



PGS HERITAGE

**PHASE 1 PALAEOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED
N'KOMATI ANTHRACITE MADADENI OPENCAST NORTHERN EXTENSION, IN THE
BARBERTON MAGISTERIAL DISTRICT, MPUMALANGA PROVINCE**

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Client: SENTULA MINING LIMITED
PGS Project No: 462HIA – N'komati Anthracite

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological 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 favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

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

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Banzai Environmental (Pty) Ltd

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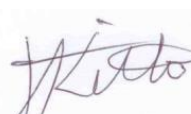
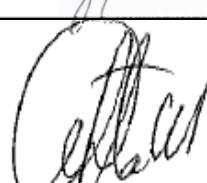
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ACKNOWLEDGMENT OF RECEIPT

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This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to Appendix A	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 1 and 11	
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 7 Approach and 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,	Section 1 and 11	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
inclusive of a site plan identifying site alternatives;		
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(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 1 and 11	
(k) Any mitigation measures for inclusion in the EMPr	Section 12	Chance find Protocol
(l) Any conditions for inclusion in the environmental authorisation	Section 12	
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 12	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 11	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance,	Section 1 and 11	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	Not applicable. A public consultation process will be conducted as part of the EIA and EMPr process.
(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	Not applicable.
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Phase 1 Palaeontological Assessment (PIA) to assess the N'komati Anthracite Mine Madadeni Opencast proposed Northern Extension, in the Barberton Magisterial District, Mpumalanga Province. According to the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), a Palaeontological Impact Assessment is necessary to determine the presence of fossil material in the planned development footprint. This PIA is thus necessary to evaluate the effect of the construction on the palaeontological resources.

The N'komati Anthracite Mine proposed Madadeni Opencast Northern Extension, is underlain by sediments of the Undifferentiated Karoo. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Undifferentiated Karoo is Very High.

A one-day site specific field survey of the proposed Madadeni Opencast Northern Extension footprint was conducted on foot and by motor vehicle on 29 August 2020. No visible evidence of fossiliferous outcrops was found. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of the anthracite mine extension will be of a moderate significance in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

However, if fossil remains are discovered during any phase of construction or operation, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO in charge of this development. These discoveries should be protected (if possible, *in situ*) and the ECO must report the discovery to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (e.g. recording and collection) can be undertaken by a paleontologist.

Preceding any collection of fossil material, the palaeontologist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies required by SAHRA.

TABLE OF CONTENTS

1	INTRODUCTION	1
1.1	Background to the project	1
1.2	Madadeni Opencast Northern Extension	1
2	QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR	2
3	LEGISLATION	2
3.1	National Heritage Resources Act (25 of 1999)	2
4	OBJECTIVE.....	7
5	GEOLOGICAL AND PALAEONTOLOGICAL HISTORY	8
6	GEOGRAPHICAL LOCATION OF THE SITE	12
7	METHODS	12
7.1	Assumptions and Limitations	12
8	ADDITIONAL INFORMATION CONSULTED.....	13
9	SITE VIST	13
10	METHODOLOGY FOR IMPACT ASSESSMENT	16
10.1	Significance Assessment	17
10.2	Spatial Scale	18
10.3	Temporal/Duration Scale	19
10.4	Degree of Probability	19
10.5	Degree of Certainty	19
10.6	Quantitative Description of Impacts	20
10.7	Summary of Impact Tables	21
11	FINDINGS AND RECOMMENDATIONS	21
12	CHANCE FINDS PROTOCOL	22
12.1	Legislation	22
12.2	Background	23
12.3	Introduction	23
12.4	Chance Find Procedure	23
13	REFERENCES	24

List of Figures

Figure 1: Proposed Madadeni Opencast Northern Extension (provided by client)	2
Figure 2: Google Earth Image (2020) indicating the locality of the N'komati Anthracite mine (indicated in yellow). The proposed extension area is indicated in green.	4
Figure 3: Google Earth Image (2020) indicating the locality of the proposed N'komati Opencast Northern Extension area in green and current opencast mine area in yellow.	5
Figure 4: Locality map of the proposed N'komati Opencast Northern Extension area in green and current opencast mine area in yellow.	6
Figure 5: Extract of the 2530 Barberton Map (Council of Geoscience) indicating the surface geology of the N'komati Opencast Northern Extension area, in the Barberton Magisterial District, Mpumalanga Province. The proposed development is underlain by sandstones and shales of the undifferentiated Permian-Triassic Karoo Supergroup).	10
Figure 6: Glossopteris leaf. https://www.Mesosaurus	11
Figure 7: Mesosaurus sp. https://www.Mesosaurus	11
Figure 7: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in green.	12
Figure 8: Vegetation of the proposed extension area	14
Figure 9: Excavations indicate thick recent alluvial and fluvial sediments.	15
Figure 10: Down-washed alluvial screed in the foreground with typical vegetation in the background. Note that no rock outcrops are present	16

List of Tables

Table 1 - NEMA Table	iv
Table 2: Abbreviations	xi
Table 3: Quantitative rating and equivalent descriptors for the impact assessment criteria ...	17
Table 4: Description of the significance rating scale	17
Table 5: Description of the Spatial significance rating scale	18
Table 6: Description of the temporal rating scale	19
Table 7: Description of the degree of probability of an impact occurring	19
Table 8: Description of the degree of certainty rating scale	20
Table 9: Example of Rating Scale	20
Table 10: Impact Risk Classes	21

Appendix A: CV

TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

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

Cultural significance

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

Development

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

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

Fossil

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

Heritage

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

Heritage resources

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

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

Holocene

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

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.

Table 2: Abbreviations

Abbreviations	Description
DIA	Desktop Impact Assessment
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LOM	Life of Mine
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SAHRA	South African Heritage Resources Agency

1 INTRODUCTION

1.1 Background to the project

PGS Heritage (Pty) Ltd was appointed to conduct the Heritage Impact Assessment (HIA) for the proposed Madadeni Opencast Northern Extension at the N'komati Anthracite Mine located between Komatipoort and Barberton in the Mpumalanga Province (**Figure 2 to Figure 4**). PGS Heritage appointed Banzai Environmental to undertake the Phase 1 Palaeontological Impact Assessment (PIA).

1.2 Madadeni Opencast Northern Extension

N'komati Anthracite is an existing anthracite mine in the Komatipoort area of the Mpumalanga Province. The Madadeni area of the mine currently abstracts anthracite by means of opencast mining from where the run of mine ore is trucked to the processing plant via a haul road before it is processed and sold. With the current Madadeni Opencast operation nearing its economical life, N'komati Anthracite have undertaken numerous studies to evaluate the mineable reserves within its mining right that will ensure a sustainable extension of the operation. One such opportunity was identified through the proposed extension of the current Madadeni Operation in a North Easterly direction. This extension will allow N'komati Anthracite access to an additional anthracite reserve that will ensure the operation's life for a period of approximately 5 years from its inception¹.

Opencast mining will be undertaken using the current mining method being applied at Madadeni Opencast, which utilises a truck and shovel operation to expose and extract the underlying reserve. The mine will be implementing concurrent rehabilitation of stockpiles through the strategic placement of overburden as it is removed from the pit. The overburden will be placed around existing stockpiles, battered and shaped to slope the said stockpiles to 1:3 in order to facilitate slope stabilisation and rehabilitation¹. See **Figure 1**.

¹ Information provided by N'komati Anthracite

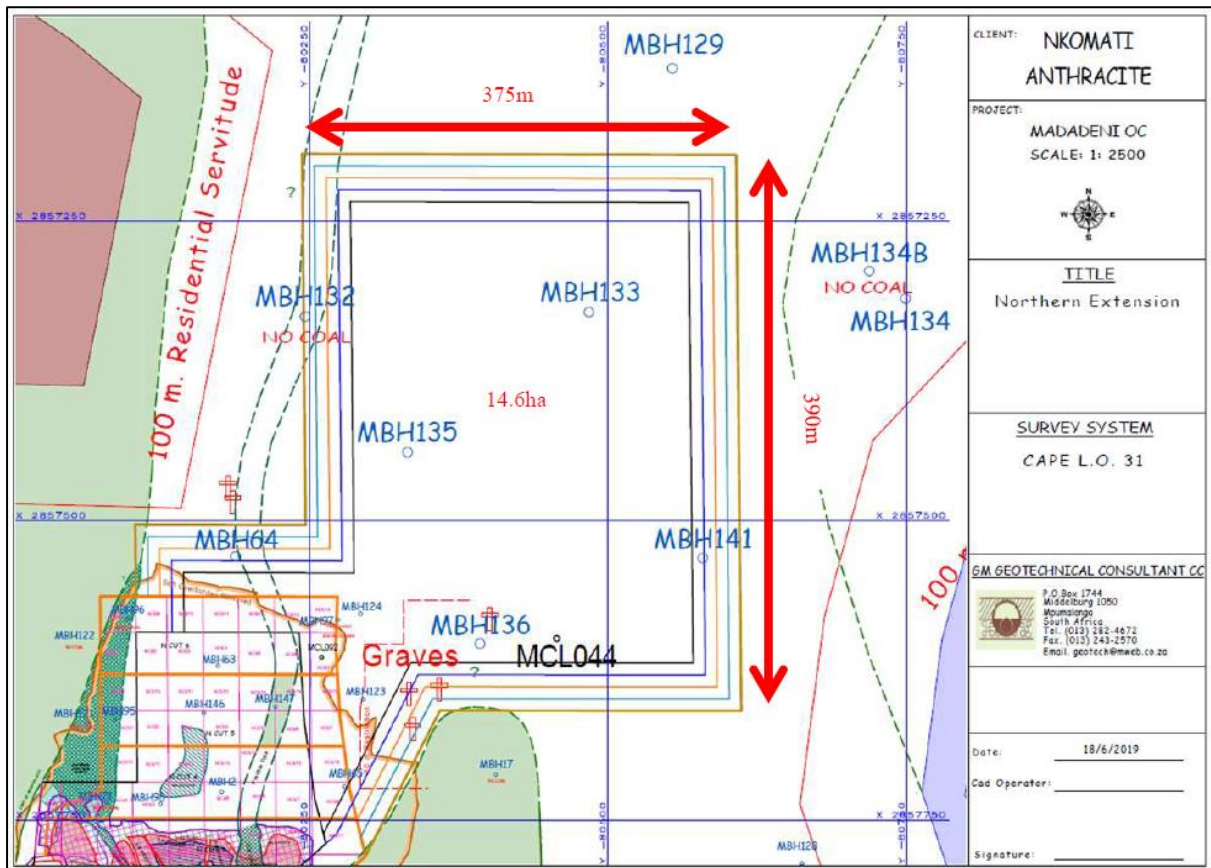


Figure 1: Proposed Madadeni Opencast Northern Extension (provided by N'komati Anthracite)

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa (PSSA) for 12 years. She has been conducting PIAs since 2014.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa includes all heritage resources and is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include, “all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, broken, moved or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This PIA forms part of the Heritage Impact Assessment (HIA) and adhere to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

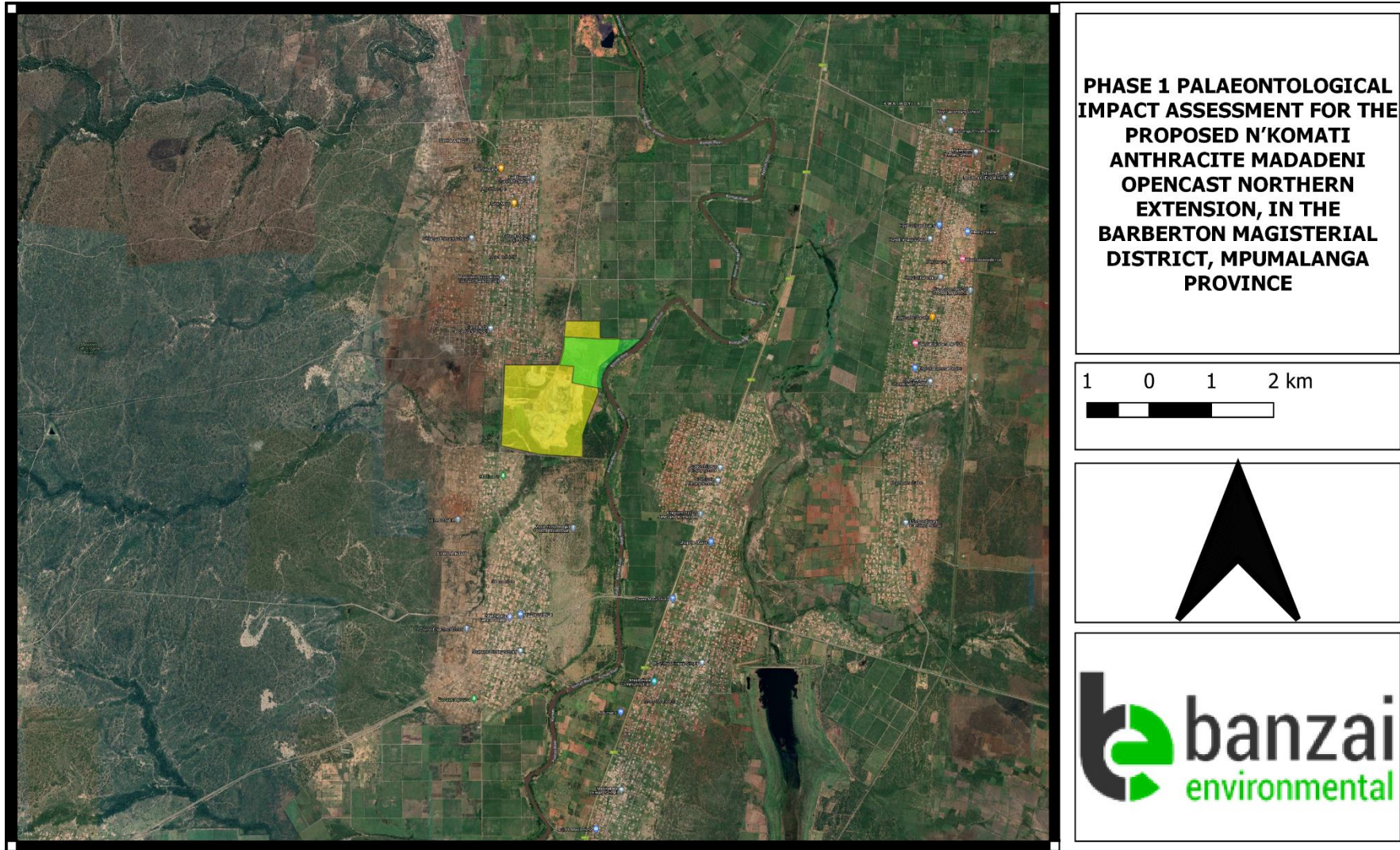


Figure 2: Google Earth Image (2020) indicating the locality of the N'komati Anthracite mine (indicated in yellow). The proposed extension area is indicated in green.

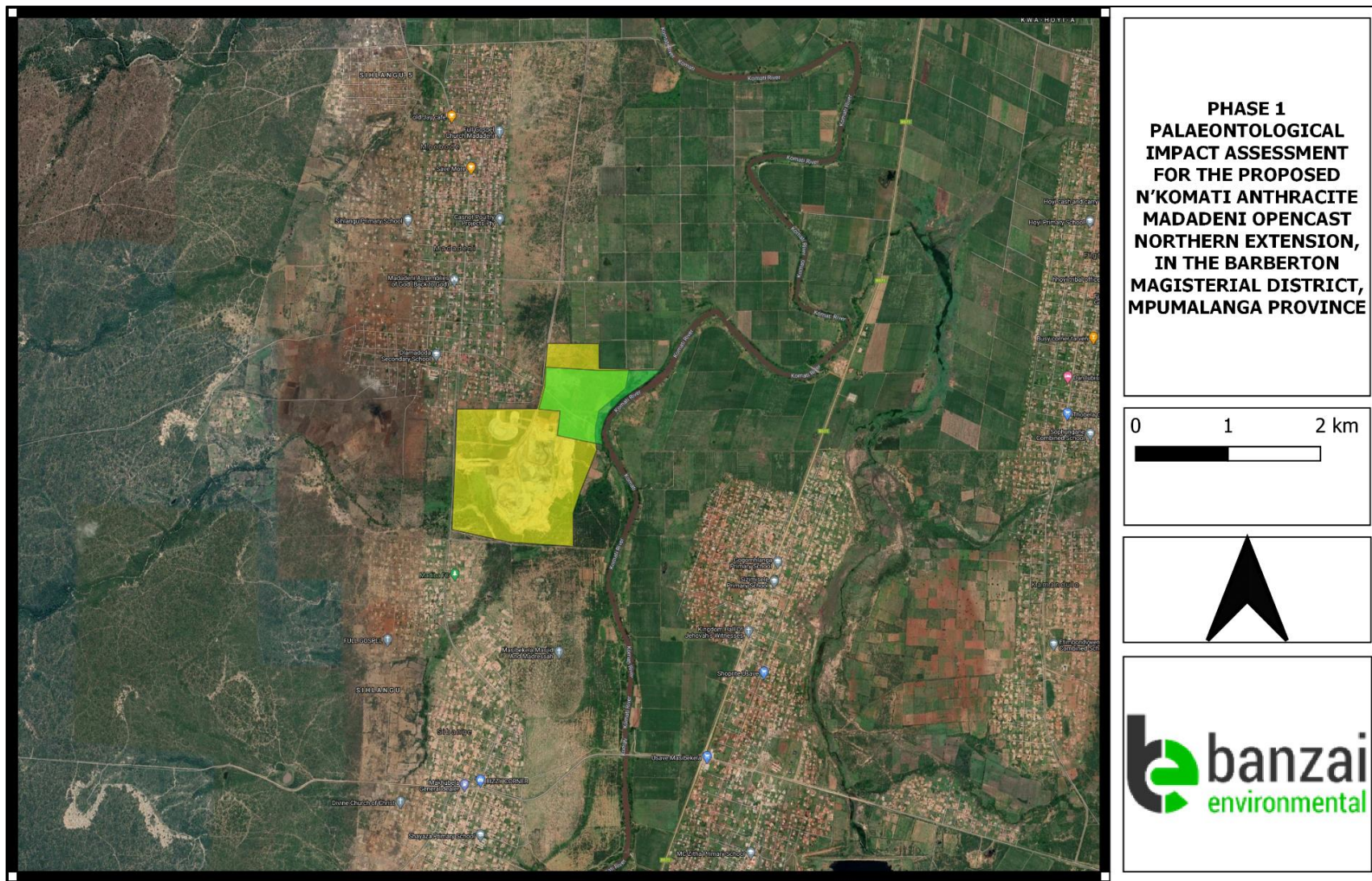


Figure 3: Google Earth Image (2020) indicating the locality of the proposed N'komati Opencast Northern Extension area in green and current opencast mine area in yellow.

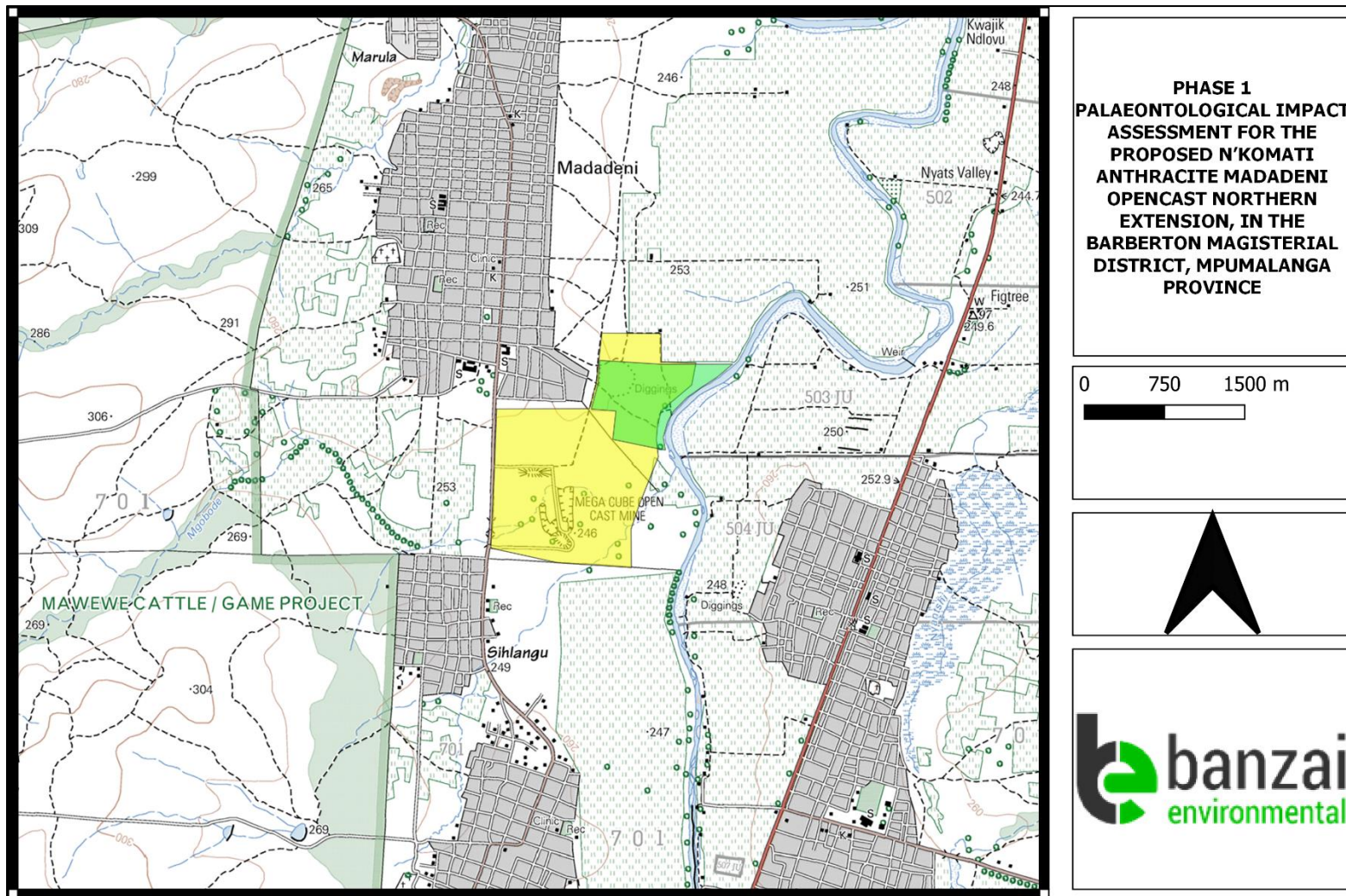


Figure 4: Locality map of the proposed N'komati Opencast Northern Extension area in green and current opencast mine area in yellow.

4 OBJECTIVE

The objective of a PIA is to determine the impact of the development on potential palaeontological material at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed rock as well as rock formations just below the surface in the development footprint; 2) to estimate the **palaeontological importance** of the formations; 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study,
- Description and location of the proposed development and provide geological and topographical maps
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
 - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
 - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
 - c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Fair assessment of alternatives (infrastructure alternatives have been provided):

- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The geology of the proposed development is indicated on the 1: 250 000 2530 Barberton Map (Council of Geoscience). The proposed N'komati Anthracite Madadeni Opencast Extension is underlain by sandstones and shales of the undifferentiated Permian-Triassic Karoo Supergroup (Figure 5). These rocks are undifferentiated as no Glossopteris flora or vertebrate fossils have been recovered from these sediments. If specimens are found in the sediments, they would be used to identify the specific strata from which they are recovered, similar to what was done in the Main Karoo Basin (Hancox *et al.*, 2001; Rubidge *et al.*, 1995; Johnson *et al.*, 2006).

The N'komati Anthracite Mine proposed Madadeni Opencast Northern Extension in Mpumalanga is situated in the Kangwane Coalfield. This Coalfield is approximately 210,000 ha in extent and extends from near Komatipoort in the north, to the Mananga Border Post (eSwatini border) in the south (Hancox *et al.*, 2014).

The area is extensively weathered and covered by recent alluvial and fluvial sediments and thus representative outcrops of the Karoo Supergroup rocks are rare. In the Kangwane Coalfield the Karoo Supergroup succession consists of the Dwyka Group at the bottom, which are occasionally absent in places, followed by the Vryheid and Volksrust formations of the Ecca Group. Locally, equivalents of the Beaufort and Stormberg Group may occur. The succession is covered by the Lebombo Group volcanic formations, which are the temporal equivalent of the Drakensberg Group formations in the Main Karoo Basin (Hancox *et al.*, 2014). Coal seams that can be utilized for mining are present in the fine- to coarse-grained sandstones and subordinate mudstones and siltstones of the Vryheid Formation. The Vryheid Formation overlies Archaean basement granites or diamictites of the Dwyka Group unconformably.

The Vryheid Formation is known to contain a rich assemblage of Glossopteris flora which is the source vegetation for the Vryheid Formation. Gymnospermous glossopterids dominated the peat and non-peat accumulating of Permian wetlands after continental deglaciation took place (Falcon, 1986c, Greb *et al.*, 2006).

Recent paleobotanical studies include that of Adendorff (2005), Bordy and Prevec (2008) and Prevec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) has described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia sp.*, *Raniganjia sp.*, *Asterotheca spp.*, *Liknopetalon enigmata*,

Hirsutum sp., *Scutum* sp., *Ottokaria* sp., *Estcourtia* sp., *Arberia* sp., *Lidgettonia* sp., *Noeggerathiopsis* sp., *Podocarpidites* sp as well as more than 20 *Glossopteris* species.

In the past, palynological studies have focused on the coal-bearing successions of the Vryheid Formation and include articles by Aitken (1993, 1994, 1998), and Millstead (1994, 1999), while recent studies were conducted by Götz and Ruckwied,(2014).

Bamford (2011) is of the opinion that only a small amount of data have been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines while in other areas the exposures are poor and of little interest. When plant fossils do occur they are usually abundant. According to Bamford, it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Non-marine bivalves and fish scales have also been reported from this formation. Trace fossils are abundantly found but the diversity is low. The mesosaurid reptile, *Mesosaurus* has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare and irregular occurrence of fossils in this biozone, a single fossil may be of scientific importance as many fossil taxa are known from only a single fossil.

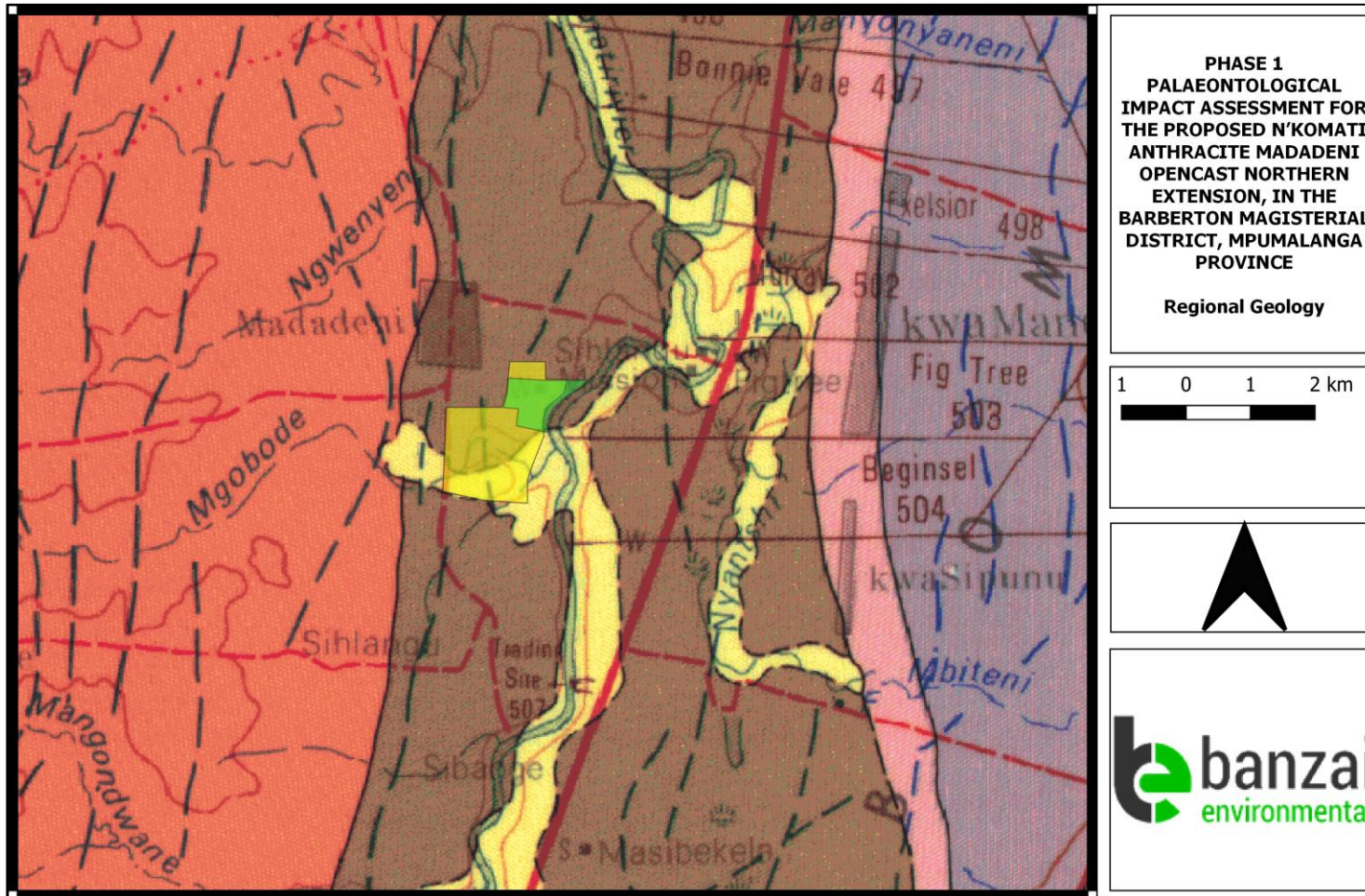


Figure 5: Extract of the 2530 Barberton Map (Council of Geoscience) indicating the surface geology of the N'komati Opencast Northern Extension area, in the Barberton Magisterial District, Mpumalanga Province. The proposed development is underlain by sandstones and shales of the undifferentiated Permian-Triassic Karoo Supergroup).



Figure 6: *Glossopteris* leaf. <https://www.Mesosaurus>



Figure 7: *Mesosaurus* sp. <https://www.Mesosaurus>

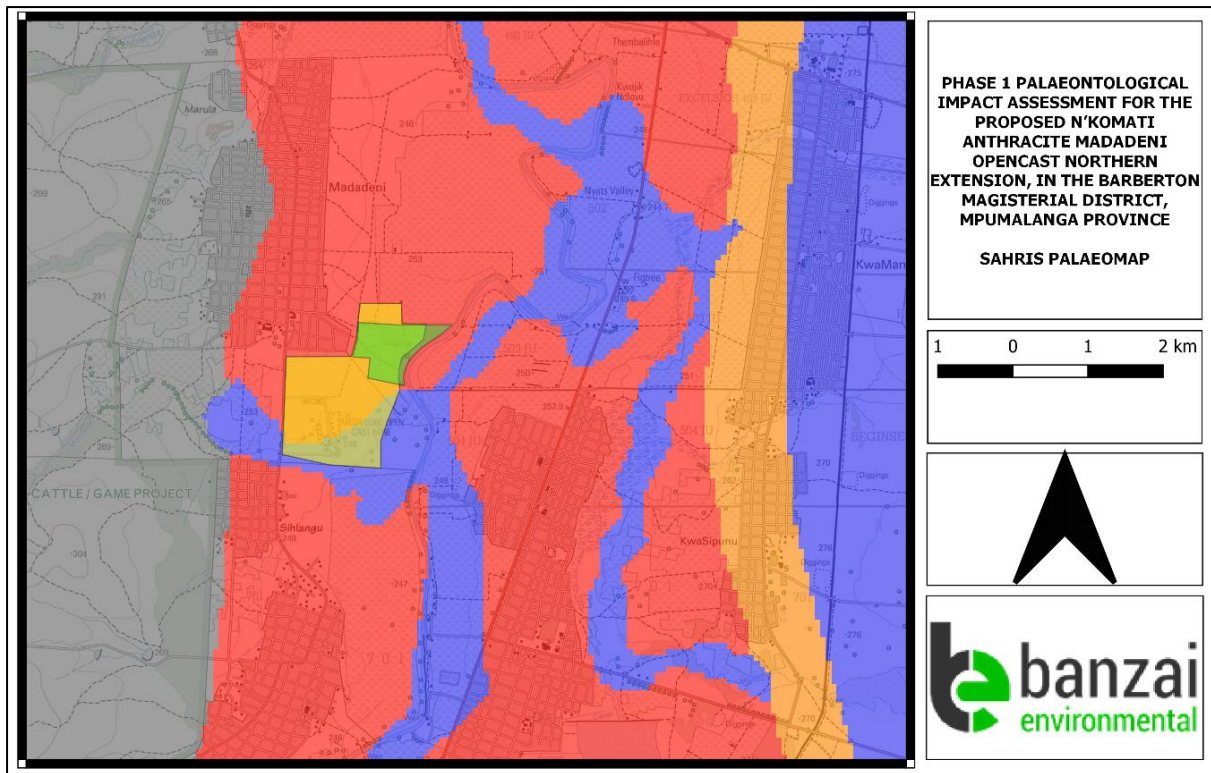


Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in green.

According to the SAHRIS Palaeo Sensitivity map (**Figure 8**) there is a high chance of finding fossils in this area (the red colour indicates Very High palaeontological sensitivity).

6 GEOGRAPHICAL LOCATION OF THE SITE

The N'komati Anthracite Mine is located approximately 2 km south of the town Madadeni. in the Barberton Magisterial District, Mpumalanga Province. The proposed extension area is situated just north of the current Madadeni Opencast operation of the mine.

7 METHODS

A PIA study was undertaken to evaluate the possible risk to palaeontological heritage (this includes fossils as well as trace fossils) in the proposed extension area. In compiling the report aerial photos, Google Earth 2018, topographical and geological maps and other reports from the same area, as well as the author's experience were used to assess the proposed expansion footprint. A site visit was also undertaken to confirm this information.

7.1 Assumptions and Limitations

The accuracy of a PIA is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information were not

accurately documented in the past. Various remote areas of South Africa have not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentrate on the geology of an area and the sheet explanations were never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and Assemblage Zones generally **assume** that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website.
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- Geological Map 1: 250 000 2530 Barberton (Council for Geoscience).
- A Google Earth map with polygons of the proposed development was obtained from PGS.

9 SITE VISIT

As part of the PIA, a field-survey of the development footprint was conducted on 30 November 2019, to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed footprint of the development.

A one-day site specific field survey of the N'komati Anthracite Madadeni Opencast Northern Extension footprint was conducted on foot and by motor vehicle on 29 August 2020. No visible evidence of fossiliferous outcrops was identified during the site investigation.

The following photographs were taken during the site visit to the proposed N'komati Anthracite Madadeni Opencast Northern Extension. Province.



*Figure 9: Vegetation of the proposed extension area
GPS coordinates 25°49'10"S 31°47'35"E*



Figure 10: Excavations indicate thick recent alluvial and fluvial sediments.

GPS coordinates 25°49'21"S 31°48'02"E



Figure 11: Down-washed alluvial scree in the foreground with typical vegetation in the background.

Note that no rock outcrops are present

GPS coordinates 25°49'17"S 31°47'53"E

10 METHODOLOGY FOR IMPACT ASSESSMENT

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors, along with the equivalent quantitative rating scale for each of the aforementioned criteria, is given in Table 3: .

Table 3: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	<i>Isolated site/ proposed corridor</i>	<u>Incidental</u>
2	LOW	<i>Study area</i>	<u>Short-term</u>
3	MODERATE	<i>Local</i>	<u>Medium-term</u>
4	HIGH	<i>Regional / Provincial</i>	<u>Long-term</u>
5	VERY HIGH	<i>Global / National</i>	<u>Permanent</u>

A more detailed description of each of the assessment criteria is given in the following sections.

10.1 Significance Assessment

The Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these, since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of an area affected by atmospheric pollution may be extremely large (1000 km²) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed, the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common.

A more detailed description of the impact significance rating scale is given below.

Table 4: Description of the significance rating scale

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	Impact is of substantial order within the bounds of impacts which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse

RATING		DESCRIPTION
		impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity are needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit. Three additional categories must also be used where relevant. They are in addition to the category represented on the scale, and if used, will replace the scale.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

10.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in the table below.

Table 5: Description of the Spatial significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of possible impacts, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect an area not exceeding the boundary of the study area.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

10.3 Temporal/Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal or duration scale is rated according to criteria set out below.

Table 6: Description of the temporal rating scale

RATING		DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium-term	The environmental impact identified will operate for the duration of life of the project.
4	Long-term	The environmental impact identified will operate beyond the life of operation of the project.
5	Permanent	The environmental impact will be permanent.

10.4 Degree of Probability

The probability, or likelihood, of an impact occurring will be described as shown in **Error! Reference source not found.** below.

Table 7: Description of the degree of probability of an impact occurring

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very likely
5	It's going to happen / has occurred

10.5 Degree of Certainty

As with all studies, it is not possible to be 100% certain of all facts, and for this reason a standard “degree of certainty” scale is used, as discussed in **Table 8: The level of detail for specialist studies** is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 8: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

10.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner, in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale, as described below:

$$\text{Impact Risk} = \frac{(\text{SIGNIFICANCE (5)} + \text{Spatial (2)} + \text{Temporal (5)}) \times \text{Probability (3)}}{5}$$

An example of how this rating scale is applied is shown below:

Table 9: Example of Rating Scale

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	Very High	Study area	Permanent	Could Happen	LOW
Impact on heritage sites	5	2	5	3	2.4

Note: The significance, spatial and temporal scales are added to give a total of 12, which is divided by 3 to give a criterion rating of 4. The probability (3) is divided by 5 to give a probability rating of 0.6. The criteria rating of 4 is then multiplied by the probability rating (0,6) to give the final rating of 2.4.

The impact risk is classified according to 5 classes as described in the table below.

Table 10: Impact Risk Classes

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	1	Very Low
1.1 – 2.0	2	Low
2.1 – 3.0	3	Moderate
3.1 – 4.0	4	High
4.1 – 5.0	5	Very High

An impact rating of 2.4 will fall in the Impact Class 3, which will be considered to be a moderate impact.

10.7 Summary of Impact Tables

A Very High palaeontological sensitivity has been allocated to the Undifferentiated Karoo Group formations. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent**. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a moderate impact.

The significance, spatial and temporal scales are added to give a total of 12, which is divided by 3 to give a criterion rating of 4. The probability (3) is divided by 5 to give a probability rating of 0.6. The criteria rating of 4 is then multiplied by the probability rating (0,6) to give the final rating of 2.4 and falls into Impact Class 3.

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Palaeontology	Negative	VERY HIGH	Study Area	Permanent	Could happen	
	-	5	2	5	3	2,40

11 FINDINGS AND RECOMMENDATIONS

The proposed N'komati Anthracite Madadeni Opencast Northern Extension is underlain by sediments of the Undifferentiated Karoo Group. According to the PalaeoMap in the South African Heritage Resources Information System (SAHRIS) database the Palaeontological Sensitivity of the Undifferentiated Karoo is Very High.

A one-day site specific field survey of the N'komati Anthracite Madedeni Opencast Northern Extension footprint was conducted on foot and by motor vehicle on 29 August 2020. No visible evidence of fossiliferous outcrops was identified. The scarcity of fossil heritage at the proposed extension footprint indicates that the impact of the anthracite mine extension will be of a moderate significance in palaeontological terms. It is therefore considered that the proposed extension is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area.

However, if fossil remains are discovered during any phase of construction or operation, either on the surface or exposed by excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries should be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that suitable mitigation (e.g. recording and collection) can be carried out by a paleontologist.

Preceding any collection of fossil material, the palaeontologist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies required by SAHRA.

12 CHANCE FINDS PROTOCOL

The following procedure will only be followed if fossils are uncovered during excavation or operation.

12.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

12.2 Background

A “fossil” is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

12.3 Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Control Officer (ECO) of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the ECO, a member of the staff must be appointed to be responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

12.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ECO or site manager. The ECO must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the ECO (site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered

by a plastic sheet or sand bags. The Heritage Agency will also be able to advise on the most suitable method of protection of the find.

- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ECO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once the Heritage Agency has issued the written authorization and the fossil has been removed by the palaeontologist, the developer may continue with the development.

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Appendix A – Elize Butler CV

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist
YEARS' EXPERIENCE: 26 years in Palaeontology

EDUCATION: B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

Registered as a PhD fellow at the Zoology Department of the UFS 2013 to current

Dissertation title: A new gorgonopsian from the uppermost *Daptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant Department of Zoology & Entomology
University of the Free State Zoology 1989-1992

Part-time laboratory assistant Department of Virology
University of the Free State Zoology 1992

Research Assistant National Museum, Bloemfontein 1993 – 1997

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