

# **HERITAGE IMPACT ASSESSMENT: PROPOSED QUARRY ON PORTION 4 OF FARM 120, WAAI KRAAL, OUTSIDE BEAUFORT WEST, WESTERN CAPE**

(Assessment conducted under Section 38 (8) of the National Heritage Resources Act (No.  
25 of 1999) as part of Basic Assessment)

Prepared for

**Greenmined Environmental**

On behalf of

**Lombardskraal Doleriet (Pty) Ltd**

December 2020

Version 1.0



**ACO Associates cc**  
Archaeology and Heritage Specialists

Prepared by

**John Gribble (MA)**

ACO Associates

8 Jacobs Ladder, St James, Cape Town, 7945

Phone (021) 706 4104

Fax (086) 603 7195

Email: [john.gribble@aco-associates.com](mailto:john.gribble@aco-associates.com)

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(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 3: Terms of Reference
(cA) an indication of the quality and age of base data used for the specialist report;	Section 6: Methodology
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 14: Impacts and Risks
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 6.3:
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 6: Methodology
(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;	Sections 8-14: Heritage Assessments
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(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6.3: Restrictions and Assumptions
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Sections 8 - 13

(k) any mitigation measures for inclusion in the EMPr;	Section 14: Impact Assessment
(l) any conditions for inclusion in the environmental authorisation;	Section 14: Impact Assessment
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 14: Impact Assessment
(n) a reasoned opinion—  i. as to whether the proposed activity, activities or portions thereof should be authorised;  iA. Regarding the acceptability of the proposed activity or activities; and  ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	Section 15: Conclusion
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 5: Public Participation
(p) any other information requested by the competent authority	N/A
Where a government notice gazetted 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.	N/A

## DETAILS OF THE SPECIALIST

This study has been undertaken by John Gribble BA Hons, MA (ASAPA) of ACO Associates CC, archaeologists and heritage consultants.

Unit D17, Prime Park, Mocke Road, Diep River, Cape Town, 7800

Email: [john.gribble@aco-associates.com](mailto:john.gribble@aco-associates.com)

Phone: 021 706 4104

Fax: 086 6037195

## CONSULTANT DECLARATION OF INDEPENDENCE

I, John Gribble, declare that – general declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

**Signature of the specialist:**



**Name of company (if applicable):** ACO Associates CC

**Date:** 10 December 2020

## EXECUTIVE SUMMARY

ACO Associates cc was appointed by Greenmined Environmental, on behalf of Lombardskraal Doleriet (Pty) Ltd), to carry out a heritage impact assessment for a proposed gravel quarry on Portion 4 of the farm Waai Kraal (Farm 120) outside Beaufort West in the Western Cape.

The HIA comprises archaeological and palaeontological desktop assessments. Covid-19 related constraints have meant that it was not possible for ACO Associates to conduct an archaeological site visit before the HIA was required for inclusion in the draft Basic Assessment Report. An archaeological site visit will be required before quarrying can commence on the site, as will any mitigation of any significant sites and/or artefacts this survey identifies in the quarry area. Provision for both have been made in the mitigation measures proposed in this report.

The desktop archaeological review, available satellite imagery and some photographs of the quarry site suggest that significant archaeological sites and materials are unlikely to be present on the site, although some archaeological material must be expected and a possibly historical stone-walled kraal structure has been identified on the site. The quarrying of the area will result in the loss and destruction of any archaeological material and structures on the site

The palaeontological assessment indicates that Tierkloof Formation bedrock which underlies a substantial portion of the proposed quarry is fossiliferous and of potentially high significance. The quarrying of the area will result in the loss and destruction of fossil material within the shales and mudstones that underly the site and which are the target resource of the proposed quarry.

The following mitigation measures are recommended:

### Palaeontology

- A site visit by a suitably qualified palaeontologist prior to the commencement of quarrying to establish whether fossils are visible on the site;
- The implementation of a Fossil Chance Finds Protocol once quarrying commences to ensure the reporting, safeguarding and recovery of any finds made;
- The requirement to implement a Fossil Chance Finds Protocol, example of a Fossil Chance Find Protocol is attached as Appendix D, must be included in the EMPr for the project; and
- If fossils are found once quarrying has commenced, they must be excavated and collected by a professional palaeontologist, working under a HWC permit and then housed in a recognised repository.

### Archaeology

- An archaeological walkover survey of the site is conducted by a suitably qualified professional archaeologist to identify any archaeological sites and/or materials, and to assess the stone-walled structure;
- If any significant archaeological remains are located which cannot be avoided by, or excluded from the quarrying, they will require mitigation prior to any quarry-related

activities on the site. A Workplan application will need to be made to HWC to conduct this work;

- Should any human remains be encountered at any stage during the works associated with the project, work must in the vicinity must cease immediately, the remains must be left *in situ* but made secure and the project archaeologist and HWC must be notified immediately.

#### Built Environment

- Depending on the outcome of field assessment to confirm the accuracy of the grading given above, provided the kraal structure is photographically recorded and its position accurately mapped, this assessment suggests that it need not be retained once quarrying commences on the site.
- Should the field assessment find, however, that the kraal is associated with archaeological material – whether per-colonial or colonial - further mitigation, possibly in the form of artefact collection or excavation may be required. This will need to be agreed with HWC and must take place prior to any quarry-related activities on the site.

This assessment has found that the area identified for proposed quarry in Portion 4 of the farm Waai Kraal (120) is a moderately-low sensitive heritage environment and that impacts on heritage resources arising from expanded mining operations can be expected.

It is our considered opinion that provided the mitigation measures set out above are implemented, the overall impact of the proposed quarry on Waai Kraal will be of low heritage significance and the proposed activity is acceptable.

## GLOSSARY

**Archaeology:** 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.

**Craton:** The stable interior portion of a continent characteristically composed of ancient crystalline basement rock.

**Cultural landscape:** The combined works of people and natural processes as manifested in the form of a landscape.

**Diamictite:** A type of lithified sedimentary rock that consists of nonsorted to poorly sorted terrigenous sediment containing particles that range in size from clay to boulders, suspended in a matrix of mudstone or sandstone.

**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).

**Late Stone Age:** The archaeology of the last 20 000 years associated with fully modern people.

**Lithology:** The description of the physical characteristics of a rock unit, visible at outcrop, in hand or in core samples.

**Middle Stone Age:** The archaeology of the Stone Age between 20 000-300 000 years ago associated with early modern humans.

**National Estate:** The collective heritage assets of the Nation.

**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.

**Pleistocene:** A geological time period (of 3 million – 10 000 years ago).

**Quaternary:** The geologic time period that encompasses the most recent 2.6 million years. It comprises the Pleistocene (2.6 Ma – 10,000 years ago) and the Holocene (10,000 years ago to the present) and is characterised by a series of global glacial cycles.

**SAHRA:** South African Heritage Resources Agency – the compliance authority which protects national heritage.

**Structure (historic):** Any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith. Protected structures are those which are over 60 years old.

**Tillite:** A sedimentary rock consisting of consolidated masses of unweathered blocks and glacial till in a rock flour.

## **ACRONYMS**

<b>ESA</b>	Early Stone Age
<b>GPS</b>	Global Positioning System
<b>Ha</b>	Hectare
<b>HIA</b>	Heritage Impact Assessment
<b>HWC</b>	Heritage Western Cape
<b>LSA</b>	Late Stone Age
<b>MSA</b>	Middle Stone Age
<b>NHRA</b>	National Heritage Resources Act
<b>NID</b>	Notice of Intent to Develop
<b>SAHRA</b>	South African Heritage Resources Agency
<b>SAHRIS</b>	South African Heritage Resources Information System



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## **1 INTRODUCTION**

ACO Associates cc (ACO) was appointed by Greenmined Environmental, on behalf of Lombardskraal Doleriet (Pty) Ltd, to carry out a heritage impact assessment (HIA) for a proposed gravel quarry on Portion 4 of the farm Waai Kraal (Farm 120) outside Beaufort West in the Western Cape (Figure 1 and Figure 2).

## **2 DEVELOPMENT PROPOSAL**

Lombardskraal Doleriet is proposing to mine gravel on an undisturbed 4.9 ha area of the farm occasionally used for grazing (Figure 3). The anticipated lifespan of the quarry is at least 2 years, with a possible extension of another 3 years.

The quarrying method will make use of blasting to loosen the hard rock. The loosened aggregate will then be removed and transported to an onsite crushing plant where it will be crushed and screened to various sized stockpiles.

The graded aggregate will be stockpiled until it is transported from site using tipper trucks.

All mining related activities will be contained within the approved mining permit boundaries and following the closure of the quarry the site will be sloped and landscaped by replacing the stockpiled topsoil and vegetating the disturbed area.

Access to the proposed quarry will be from the N1 by way of an existing haul road that serves the adjacent Rhenosterkop quarry. This haul road will be extended as the quarrying progresses and will be rehabilitated as part of the final reinstatement of the area on the closure of the quarry.

- The quarry site will contain the following:
- A site office (container);
- A weighbridge;
- Ablution facilities (chemical toilet).
- Parking area for visitors and site vehicles;
- Excavating and earth moving plant;
- Mobile crushing and screening plant; and
- Site vehicles.

The aggregate from the quarry will be used to supply the construction industry in the Beaufort West area. The proposed quarry will contribute to the upgrading and maintenance of road infrastructure and building contracts in region.

## **3 TERMS OF REFERENCE**

ACO Associates was commissioned to produce a HIA as part of the Basic Assessment (BA) process for this project, as required by the National Environmental Management Act (No. 107 of 1998), as amended.

The HIA was requested by Heritage Western Cape (HWC), the competent heritage authority in the Western Cape in its response to a Notice of Intent to Develop (Case No. 20112407) submitted to it by Greenmined Environmental.

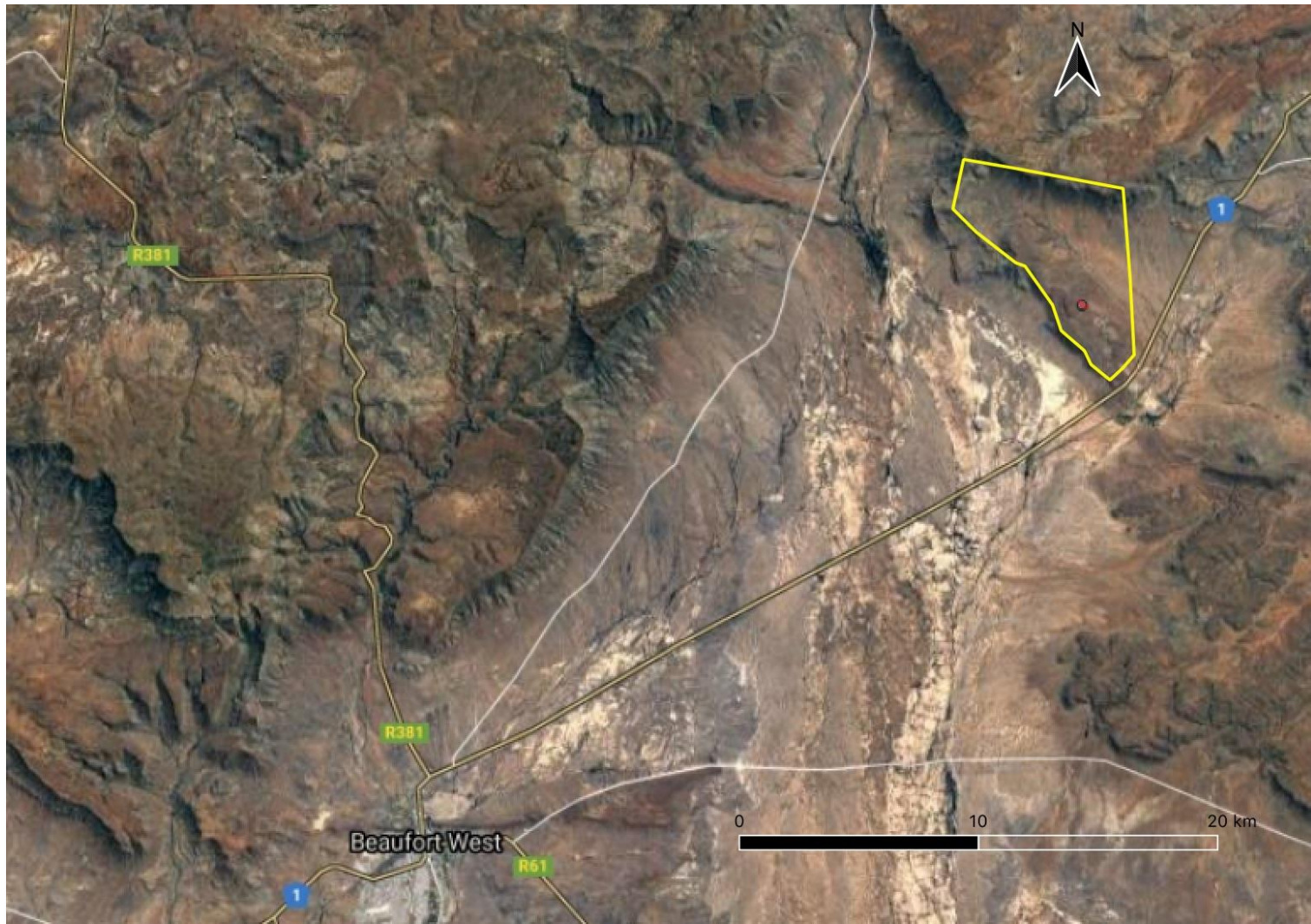


Figure 1: Location of Waai Kraal (Portion 4 of Farm 120) (yellow polygon), north-east of Beaufort West. The proposed mining area is marked by the red point in the southern half of the farm (Source: Google Earth).

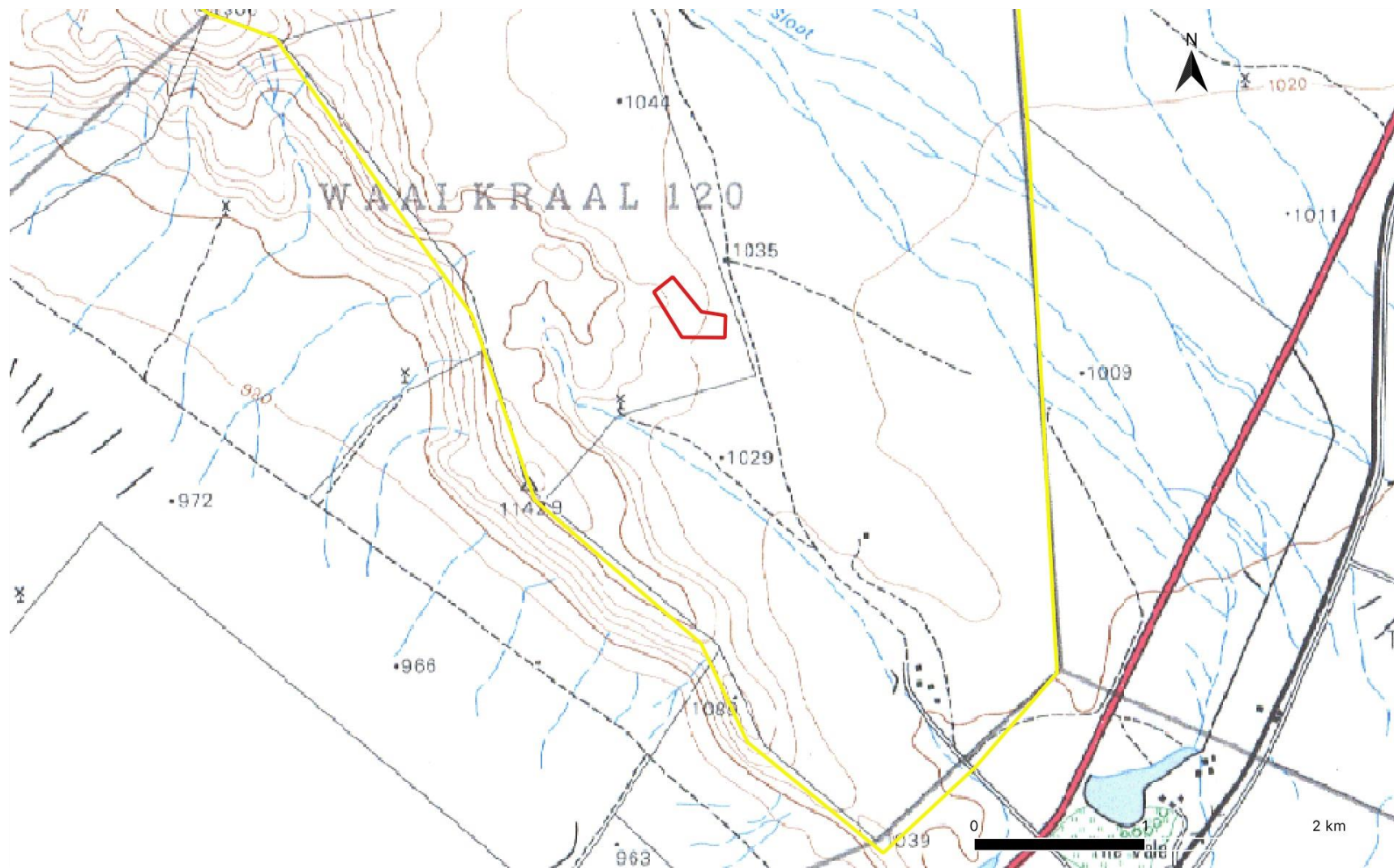
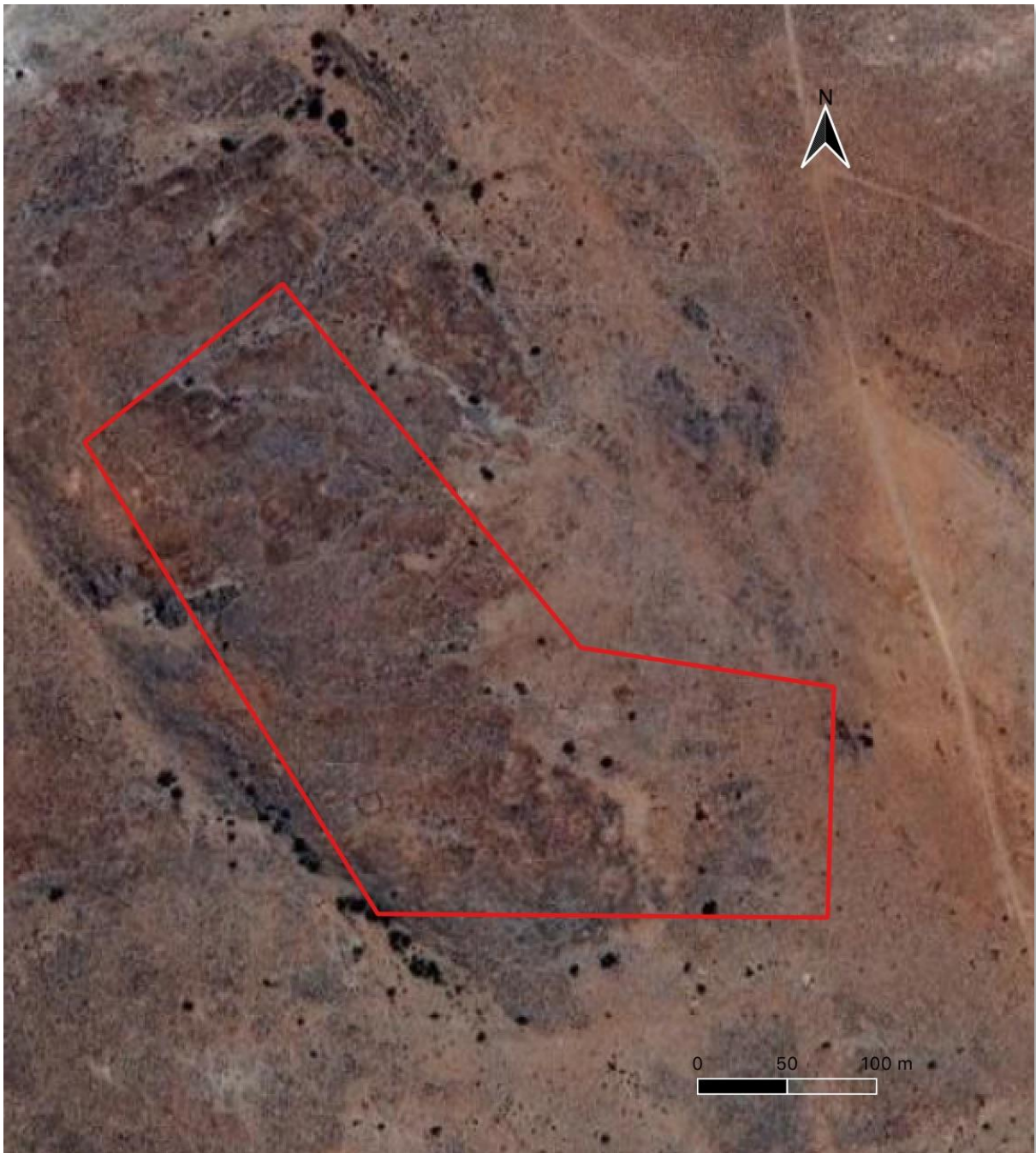


Figure 2: Position of the proposed mining area on 1:50 000 map sheet 3222BB (Source: Source: Chief Directorate: National Geo-Spatial Information. Website: [www.ngi.gov.za](http://www.ngi.gov.za)).





**Figure 3: Proposed 4,9 ha quarry area within context of farm landscape (Source: Google Earth)**

HWC stated that “since there is reason to believe that the proposed development will impact on heritage resources ... a Heritage Impact Assessment (HIA) that satisfies the provisions of section 38(3) of the [National Heritage Resources Act] be submitted”. HWC stipulated that the HIA required must include both archaeological and palaeontological impact assessments.

The aim of the HIA is to identify heritage resources which may be impacted by the proposed quarry on Waai Kraal, to assess their significance and to provide recommendations for mitigating identified impacts.

This document therefore includes the following:

- A desk-top literature review to assess the potential for archaeological, cultural and historic sites on the proposed quarry site; and
- A desk-top palaeontological review to assess the potential for the occurrence of fossil material on the proposed quarry site.

The results of these studies are integrated in this HIA report along with an assessment of the sensitivity and significance (grading) of any identified heritage resources, an evaluation of the potential impacts on heritage resources and on the cultural landscape of the proposed quarry site, a comment on the socio-economic benefits on the development and recommendations for measures to mitigate any negative impacts of the proposed quarry on heritage resources.

This HIA will form part of the BA and must be submitted for comment to HWC as part of the BA process.

## **4 RELEVANT LEGISLATION**

### **4.1 National Heritage Resources Act (No 25 of 1999)**

The National Heritage Resources Act (NHRA) came into force in 2000 with the establishment of the SAHRA, replacing the National Monuments Act (No. 28 of 1969 as amended) and the National Monuments Council as the national agency responsible for the management of South Africa's cultural heritage resources.

The NHRA reflects the tripartite (national/provincial/local) nature of public administration under the South African Constitution and makes provision for the devolution of cultural heritage management to the appropriate, competent level of government. In the Western Cape this is Heritage Western Cape.

The NHRA gives legal definition to the range and extent of what are considered to be South Africa's heritage resources. According to Section 2(xvi) of the Act a heritage resource is "any place or object of cultural significance". This means that the object or place has aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

In terms of the definitions provided in Section 2 of the NHRA, heritage resources potentially relevant to this assessment are:

- Material remains of human activity which are in a state of disuse and are in or on land [which includes land under water] and which are older than 100 years, including artefacts, human and hominid remains and artificial features;
- 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;
- 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;

- Any movable property of cultural significance which may be protected in terms of any provisions of the NHRA, including any archaeological artefact or palaeontological specimen; and
- Intangible heritage such as traditional activities, oral histories and places where significant events happened.

As per the definitions provided above, these cultural heritage resources are protected by the NHRA and a permit from HWC is required to destroy, damage, excavate, alter, deface or otherwise disturb any such site or material.

It is also important to be aware that in terms of Section 35(2) of the NHRA, all archaeological objects and palaeontological material is the property of the State and must, where recovered from a site, be lodged with an appropriate museum or other public institution.

Section 38 of the NHRA requires a HIA for certain kinds of development. In relation to this project, the relevant activity is a development which will change the character of a site exceeding 5000 m<sup>2</sup> in extent (Section 38(1)(c)(i)).

#### **4.1.1 Grading of Heritage Resources**

The South African heritage resources management system is based on grading, which provides for assigning the appropriate level of management responsibility to a heritage resource.

Grading, according to Winter & Oberholzer (2014) is “generally based on the intactness, rarity and representivity of the resource, as well as its role in the larger landscape or cultural context”.

Heritage resources are graded according to criteria specified in Section 3 of the NHRA which suggests the following criteria for assigning heritage significance:

- Importance in the community or pattern in South Africa’s history;
- Possession of uncommon, rare or endangered aspects of South Africa’s natural or cultural heritage;
- Potential to yield information that will contribute to an understanding of South Africa’s natural or cultural heritage;
- Importance in demonstrating the principal characteristics of a particular class of South Africa’s natural or cultural places or objects;
- Importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- Importance in demonstrating a high degree of creative or technical achievement during a particular period;
- Strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- Strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
- Significance in relating to the history of slavery in South Africa.

The generally accepted heritage resource grades are shown in Table 1 below.

**Table 1: Grading of heritage resources (Source: Baumann & Winter 2005: Box 5).**

<b>Grade</b>	<b>Level of significance</b>	<b>Description</b>
1	National	Of high intrinsic, associational and contextual heritage value within a national context, i.e. formally declared or potential Grade 1 heritage resources.
2	Provincial	Of high intrinsic, associational and contextual heritage value within a provincial context, i.e. formally declared or potential Grade 2 heritage resources.
3A	Local	Of high intrinsic, associational and contextual heritage value within a local context, i.e. formally declared or potential Grade 3A heritage resources.
3B	Local	Of moderate to high intrinsic, associational and contextual value within a local context, i.e. potential Grade 3B heritage resources.
3C	Local	Of medium to low intrinsic, associational or contextual heritage value within a national, provincial and local context, i.e. potential Grade 3C heritage resources.

## **4.2 National Environmental Management Act (No 107 of 1998)**

The National Environmental Management Act (NEMA) provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals that are likely to have a negative effect on the environment.

Regulations governing the environmental authorisation process have been promulgated in terms of NEMA and include the EIA Regulations, 2014 as amended (GNR R326/2017) and Listing Notices 1 – 3 (GNR 324, 325 and 327/2017). These regulations were amended in April 2017 by Government Notices 324, 325, 326 and 327.

The proposed Waai Kraal quarry triggers a number of activities in the Listing Notice 1 (Activities 21, 22, 27 and 28) and Listing Notice 3 (Activity 12). In terms of GNR 325 and 327 therefore the proposed project requires an environmental impact assessment (EIA) (Basic Assessment process) that assesses project specific environmental impacts and alternatives, considers public input, and proposes mitigation measures, to ultimately culminate in an environmental management programme that informs the competent authority, Department of Mineral Resources and Energy (Western Cape) when considering environmental authorisation.

## **4.3 Other Legislation Triggered by the Proposed Project**

A mining permit in terms of Section 27 of the Mineral and Petroleum Resources Development Act, 2002 (Act No 28 of 2002) must be obtained from the Department of Mineral Resources and Energy (Western Cape).



## **5 PUBLIC PARTICIPATION**

As required by the Basic Assessment process, a Background Information Document (BID) dated 9 November 2020 was circulated to interested and affected parties (I&APs). No heritage conservation bodies with an interest in this area of the Karoo are registered with HWC but the BID was sent to Heritage Western Cape, the Central Karoo District Municipality and the Beaufort West Local Municipality for comment. The *BID Comments and Responses Report* (Greenmined, November 2020) elicited no heritage-related comments.

Any comments related to heritage issues received during the public participation on the draft BAR will be incorporated into and addressed in the final HIA and BAR.

## **6 METHODOLOGY**

This study was commissioned as a heritage impact assessment and attempts to assess the impacts of the proposed quarry on heritage resources in the area.

### **6.1 Palaeontological Desktop Review**

Professor Marion Bamford of the University of the Witwatersrand undertook the palaeontological assessment of the quarry site, the aim of which was assess the palaeontological potential of the site and to recommend feasible management measures to comply with the requirements of HWC and the NHRA.

The PIA was a desktop exercise, and included a consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the proposed quarry area. These sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and on databases maintained by SAHRA.

### **6.2 Archaeological Desktop Review**

A number of heritage assessments have been carried out in the wider Beaufort West area and those accessible on the SAHRIS online platform (<https://sahris.sahra.org.za/>), in ACO's project archive or from colleagues were reviewed and their findings have contributed to this assessment. The reports used are listed in the reference section below.

### **6.3 Restrictions and Assumptions**

Covid-19 related constraints have meant that it was not possible for ACO Associates to conduct an archaeological site visit before the HIA was required for inclusion in the draft BAR.

The desktop archaeological review, available satellite imagery and some photographs of the quarry site suggest that significant archaeological sites and materials are unlikely to be present, although some archaeological material must be expected, and a possibly historical stone-walled kraal structure has already been identified on the site.

An archaeological site visit will be required before quarrying can commence on the site, as will any mitigation of any significant sites and/or artefacts this survey identifies in the quarry

area. Provision for both have been made in the mitigation measures proposed at the end of this report.

Although we believe that most of the relevant archaeological assessments and HIAs from the area have been located and reviewed for this report, it is acknowledged that recent heritage reports in the Western Cape do not always appear on the South African Heritage Resources Information System (SAHRIS) database maintained by SAHRA, and this can mean that some reports may not have been identified for review. We believe that those reports that have been reviewed, however, provide a good picture of the archaeology of the region.

In respect of the palaeontology of the site, based on the geology of the area and the palaeontological record as it is known, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are typical for the country and do contain fossil vertebrate material. The sands of the Quaternary period would not preserve fossils and nor would the dolerite dykes.

## **7 RECEIVING ENVIRONMENT**

The proposed quarry is located approximately 30 km north-east of Beaufort West on the N1 on the north-eastern slope of a spur of hills that extend out from the eastern Nieuweveldberge of the Great Southern Escarpment (see Figure 1).

The site overlooks the drainages of the Hoek se Sloot and Renosterspruit Rivers to the east, while the larger Platdoring River drainage lies immediately to the west of the line of hills.

According to the BID for this project (Greenmined 2020:6), the geology of the study area comprises shallow and stony “primitive, skeletal soils ... developing over sedimentary rocks such as mudstones and arenites of the Adelaide Subgroup of the Karoo Supergroup, shales of the Ecca Group ... and Jurassic dolerite sills, dykes and ... boulder slopes”.

The land use of proposed quarry area, the remainder of Portion 4 of the farm Waai Kraal (120) and surrounding farms is mainly stock grazing and a variety of mixed agriculture. An existing South African National Roads Agency (SANRAL) quarry is currently operational on Portion 4 of Waai Kraal, approximately 500 m to the south of the proposed quarry (Figure 4).

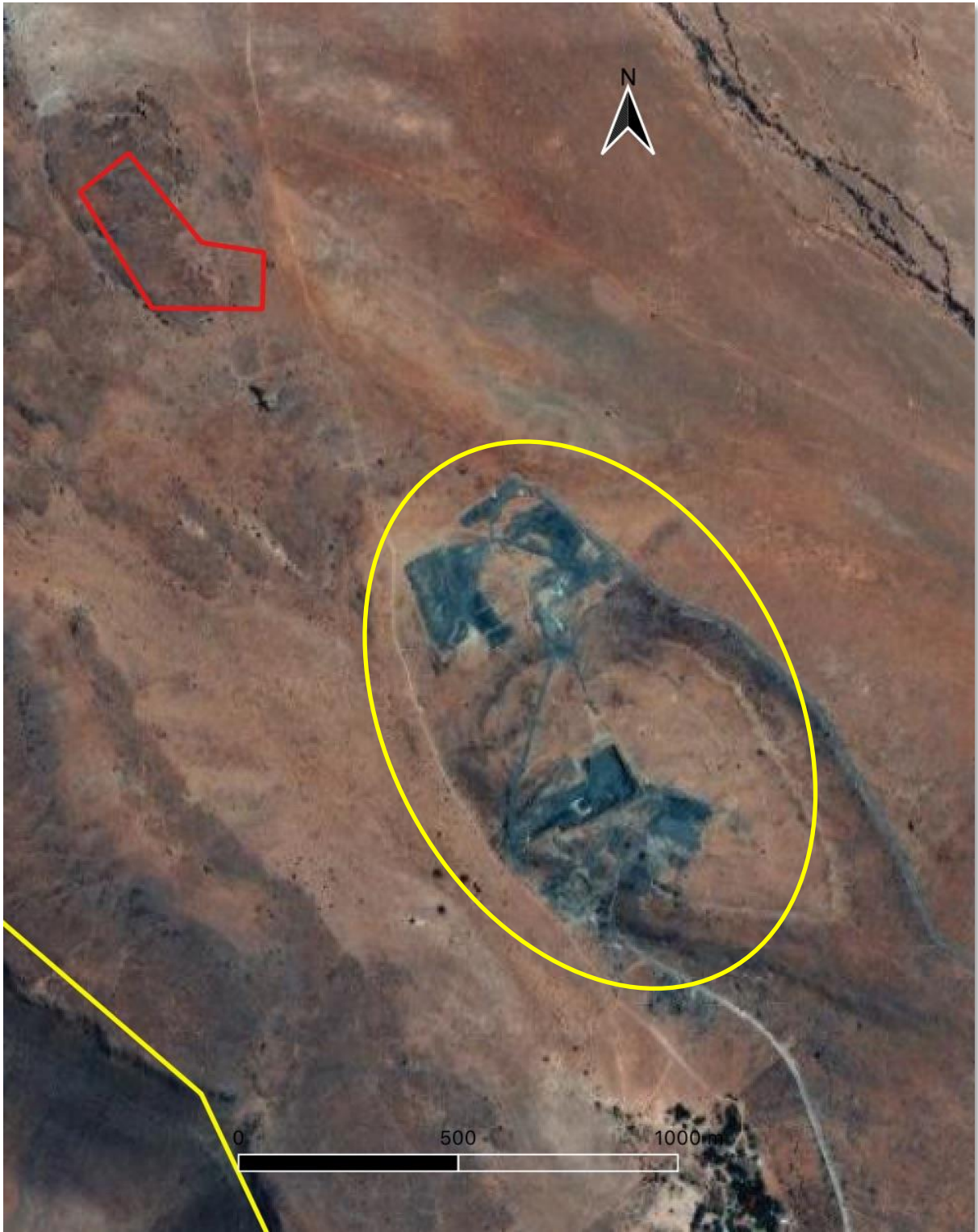


Figure 4: Location of the existing SANRAL quarry (circled in yellow) in relation to the proposed quarry (red polygon) (Source: Google Earth).

## 8 PALAEOONTOLOGICAL ASSESSMENT

A requested by HWC in response to the NID, therefore, a palaeontological impact assessment was commissioned from Professor Marion Bamford of the University of the Witwatersrand, the results of which are presented below. The full report is attached as Appendix B.

### 8.1 Project Location and Geological Context

The proposed quarry area is located in the southwestern part of the main Karoo Basin with mostly Beaufort Group rocks and numerous dolerite dykes that intruded the sediments during the Jurassic. These dykes are harder and more resistant than the older sediments and frequently form the types of ridges or caps on flat hills such as it present on the proposed quarry site (Figure 5 and Table 2).

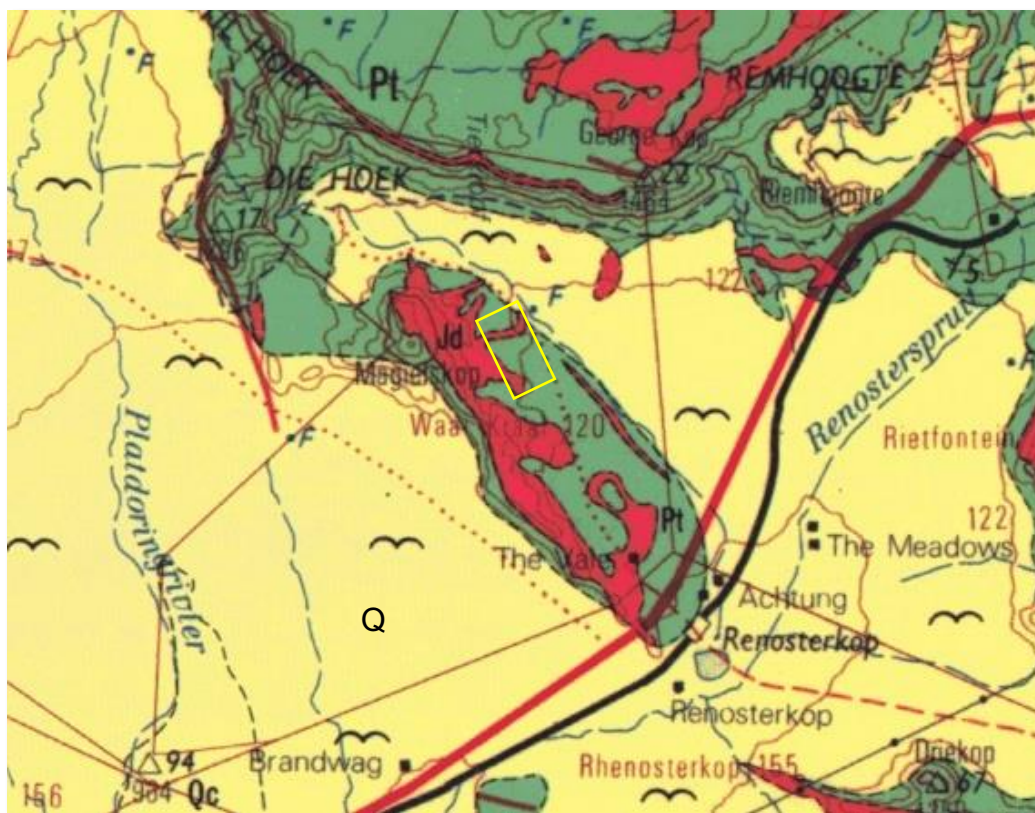


Figure 5: Geological map of the area around Farm Waai Kraal 120, with the location of the proposed project is indicated by the yellow rectangle. Abbreviations of the rock types are explained in Table 2. (Map enlarged from the Geological Survey 1: 250 000 map 3222 Beaufort West).

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006. Johnson et al., 2006; McCarthy et al., 2006; Robb et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma



Symbol	Group/Formation	Lithology	Approximate Age
Pt	Tierkloof Fm, Adelaide Subgroup, Beaufort Group, Karoo SG.	Mudstone, sandstone, cherty beds near base	Late Permian ca 260 – 255 Ma

The Karoo Basin is a large depression on the Kaap Vaal Craton that received meltwaters from the southern highlands and glacial ice sheets that covered much of the area during the Late Carboniferous when the continent was positioned over the South Pole.

As the continent moved northwards and the Earth warmed, sediments and water filled the basin. The lowermost sediments are the diamictites, tillites, mudstones and shales of the Dwyka Group. Then the Ecca Group sediments are shales, mudstones, sandstones and coal seams from the early Permian times, together with plants of the *Glossopteris* flora.

Overlying Beaufort sediments provide evidence of the drying up of the system and braided streams and channels. By this time vertebrates were inhabiting the continent.

To the northeast of the Karoo are the Stormberg Group sediments capped by the Drakensberg basaltic outpourings – the Drakensberg Mountains are what remains, including the numerous dolerite dykes.

## 8.2 Palaeontological Context

The dolerite on the quarry site does not contain any fossils because it is intrusive volcanic rock. Furthermore, dolerite dykes often destroy any fossils in the close vicinity during their formation.

The Tierkloof Formation potentially can preserve fossils of the Cistecephalus Assemblage Zone at the base and the Dicynodon (Rubidge 1995) or of the Lower and Upper Daptocephalus Assemblage Zone (Viglietti et al., 2016). The groups of vertebrate fossils are the fish, amphibians, parareptiles, dicynodonts, biarmosuchians, gorgonopsians, therocephalians and cynodonts (see full list in Appendix B). However, there is no record of any fossils on the farm Waai Kraal 120 on the unpublished map of fossils finds in the Karoo by Prof James Kitching, in the Evolutionary Studies Institute, University of the Witwatersrand.

Plants, however, are not common in the Tierkloof Formation (Plumstead, 1969; Anderson and Anderson, 1985). Fossil pollen from the Tierkloof Formation deposits are rather patchy but are indicative of the *Glossopteris* flora (Barbolini et al., 2018).

The SAHRIS palaeo-sensitivity map (see <https://sahris.sahra.org.za/map/palaeo>) indicates palaeontological sensitivity of the footprint of the proposed quarry (Figure 6 below). The map shows the area as partly very highly (red) and also of zero sensitivity (grey). These sensitivities apply to the Tierkloof Formation and dolerite dykes on the site, respectively.

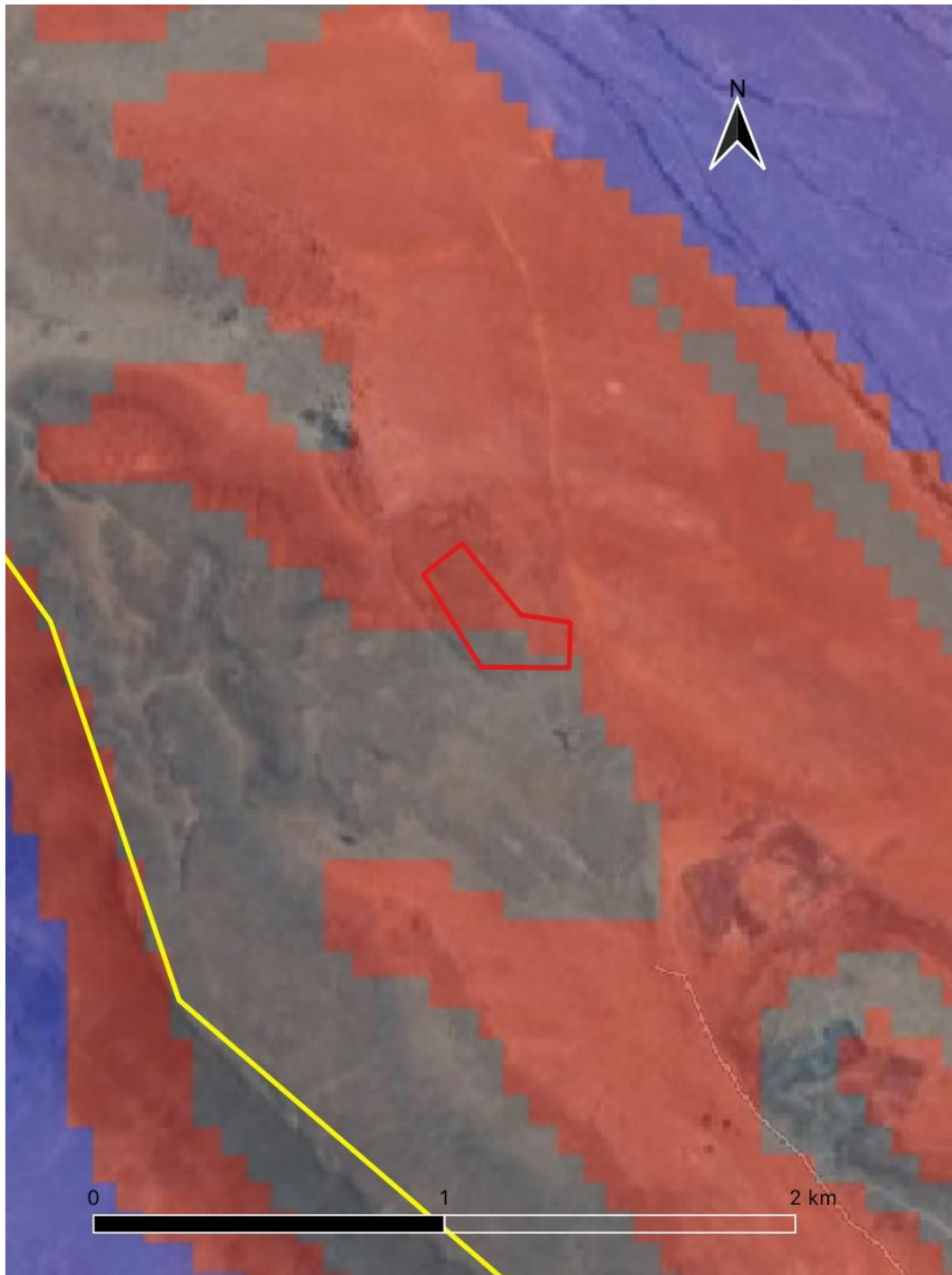


Figure 6: Overlay of proposed quarry area (red polygon) on the SAHRIS palaeo-sensitivity map. The background colours indicate the following degrees of sensitivity: red = high, blue = low, grey – insignificant/zero (Source: <https://sahris.sahra.org.za/map/palaeo>).

## 9 ARCHAEOLOGICAL ASSESSMENT

Numerous impact assessments have been conducted in proximity to the proposed quarry. In their assessment of the proposed Aberdeen to Droerivier 400 kV transmission line, Hart & Schietecatte (2012) provide a useful summary of the archaeological and colonial history of

the area noting that more than 90% of Karoo archaeological sites are open sites containing stone artefacts, ostrich eggshell fragments and, occasionally, pottery. Bone is rarely preserved.

“Artefacts of both the Early and Middle Stone Age are widespread [in the Karoo] and may generally be described as an ancient litter that occurs at a low frequency across the landscape. Where definable scatters of Early and Middle Stone Age material occur, they are considered to be significant heritage sites” (Hart & Schietecatte 2012:19).

A more intensive occupation of the Karoo started around 13 000 years ago during the Later Stone Age, and the archaeology of the period reflects the heritage of Khoisan groups who lived throughout the region until 18<sup>th</sup> century colonial expansion disrupted and destroyed their way of life. The archaeological legacy of the San includes numerous open living sites, hunting blinds or skerms as well as rock art – in the form of paintings within the rare Karoo caves or shelters, or rock engravings on the dolerite boulders that characterise many parts of the Karoo landscape (Hart & Schietecatte 2012). Naturally elevated features like dolerite dykes and ridges played a significant role in San settlement patterns.

“The introduction of pastoralism (sheep and goats, later cattle) roughly 2000 years along with the arrival of the Khoekhoen was a significant event that broke the ancient tradition of hunting and gathering. ... These transhumant communities (herding cattle and sheep) may have utilized the grazing opportunities of the Karoo on a seasonal basis but information on this is sketchy” (Hart & Schietecatte 2012:20). Recent evidence has revealed the presence of early stone stock kraals, possibly associated with the Khoekhoen (Hart 2005) in the high Karoo near Sutherland, as well as on the escarpment of the eastern Karoo in the Sneeuwberg Mountains (Sampson et al 1989).

The Cape colonial frontier was opened up well before the 1838 Great Trek by the advance of transhumant trekboer farmers into the interior. Trekboer expansion began early in the 1700s with the colonisation of the Cape south of the Cape Fold Belt mountains and by 1740 European stock farmers had begun to penetrate into the Great Karoo. By 1760 this expansion had reached as far as the Nieuweveldsberge in the Beaufort West district (Hart & Schietecatte 2012, Van der Merwe 1937).

The indigenous San and Khoekhoen waged a bitter war against colonial expansion but were gradually pushed off their traditional land and many appear to have retreated to the Great Karoo above the Escarpment from where they continued to resist the newcomers. According to Penn (2005) the most determined indigenous resistance to Trekboer expansion occurred when they entered the harsh environment of the escarpment of the interior plateau, namely Hantam, Roggeveld and the Nieuweveld Mountains above Beaufort West.

Hart & Schietecatte (2012:22) describe the trekboere settling on the Escarpment, where most of the springs were found and from where they were able to exploit the vegetation of the onder-Karoo on a seasonal basis. “These European pastoralists were highly mobile; trekking between winter and summer grazing on and off the Escarpment. Land ownership was informal, and only became regulated after the implementation of the quitrent system used by the Government to control the lives and activities of the farmers.

One of the two major administrative centres established in the interior to exert hegemony over the activities of the trekboere, who tended to behave as free agents without governance, was Beaufort West (Hart & Schietecatte 2012).

## **9.1 Review of Archaeological Reports**

Stone Age artefacts from the of Early (ESA), Middle (MSA) and Later (LSA) Stone Ages have been widely reported in the Beaufort West area. These invariably occur in secondary contexts, often associated with gravel, having survived extensive erosion of the soils in which they were once deposited (Dreyer 2005; Halkett 2009; Kaplan 2006, 2007; Orton 2010; Webley & Halkett 2015; Webley & Hart 2010a, 2010b).

Isolated ESA artefacts, including occasional handaxes have been reported from the Beaufort West area but are generally quite ephemeral. Kinahan (2008) noted with respect the archaeology of Ryst Kuil, a total of only seven ESA sites, with isolated finds of quartzite artefacts none of which was considered to be in primary context and therefore of little research value. Dreyer (2005) also reported

Middle Stone Age artefacts are widespread across the region, occurring in isolated as well as relatively dense concentrations over large areas. They do not occur with any associated archaeological material or organic remains. They have been reported by amongst others, Kinahan (2008), Kaplan (2007, 2008), Dreyer (2005) and Orton (2010, 2011), and are most often described as a continuous surface scatter almost without focal points.

While ESA and MSA stone artefacts are ubiquitous, LSA artefacts are scarcer. They tend to be manufactured on hornfels (indurated shale), an excellent tool raw material, which is sourced from the hundreds of dolerite dykes which criss-cross the Karoo. Large numbers of Later Stone Age tools were documented by Kaplan (2007) at the borrow pits locations he surveyed. At Ryst Kuil south of Beaufort West, Halkett (2009) noted that LSA material was located close to dry river courses, typically marked by dense acacia growth. The pre-colonial inhabitants were probably restrained by the need for water and shelter, of which the latter is almost completely absent and acacia stands are the only possibility of respite from wind and sun. The LSA reported by Halkett (2009) included a number of suspected hut circles and short lengths of stone walling as well as possible burial cairns. The hut circles/stone kraals have been interpreted to represent pre-colonial pastoralist groups.

Historical resources are also sometimes encountered, and these include farmsteads and their associated outbuildings, kraals and sometimes graves (Halkett 2009; Orton 2011; Webley & Hart 2010b). For example, Kaplan (2007) reported colonial period remains including possible graves, a number of stone-walled structures and possible shepherds' huts and associated ceramics and glass in his survey of the borrow pits referred to above.

Rock art, either very occasional painted panels in rocky overhangs, but more usually in this area in the form of rock engravings on the dark dolerite boulders that characterise parts of the Karoo are well reported to the east of the quarry site near Nelspoort (Nelspoort Rock Art n.d.; Parkington *et al.* 2008).

In the immediate vicinity of the proposed quarry, rock engravings have been reported by Orton (2010) in an archaeological assessment of the proposed haul road for the Renosterkop quarry referred to earlier and adjacent to the proposed new quarry on Waai



Kraal. The existing quarry is located on an extensive dolerite outcrop that forms a very large, low hill and Orton (2010) reports a number of rock engravings and areas of scratching on both dolerite slabs and boulders to the east of the hill. The engravings and scratched areas range from those that due to the subject matter, execution and patination present are clearly pre-colonial, to those that are probably much more recent, such as an engraving of a horse.

## 10 BUILT ENVIRONMENT

In the absence for the time being of a field survey, Google Earth satellite imagery was interrogated for evidence of historical built structures within the quarry footprint.

No historic buildings are present within the area, but a roughly circular stone-walled structure, believed to be a kraal, is present in the south-west of the quarry footprint (Figure 7 and Plate 1).

Photographs supplied by the landowner and the ecologist indicate that the structure is low-walled, three to four courses high, is constructed from dolerite slabs and cobbles and is situated on dolerite bedrock. While the age of the kraal is currently unknown its shape and structure suggests that it is historical, rather than pre-colonial (Tim Hart pers. comm.).



**Figure 7: Satellite image showing the location of the kraal (red arrow) within the proposed mining area (white polygon). The kraal is visible in the most recent Google Earth image, but the image dated 19 September 2009 was chosen for its clarity (Source: Google Earth).**



**Plate 1: Stone-walled kraal located within the proposed mining area (Photo: Gerhard Botha).**

## **11 CEMETERIES AND GRAVES**

According to the landowner, and again drawing on available satellite imagery, no cemeteries or graves appear to be present in the proposed quarry area.

## **12 SENSE OF PLACE / CULTURAL LANDSCAPE**

Although not referenced in the NHRA, the concept of “cultural landscapes” finds expression in Article 1 of the World Heritage Convention 1972 where it is defined as a category of cultural heritage site which is representative of the “combined works of nature and of man”. A consideration of any proposed development within the context of the cultural landscape within which it is proposed has become a standard requirement of HIA’s in South Africa.

The term “cultural landscape” embraces a diversity of manifestations of the interaction between humankind and its natural environment and cultural landscapes are illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal (<https://whc.unesco.org/en/culturallandscape/#1>).

The Operational Guidelines (2008) of the World Heritage Convention define three main categories of cultural landscape, namely:

- **Clearly defined landscapes designed and created intentionally by people.** This embraces garden and parkland landscapes constructed for aesthetic reasons which are often (but not always) associated with religious or other monumental buildings and ensembles.
- **Organically evolved landscapes.** These result from an initial social, economic, administrative, and/or religious imperative and have developed their present form by association with and in response to their natural environment. Such landscapes reflect that process of evolution in their form and component features. They fall into two sub-categories:
  - **a relict (or fossil) landscape** in which an evolutionary process came to an end at some time in the past, either abruptly or over a period. Its significant distinguishing features are, however, still visible in material form.
  - **a continuing landscape**, which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress. At the same time it exhibits significant material evidence of its evolution over time.
- **Associative cultural landscapes.** The inclusion of such landscapes on the World Heritage List is justifiable by virtue of the powerful religious, artistic or cultural associations of the natural element rather than material cultural evidence, which may be insignificant or even absent.

The surrounding cultural landscape of the proposed quarry can best be described as an organically evolved landscape which probably contains both relict (the pre-colonial use of and interaction with the land) and continuing (the modern, largely agricultural influences on the Karoo landscape) landscape elements.

The context of the proposed quarry is the vast expanse of the semi-arid Karoo landscape. The area is characterised by isolated farm complexes, widely spaced on vast farms with farm buildings dating from the 19th and 20th centuries and the vastness of the scenery along the N1 and other regional roads is generally broken only by the occasional town and service station.

The establishment of the proposed quarry on Waai Kraal will introduce an industrial element into this overwhelmingly natural landscape where the human imprint is relatively light.

That said, the proposed quarry is not likely to be visible from the N1, and will thus not materially alter the character or sense of place of the wider cultural landscape in which it will operate. The change in landscape character the quarry will occasion is partially offset by the presence of an existing quarry approximately 500 m south-east of the proposed development area on the same farm.

## **13 SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS**

Section 38 (3) (d) requires that a heritage impact assessment “evaluate the impact of [a] development on heritage resources relative to the sustainable social and economic benefits to be derived from the development”.



In respect of the proposed quarry, the heritage potential of the area to be affected is low, although this assessment is subject to confirmation and change by the field survey that must still be undertaken.

The aggregate and gravel that will be produced at the quarry will be used by the construction industry in the wider area and the proposed quarry will therefore contribute to the upgrading and maintenance of road infrastructure and to building contracts in and around the Beaufort West area.

Based on the above, it is likely that the sustainable social and economic benefits arising from the operation of a quarry on this site will outweigh impacts to the heritage resources on site, particularly if the mitigation measures set out above in respect of the various heritage resources are successfully and diligently implemented.

## 14 IMPACTS ASSESSMENT

Impacts arising from the establishment and operation of the proposed quarry are likely to be limited to within the boundaries of the quarry as all quarry-related activities and infrastructure will take place and be located within the permitted mining area, or on existing access roads.

Heritage resources located within the footprint of the proposed quarry, however, will be affected by quarrying activities, except if expressly excluded from these activities.

The stripping for stockpiling of the topsoil from the site will result in the disturbance of any archaeological material (both pre-colonial and historical) present, and the destruction of any stratified sites. This includes the stone-walled possible kraal on the site and any associated artefacts.

### 14.1 Methodology

The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur.

For each potential impact, the **DURATION** (time scale), **EXTENT** (spatial scale), **IRREPLACABILITY** (loss of resources), **REVERSIBILITY** of the potential impacts, **MAGNITUDE** of negative or positive impacts, and the **PROBABILITY** of occurrence of potential impacts is assessed.

The assessment of the above criteria is used to determine the **SIGNIFICANCE** of each impact, with and without the implementation of the mitigation measures.

The scales used to assess these variables and to define the rating categories are shown in Table 3 and Table 4 below.

**Table 3: Evaluation components, ranking scales and descriptions (criteria)**

Evaluation component	Ranking scale and description (criteria)
<b>MAGNITUDE of NEGATIVE IMPACT</b>	<b>10 - Very high:</b> Bio-physical and/or social functions and/or processes might be <i>severely</i> altered <b>8 - High:</b> Bio-physical and/or social functions and/or processes might be <i>considerably</i> altered

(at the indicated spatial scale)	<p><b>6 - Medium:</b> Bio-physical and/or social functions and/or processes might be <i>notably</i> altered</p> <p><b>4 - Low :</b> Bio-physical and/or social functions and/or processes might be <i>slightly</i> altered</p> <p><b>2 - Very Low:</b> Bio-physical and/or social functions and/or processes might be <i>negligibly</i> altered</p> <p><b>0 - Zero:</b> Bio-physical and/or social functions and/or processes will remain <i>unaltered</i></p>
<p><b>MAGNITUDE of POSITIVE IMPACT</b></p> <p>(at the indicated spatial scale)</p>	<p><b>10 - Very high (positive):</b> Bio-physical and/or social functions and/or processes might be <i>substantially</i> enhanced</p> <p><b>8 - High (positive):</b> Bio-physical and/or social functions and/or processes might be <i>considerably</i> enhanced</p> <p><b>6 - Medium (positive):</b> Bio-physical and/or social functions and/or processes might be <i>notably</i> enhanced</p> <p><b>4 - Low (positive):</b> Bio-physical and/or social functions and/or processes might be <i>slightly</i> enhanced</p> <p><b>2 - Very Low (positive):</b> Bio-physical and/or social functions and/or processes might be <i>negligibly</i> enhanced</p> <p><b>0 - Zero (positive):</b> Bio-physical and/or social functions and/or processes will remain <i>unaltered</i></p>
<b>DURATION</b>	<p><b>5 - Permanent</b></p> <p><b>4 - Long term:</b> Impact ceases after operational phase/life of the activity (&gt; 20 years)</p> <p><b>3 - Medium term:</b> Impact might occur during the operational phase/life of the activity (2 to 20 years)</p> <p><b>2 - Short term:</b> Impact might occur during the construction phase (&lt; 2 years)</p> <p><b>1 – Immediate</b></p>
<p><b>EXTENT</b></p> <p>(or spatial scale/influence of impact)</p>	<p><b>5 - International:</b> Beyond National boundaries</p> <p><b>4 - National:</b> Beyond Provincial boundaries and within National boundaries</p> <p><b>3 - Regional:</b> Beyond 5 km of the proposed development and within Provincial boundaries</p> <p><b>2 - Local:</b> Within 5 km of the proposed development</p> <p><b>1 - Site-specific:</b> On site or within 100 m of the site boundary</p> <p><b>0 – None</b></p>
<p><b>IRREPLACEABLE</b></p> <p>(loss of resources)</p>	<p><b>5 – Definite</b> loss of irreplaceable resources</p> <p><b>4 – High</b> potential for loss of irreplaceable resources</p> <p><b>3 – Moderate</b> potential for loss of irreplaceable resources</p> <p><b>2 – Low</b> potential for loss of irreplaceable resources</p> <p><b>1 – Very low</b> potential for loss of irreplaceable resources</p> <p><b>0 – None</b></p>
<p><b>REVERSIBILITY</b></p> <p>(of impact)</p>	<p><b>5 – Impact cannot</b> be reversed</p> <p><b>4 – Low</b> potential that impact might be reversed</p> <p><b>3 – Moderate</b> potential that impact might be reversed</p>

	<p><b>2 – High</b> potential that impact might be reversed</p> <p><b>1 – Impact will be</b> reversible</p> <p><b>0 – No impact</b></p>
<b>PROBABILITY</b> (of occurrence)	<p><b>5 - Definite:</b> &gt;95% chance of the potential impact occurring</p> <p><b>4 - High probability:</b> 75% - 95% chance of the potential impact occurring</p> <p><b>3 - Medium probability:</b> 25% - 75% chance of the potential impact occurring</p> <p><b>2 - Low probability:</b> 5% - 25% chance of the potential impact occurring</p> <p><b>1 - Improbable:</b> &lt;5% chance of the potential impact occurring</p>

**Table 4: Cumulative Impacts**

<b>Evaluation component</b>	<b>Ranking scale and description (criteria)</b>
<b>CUMULATIVE IMPACTS</b>	<p><b>High:</b> The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern</p> <p><b>Medium:</b> The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern</p> <p><b>Low:</b> The activity is localised and might have a negligible cumulative impact</p> <p><b>None:</b> No cumulative impact on the environment</p>

Once the evaluation components have been ranked for each potential impact, the significance of each potential impact will be assessed (or calculated) using the following formula:

$$\text{SP (significance points)} = (\text{magnitude} + \text{duration} + \text{extent} + \text{irreplaceable} + \text{reversibility}) \times \text{probability}$$

The maximum value is 150 SP (significance points). The unmitigated and mitigated scenarios for each potential environmental impact should be rated as per Table 5 below.

**Table 5: Definition of significance ratings (positive and negative)**

<b>Significance Points Environmental</b>	<b>Environmental Significance</b>	<b>Description</b>
125 – 150	<b>Very High (VH)</b>	An impact of very high significance will mean that the project cannot proceed, and that impacts are irreversible, regardless of available mitigation options
100 – 124	<b>High (H)</b>	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options

75 – 99	Medium-High (MH)	If left unmanaged, an impact of medium-high significance could influence a decision about whether or not to proceed with a proposed project. Mitigation options should be re-evaluated at
40 – 74	Medium (M)	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project
<40	Low (L)	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation
+	Positive Impact (+)	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project

## 14.2 Palaeontology

The PIA indicates that Tierkloof Formation bedrock that underlies a substantial portion of the proposed quarry is fossiliferous and of potentially high significance.

The quarrying of the area will result in the loss and destruction of fossil material within the shales and mudstones that underly the site and which are the target resource of the proposed quarry.

Potential impacts on palaeontological resources arising from the operation of the quarry are assessed thus as follows:

**Table 6: Impact Assessment: Loss or destruction of palaeontological resources**

Evaluation Component	Ranking Scale	Significance Points	Ranking Scale after Mitigation	Significance Points after Mitigation
<u>MAGNITUDE of NEGATIVE IMPACT</u>	Very low	2	Very low	2
<u>MAGNITUDE of POSITIVE IMPACT</u>	Very low	2**	Low (positive)	4**
DURATION	Permanent	5	Permanent	5
EXTENT	Site-specific	1	Site-specific	1
IRREPLACEABLE	High	4	Moderate	2
REVERSIBILITY	Cannot be reversed	5	Cannot be reversed	5
PROBABILITY	High probability	5	Low probability	2
Significance Points (Total)		85		30
Significance		Medium-High		Low

\*\* Magnitude of positive impact is not counted in the significance points equation

### 14.2.1 Cumulative Impact

As an activity which has a current similar activity in the same geographical area, and might have a combined impact of moderate significance on a heritage resource of national and international interest, the cumulative impact of the proposed quarry on palaeontological resources is expected to be **medium**.

### 14.2.2 Mitigation Measures

The PIA indicates that based on the geological record and fossil collecting map maintained by the Evolutionary Studies Institute, there is a chance that vertebrate fossils could occur on the site but none have been recorded to date.

If dolerite is the material to be mined than there will be no fossils, but if mudstones and shales are to be mined there is a moderate chance that fossils would be present.

The following mitigation measures are recommended:

- A site visit by a suitably qualified palaeontologist prior to the commencement of quarrying to establish whether fossils are visible on the site;
- The implementation of a Fossil Chance Finds Protocol once quarrying commences to ensure the reporting, safeguarding and recovery of any finds made;
- The requirement to implement a Fossil Chance Finds Protocol, example of a Fossil Chance Find Protocol is attached as Appendix D, must be included in the EMPr for the project; and
- If fossils are found once quarrying has commenced, they must be excavated and collected by a professional palaeontologist, working under a HWC permit and then housed in a recognised repository.

## 14.3 Archaeology

Based on the review of other assessments in the area, it has been assumed that MSA and potentially LSA lithic scatters will be present on the site. It has also been assumed that rock engravings are likely to be present.

The nature of quarrying means that where archaeological sites/materials occur within the mining area they are likely to be disturbed and lost.

Potential impacts on archaeological heritage resources arising from the operation of the quarry are assessed thus as follows:

<b>Evaluation Component</b>	<b>Ranking Scale</b>	<b>Significance Points</b>	<b>Ranking Scale after Mitigation</b>	<b>Significance Points after Mitigation</b>
<b>MAGNITUDE of <u>NEGATIVE IMPACT</u></b>	Low	4	Negligible	2



<b>MAGNITUDE of POSITIVE IMPACT</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>	<b>N/A</b>
<b>DURATION</b>	<b>Permanent</b>	<b>5</b>	<b>Permanent</b>	<b>5</b>
<b>EXTENT</b>	<b>Site-specific</b>	<b>1</b>	<b>Site-specific</b>	<b>1</b>
<b>IRREPLACEABLE</b>	<b>Very low</b>	<b>1</b>	<b>Very low</b>	<b>1</b>
<b>REVERSIBILITY</b>	<b>Cannot be reversed</b>	<b>5</b>	<b>Cannot be reversed</b>	<b>5</b>
<b>PROBABILITY</b>	<b>High probability</b>	<b>5</b>	<b>Low probability</b>	<b>2</b>
<b>Significance Points (Total)</b>		<b>60</b>		<b>24</b>
<b>Significance</b>		<b>Medium</b>		<b>Low</b>

\*\* Magnitude of positive impact is not counted in the significance points equation

### 14.3.1 Cumulative Impact

As an activity which is localised and in an area where archaeological resources are expected to be limited and of relatively low significance, the cumulative impact of the proposed quarry on archaeological resources is expected to be **low**.

### 14.3.2 Mitigation Measures

The available archaeological literature and assessment reports for this area of the Karoo cited above suggest that an archaeological background “litter” of Middle Stone Age lithics can be expected within the quarry area. The lack of rocky overhangs or shelters means that any archaeological sites within the proposed quarry footprint are likely to be open, unstratified sites. The presence of rock engravings on the site is possible. The existence of a possible stone-walled kraal, of likely colonial period age has been confirmed.

The following pre-quarrying archaeological mitigation measures are recommended:

- An archaeological walkover survey of the site is conducted by a suitably qualified professional archaeologist to identify any archaeological sites and/or materials, and to assess the stone-walled structure;
- If any significant archaeological remains are located which cannot be avoided by, or excluded from the quarrying, they will require mitigation prior to any quarry-related activities on the site. A Workplan application will need to be made to HWC to conduct this work;
- Should any human remains be encountered at any stage during the works associated with the project, work must in the vicinity must cease immediately, the remains must be left *in situ* but made secure and the project archaeologist and HWC must be notified immediately.

## 14.4 Built Environment

The quarrying of the proposed mining area is likely to result in the destruction of the kraal structure and any potential associated artefactual material. Although this is still to be

confirmed by a field assessment, the our current knowledge of the kraal structure suggests that can probably be graded 3C and is of relatively low heritage significance.

Potential impacts on this heritage resource arising from the operation of the mine are assessed thus as follows:

**Table 7: Impact Assessment: Loss or destruction of built environment**

<b>Evaluation Component</b>	<b>Ranking Scale</b>	<b>Significance Points</b>	<b>Ranking Scale after Mitigation</b>	<b>Significance Points after Mitigation</b>
<b>MAGNITUDE of <u>NEGATIVE</u> IMPACT</b>	Low	4	Negligible	2
<b>MAGNITUDE of <u>POSITIVE</u> IMPACT</b>	Low	4	Very low	2
<b>DURATION</b>	Permanent	5	Permanent	5
<b>EXTENT</b>	Site-specific	1	Site-specific	1
<b>IRREPLACEABLE</b>	Very low	1	Very low	1
<b>REVERSIBILITY</b>	Cannot be reversed	5	Cannot be reversed	5
<b>PROBABILITY</b>	High probability	5	Low probability	2
<b>Significance Points (Total)</b>		<b>80</b>		<b>28</b>
<b>Significance</b>		<b>Medium-High</b>		<b>Low</b>

\*\* Magnitude of positive impact is not counted in the significance points equation

#### **14.4.1 Cumulative Impact**

As an activity which is localised and in an area where built environment resources are limited and of relatively low significance, the cumulative impact of the proposed quarry on archaeological resources is expected to be **low**.

#### **14.4.2 Mitigation Measures**

Depending on the outcome of field assessment to confirm the accuracy of the grading given above, provided the kraal structure is photographically recorded and its position accurately mapped, this assessment suggests that it need not be retained once quarrying commences on the site.

Should the field assessment find, however, that the kraal is associated with archaeological material – whether per-colonial or colonial - further mitigation, possibly in the form of artefact collection or excavation may be required. This will need to be agreed with HWC and must take place prior to any quarry-related activities on the site.

## **14.5 The No-Go Alternative**

Not implementing the proposed project will result in no impacts to heritage resources, preserving the *status quo* on the site.

## **15 CONCLUSION**

This assessment has found that the area identified for proposed quarry in Portion 4 of the farm Waai Kraal (120) is a moderately sensitive heritage environment and that impacts on heritage resources arising from expanded mining operations can be expected.

It is our considered opinion that provided the mitigation measures set out above are implemented, the overall impact of the proposed quarry on Waai Kraal will be of low heritage significance and the proposed activity is acceptable.

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## 16.1 Online Resources

Cultural Landscapes (Accessed online 9 December 2020)

<https://whc.unesco.org/en/culturallandscape/#1>.

Nelspoort Rock Art. n.d. (No longer accessible 8 December 2020)

<http://www.beaufortwestsa.co.za/Rockart.htm>.

South African Heritage Resources Information System (Accessed online on 8 December 2020). <http://www.sahra.org.za/sahris>.

SAHRA Palaeo-sensitivity Map (Accessed online on 8 December 2020)  
<https://sahris.sahra.org.za/map/palaeo>.

## **APPENDIX A: HERITAGE WESTERN CAPE NID RESPONSE**

## **APPENDIX B: PALAEOONTOLOGICAL IMPACT ASSESSMENT**

# **Palaeontological Impact Assessment for the proposed gravel quarry on Farm Waai Kraal 120, 10km northeast of Beaufort West, Northern Cape Province**

**Desktop Study (Phase 1)**

**For**

**ACO Associates (Pty) Ltd**

**10 December 2020**

**Prof Marion Bamford**

Palaeobotanist

P Bag 652, WITS 2050

Johannesburg, South Africa

[Marion.bamford@wits.ac.za](mailto:Marion.bamford@wits.ac.za)



## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford

Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf

Experience: 31 years research; 23 years PIA studies

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by ACO Associates (Pty) Ltd, Cape Town, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

A handwritten signature in blue ink, appearing to read 'MKBamford', written over a horizontal line.

Signature:

## **Executive Summary**

A palaeontological Impact Assessment was requested for the establishment of a gravel quarry on Farm Waaikraal 120, about 20km northeast of Beaufort West, Western Cape Province by the company Lombaardskraal Dolereit (Pty) Ltd.

To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed site lies on the mudstones and shales of the Tierkloof Formation, Adelaide Subgroup, Beaufort Group, Karoo Supergroup and is potentially fossiliferous. It is possible that vertebrate fossils of the Cistecephalus and Dicynodon (Daptocephalus) Assemblage Zones could occur on the site, however none has been reported and they are seldom found on relatively flat hilltops. Therefore a site visit is recommended because there is a moderate chance of finding fossils on the site.

## **Background**

Lombardskraal Doleriet (Pty) Ltd (hereafter referred to as the applicant) applied for a mining permit for the mining of gravel, 4.9 ha on a portion of Portion 4 of the farm Waai Kraal No 120 situated in the Beaufort West magisterial district of the Western Cape Province.

## **Site Description**

The proposed mining footprint will be 4.9 ha and will be developed over an undisturbed area of the farm occasionally used for grazing. The mining method will make use of blasting in order to loosen the hard rock; the material will then be loaded and hauled to the crushing plant where it will be screened to various sized stockpiles. The aggregate will be stockpiled until it is transported from site using tipper trucks. All mining related activities will be contained within the approved mining permit boundaries. The proposed GPS coordinates of the area applied for are as indicated in Figure 1.

## **Project Description**

Lombardskraal Doleriet (Pty) Ltd applied for a mining permit to develop over an undisturbed area of the farm occasionally used for grazing. The mining method will make use of blasting in order to loosen the hard rock; upon which the loosened material will be transported to a processing area (inside mining boundary) where it will be crushed and screened to various sized stockpiles, before being sold and transported from site to clients. All activities will be contained within the boundaries of the site.

The proposed mining area is approximately 4.9 ha in extent and the applicant, intends to win material from the area for at least 2 years with a possible extension of another 3 years. The aggregate / gravel to be removed from the quarry will be used for construction industry in the vicinity. The proposed quarry will therefore contribute to the upgrading / maintenance of road infrastructure and building contracts in and around the Beaufort West area.

The mining activities will consist out of the following:

- Stripping and stockpiling of topsoil;
- Blasting
- Excavating;
- Crushing;
- Stockpiling and transporting;
- Sloping and landscaping upon closure of the site; and
- Replacing the topsoil and vegetation the disturbed area.

The mining site will contain the following:

- Excavating equipment;
- Earth moving equipment;
- Mobile crushing and screening plants;
- Access Roads;
- Site office (Container);
- Site vehicles;
- Parking area for visitors and site vehicles;

Weighbridge;  
Ablution facilities (Chemical toilet).

## Access Route

Access to the proposed mining area will be via the N1, making use of the existing internal/haul roads to access the mining area.

Haul roads will be extended as the open cast mining progress, and will be rehabilitated as part of the final reinstatement of the area.

A Palaeontological Impact Assessment was requested for the Mining Rights Application for this project. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is reported herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
ai	Details of the specialist who prepared the report	Appendix B
a ii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
b	A declaration that the person is independent in a form as may be specified by the competent authority	Page 41
c	An indication of the scope of, and the purpose for which, the report was prepared	Section 0
ci	An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report	Yes
cii	A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 5
d	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
e	A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 0
f	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 4
g	An identification of any areas to be avoided, including buffers	N/A
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;	N/A

i	A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 0
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 0
k	Any mitigation measures for inclusion in the EMPr	Section 7, Appendix A
l	Any conditions for inclusion in the environmental authorisation	N/A
m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 7, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	N/A
nii	If the opinion is that the proposed activity 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	N/A
o	A description of any consultation process that was undertaken during the course of carrying out the study	N/A
p	A summary and copies if any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A



Figure 1: Google Earth map of the proposed gravel quarry on Farm Waakraal 120, about 20km northeast of Beaufort West.

## Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).
- 5.

## Geology and Palaeontology

### Project location and geological context

The site is in the southwestern part of the main Karoo Basin with mostly Beaufort Group rocks and numerous dolerite dykes that intruded the sediments in the Jurassic. These dykes are harder and more resistant than the older sediments and frequently form ridges or caps on flat hills, mesas.

The Karoo Basin is a large depression on the Kaap Vaal Craton that received meltwaters from the southern highlands and glacial ice sheets that covered much of the area during the Late Carboniferous when the continent was positioned over the South Pole. As the continent moved northwards and the Earth warmed, sediments and water filled the basin. The lowermost sediments are the diamictites, tillites, mudstones and shales of the Dwyka Group. Then the Ecca Group sediments are shales, mudstones, sandstones and coal seams from the early Permian times, together with plants of the *Glossopteris* flora. Overlying Beaufort sediments show the drying up of the system and braided streams and channels. By this time vertebrates were inhabiting the continent. To the northeast are the Stormberg Group sediments capped by the Drakensberg basaltic outpourings – the Drakensberg Mountains are what remains, including the numerous dolerite dykes (Figure 2; Table 2; Johnson et al., 2006).

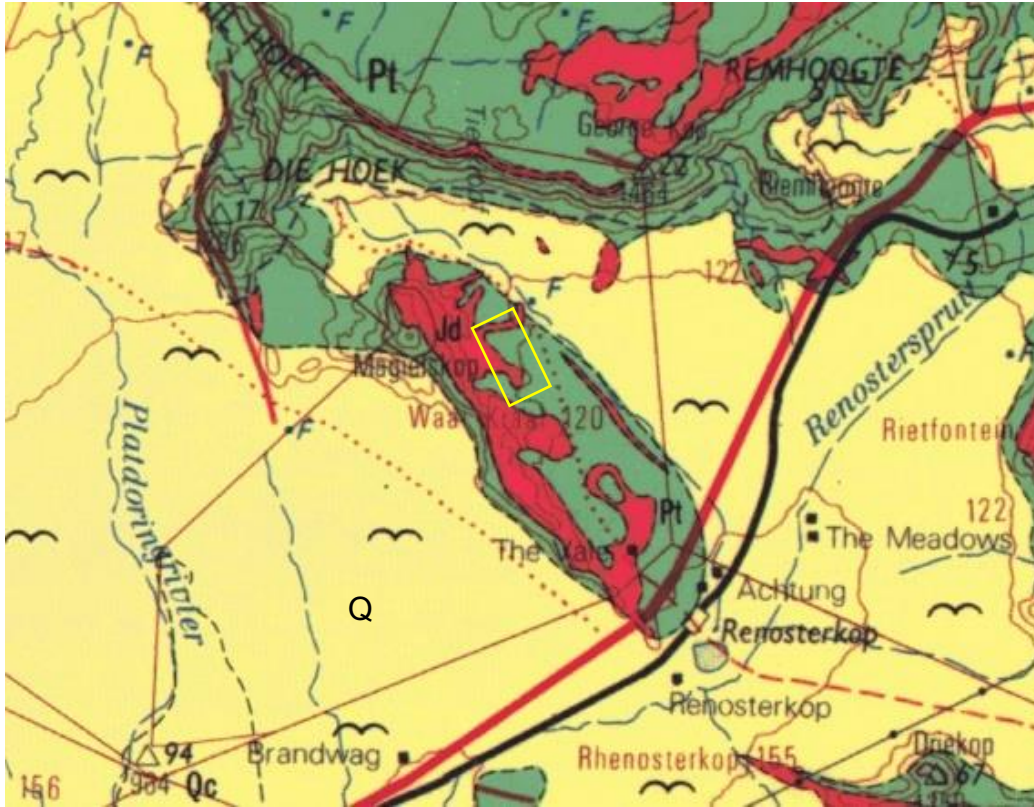


Figure 2: Geological map of the area around Farm Waaikraal 120, with the location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 3222 Beaufort West.

Table 2: Explanation of symbols for the geological map and approximate ages (Eriksson et al., 2006; Johnson et al., 2006; McCarthy et al., 2006; Robb et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pt	Tierkloof Fm, Adelaide Subgroup, Beaufort Group, Karoo SG.	Mudstone, sandstone, cherty beds near base	Late Permian ca 260 – 255 Ma

### Palaeontological context

The dolerite does not preserve any fossils because it is intrusive volcanic rock. Furthermore, the dykes often destroy any fossils in the close vicinity. The Tierkloof Formation potentially can preserve fossils of the Cistecephalus Assemblage Zone at the base and the Dicynodon (Rubidge et al., 1995) or of the Lower and Upper Daptocephalus Assemblage Zone (Viglietti et al., 2016). The groups of vertebrate fossils are the fish, amphibians, parareptiles, dicynodonts, biarmosuchians, gorgonopsians, therocephalians and cynodonts (see full list in Appendix A). However, there is no record of any fossils on the Farm Waaikraal 120 on the unpublished map of fossils finds in the Karoo by Prof James Kitching, in the Evolutionary Studies Institute, University of the Witwatersrand.



Plants, however, are not common in the Tierkloof Formation (Plumstead, 1969; Anderson and Anderson, 1985). Fossil pollen from the Tierkloof Formation deposits are rather patchy but are indicative of the *Glossopteris* flora (Barbolini et al., 2018). The palaeontological sensitivity of the area under consideration is presented in Figure 3.

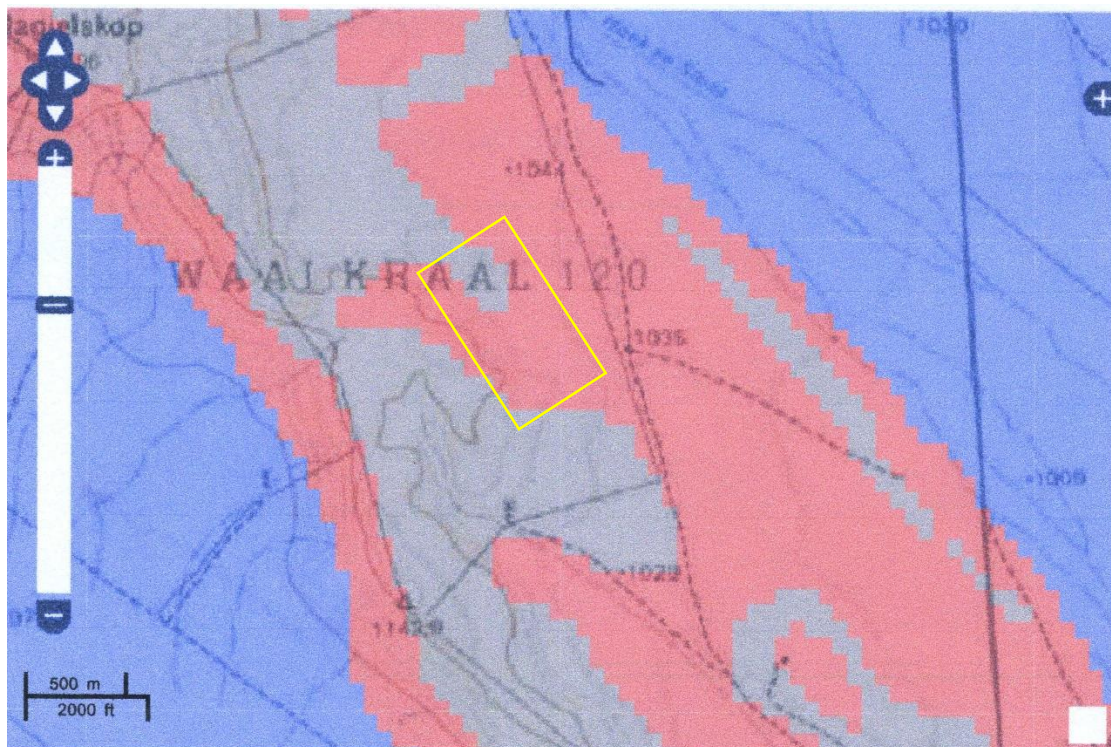


Figure 3: SAHRIS palaeosensitivity map for the site for the proposed quarry on Farm Waaikraal 120 shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as partly very highly (red) and also of zero sensitivity (grey) that applies to the Tierkloof Formation and dolerite dykes, respectively.

### Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

**Table 3a: Criteria for assessing impacts**

PART A: DEFINITION AND CRITERIA		
<b>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</b>	<b>H</b>	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	<b>M</b>	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	<b>L</b>	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.

	<b>L+</b>	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	<b>M+</b>	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	<b>H+</b>	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
<b>Criteria for ranking the DURATION of impacts</b>	<b>L</b>	Quickly reversible. Less than the project life. Short term
	<b>M</b>	Reversible over time. Life of the project. Medium term
	<b>H</b>	Permanent. Beyond closure. Long term.
<b>Criteria for ranking the SPATIAL SCALE of impacts</b>	<b>L</b>	Localised - Within the site boundary.
	<b>M</b>	Fairly widespread – Beyond the site boundary. Local
	<b>H</b>	Widespread – Far beyond site boundary. Regional/ national
<b>PROBABILITY (of exposure to impacts)</b>	<b>H</b>	Definite/ Continuous
	<b>M</b>	Possible/ frequent
	<b>L</b>	Unlikely/ seldom

**Table 3b: Impact Assessment**

<b>PART B: Assessment</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	So far there are no records from the Tierkloof Fm of plant fossils; pollen is rare. Vertebrate fossils typical of the Cistecephalus and Dicynodon /Daptocephalus AZ do occur in some outcrops.
	<b>L</b>	-
	<b>L+</b>	-
	<b>M+</b>	-
	<b>H+</b>	-
<b>DURATION</b>	<b>L</b>	-
	<b>M</b>	-
	<b>H</b>	Where manifest, the impact will be permanent.
<b>SPATIAL SCALE</b>	<b>L</b>	-
	<b>M</b>	Since only the possible fossils within the area would be vertebrate fossils plants from the Cistecephalus or Dicynodon / Daptocephalus AZ but rare on hill tops, the spatial scale will be localised within the site boundary.-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	It is possible that vertebrate fossils may occur but not close to the dyke and seldom on flat hill tops, so a site visit is required.
	<b>L</b>	-

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are the wrong kind to preserve fossils in the case of the dolerite dykes, but the correct age and type in the case of the Tierkloof Formation mudstones and shales. Fossils are often destroyed by dykes if in the near vicinity, and fossils are seldom expose on relatively flat hill tops. Taking account of the defined criteria, the potential impact to fossil heritage resources is **moderate**.

### **Assumptions and uncertainties**

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the dolomites, sandstones, shales and sands are

typical for the country and do contain fossil vertebrate material. The sands of the Quaternary period would not preserve fossils and nor would the dolerite dykes.

### **Recommendation**

Based on the geological record and fossil collecting map in the ESI, there is a chance that vertebrate fossils could occur on the site but none has been recorded. If dolerite is the material to be mined then there will be no fossils, If mudstones and shales are to be mined then there is a moderate chance that fossils would be present. A site visit is recommended. If fossils are found once mining has commenced then they should be excavated and collected with the relevant HWC/SAHRA permit and housed in a recognised institution.

### **References**

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodrum of South African megaflores, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

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Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). *The Geology of South Africa*. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. *Geological Society of southern Africa*, Annexure to Volume LXXII. 72pp + 25 plates.

## Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the blasting / drilling / mining activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when blasting / drilling/mining commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (fish bones, vertebrate bones) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the fossils in the shales and mudstones (for example see Figure 4, 5). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

**Appendix A – Examples of fossils from the Cistecephalus and Dicynodon Assemblage Zones.**

Table 4: List of vertebrate taxa from the Tierkloof Formation

Dicynodon Assemblage Zone (Rubidge et al., 1995)	
Captorhinida	<i>Pareiasaurus</i> <i>Milleretta</i> <i>Millerosaurus</i> <i>Anthodon</i> <i>Spondyloestes</i> <i>Owenetta</i>
Eosuchia	<i>Youngina</i> <i>Saurostemon</i>
Dicynodontia	<i>Pristerodon</i> <i>Diictodon</i> <i>Dicynodon</i> <i>Emydops</i> <i>Aulacocephalodon</i> <i>Oudenodon</i> <i>Pelanomodon</i> <i>Dianomodon</i>
Biarmosuchia	<i>Rubidgina</i> <i>Burnettia</i> <i>Ictidorhinus</i> <i>Lemurosaurus</i>
Gorgonopsia	<i>Lycaenops</i> <i>Cyonosaurus</i> <i>Prorubidgea</i> <i>Leontocephalus</i>

	<i>Broomicephalus</i> <i>Rubidgea</i> <i>Dinogorgon</i> <i>Clelandrina</i> <i>Paragalerhinus</i>
Terocephalia	<i>Ictidosuchoides</i> <i>Ictidosuchops</i> <i>Theriognathus</i> <i>Homodontosaurus</i> <i>Scaloporhinus</i> <i>Scaloposuchus</i> <i>Nanictidops</i> <i>Akidnognathus</i> <i>Lycideops</i> <i>Cerdops</i> <i>Promosuchorhynchus</i> <i>Tetracynodon</i> <i>Moschorhinus</i>
Cynodontia	<i>Procynosuchus</i> <i>Cynosaurus</i> <i>Nanictosaurus</i>





Figure 4: Unidentified fossil bones seen in situ and partially buried.

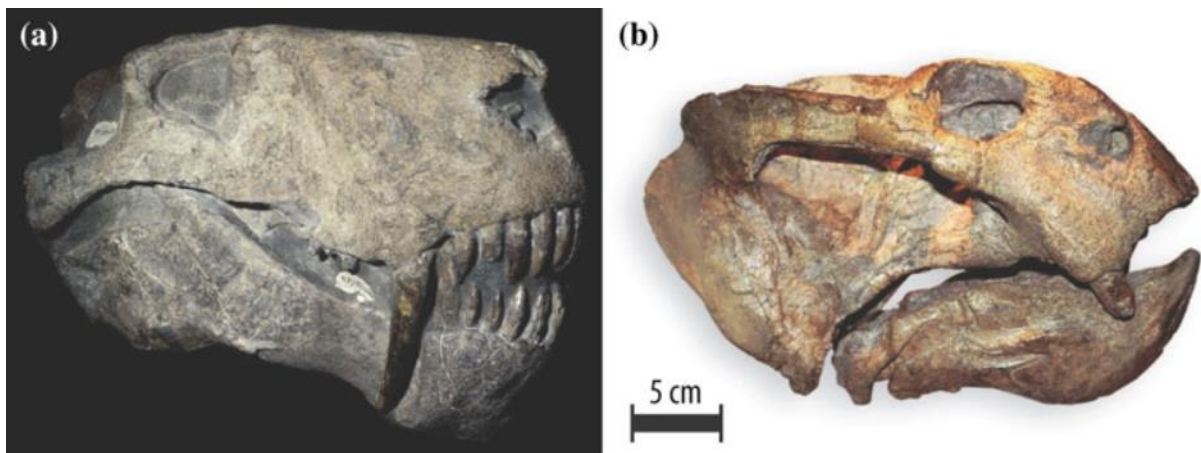


Figure 5: Therapsid skulls representative of two families that went extinct in the Permian: a - flesh eating gorgonopsian, and b - the herbivore dicynodont *Daptocephalus* (Photos supplied by Bruce Rubidge). In Linol and de Wit (2016) book Preface



## APPENDIX C: CURRICULUM VITAE: JOHN GRIBBLE

**Name:** John Gribble  
**Profession:** Archaeologist (Maritime)  
**Date of Birth:** 15 November 1965  
**Parent Firm:** ACO Associates cc  
**Position in Firm:** Senior Archaeologist  
**Years with Firm:** 2.5  
**Years of experience:** 29  
**Nationality:** South African  
**HDI Status:** n/a

### Education:

1979-1983 Wynberg Boys' High School  
1986 BA (Archaeology), University of Cape Town  
1987 BA (Hons) (Archaeology), University of Cape Town  
1990 Master of Arts, (Archaeology) University of Cape Town

### Employment:

- September 2017 – present: ACO Associates, Senior Archaeologist and Consultant
- 2014-2017: South African Heritage Resources Agency, Manager: Maritime and Underwater Cultural Heritage Unit
- 2012-2018: Sea Change Heritage Consultants Limited, Director
- 2011-2012: TUV SUD PMSS (Romsey, United Kingdom), Principal Consultant: Maritime Archaeology
- 2009-2011: EMU Limited (Southampton, United Kingdom), Principal Consultant: Maritime Archaeology
- 2005-2009: Wessex Archaeology (Salisbury, United Kingdom), Project Manager: Coastal and Marine
- 1996-2005: National Monuments Council / South African Heritage Resources Agency, Maritime Archaeologist
- 1994-1996: National Monuments Council, Professional Officer: Boland and West Coast, Western Cape Office

### **Professional Qualifications and Accreditation:**

- Member: Association of Southern African Professional Archaeologists (ASAPA) (No. 043)
- Principal Investigator: Maritime and Colonial Archaeology, ASAPA CRM Section
- Field Director: Stone Age Archaeology, ASAPA CRM Section
- Class III Diver (Surface Supply), Department of Labour (South Africa) / UK (HSE III)

### **Experience:**

I have more than 30 years of professional archaeological and heritage management experience. After completing my postgraduate studies and a period of freelance archaeological work in South Africa and aboard, I joined the National Monuments Council (NMC) (now the South African Heritage Resources Agency (SAHRA)) in 1994. In 1996 I became the NMC's first full-time maritime archaeologist and in this regulatory role was responsible for the management and protection of underwater cultural heritage in South Africa under the National Monuments Act, and subsequently under the National Heritage Resources Act.

In 2005 I moved to the UK to join Wessex Archaeology, one of the UK's biggest archaeological consultancies, as a project manager in its Coastal and Marine Section. In 2009 I joined Fugro EMU Limited, a marine geosurvey company to set up their maritime archaeological section. I then spent a year at TUV SUD PMSS, an international renewable energy consultancy, where I again provided maritime archaeological consultancy services to principally the offshore renewable and marine aggregate industries.

In August 2012 I established Sea Change Heritage Consultants Limited, a maritime archaeological consultancy. Sea Change traded until 2018, providing archaeological services to a range of UK maritime sectors, including marine aggregates and offshore renewable energy. Relevant experience includes specialist archaeological consultancy for more than two dozen offshore renewable energy projects and aggregate extraction licence areas in UK waters including:

- Lynn and Inner Dowsing OWF;
- Humber Gateway OWF;
- Sheringham Shoal OWF;
- Race Bank OWF;
- Docking Shoal OWF;
- Triton Knoll OWF;
- Neart na Gaoithe OWF;
- Dogger Bank OWF;
- Hornsea OWF;
- Navitus Bay OWF;
- Aggregate Area 392/393, Hilbre Swash;
- Area 478, East English Channel;
- Area 372/1, North Nab;
- Areas 401 & 2;
- Area 466, North West Rough; and

- Area 447, Cutline.

In the UK I was also involved in strategic projects which developed guidance and best practice for the UK offshore industry with respect to the marine historic environment. This included the principal authorship of two historic environment guidance documents for COWRIE and the UK renewable energy sector (*Historical Environment Guidance for the Offshore Renewable Energy Sector* (2007) and *Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector* (2010)). I was also manager and lead author in the development of the archaeological elements of the first Regional Environmental Assessments for the UK marine aggregates industry, and in the 2009 *UK Continental Shelf Offshore Oil and Gas and Wind Energy Strategic Environmental Assessment* for Department of Energy and Climate Change. More recently I undertook a review of the potential impacts of marine mining on South Africa's palaeontological and archaeological heritage resources for the Council for Geoscience, on behalf of the Department of Mineral Resources. In 2013-14 I was lead author and project co-ordinator on *The UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001: An Impact Review for the United Kingdom* and in 2016 I was co-author of a Historic England / Crown Estate / British Marine Aggregate Producers Association funded review of marine historic environment best practice guidance for the UK offshore aggregate industry.

I returned to South African in mid-2014 where I was re-appointed to my earlier post at SAHRA: Manager of the Maritime and Underwater Cultural Heritage Unit. In July 2016 I was appointed as Acting Manager of SAHRA's Archaeology, Palaeontology and Meteorites Unit.

I left SAHRA in September 2017 to join ACO Associates as Senior Archaeologist and Consultant. Since being at ACO I have carried out a number of offshore impact assessments (see list of recent projects below) and authored a review of the potential impacts of marine mining on South Africa's palaeontological and archaeological heritage for the Council for Geoscience, on behalf of the Department of Mineral Resources.

I have been a member of the Association of Southern African Professional Archaeologists (No. 043) for more than twenty years and am accredited by ASAPA's Cultural Resource Management section.

I have been a member of the ICOMOS International Committee for Underwater Cultural Heritage since 2000 and served as a member of its Bureau between 2009 and 2018.

Since 2010 I have been a member of the UK's Joint Nautical Archaeology Policy Committee.

I am a member of the Advisory Board of the George Washington University / Iziko Museums of South Africa / South African Heritage Resources Agency / Smithsonian Institution 'Southern African Slave Wrecks Project' and serve on the Heritage Western Cape Archaeology, Palaeontology and Meteorites Committee.

### **Selected Project Reports:**

Gribble, J. 2017. *Archaeological Assessment of Farm No 8/851, Drakenstein*. Unpublished report prepared for Balwin Properties Pty Ltd. ACO Associates.

- Gribble, J. 2017. *Archaeological Assessment of Bosjes Phase 2, Farm 218 Witzenberg*. Unpublished report prepared for Farmprops 53 (Pty) Ltd. ACO Associates.
- Gribble, J. 2017. *Canal Precinct, V&A Waterfront: Heritage Impact Assessment*. Unpublished report prepared for Nicolas Baumann Urban Conservation and Planning. ACO Associates.
- Gribble, J. 2017. *Archaeological Assessment of the proposed dam on the farm Constantia Uitsig, Erven 13029 and 13030, Cape Town*. Unpublished report prepared for SLR Consulting (South Africa) (Pty) Ltd. ACO Associates.
- Gribble, J. 2017. *Archaeological Assessment of Erf 4722 Blouvillei, Wellington*. Unpublished report prepared for Urban Dynamics Western Cape (Pty) Ltd. ACO Associates.
- Hart, T.G., Gribble, J. & Robinson, J. 2017 *Heritage Impact Assessment for the Proposed Phezukomoya Wind Energy Facility to be Situated in the Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.
- Hart, T.G., Gribble, J. & Robinson, J. 2017 *Heritage Impact Assessment for the Proposed San Kraal Wind Energy Facility to be Situated in the Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.
- Gribble, J. 2018. *Integrated Heritage Impact Assessment of the Peter Falke Winery on Farm 1558 Groenvlei, Stellenbosch*. Unpublished report prepared for Werner Nel Environmental Consulting Services. ACO Associates.
- Gribble, J. & Halkett, D. 2018. *Heritage Impact Assessment for a Proposed Extension of the Kaolin Mine on Portion 1 of the Farm Rondawel 638, Namaqualand District, Northern Cape*. Unpublished report prepared for Rondawel Kaolien (Pty) Ltd. ACO Associates.
- Gribble, J. 2019. *Archaeological Impact Assessment for Proposed Sand Mining on Portion 2 of Farm Kleinfontein 312, Klawer District, Western Cape*. Unpublished report prepared for Green Direction Sustainability Consulting (Pty) Ltd. ACO Associates.
- Halkett, D. & Gribble, J. 2018. *Archaeological/Heritage Report for the Expansion of the Current Granite Mining at Oeranoep and Ghaams, Northern Cape Province*. Unpublished report prepared for Klaas Van Zyl. ACO Associates.
- Gribble, J. 2018. *Potential Impacts of Marine Mining on South Africa's Palaeontological and Archaeological Heritage*. Report prepared for Council for Geoscience. ACO Associates.
- Gribble, J. 2018. *Maritime Heritage Impact Assessment: Block ER236, Proposed Exploration Well Drilling*. Unpublished report prepared for ERM Southern Africa (Pty) Ltd. ACO Associates.
- Gribble, J. 2018. *Maritime Heritage Impact Assessment: IOX Cable Route*. Unpublished report prepared for ERM Southern Africa. ACO Associates.
- Gribble, J. 2018. *Archaeological Assessment of the Terrestrial Portion of the IOX Cable Route*. Unpublished report prepared for ERM Southern Africa. ACO Associates.

- Gribble, J. 2018. *Archaeological Assessment: Erven 11122, 11123, 11124, 11125, 11126, 11127 and Re 11128, Corner Frere Street and Albert Road, Woodstock, Cape Town.* Unpublished report prepared for Johan Cornelius. ACO Associates.
- Gribble, J. 2018. *Maritime Heritage Impact Assessment: Expansion of Diamond Coast Aquaculture Farm on Farm 654, Portion 1, Kleinzee, Northern Cape.* Unpublished report prepared for ACRM. ACO Associates.
- Gribble, J. 2018. *Heritage Impact Assessment: Ship Repair Facility, Port of Mossel Bay.* Unpublished report prepared for Nema Consulting. ACO Associates.
- Gribble, J. 2018. *Archaeological Assessment: Sites B and C, Portwood Ridge Precinct, V&A Waterfront.* Unpublished report prepared for Urban Conservation. ACO Associates.
- Gribble, J. 2018. *Heritage Impact Assessment: Zandrug, Farm Re 9/122, Cederberg.* Unpublished report prepared for Cederberg Environmental Assessment Practice. ACO Associates.
- Gribble, J. and Hart, T.G. 2018. *Initial Assessment Report and Motivation for Exploratory Permit, Erf 4995, corner of Waterfall and Palace Hill Roads, Simonstown.* Unpublished report prepared for Regent Blue Sayers' Lane (Pty) Ltd. ACO Associates.
- Gribble, J. and Hart, T.G. 2018. *Initial investigation report with respect to human remains found at Erf 4995, corner of Waterfall and Palace Hill Roads, Simonstown.* Unpublished permit report prepared for Regent Blue Sayers' Lane (Pty) Ltd. ACO Associates.
- Gribble, J. 2019. *Maritime Heritage Impact Assessment: ASN Africa METISS Subsea Fibre Optic Cable System.* Unpublished report prepared for ERM Southern Africa. ACO Associates.
- Gribble, J. 2019. *Maritime Archaeological Impact Assessment of Proposed Aquaculture Areas 1, 6 And 7, Algoa Bay, Eastern Cape Province.* Unpublished report prepared for Anchor Research & Monitoring (Pty) Ltd. ACO Associates.
- Gribble, J. 2019. *Heritage Impact Assessment: Rooilandia Farm Dam, Pipeline and New Irrigation Areas.* Unpublished report prepared for Cornerstone Environmental Consultants. ACO Associates.
- Gribble, J. 2019. *Maritime Archaeological Impact Assessment of Proposed Equiano Cable System, landing at Melkbosstrand, Western Cape Province.* Unpublished report prepared for Acer (Africa) Environmental Consultants. ACO Associates.
- Gribble, J. 2019. *Heritage Baseline for Prospecting Right Applications: Sea Concession Areas 14b, 15b and 17b, West Coast, Western Cape Province.* Unpublished report prepared for SLR Consulting. ACO Associates.
- Gribble, J. & Euston-Brown, G.L. 2019. *Archaeological Amendment Report: San Kraal Wind Energy Facility, Noupoot, Northern Cape.* Unpublished report prepared for Arcus Consulting. ACO Associates.

- Gribble, J. & Euston-Brown, G.L. 2019. *Archaeological Amendment Report: Phezukomoya Wind Energy Facility, Noupoot, Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.
- Gribble, J. & Euston-Brown, G.L. 2019. *Archaeological Amendment Report: Hartebeeshoek West Wind Energy Facility, Noupoot, Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.
- Gribble, J. & Euston-Brown, G.L. 2019. *Archaeological Amendment Report: Hartebeeshoek East Wind Energy Facility, Noupoot, Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.
- Gribble, J. & Euston-Brown, G.L. 2019. *Heritage Assessment: Infrastructure Associated with the San Kraal, Phezukomoya and Hartebeeshoek East and West Wind Energy Facilities, Noupoot, Northern Cape*. Unpublished report prepared for Arcus Consulting. ACO Associates.

#### **Publications:**

- Gribble, J. and Scott, G., 2017, *We Die Like Brothers: The sinking of the SS Mendi*, Historic England, Swindon.
- Sharfman, J., Boshoff, J. and Gribble, J. 2017. Benefits, Burdens, and Opportunities in South Africa: The Implications of Ratifying the 2001 UNESCO Convention on the Protection of Underwater Cultural Heritage, in L. Harris (ed) *Sea Ports and Sea Power: African Maritime Cultural Landscapes*, Springer International Publishing, Switzerland, pp 101-110.
- Lloyd Jones, D., Langman, R., Reach, I., Gribble, J., and Griffiths, N., 2016, Using Multibeam and Sidescan Sonar to Monitor Aggregate Dredging, in C.W. Finkl and C. Makowski (eds) *Seafloor Mapping along Continental Shelves: Research and Techniques for Visualizing Benthic Environments*, Coastal Research Library 13, Springer International Publishing, Switzerland, pp 245-259.
- Athiros, G. and Gribble, J., 2015, *Wrecked at the Cape Part 2*, The Cape Odyssey 105, Historical Media, Cape Town.
- Gribble, J. and Sharfman, J., 2015, The wreck of SS Mendi (1917) as an example of the potential trans-national significance of World War I underwater cultural heritage, *Proceedings of the UNESCO Scientific Conference on the Underwater Cultural Heritage from World War I*, Bruges, 26-28 June 2014.
- Gribble, J., 2015, Underwater Cultural Heritage and International Law. Cambridge by Sarah Dromgoole, in *South African Archaeological Bulletin*, 70, 202, pp 226-227.
- Athiros, G. and Gribble, J., 2014, *Wrecked at the Cape Part 1*, The Cape Odyssey 104, Historical Media, Cape Town.
- Gribble, J., 2014, Learning the Hard Way: Two South African Examples of Issues Related to Port Construction and Archaeology, in *Dredging and Port Construction: Interactions*

with Features of Archaeological or Heritage Interest, *PIANC Guidance Document 124*, pp 97-107.

UK UNESCO 2001 Convention Review Group, 2014, *The UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001: An Impact Review for the United Kingdom*, ISBN 978-0-904608-03-8.

Sadr, K., Gribble, J. and Euston-Brown, G, 2013, Archaeological survey on the Vredenburg Peninsula, in Jerardino et al. (eds), *The Archaeology of the West Coast of South Africa*, BAR International Series 2526, pp 50-67.

Gribble, J. and Sharfman, J, 2013, Maritime Legal Management in South Africa, *Online Encyclopaedia of Global Archaeology*, pp 6802-6810.

Gribble, J., 2011, The UNESCO Convention on the Protection of the Underwater Cultural Heritage 2001, *Journal of Maritime Archaeology* 6:1 77-86.

Gribble, J., 2011, The SS Mendi, the Foreign Labour Corps and the trans-national significance of shipwrecks, in J. Henderson (ed.): *Beyond Boundaries, Proceedings of IKUWA 3, The 3rd International Congress on Underwater Archaeology*, Römisch-Germanische Kommission (RGK), Frankfurt.

Gribble, J., 2011, Competence and Qualifications, in Guèrin, U., Egger, B. and Maarleveld, T. (eds) *UNESCO Manual for Activities directed at Underwater Cultural Heritage*, UNESCO - Secretariat of the 2001 Convention, Paris.

Gribble, J. and Leather, S. for EMU Ltd., 2010, *Offshore Geotechnical Investigations and Historic Environment Analysis: Guidance for the Renewable Energy Sector*. Commissioned by COWRIE Ltd (Project reference GEOARCH-09).

Sadr, K and Gribble, J., 2010, The stone artefacts from the Vredenburg Peninsula archaeological survey, west coast of South Africa, *Southern African Humanities* 22: 19–88.

Gribble, J., 2009, HMS Birkenhead and the British warship wrecks in South African waters in *Proceedings of the Shared Heritage Seminar*, University of Wolverhampton, 8 July 2008.

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Gribble, J. and Athiros, G., 2008, *Tales of Shipwrecks at the Cape of Storms*, Historical Media, Cape Town.

Gribble, J., 2008, The shocking story of the ss Mendi, in *British Archaeology*, March/April 2008.

Gribble, J., 2007, The Protection of the Underwater Cultural Heritage: National Perspectives in light of the UNESCO Convention 2001 by Sarah Dromgoole, in *The International Journal of Nautical Archaeology*, 36, 1, pp 195-6.



- Gribble, J., 2006, The Sad Case of the ss Maori, in Grenier, R., D. Nutley and I. Cochran (eds) *Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts*, pp 41-43, ICOMOS, Paris.
- Gribble, J., 2006, Pre-Colonial Fish Traps on the South Western Cape Coast, South Africa, in Grenier, R., D. Nutley and I. Cochran (eds) *Underwater Cultural Heritage at Risk: Managing Natural and Human Impacts*, pp 29-31, ICOMOS, Paris.
- Forrest, C.S.J., and Gribble, J., 2006, The illicit movement of underwater cultural heritage: The case of the Dodington coins, in *Art and Cultural Heritage: Law, Policy and Practice*, (ed B.T. Hoffman), New York, Cambridge University Press.
- Forrest, C.S.J., and Gribble, J., 2006, Perspectives from the Southern Hemisphere: Australia and South Africa, in *The UNESCO Convention for the Protection of the Underwater Heritage: Proceedings of the Burlington House Seminar*, October 2005, JNAPC / NAS.
- Gribble, J., 2003, "Building with Mud" – Developing historical building skills in the Karoo, in ICOMOS South Africa, in *The Proceedings of Symposium on Understanding and using urban heritage in the Karoo*, Victoria West, South Africa, 3-5 March 2002.
- Forrest, C.S.J., and Gribble, J., 2002, The illicit movement of underwater cultural heritage: The case of the Dodington coins, *International Journal of Cultural Property*, Vol II (2002) No 2, pp 267-293.
- Gribble, J. 2002, The Past, Present and Future of Maritime Archaeology in South Africa, *International Handbook of Underwater Archaeology* (eds Ruppe and Barstad), New York, Plenum Press.
- Thackeray, F. and Gribble, J., 2001, Historical Note on an Attempt to Salvage Iron from a Shipwreck, *Looking Back*, Vol 40, November 2001, pp 5-7.
- Gribble, J., 1998, Keeping Our Heads Above Water – the development of shipwreck management strategies in South Africa, *AIMA Bulletin*, Vol 22, pp 119-124.
- Gribble, J. 1996, Conservation Practice for Historical Shipwrecks, Monuments and Sites of South Africa, Colombo, Sri Lanka, ICOMOS 11th General Assembly.
- Gribble, J. 1996, National Databases on Monuments and Sites, Monuments and Sites of South Africa, Colombo, Sri Lanka, ICOMOS 11th General Assembly.
- Sadr, K, Gribble, J, & Euston-Brown, G L, 1992 The Vredenburg Peninsula survey, 1991/1992 season, *Guide to Archaeological Sites in the South-western Cape, Papers compiled for the South African Association of Archaeologists Conference*, July 1992, by A.B. Smith & B. Mutti, pp 41-42.
- Smith, AB, Sadr, K, Gribble, J, & Yates, R., 1992 Witklip and Posberg Reserve, *Guide to Archaeological Sites in the South-western Cape*, Papers compiled for the South African Association of Archaeologists Conference, July 1992, by A.B. Smith & B. Mutti, pp 31-40.

Smith, AB, Sadr, K, Gribble, J & Yates, R., 1991, Excavations in the south-western Cape, South Africa, and the archaeological identity of prehistoric hunter-gatherers within the last 2000 years, *The South African Archaeological Bulletin* 46: 71-91.

# APPENDIX D: CURRICULUM VITAE (SHORT) - MARION BAMFORD PHD

NOVEMBER 2020

## I) Personal details

Surname **Bamford**  
First names **Marion Kathleen**  
Present employment Professor; Director of the Evolutionary Studies Institute.  
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-  
Telephone +27 11 717 6690  
Fax +27 11 717 6694  
Cell 082 555 6937  
E-mail [marion.bamford@wits.ac.za](mailto:marion.bamford@wits.ac.za); [marionbamford12@gmail.com](mailto:marionbamford12@gmail.com)

## ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:  
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.  
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.  
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.  
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

## iii) Professional qualifications

*Wood Anatomy Training (overseas as nothing was available in South Africa):*  
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps  
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer  
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

## iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa  
Royal Society of Southern Africa - Fellow: 2006 onwards  
Academy of Sciences of South Africa - Member: Oct 2014 onwards  
International Association of Wood Anatomists - First enrolled: January 1991  
International Organization of Palaeobotany – 1993+  
Botanical Society of South Africa  
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016  
SASQUA (South African Society for Quaternary Research) – 1997+  
PAGES - 2008 –onwards: South African representative  
ROCEEH / WAVE – 2008+  
INQUA – PALCOMM – 2011+onwards

## vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
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Honours	9	2
Masters	9	5
PhD	11	5
Postdoctoral fellows	10	4

#### **viii) Undergraduate teaching**

Geology II – Palaeobotany GEOL2008 – average 65 students per year  
 Biology III – Palaeobotany APES3029 – average 25 students per year  
 Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;  
 Micropalaeontology – average 2-8 students per year.

#### **ix) Editing and reviewing**

Editor: *Palaeontologia africana*: 2003 to 2013; 2014 – Assistant editor  
 Guest Editor: *Quaternary International*: 2005 volume  
 Member of Board of Review: *Review of Palaeobotany and Palynology*: 2010 –  
*Cretaceous Research*: 2014 –  
*Journal of African Earth Sciences*: 2020 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

#### **x) Palaeontological Impact Assessments**

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS

- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO
- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lieliefontein N&D 2019 for Enviropro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells

### **xi) Research Output**

Publications by M K Bamford up to November 2020 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 8 book chapters.  
 Scopus h-index = 29; Google scholar h-index = 36; -i10-index = 80  
 Conferences: numerous presentations at local and international conferences.

### **xii) NRF Rating**

NRF Rating: B-2 (2016-2020)  
 NRF Rating: B-3 (2010-2015)  
 NRF Rating: B-3 (2005-2009)  
 NRF Rating: C-2 (1999-2004)