that once the capital of the *Zuid-Afrikaansche Republiek* fell, the war would be over. However, the success of the British Army required all focus on the immediate front, as the land between Bloemfontein and Pretoria was bisected by a myriad of rivers, dongas and hills, all strategically significant obstacles from where the Boer forces could implement a solid defence. The Boer forces standing between Lord Roberts and Transvaal capital were estimated by British Intelligence to comprise two main groups namely a force of between 5 000 to 6 000 burghers with 18 guns under General Louis

	Botha and a similarly large force in the surroundings of Kroonstad (Maurice & Grant, 1906). After departing from Bloemfontein, Lord Roberts's force was involved in a couple of successful actions on their way to Pretoria, including Brandfort (3 May 1900) and Vet River (4 - 6 May 1900). With the successful conclusion of the battle of Vet River, Lord Robers and almost his entire army crossed over the river successfully, and by the evening of 6 May 1900 bivouacked at the small railway siding known as Smaldeel. The town of Theunissen is located here today (Maurice & Grant, 1906). A short distance to the north lay the next, and far more daunting, obstacle on Lord Roberts's march to Pretoria, the Zand (or Sand) River. It was here, at this river, that General Louis Botha, the commanders-in chief of the Transvaal republican forces, was determined to halt Lord Roberts's march on Pretoria. Kroonstad remained the Free State capital until 11 May 1900, when the British were victorious at Zand River. Kroonstad remained in British hands for the rest of the war, and housed concentration camps for both Boer civilians and black people (Pretorius 2010: 225-226).

Figure 29 – Lord Frederick Sleigh Roberts (left) and General Louis Botha (right). These two officers commanded the opposing forces at the Battle of Zand River (Changuion, 2001:77 & 117).

7 – 10 May 1900	On 7 May 1900 a reconnaissance of the Zand River by General Edward Hutton indicated that the northern bank of the river was held by a force of roughly 6 000 Boers supported by two heavy and eight light pieces of artillery. These estimates provided by General Hutton allowed Lord Robers to draw up a battle plan (Maurice & Grant, 1906). On the 9th of May 1900, Lord Roberts moved his army forward and established his headquarters at the Welgelegen Station. The movement of the British Army under Lord Roberts from a position a short distance south of the study area at Smaldeel to a position a short distance east of

	it, suggests that the main component of Lord Roberts's force followed the railway line and in this way skirted around the region. Lord Roberts's battle plan focussed on securing significant drifts that provides safe crossing of his infantry over the Zand River, and especially so Junction Drift, Merriespruit, Du Preez Leger Drift (located where the bridge on the road between Theunissen and Welkom crosses the river) and De Klerks Kraal Drift. For the purposes of this discussion, the events associated with the latter two of these drifts will be discussed in more detail below. On the morning of 9 May 1900, Lieutenant-Colonel Thomas William Porter with the 1s Cavalry Brigade departed from Smaldeel to reconnoitre the two drifts at Du Preez Leger and De Klerks Kraal. They were assisted in this task by Major-General J.B.B. Dickson with the 4th Cavalry Brigade. Meanwhile, at 11 am, Major-General John French with his advance guard reached Kalkoenkrans. At Kalkoenrkans, French received word from the reconnaissance units on the river that the Du Preez Leger Drift was not held by the enemy. Seizing the opportunity to outflank the Boer positions, French immediately ordered a squadron of the Scots Greys forward to take possession of the drift, and ordered the remainder of the 1st Cavalry Brigade to follow and assist in this task. The 4th Cavalry Brigade was left at Kalkoenkrans in support. By 15h30 that afternoon the Du Preez Leger Drift was occupied by the British force, with the De Klerks Kraal Drift was taken shortly thereafter. Incidentally, the other significant drifts on the river had also been taken with similar ease. On the morning of 10 May 1900, Lord Roberts's army advanced on the river. On its left flank General French with the 1st Cavalry Brigade, the 4th Cavalry Brigade as well as Hutton's Mounted Infantry, crossed over the Du Preez Leger Drift from where they moved in a north-eastern direction. On the left centre of the front, the 3rd Cavalry Brigade and Henry's Mounted Infantry crossed over the drift at the railway line in proximity to present-day Virginia. The northern bank was occupied by 8 am that same morning. The crossing of the drifts further to the east was achieved with more difficulty, but the northern banks were also occupied a mere half an hour after the crossing over the Merriespruit Drift near the railway line. This meant that Lord Roberts's front comprising cavalry and mounted infantry units had successfully crossed over the Zand River early on the morning of 10 May 1900, without meeting any significant resistance. However, the fortunes of war were about to change for Lord Roberts. A patrol sent out by General French ran into a large Boer force of between 2 000 and 3 000 burghers moving down onto the centre of Lord Roberts's front at the Virginia Station. French ordered an attack by one squadron each from the 6th Inniskilling Dragoons, Scots Greys and Australian Horse and two troops from the 6th Dragoon Guards (Carabiniers). Their attack was focussed on the centre of the advancing Boer force on a ridge located on the farm Vredes Verdrag. Suffice to say that the battle raged for some time and the outcome was not at all clear until 14h00 that afternoon when the Boers abandoned the field of battle, allowing the British to occupy the ridge and proceed forward (Maurice & Grant, 1906). Further battles and actions took place to the east, near Junction Drift. However, by the afternoon of 10 May 1900, all the drifts had been successfully cleared and occupied to allow for the crossing of the Zand River by Lord Roberts's infantry (Maurice & Grant, 1906).

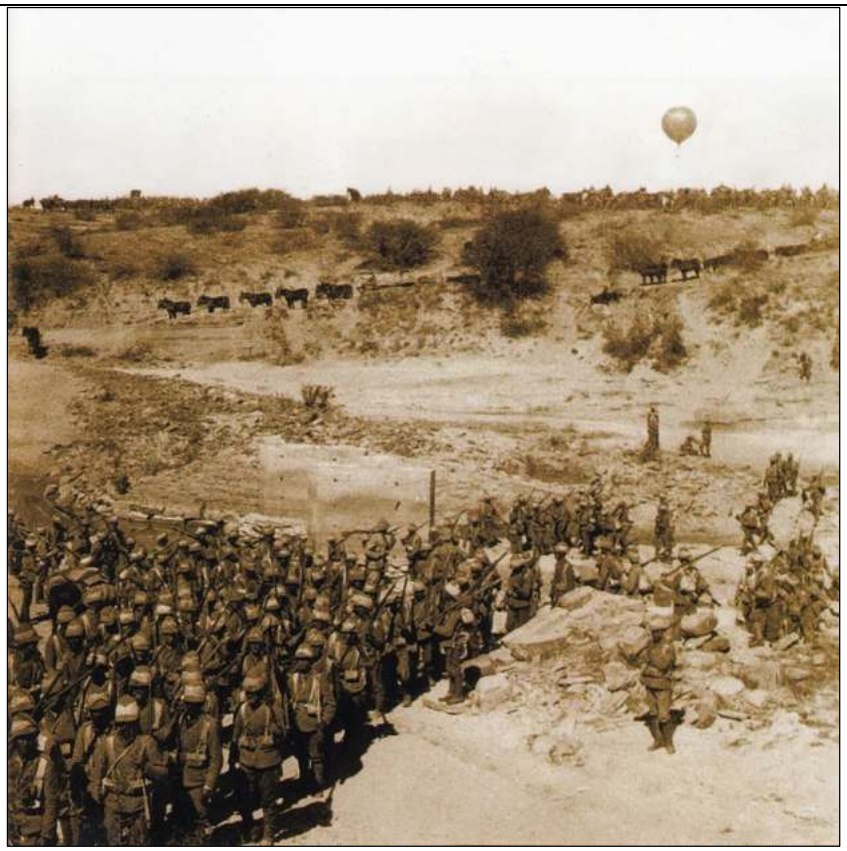


Figure 30 – Lord Roberts's infantry crossing the Zand River at the conclusion of the Battle of Zand River. This photograph was in all likelihood taken during the afternoon of 10 May 1900, after all the significant drifts across the river had been cleared by the cavalry and other units. The crossing and surrounding landscape are monitored by an observation balloon (see top right). It is not possible to identify the exact drift where this crossing took place, although the remnants of a bridge foundation structure can be seen in the river bed (Raath, 2007:351).

10 May 1900	In a last ditch attempt to halt the British advance through the Free State, the Boer leaders decided to entrench themselves on both sides of the railway line along a ridge known as Boschrand some six miles south of Kroonstad. This strong position was supported by artillery as well. However, Lord Roberts acquired intelligence on 10 May 1900, which informed him of the strong Boer position at Boschrand. In an attempt to outflank the Boer position and at the same time place more pressure on the Boer forces and their leaders, Lord Roberts ordered General French and his cavalry to flank around Boschrand and Kroonstad, and destroy the railway line leading north out of town. Lord Roberts's intention with this manoeuvre was to trap the majority of the Boer artillery, goods and ammunition in the town.
11 May 1900	Early on the morning of 11 May 1900, General French and his cavalry started on their journey to outflank the Boer position. However, he became bogged down by the Boer defenders to the west of Kroonstad, and was unable to push forward. Nonetheless, the destruction of the railway was successfully executed that evening by a small force of 50 hand-picked men of the 1st Cavalry Brigade and eight mounted Sappers, all under the command of Major A.G. Hunter-Weston and assisted by an American scout named F.R. Burnam (Maurice & Grant, 1906).

	Meanwhile, on the morning of 11 May 1900, Lord Roberts's forces moved slowly forward toward Kroonstad, until their advance was halted by the Boer position at Boschrand. An artillery duel ensued between the British artillery forming part of Lord Roberts's advance and the Boer artillery ensconced at Boschrand. The artillery duel lasted until sunset, and the infantry units at the front of Lord Roberts's forces bivouacked below Boschrand while Lord Roberts established his headquarters at Geneva Station. That evening, the Boer positions at Boschrand and Kroonstad were evacuated and the Boer armies retreated further north (Maurice & Grant, 1906).
1900 - 1902	After the fall of Pretoria on 5 June 1900 and the subsequent battles of Diamond Hill (11-12 June 1900) and Bergendal (21-27 August 1900), the Boer generals decided that the only way to proceed with the war would be the implementation of a completely different strategy, a strategy based on mobility by using smaller commandos to attack and harass the British on all fronts in what was to become known as guerrilla warfare. This style of warfare had significant successes, and extended the war for nearly another two years. However, these successes also came with significant losses as the war increasingly dragged the civilian population of the Boer Republics into the carnage of war. No skirmishes or battles associated with the guerrilla war are known from within the study area or its immediate surroundings. This said, the study area and surroundings, as with almost the entire South Africa, experienced the effects of guerrilla warfare. For example, after reports had been received that the Boer commandoes were using Ventersburg as a storage place for food, Major-General Bruce Hamilton was ordered to burn a number of houses in town. Furthermore, in retaliation to the new form of warfare, the British High Command devised a strategy of building extensive blockhouse lines across the country as a way of hindering the mobility of the Boer commandoes. By December 1900, earth and stone blockhouses had been built at a number of places along the main railway line between Bloemfontein and Pretoria, including at Boschrand and Holfontein stations. Shortly thereafter, a number of key positions along the railway line in proximity to Kroonstad were further fortified. A soil defensive structure was erected at Boschrand while a hexagonal fort was built at Holfontein. Between December 1900 and early 1901, a number of stone blockhouses were also erected in proximity to Kroonstad, including two such stone blockhouses built by contractors at Holfontein. From early 1901 onward, the existing soil and stone defensive works along the railway line between Kroonstad and Bloemfontein were replaced by stone and corrugated iron blockhouses. For example, the non-permanent defensive works at Boschrand were replaced by a Rice-type blockhouse (Hattingh & Wessels, 1997). Lord Kitchener, in particular, also implemented a strategy that was to become known as scorched earth whereby Boer farms were burnt to the ground and the civilian population (both white and black) remaining on these farms forced into concentration camps. Untold hardship ensued in these camps, and many women and children died as a result of exposure, inadequate nutrition and poor medical facilities. While their exact localities are not known, these camps were situated along the railway line at the following stations: Holfontein, Geneva and Boschrand. It is worth noting that Campbell (1995) indicates that the

	latter two camps were two of the three largest camps during the war, and with Honing Spruit housed a combined population of an incredible 7 000 people. The closest two white concentration camps were located at Kroonstad (west of the study area) and Winburg (south of the study area) (www.angloboerwar.com).
The Early Twentieth Century (1902 – 1913)	
1904	After the South African War, renewed efforts were made to carry out gold prospecting work in the area. In 1904, a prospector named Archibald Megson arrived on the farm Aandenk, and the farmer showed him the trench where Donaldson and Hind had looked for gold. Megson opened up the old trench and continued with the excavations. At a depth of 30 meters, he found indications of gold and took a number of samples. Megson returned to Johannesburg with his samples and attempted to gain the interest of various mining houses and investors on the rand. However, with the rapid development and expansion of the Witwatersrand gold mining industry attracting all of the attention, no one seemed interested in possible gold discoveries so far away from Johannesburg (www.sahra.org.za).
	
Figure 31 – Archibald Megson standing in the prospecting trench on the farm Aandenk (Felstar Publications, 1968).	
August 1907	In August 1907, the town of Theunissen was proclaimed. This proclamation followed on a petition by farmers living in proximity to Smaldeel Siding. The town was named in honour of Commandant Helgaardt Theunissen, who led the petition and had also been the leader of the local commando during the South African War. The town of Theunissen became a municipality in 1912 (Erasmus, 2004).
The Boer Rebellion (1914 – 1918)	
At the end of the South African War (1899 – 1902), the Transvaal and Orange Free State republics lost their independence to the British Empire. In 1910, the Union of South Africa was established consisting of the Cape Colony, Natal, the Transvaal Colony and the Orange River Colony. General Louis Botha was appointed the Union's first prime minister and believed that South Africa's future would be best served as part of the British Commonwealth. In 1914, the South African government under General Louis Botha decided to assist Great Britain in its war with Germany. A number of Boer leaders were not happy about this turn of events, and when General Koos de la Rey was killed at a roadblock in Johannesburg, emotions reached a boiling point and rebellion broke out across the former Boer republics. This rebellion saw more than 11 000 Boer men under the leadership of some of the former Boer War generals such as De Wet, Maritz, Kemp and Beyers rebelling against the South African government and its armed forces under the leadership of former Boer War generals Louis Botha and Jan Smuts.	

16 November 1914	In terms of the study area, the most notable event relating to the Boer Rebellion was the battle that occurred between the commando of General De Wet and the Government forces under the command of Colonel Enslin at the Virginia railway station on 16 November 1914. This battle followed on the defeat of De Wet's rebels at Mushroom Valley, south-east of Winburg, at the hands of General Louis Botha. De Wet and 2 000 rebels managed to escape from Mushroom Valley and followed the railway line north-eastwards towards the Virginia Station on the Zand River. De Wet wanted to cross over the railway line, and as a result, a fight ensued with Colonel Enslin's forces stationed at Virginia Station. General De Wet suffered a number of casualties and 50 of his men were also taken prisoner. After the battle, De Wet and his men followed the Zand River in a western direction and crossed over the river into the Transvaal Colony in proximity to Hoopstad (Union of South Africa, 1916).

Figure 32 –The hardships experienced by General C.R. de Wet during the rebellion can be seen on these photographs. The one on the left shows De Wet shortly after the South African War (Van Schoor, 2007) with the image on the right depicting the general in the Bloemfontein prison after his capture late in 1914 (Raath & Langner, 2014:119).

The Remainder of the Twentieth Century (1915 – Present Day)	
1929 - 1933	Nearly 25 years after finding the first indications of gold on the farm Aandenk, Archibald Megson finally managed to raise the interests of possible investors in Johannesburg. In 1929, during a chance encounter with Joseph Freedman, Megson found a more welcoming response. Freedman introduced the prospector to Johannesburg attorney, Emmanuel Jacobson, and his friend Allan Roberts, a dental technician. Despite being interested in what the prospector had to say, it took almost four years before Jacobson, Roberts and Megson travelled to the Free State (Shorten, 1970). Allan Roberts, who was an amateur prospector, was able to trace a conglomerate outcrop all along the farm Aandenk, and incorrectly identified it as part of the Upper Witwatersrand series. The two friends returned to Johannesburg and formed a syndicate comprising themselves, F.L. Marx, Dr. E.B. Woolf, Samuel Potter and Joseph Freedman. Freedman represented the interests of the old prospector Archibald Megson in the syndicate (Shorten, 1970). The syndicate acquired prospecting options on 31 farms in the area and the company Wit. Extensions Limited was established by the syndicate.

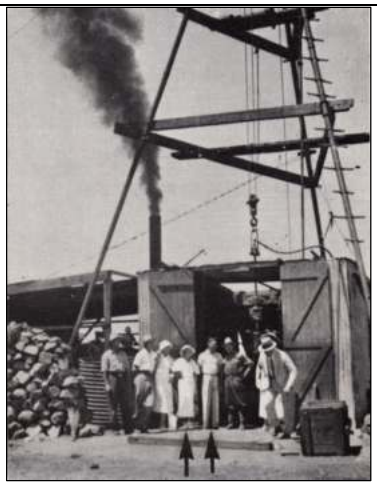
	On 23 October 1933, drilling commenced at a point roughly 80 m from Megson's trench on the same farm Aandenk. However, by February 1935 the drilling work had to be halted due to a lack of funds without any evidence for gold-bearing reefs identified. Many years later, it was estimated that if the two friends had only managed to deepen the hole by another 400 feet, they would have become very rich men and the discoverers of the Free State goldfields. Sadly, this was not to be their fate. Allan Roberts died in such poverty in 1939 and his friends had to pay for his funeral whereas Emmanuel Jacobson had to sell all his assets to survive (Shorten, 1970). Today, the town of Allanridge (named after Allan Roberts) and a monument to the west of the road between Welkom and Bothaville are all that is left of the dreams and expectations of these two mining pioneers.
 *Figure 33 - The first gold prospecting borehole in the Free State was sunk on the farm Aandenk between October 1933 and February 1935. The arrows indicate the positions of Allan Roberts and his wife (Felstar Publications, 1968:11).*	
1935	After the failure of Wit. Extensions Limited, an agreement was reached with the Anglo-French Exploration Company to continue prospecting work at Aandenk. However, instead of continuing deeper on the same borehole, the Anglo-French Exploration Company decided to rather deflect the borehole and no results were achieved. It was later estimated that if either one of these companies had deepened the borehole by only another 400 feet, payable gold would have been discovered (Shorten, 1970). The agreement between Wit. Extensions Limited and Anglo-French Exploration Company came to an end and the famous geologist Dr. Hans Merensky acquired an interest in Wit. Extensions Limited. He subsequently carried out extensive prospecting work including the drilling of further boreholes. However, even these more extensive attempts by Merensky to find the Free State goldfields also failed (Shorten, 1970). Machens (2009) indicates that when news broke that the famous discoverer of inter alia South Africa's platinum reserves owned options in a company working on the Free State goldfields, the interest from investors and mining companies to this part of the Free State was further awakened.

Figure 34 –The famous geologist Dr. Hans Merensky, who had his role to play in the discovery of the Free State goldfields (Machens, 2009).

1 February 1937 – April 1939	After failing to discover any payable gold, Merensky sold his shares in Wit. Extensions to the Anglo American Corporation, who on 1 February 1937 established the West Rand Investment Trust. The trust also carried out an extensive drilling operation. The activities and interest of the Anglo American Corporation in this part of the Free State attracted the interest of other mining houses and investment companies, and prospecting options were taken out on a large number of farms from this area (Shorten, 1970). Despite all this interest, the first payable gold in the Free state was only identified in March 1939 during drilling operations by the African and European Investment Company on the farm Uitsig at a depth of 2 701 feet (Felstar Publishers, 1968). One month later, during April 1939, another discovery of payable gold was made on the farm St. Helena at a depth of 1 143 feet (Shorten, 1970). The discoveries of payable gold at Uitsig and St. Helena created significant excitement amongst mining companies and investors, and increasing numbers of prospecting options and eventually mines were acquired and developed. The Free State gold rush had begun.
1941	The first gold mining lease in the Free State was granted by the government of the Union of South Africa for the farm St. Helena in 1941, and the St. Helena Gold Mining Company was established to mine and develop the property (Felstar Publishers, 1968). A number of other gold mining companies were also established in a relatively short spate of time, including the Welkom Gold Mining Company, President Steyn Gold Mining Company and the President Brand Gold Mining Company.

Figure 35 –The first mine shaft ever sunk along the Free State goldfields, namely the No. 3 Incline Shaft at the St. Helena Gold Mine (Felstar Publishers, 1968:151).

16 April 1946	The borehole of the Blinkpoort Gold Syndicate Limited on the boundary of the farms Geduld and Friedenheim, reached payable gold in 1946. On 16 April 1946 it was announced that the gold-bearing material retrieved at a depth of 3 922 feet from this borehole assayed at an impressive 1 252 dwts per ton which was unique in the history of golf prospecting and mining in South Africa, with averages usually in the region of 250 dwts per ton. This discovery led to further interest in the Free State goldfields (Felstar Publishers, 1968).
11 July 1946 – 15 April 1947	On 11 July 1946 an application was made by the land company of Sir Ernest Oppenhaimer's Anglo American Corporation, namely the South African Township and Mining and Finance Corporation, for the establishment of a new town called Welkom. After some legal and procedural processes and debate between the township applicants and its opponents (including the Odendaalsrus Town Council), the application for the establishment of the town of Welkom was approved on 15 April 1947 (Felstar Publishers, 1968). William Backhouse designed the town as a garden city with a commercial centre built around a town square and traffic circles rather than stop streets or traffic lights. More than a million trees were also planted (Erasmus 2014).
1953	After gold was discovered in the area, Odendaalsrus became a prominent town in the Free State. A railway line was built from Allanridge to Odendaalsrus in 1953 and served the two Freddie's mines (Nienaber et al. 1982).
1954	Three of the six mines surrounding Welkom had reached production stage by 1954. These were the Welkom, Western Holdings and St. Helena Mines. During the same year, the town of Virginia was laid out on the banks of the Zand River. As indicated elsewhere, the name of this town was derived from the nearby railway station, which in turn was named this after two American engineers working on the line in 1890 had carved the name "Virginia" on a boulder from a nearby hill (Erasmus 2014).

5.3 Previous heritage impact assessment reports from the study area and surroundings

A search of the South African Heritage Resources Information System (SAHRIS) database revealed that several previous archaeological and heritage impact assessments had been undertaken within the surroundings of the study area. In each case, the results of each study are shown in bold. These previous studies are listed below in descending chronological order:

- ***De Bruyn, C. 2018. Heritage Impact Assessment the prospecting right and environmental authorisation application for Kroonstad South situated in the Free State Province.***

  The project area was located approximately 6km west of the present study area. A cemetery with several marked and unmarked graves as well as two historical farm houses were found within the project area.

- ***Birkholtz, P. 2016. Heritage Study: Proposed Motuoane Hennenman Exploration Right Application.***
  The project area was located approximately 10km west of the present study area. Three heritage sites were identified These included two cemeteries and a poorly preserved historic farmstead.

- ***Van der Walt, J. 2013a. Archaeological Impact Assessment Report for the Proposed Steynsrus (19.5MW) Photovoltaic Plant, Free State Province.***
  The project area was located approximately 2.5km west of the present study area. Six sites of heritage significance were identified during the survey. These included the demolished remains of two residential dwellings and the foundations of a rectangular cattle kraal; A large farm labourer compound; a burial ground with 23 stone packed graves and a site with three stone cairns roughly aligned east to west that might represent graves.

- ***Van der Walt, J. 2013b. Archaeological Impact Assessment for the proposed Heuningspruit PV1 and PV2 Solar Energy Facility near Koppies, Free State***
  The project area was located approximately 29km north-west of the present study area. An informal cemetery was recorded.

- ***Van Schalkwyk, J. 2013. Cultural heritage impact assessment for the Upgrade Of A Section Of National Route 1, Between Kroonstad And Ventersburg, Free State Province.***
  The project area was located approximately 39km west of the present study area.
- ***Dreyer C. 2008.*** **Archaeological and Cultural Heritage Assessment of the Proposed Residential Developments at Matlwantlwang (Steynsrust), Free State.**
  The project area was located approximately 3.7km south of the present study area. No archaeological or any cultural remains were found at the site.

5.4 Heritage Screening

A Heritage Screening Report was compiled using the DFFE National Web-based Environmental Screening Tool as required by Regulation 16(1)(v) of the Environmental Impact Assessment Regulations 2014, as amended. According to the Heritage screening report, the directly affected area has a **low** sensitivity rating (**Figure 2**). **The field work demonstrates that one burial ground and two localities with sandstone boundary markers of heritage significance, warrants conservation. Therefore, in the case of this study area, the DFFE screening tool sensitivity**

map is only partly supported based on the findings of this fieldwork. This is most likely is due to the level of disturbance related to agricultural practices in the study area.

5.4.1 Heritage sensitivity

The sensitivity maps were produced by overlying:

- Satellite Imagery;

Current Topographical Maps;

- First edition Topographical Maps dating from the 1960's.

This enabled the identification of possible heritage sensitive areas around the proposed development area that included:

- Cluster of dwellings (farmsteads),
- Homesteads ("huts") and
- Structures/Buildings.

By superimposition and analysis, it was possible to rate these structure/areas according to age and thus their level of protection under the NHRA. Note that these structures refer to possible tangible heritage sites as listed in **Table 6**.

Table 6 - Tangible heritage site in the study area.

Name	Description	Legislative protection
Archaeology	Older than 100 years	NHRA Sections 3 and 35
Structures	Possibly older than 60 years	NHRA Sections 3 and 34
Burial grounds	Graves	NHRA Sections 3 and 36 and MP Graves Act

5.4.2 Possible Heritage Finds

The evaluation of satellite imagery and the analysis of the studies previously undertaken in the area has indicated that certain areas may be sensitive from a heritage perspective. This combined analysis of satellite imagery and previous heritage studies has assisted in the development of the following landform type to heritage find matrix (**Table 7**)

Table 7 - Landform type to heritage find matrix

LANDFORM TYPE	HERITAGE TYPE
Crest and foot hill	LSA and MSA scatters, LIA settlements
Crest of small hills	Small LSA sites – scatters of stone artefacts, ostrich eggshell, pottery, and beads
Water holes/pans/rivers	MSA and LSA sites, LIA settlements
Farmsteads	Historical archaeological material
Ridges and drainage lines	LSA sites, LIA settlements

6 FIELDWORK FINDINGS[1]

The fieldwork was conducted between 29 November – 3 December 2022 by a geoarchaeologist (Dr Matt Lotter) contracted by PGS. Their movement on site was tracked by GPS and a tracklog map can be seen in **Figure 36 - Figure 38.**

During the fieldwork a total of five heritage features and resources where identified (**Figure 39**). These consist of one burial ground with approximately 27 graves (**013; Figure 44**), two localities with several sandstone blocks which are possibly boundary markers (**006, 009; Figure 42 - Figure 43**) and two localities with historic structures (**007, 008**). See **Figure 39 - Figure 41** and the individual site descriptions as contained in **Appendix C**.

It must be noted that one alternative well location (waypoint: 017) was proposed based on various specialist observations.

Only one of the identified heritage resources (006) is located within proximity of the newly proposed alternative well site (017).

[1] *Site in this context refers to a place where a heritage resource is located and not a proclaimed heritage site as contemplated under s27 of the NHRA.*

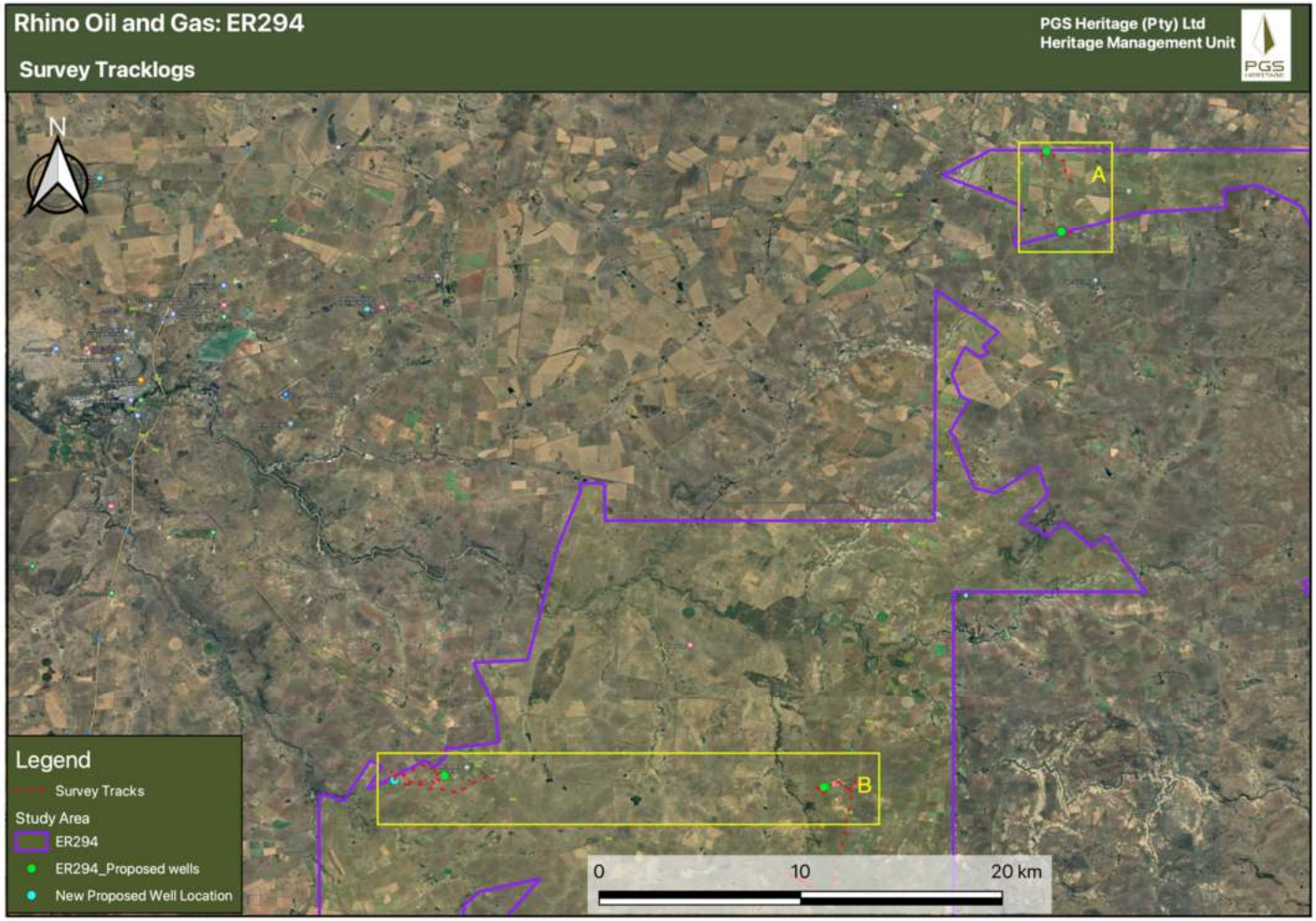


Figure 36 - Fieldwork tracklogs (track in red). See insets below.

Figure 37 - Fieldwork tracklogs Map Inset A.

Figure 38 - Fieldwork tracklogs Map Inset B.

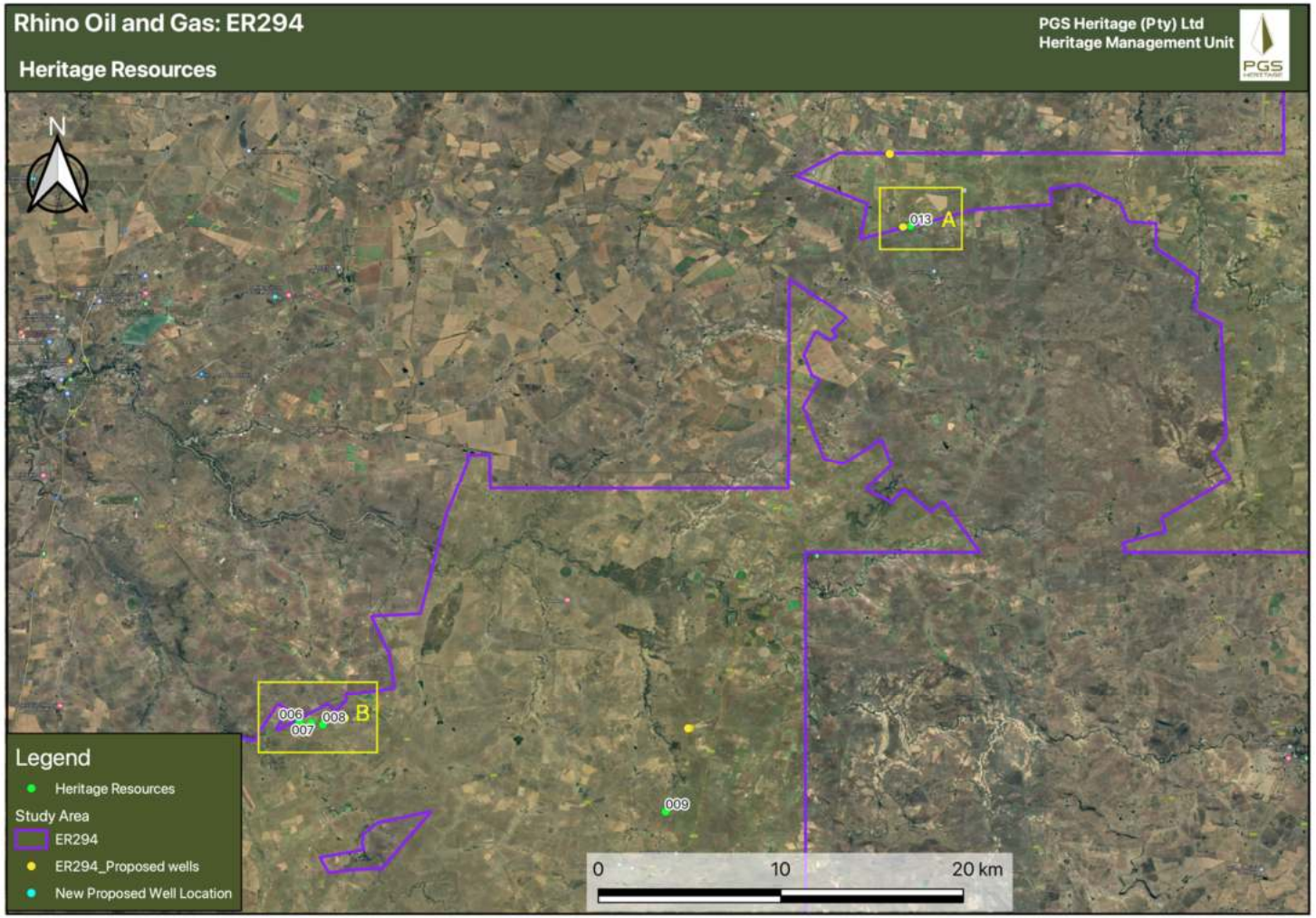


Figure 39 - Identified heritage resources within the study area. See insets below.

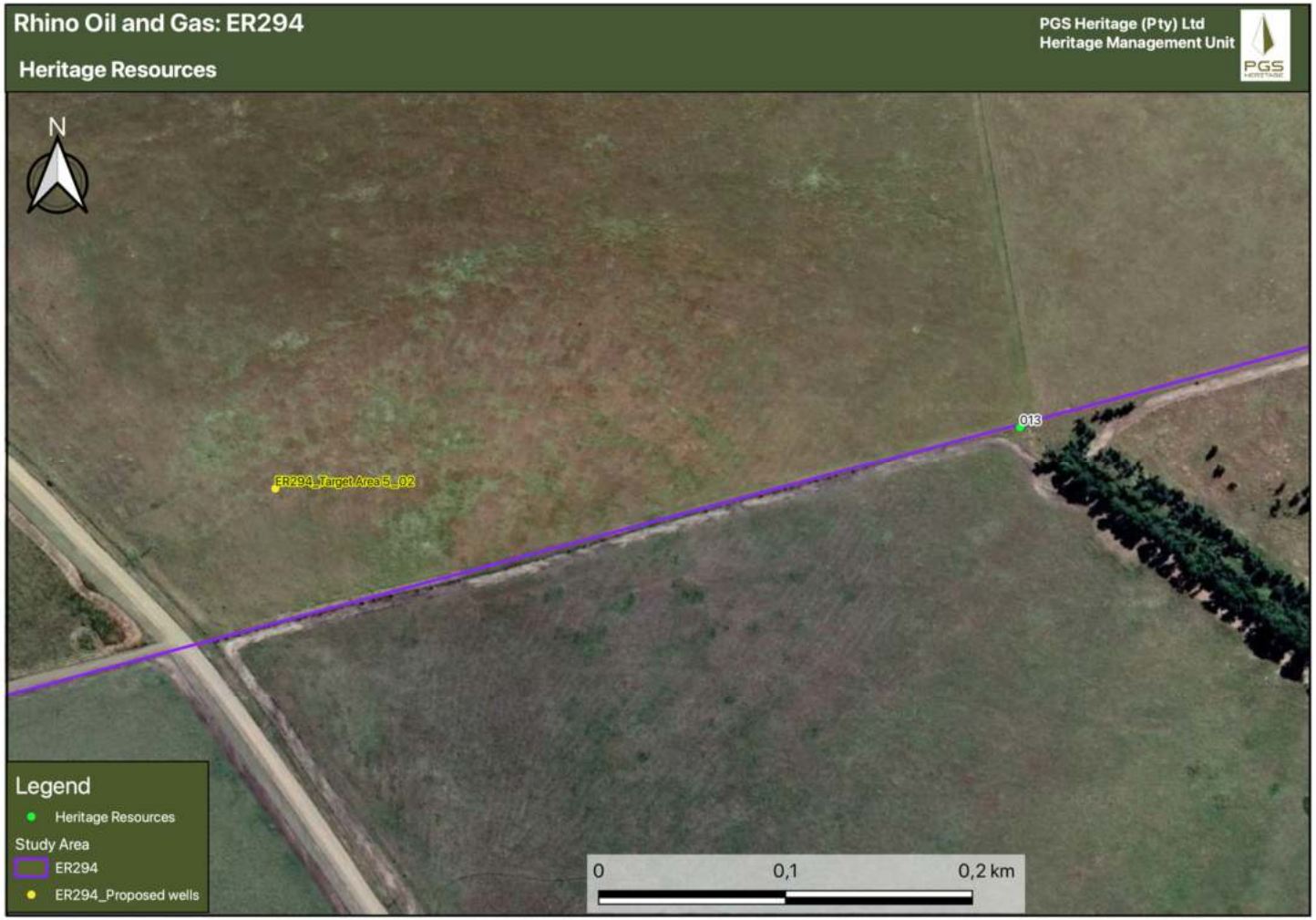


Figure 40 – Heritage Resources Map Inset A.

Figure 41 - Heritage Resources Map Inset B.

Figure 42 - View of the sandstone boundary marker at 006.

Figure 43 - View of the sandstone boundary marker at 009.

Figure 44 - View of the burial ground at 013.

7 IMPACT ASSESSMENT

In this section, an assessment will be made of the impact of the proposed well sites on the identified heritage sites. An overlay of all the heritage sites identified during the fieldwork over the proposed development footprint areas was made to assess the impact of the proposed project on these identified heritage sites. This overlay resulted in the following observations:

The following general observations will apply for the impact assessment undertaken in this report:

- The impact assessment rating is based on the rating scale as contained in **Appendix B**.
- Heritage sites assessed to have a low heritage significance are not included in these impact risk assessment calculations. The reason for this is that sites of low significance will not require mitigation. These sites are the 2 structures (**007, 008**).
- One burial ground (**013)** and one locality with sandstone boundary markers (**009**) are located more than 100m away from the proposed well sites. As a result, no impact is expected from the proposed development on these sites. This means that no impact assessment will be undertaken for the sites.
- One locality with sandstone boundary markers (**006**) is located further than 200m away from proposed well ER294_Traget Area_4_02 but is located less than 20m from the newly proposed alternative well site (017). As a result, an impact is expected from the proposed well site (017) on this site.
- It is necessary to realise that the heritage resources located during the fieldwork do not necessarily represent all the possible heritage resources present within the area. Various factors account for this, including the subterranean nature of some heritage sites. The impact assessment conducted for heritage sites assumes the possibility of finding heritage resources during the project life and has been conducted as such.

The following impact rating tables are based on the proposed well sites within the region.

7.1 Impact assessment table

Implementing the impact assessment methodology as supplied by the SLR**,** the table below provides a quantitative assessment of the impacts of the proposed project.

Table 8 - Rating of impacts on archaeological resources

Issue: Destruction or damage to previously unidentified archaeological resources and historical resources.		
Phases: Pre-Construction and Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Local	Site
Consequence	Medium	Low
Probability	Conceivable	Improbable
Significance	Low -	Very Low -
Additional Assessment Criteria		
Degree to which impact can be reversed	Irreversible impact.	
Degree to which impact may cause irreplaceable loss of resources	Heritage resources are irreplaceable. However, the implementation of a chance finds protocol will enable the monitoring and where required documentation of such resources.	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	There is significant scope for mitigation as per the recommended mitigation measures in **Section 8** below.	
Cumulative Impacts		
Nature of cumulative impacts	The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources.	
Extent to which a cumulative impact may arise	Unlikely. However, until a regional detailed study is commissioned by SAHRA. No further mitigations measures can be proposed other than those already recommended for the site-specific mitigation of sites in this report.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
Residual impacts	Due to the nature of heritage resources, subsurface artefact deposits are possible and can be exposed during construction activities. However, with the implementation of the approved mitigation measures as confirmed by SAHRA such finds can be successfully mitigated.	

Table 9 - Rating of impacts on boundary markers (006)

Issue: Construction activities close to boundary markers (identified at waypoint **006**), can damage and cause irreparable damage or destroy the resource.		
Phases: Pre-Construction and Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Very Low
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Medium	Low
Probability	Possible	Improbable
Significance	Medium -	Very Low -
Additional Assessment Criteria		
Degree to which impact can be reversed	Irreversible impact.	
Degree to which impact may cause irreplaceable loss of resources	Heritage resources are irreplaceable. However, the implementation of a chance finds protocol will enable the monitoring and where required documentation of such resources.	
Degree to which impact can be avoided	High	
Degree to which impact can be mitigated	There is significant scope for mitigation as per the recommended mitigation measures in **Section 8** below.	
Cumulative Impacts		
Nature of cumulative impacts	The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources.	
Extent to which a cumulative impact may arise	Unlikely. However, until a regional detailed study is commissioned by SAHRA. No further mitigations measures can be proposed other than those already recommended for the site-specific mitigation of sites in this report.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
Residual impacts	Due to the nature of heritage resources, subsurface artefact deposits are possible and can be exposed during construction activities. However, with the implementation of the approved mitigation measures as confirmed by SAHRA such finds can be successfully mitigated.	

8 MANAGEMENT RECOMMENDATIONS AND GUIDELINES

The following section must be read in conjunction with **Table 11** of this report.

8.1 Construction and operational phases

The project will encompass a range of activities during the construction phase, including ground clearance and small-scale infrastructure development associated with the project.

It is possible that cultural material will be exposed during construction and may be recoverable, keeping in mind delays can be costly during construction, and as such must be minimised. Development surrounding infrastructure and construction of facilities results in significant disturbance, however holes do offer a window into the past and it thus may be possible to rescue some of the data and materials.

During the construction phase, it is important to recognize any significant material being unearthed, making the correct judgment on which actions should be taken. It is recommended that the following chance find procedure should be implemented.

8.2 Chance finds procedure

- An appropriately qualified heritage practitioner / archaeologist must be identified to be called upon in the event that any possible heritage resources or artefacts are identified.
- Should an archaeological site or cultural material be discovered during construction (or operation), the area should be demarcated, and construction activities halted.
- The qualified heritage practitioner / archaeologist will then need to come out to the site and evaluate the extent and importance of the heritage resources and make the necessary recommendations for mitigating the find and the impact on the heritage resource.
- The contractor therefore should have some sort of contingency plan so that operations could move elsewhere temporarily while the materials and data are recovered.
- Construction can commence as soon as the site has been cleared and signed off by the heritage practitioner / archaeologist.

8.3 Possible finds during construction

The study area occurs within a greater historical and archaeological site as identified during the desktop and fieldwork phase. Soil clearance for infrastructure as well as the proposed reclamation activities, could uncover the following:

- Historical structures and foundations
- Unmarked burial grounds and graves

8.4 Timeframes

It must be kept in mind that mitigation and monitoring of heritage resources discovered during construction activity will require permitting for collection or excavation of heritage resources and lead times must be worked into the construction time frames. **Table 10** gives guidelines for lead times on permitting.

Table 10 - Lead times for permitting and mobilisation

Action	Responsibility	Timeframe
Preparation for field monitoring and finalisation of contracts	The contractor and service provider	1 month
Application for permits to do necessary mitigation work	Service provider – Archaeologist and SAHRA	3 months
Documentation, excavation and archaeological report on the relevant site	Service provider – Archaeologist	3 months
Handling of chance finds – Graves/Human Remains	Service provider – Archaeologist and SAHRA	2 weeks
Relocation of burial grounds or graves in the way of the development	Service provider – Archaeologist, SAHRA, local government and provincial government	6 months

8.5 Heritage Management Plan for EMPr implementation

Table 11 - Heritage Management Plan for EMPr implementation

Area and site no.	Mitigation measures	Phase	Timeframe	The responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (Monitoring tool)
General project area	Implement a chance to find procedures in case where possible heritage finds are uncovered.	Construction	During construction	Applicant ECO Heritage Specialist	ECO (monthly / as or when required)	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 34-36 and 38 of NHRA	ECO Monthly Checklist/Report
Burial grounds and graves (**013**)	As the burial ground is more than 100m away from proposed well sites, no impact is expected. However, the burial ground should be retained and avoided with a **buffer zone of 50m** as per SAHRA guidelines.	Construction	During Construction	Applicant Environmental Control Officer (ECO) Heritage specialist	Monthly	Ensure compliance with relevant legislation and recommendations from SAHRA under Section 36 and 38 of NHRA	ECO Monthly Checklist/Report
Historical Structures (**007, 008**)	As the structures are more than 100m away from proposed well sites, no impact is expected. Therefore, no mitigation is required.	Pre-construction	After the approval of the EA and before construction occurs	Applicant Environmental Control Officer (ECO) Archaeologist		Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35, 36 and 38 of NHRA	ECO Monthly Checklist/Report

Area and site no.	Mitigation measures	Phase	Timeframe	The responsible party for implementation	Monitoring Party (frequency)	Target	Performance indicators (Monitoring tool)
Boundary Markers (006, 009)	▪ As the boundary markers at 009 are located more than 200m away from proposed well sites, no impact is expected. Therefore, no mitigation is required. ▪ Site 006 is located further than 200m away from proposed well ER294_Traget Area_4_02 but is located less than 20m from the newly proposed alternative well site (017). Implement a **30-meter buffer** around the boundary markers. If the markers cannot be avoided, then a permit will be required to move the marker (before any construction) to the boundary of the footprint and reinserted at a later stage. The co-ordinates of the original and new locations need to be taken and photographed.	Pre-construction	After the approval of the EA and before construction occurs	Applicant Environmental Control Officer (ECO) Archaeologist		Ensure compliance with relevant legislation and recommendations from SAHRA under Section 35, 36 and 38 of NHRA	ECO Monthly Checklist/Report

9 CONCLUSIONS AND RECOMMENDATIONS

During the fieldwork a total of five heritage features and resources where identified. These consist of one burial ground with approximately 27 graves (**013**), two localities with several sandstone blocks which are possibly boundary markers (**006, 009**) and two localities with historic structures (**007, 008**). **None of the identified heritage resources were located within proximity of the proposed well sites.**

9.1 Historical Structures

Two (2) structures (**007, 008**), which are located further than 200m away of a proposed well, were rated as having **low heritage significance**.

9.2 Boundary Markers

Two localities with sandstone blocks (**006, 009**) were rated as having **medium heritage significance**.
One site (**009**) is located further than 200m away of a proposed well.
Site **006** is located further than 200m away from proposed well ER294_Traget Area_4_02 but is located less than 20m from the newly proposed alternative well site (017).

9.3 Burial grounds and graves

One (1) burial ground (**013**) was rated as having **high heritage significance**; however, it is located a considerable distance (± 100m) from the proposed development area.

9.4 Mitigation measures

Mitigation measures are described in **Table 11** of this report.

9.5 General

It is the author's considered opinion that the overall impact on heritage resources will be **Low**. Provided that the recommended mitigation measures are implemented if chance finds are unearthed within the project area, the impact would be acceptably low or could be totally mitigated to the degree that the project could be approved from a heritage perspective. The management and mitigation measures as described in **Section 8** of this report have been developed to minimise the project impact on possible heritage resources.

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10.4 Historic Topographic Maps

All historic topographic maps used in this report were obtained from the Directorate: National Geo-spatial Information of the Department of Rural Development and Land Reform in Cape Town.

10.5 Internet

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10.6 GOOGLE EARTH

All the aerial depictions and overlays used in this report are from Google Earth.

APPENDIX A

ENVIRONMENTAL IMPACT METHODOLOGY

SLR: IMPACT ASSESSMENT METHODOLOGY

This assessment methodology enables the assessment of biophysical, cultural, and socio-economic impacts including cumulative impacts and impact significance through the consideration of intensity, extent, duration, and the probability of the impact occurring. Consideration is also given to the degree to which impacts may cause irreplaceable loss of resources, be avoided, reversibility of impacts and the degree to which the impacts can be mitigated.

METHODOLOGY USED IN DETERMINING THE SIGNIFICANCE OF IMPACTS

Part A provides the definition for determining impact consequence (combining intensity, extent, and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D. This methodology is utilised to assess both the incremental and cumulative project related impacts.

PART A: DEFINITIONS AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, extent, and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance, or degradation. Associated with severe consequences. May result in severe illness, injury, or death. Targets, limits, and thresholds of concern continually exceeded. Habitats or ecosystems of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance, or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits, and thresholds of concern regularly exceeded. Habitats or ecosystems which are important for meeting national/provincial conservation targets. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance, or discomfort. Associated with real but not substantial consequences. Targets, limits, and thresholds of concern may occasionally be exceeded. Habitats or ecosystems with important functional value in maintaining biotic integrity. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance, or nuisance. Associated with minor consequences or deterioration. Targets, limits, and thresholds of concern rarely exceeded. Habitats and ecosystems which are degraded and modified. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance, or nuisance. Associated with very minor consequences or deterioration. Targets, limits, and thresholds of concern never exceeded. Species or habitats with negligible importance. No interventions or clean-up actions required. No complaints anticipated.
	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.

	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**Very Short term**	Very short, always less than a year or may be intermittent (less than 1 year). Quickly reversible.
	Short term	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	Medium term	Medium-term, 5 to 10 years.
	Long term	Long term, between 10 and 20 years. Likely to cease at the end of the operational life of the activity or because of natural processes or by human intervention.
	Very long term/ permanent	Very long, permanent, +20 years. Irreversible. Beyond closure or where recovery is not possible either by natural processes or by human intervention.
Criteria for ranking the EXTENT of impacts	**Site**	A part of the site/property. Impact is limited to the immediate footprint of the activity and within a confined area.
	Whole site	Whole site. Impact is confined to within the project area and its nearby surroundings.
	Beyond site	Beyond the site boundary, affecting immediate neighbours.
	Local	Local area, extending far beyond site boundary.
	Regional / national	Regional/National. Impact may extend beyond district or regional boundaries with national implications.

PART B: DETERMINING CONSEQUENCE – APPLIES TO POSITIVE OR ADVERSE IMPACTS						
		EXTENT				
		Site	**Whole site**	**Beyond the site, affecting neighbours**	**Local area, extending far beyond site**	**Regional/ National**
INTENSITY = VL						
DURATION	**Very long term /permanent**	**Low**	**Low**	**Medium**	**Medium**	**Medium**
	Long term	**Very Low**	**Low**	**Low**	**Medium**	**Medium**
	Medium term	**Very Low**	**Low**	**Low**	**Low**	**Medium**
	Short term	**Very low**	**Very Low**	**Low**	**Low**	**Low**
	Very short term	**Very low**	**Very Low**	**Very Low**	**Very Low**	**Low**
INTENSITY = L						
DURATION	**Very long term /permanent**	**Low**	**Medium**	**Medium**	**High**	**High**

	Long term	Low	Medium	Medium	Medium	High
	Medium term	Low	Low	Medium	Medium	Medium
	Short term	Very low	Low	Low	Medium	Medium
	Very short term	Very low	Very low	Low	Low	Low
INTENSITY = M						
DURATION	Very long term /permanent	Medium	Medium	High	High	Very High
	Long term	Low	Medium	Medium	High	High
	Medium term	Low	Medium	Medium	Medium	High
	Short term	Low	Low	Medium	Medium	Medium
	Very short term	Very low	Low	Low	Low	Medium
INTENSITY = H						
DURATION	Very long term /permanent	Medium	High	High	Very High	Very High
	Long term	Medium	Medium	High	High	Very High
	Medium term	Low	Medium	Medium	High	High
	Short term	Low	Medium	Medium	Medium	High
	Very short term	Very low	Low	Low	Medium	Medium
INTENSITY = VH						
DURATION	Very long term /permanent	Medium	High	Very High	Very High	Very High
	Long term	Medium	High	High	Very High	Very High
	Medium term	Medium	Medium	High	High	Very High
	Short term	Low	Medium	Medium	High	High
	Very short term	Low	Low	Medium	Medium	Medium

PART C: DETERMINING SIGNIFICANCE - APPLIES TO POSITIVE OR ADVERSE IMPACTS							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Very Low	Low	Medium	High	Very High
	Probable	H	Very Low	Low	Medium	High	Very High
	Possible/ frequent	M	Very Low	Very Low	Low	Medium	High
	Conceivable	L	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	VL	Insignificant	Insignificant	Very Low	Low	Medium
			VL	L	M	H	VH
			CONSEQUENCE				

PART D: INTERPRETATION OF SIGNIFICANCE		
Significance		Decision guideline
Very High	Very High +	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.
High	High +	These beneficial or adverse impacts are considered to be very important considerations and must have an influence on the decision. In the case of adverse impacts, substantial mitigation will be required.

Medium	**Medium +**	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.
Low	**Low +**	These beneficial or adverse impacts are unlikely to have a real influence on the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Very Low	**Very Low +**	These beneficial or adverse impacts will not have an influence on the decision. In the case of adverse impacts, mitigation is not required.
Insignificant		Inconsequential, not requiring any consideration.

ADDITIONAL ASSESSMENT CRITERIA

Additional criteria that are taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process include:

- the degree to which impacts may cause irreplaceable loss of resources;
- the degree to which impacts can be avoided;
- the degree to which impacts can be reversed;
- the degree to which the impacts can be mitigated; and
- the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects is tabulated below.

ADDITIONAL ASSESSMENT CRITERIA		
Criteria for DEGREE TO WHICH AN IMPACT CAN BE REVERSED	**IRREVERSIBLE**	Where the impact cannot be reversed and is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary.
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**NONE**	Will not cause irreplaceable loss.
	LOW	Where the activity results in a marginal effect on an irreplaceable resource.
	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for DEGREE TO WHICH IMPACT CAN BE AVOIDED	**NONE**	Impact cannot be avoided and consideration should be given to compensation and offsets.
	LOW	Impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
	MEDIUM	Impact cannot be avoided, but the significance can be reduced through mitigation measures.
	HIGH	Impact can be avoided through the implementation of preventative mitigation measures.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the impact.
	LOW	Some mitigation is possible but will have marginal effect in reducing the impact significance rating.
	MEDIUM	Mitigation is feasible and will may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
	UNLIKELY	Low likelihood of cumulative impacts arising.

Criteria for POTENTIAL FOR CUMULATIVE IMPACTS	**POSSIBLE**	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

APPENDIX B

SITE DESCRIPTION FORMS

Site coordinates		
Site Number	**Lat**	**Long**
006	-27.858566	27.368871
007	-27.859156	27.375215
008	-27.860229	27.381704
009	-27.908473	27.572678
013	-27.58193	27.70899

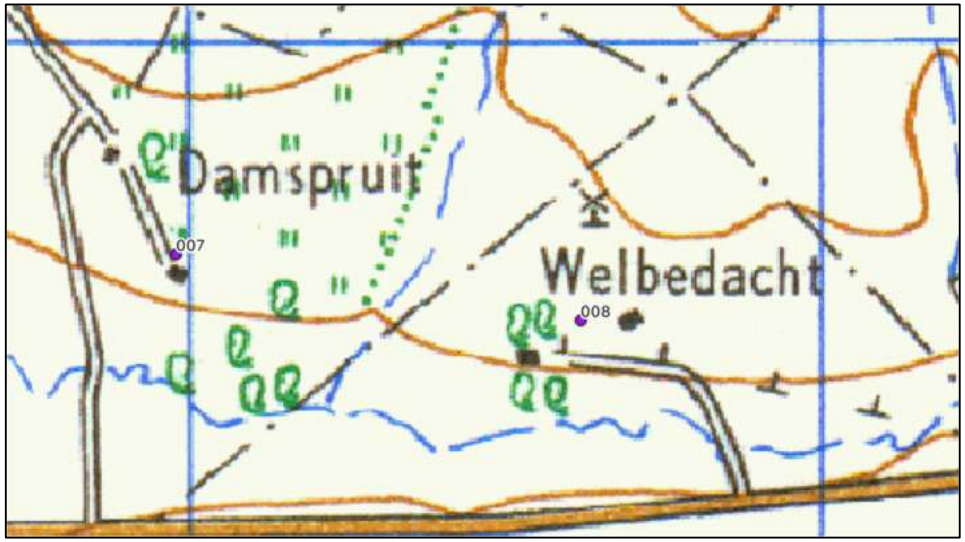
Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
006	-27.858566	27.368871	**General Landscape Characteristics** Grassy vegetation **Site Conditions** Disturbed **Time Period** Historical Period **Site Type** Historical Fence/Farm marker/Boundary marker **Notes** Blocks cover approximately 100m and comprise six low, upright stones. They do not appear to be shaped, but rather are tabular in form. Possibly historic but uncertain. No other associated heritage/archaeology.	Medium	Grade 3 - B (IIIB)

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
			 *Figure 45 - Views of the sandstone blocks identified at waypoint 006.*		
007 and 008	-27.859156 / -27.860229	27.375215 / 27.381704	**General Landscape Characteristics** Grassy vegetation **Site Conditions** Overgrown/ limited visibility **Time Period**	Low	Grade 3 - C (IIIC)

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
			Historical Period **Site Type** Structure; Historical Fence/Farm marker/Boundary marker **Notes** The area contains multiple structures comprising clay/sand brick construction, as well as shaped sandstone blocks. Large sandstone farm boundary/fence markers also occur frequently. Structures also visible within pockets of introduced vegetation (i.e., tall conifer/pine trees). The structure was only depicted at this locality on the 2727CD topographical sheet dating to 1960 (**Figure 47).** The site is therefore older than 60 years.		

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

Figure 46 - Views of the structures and boundary markers identified at the waypoints 007 and 008.

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
 *Figure 47 – 2727CD topographical sheet surveyed in 1960 depicts Farmsteads at the location of waypoints 007 and 008.*					
009	-27.908473	27.572678	**General Landscape Characteristics** Grassy vegetation **Site Conditions** Disturbed **Time Period** Historical Period **Site Type** Historical Fence/Farm marker/Boundary marker **Site Extent**	Medium	Grade 3 - B (IIIB)

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
			1m x 2m **Notes** Posts well worn by cattle passing through. Landowner suggests they are 100 years old.		

Figure 48 - Views of the boundary marker identified at waypoint 009.

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating
013	-27.58193	27.70899	**General Landscape Characteristics** Grassy vegetation **Site Conditions** Overgrown/ limited visibility **Time Period** Historical Period **Site Type** Graves **Site Extent** 20m x 20m **Notes** Approximately 27 graves. Some with headstones. Others without. Oldest dating to 1937. Most recent marked grave is 1977. Range of adult and child burials, based on grave size (smaller widths and lengths). Some constructed from bricks and cement. Others are stone, more informal.	High	Grade 3 - A (IIIA)

Figure 49 - General view of the burial ground recorded at waypoint 013.

Site number	Lat	Lon	Description	Heritage Significance	Heritage Rating

Figure 50 - Views of the graves identified within the burial ground at waypoint 013.

APPENDIX C

PGS TEAM CVS

WOUTER FOURIE

Professional Heritage Specialist and Professional Archaeologist and Director PGS Heritage

Summary of Experience

Specialised expertise in Archaeological Mitigation and excavations, Cultural Resource Management and Heritage Impact Assessment Management, Archaeology, Anthropology, Applicable survey methods, Fieldwork and project management, Geographic Information Systems, including *inter alia* -

Involvement in various grave relocation projects (some of which relocated up to 1000 graves) and grave "rescue" excavations in the various provinces of South Africa

Involvement with various Heritage Impact Assessments, within South Africa, including -

- Archaeological Walkdowns for various projects
- Phase 2 Heritage Impact Assessments and EMPs for various projects
- Heritage Impact Assessments for various projects
- Iron Age Mitigation Work for various projects, including archaeological excavations and monitoring
- Involvement with various Heritage Impact Assessments, outside South Africa, including -
- Archaeological Studies in Democratic Republic of Congo
- Heritage Impact Assessments in Mozambique, Botswana and DRC
- Grave Relocation project in DRC

Key Qualifications

BA [Hons] (Cum laude) - Archaeology and Geography - 1997

BA - Archaeology, Geography and Anthropology - 1996

Professional Archaeologist - Association of Southern African Professional Archaeologists (ASAPA) - Professional Member

Accredited Professional Heritage Specialist – Association of Professional Heritage Practitioners (APHP)

CRM Accreditation (ASAPA) -

- Principal Investigator - Grave Relocations
- Field Director – Iron Age
- Field Supervisor – Colonial Period and Stone Age
- Accredited with Amafa KZN

Key Work Experience

2003- current - Director – Professional Grave Solutions (Pty) Ltd

2007 – 2008 - Project Manager – Matakoma-ARM, Heritage Contracts Unit, University of the Witwatersrand

2005-2007 - Director – Matakoma Heritage Consultants (Pty) Ltd

2000-2004 - CEO– Matakoma Consultants

1998-2000 - Environmental Coordinator – Randfontein Estates Limited. Randfontein, Gauteng

1997-1998 - Environmental Officer – Department of Minerals and Energy. Johannesburg, Gauteng

Worked on various heritage projects in the SADC region including, Botswana, Mauritius, Malawi, Zambia, Mozambique, and the Democratic Republic of the Congo

PROFESSIONAL CURRICULUM
FOR NIKKI MANN

Name: Nikki Mann
Profession: Archaeologist
Date of birth: 1992-10-13
Parent Firm: PGS Heritage (Pty) Ltd
Position at Firm: Archaeologist
Years with firm: 2
Years of experience: 7
Nationality: South African
HDI Status: White

EDUCATION:

Name of University or Institution : University of Cape Town
Degree obtained : BSc
Major subjects : Archaeology, Environmental and Geographical Sciences
Year : 2013

Name of University or Institution : University of Cape Town
Degree obtained : BSc [Hons]
Major subjects : Archaeology
Year : 2014

Name of University or Institution : University of Cape Town
Certificate obtained : MSc – Archaeology (phytolith analysis)
Year : 2017

Professional Qualifications:
Professional Archaeologist - Association of Southern African Professional Archaeologists - Professional Member – No 472

Languages:
English
French

KEY QUALIFICATIONS
- 4 years of work in the heritage consulting field;
- 7 years working experience in archaeological excavations;
- Proven experience in report writing and report deliverables;

HERITAGE IMPACT ASSESSMENTS
South African

- HMPs for the Khangela and Umsinde WEFs and associated grid infrastructure, near Murraysburg, Western Cape. Nala Environmental. **Position:** Heritage Specialist.
- Proposed new 132kV grid connection for the authorised Emoyeni WEF, near Murraysburg, Western Cape. Nala Environmental. **Position:** Heritage Specialist.
- Proposed Apollo PV Plant, near Atlantis, Western Cape – Desktop study. TerraManzi. **Position:** Heritage Specialist.
- Proposed Eskom Witkop-Pietersburg 132kV Powerline, Limpopo. Polokwane. Acer. **Position:** Heritage Specialist.

- Proposed deviations to Eskom Nhlavuko-Tshebela 132kV Powerlines, Limpopo. Polokwane. Acer. **Position:** Heritage Specialist.
- Proposed Tetra4 Cluster 2 gas production project, near Welkom. EIMS. **Position:** Heritage Specialist.
- Kathu Tyre Management Plant HIA. Kathu. EXM. **Position:** Heritage Specialist.
- Kathu Borrow Pit Screening. Kathu. EXM. **Position:** Heritage Specialist.
- Harmony Kareerand Pipelines Project. Between Klerkdorp and Potchefstroom, North West Province. EIMS. **Position:** Heritage Specialist
- Black Mountain PV. Northern Cape. Uvuna. **Position:** Heritage Specialist
- Proposed amendment of existing mining activities for Kolomela Mine. South-west of Postmasburg, Northern Cape. EXM. **Position:** Heritage Specialist.
- Proposed amendment of existing mining activities for Kudumane Mine. Hotazel, Northern Cape. SRK. **Position:** Heritage Specialist.
- 10MW Chelsea Solar PV. Gqeberha, Eastern Cape. SLR. **Position:** Heritage Specialist.
- Koup 1 and Koup 2 WEF. Beaufort West, Western Cape. SiVEST. **Position:** Heritage Specialist.
- Victoria West Pipelines. Victoria West, Northern Cape. iXEng. – **Position:** Heritage Specialist.
- East Orchards Poultry Farm Project. Delmas, Mpumalanga. EcoSphere. – **Position:** Heritage Specialist.
- Gunstfontein WEF and OHL. Sutherland, Northern Cape. Savannah– **Position:** Heritage Specialist.
- Overhead power line for Oya PV Facility. Sutherland, Northern Cape. SiVEST– **Position:** Heritage Specialist.
- Infrastructure for Kudusberg WEF. Sutherland, Northern Cape. SiVEST– **Position:** Heritage Specialist.
- Proposed SKA fibre optic cable, between Beufort West and Carnarvon, Northern and Western Cape. **Position:** Heritage Specialist.
- Proposed SANSA Space Operations. Matjiesfontein, Western Cape. **Position:** Heritage Specialist
- Pienaarspoort WEF 1 and 2. North-west of Matjiesfontein, Western Cape. Savannah- **Position:** Heritage Specialist.
- Swellendam WEF. Swellendam, Western Cape. – **Position:** Heritage Specialist.
- Matjiesfontein Road Extension Project. Matjiesfontein, Western Cape. **Position:** Heritage Specialist.

MITIGATION WORK

1. 2020 – Coega Zone 10, Coega IDZ, Eastern Cape Province. Colonial Period Phase 2 Mitigation Archaeological Excavation. ***Archaeologist.***
2. 2019 **–** 2020 **- Lesotho Highland Development Authority – Polihali Dam Project - Heritage Management Plan development and Implementation.** Mokhotlong, Kingdom of Lesotho. ***Archaeologist***.
3. *2018- Proposed development of boreholes and associated pipelines for the Langebaan Aquifer within the Hopefield Private Nature Reserve, Hopefield, Western Cape.* ***Archaeologist.***

POSITIONS HELD

- **2021 – current:** Archaeologist - PGS (Pty) Ltd
- **2019 – 2020:** Archaeologist - PGS (Pty) Ltd Lesotho
- **2018 – 2020:** Contract Archaeologist – CTS Heritage

REFERENCES

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