



PGS HERITAGE

**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR BLACK MOUNTAIN KOA SOUTH
PROSPECTING RIGHT APPLICATION, WITHOUT BULK SAMPLING, IN THE NORTHERN
CAPE**

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EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the **Palaeontological Desktop Assessment (DIA)** to assess a Black Rock Mining Prospecting Right Application (Area 7), without bulk sampling in the Northern Cape. The proposed development is situated on Portion 1 and 2 of the farm Kalkfontein A and Portion 3 and 4 of the Farm Roode Draai in the Prieska RD Magisterial District in the Northern Cape. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA) declares that a Palaeontological Impact Assessment (PDA) is crucial to verify the presence of fossil material within the planned development. This Assessment is thus necessary to evaluate the effect of the prospecting on palaeontological resources.

The proposed Prospecting Right Application area in the Northern Cape is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province, igneous Karoo dolerite, as well as the Prince Albert, White Hill and Volksrust Formations (Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present. According to the SAHRIS PalaeoMap, the Palaeontological Sensitivity of the Kalahari Group is Moderate, the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or zero while the Prince Albert and Volksrust Formations has a High Palaeontological Sensitivity and the White Hill Formation a Very High Sensitivity.

If fossil remains are discovered during any phase of prospecting, either on the surface or exposed by prospecting activities, the **Chance Find Protocol** (which is to be included in the Environmental Management Plan) should be implemented by the ECO in charge of these developments. These discoveries must be secured (*in situ*) and the ECO will have to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a palaeontological specialist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

As only drilling is proposed for this project, it is considered that the Black Mountain Koa South Prospecting Right Application in the Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area if appropriate monitoring is implemented (Chance find Procedures).

TABLE OF CONTENT

1	INTRODUCTION	1
2	DOCUMENT STRUCTURE	1
3	SPECIALIST DETAILS	3
4	TERMS OF REFERENCE	4
5	PROJECT DESCRIPTION	5
6	LEGISLATIVE AND POLICY FRAMEWORK	7
7	METHODOLOGY	7
8	RECEIVING ENVIRONMENT	8
8.1	Geological and Palaeontological History	8
9	SPATIAL SENSITIVITY MAPPING	12
10	IMPACT ASSESSMENT	14
10.1	Impact Assessment Methodology	14
10.2	Planning Phase Impacts	20
10.3	Construction Phase Impacts	20
10.4	Operational Phase Impacts	21
10.5	Decommissioning Phase Impacts	21
10.6	Rehabilitation and Closure Phase Impacts	21
10.7	Summary of Impact Tables	21
11	SPECIALIST MANAGEMENT PLAN	21
11.1	Findings and Recommendations	21
11.2	Chance Finds Protocol	22
11.3	Legislation	22
11.4	Background	23
11.5	Chance Find Procedure	23
12	CONCLUSION	24
13	ASSUMPTIONS AND LIMITATIONS	25
14	REFERENCES	25
15	APPENDICES	27
15.1	Appendix A: Specialist Declaration Form	27
15.2	Appendix B: Specialist CV	29

LIST OF FIGURES

<i>Figure 1: Google Earth Image (2020) of the location of the Black Mountain Koa South Prospecting right Application.</i>	5
<i>Figure 2: Black Mountain Koa South Prospecting right Application</i>	6
<i>Figure 3. Surface geology of the proposed Black Mountain Koa South Prospecting right Application. Map was drawn by QGIS 2.18.28.</i>	12
<i>Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Black Mountain Koa South Prospecting right Application in the Northern Cape.</i>	13

LIST OF TABLES

<i>Table 1: Abbreviations</i>	vii
<i>Table 2: Minerals to be prospected for</i>	1
<i>Table 3 - NEMA Table</i>	2
<i>Table 4: Ecce Group and Formations. (Modified from Johnson et al, 2006).</i>	11
<i>Table 5: Criteria for Determining Impact Consequence</i>	15
<i>Table 6: Probability Scoring</i>	16
<i>Table 7: Determination of Environmental Risk</i>	17
<i>Table 8: Significance Classes</i>	17
<i>Table 9: Criteria for Determining Prioritisation</i>	18
<i>Table 10: Determination of Prioritisation Factor</i>	19
<i>Table 11: Final Environmental Significance Rating</i>	19

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 1: Abbreviations

Abbreviations	Description
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
DIA	Desktop Impact Assessment
EO	Environmental Officer
EIA practitioner	Environmental Impact Assessment Practitioner
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
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
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency

1 INTRODUCTION

Black Mountain Mining (Pty) Ltd has applied for a Prospecting Right on Portion 1 and 2 of the farm Kalkfontein A and Portion 3 and 4 of the Farm Roode Draai in the Prieska RD Magisterial District in the Northern Cape.

Table 2: Minerals to be prospected for

ITEM	DETAIL
Type of mineral(s)	Ferrous & base metals: Cu – Copper
	Ferrous & base metals: Fe- Iron
	Ferrous & base metals: Pb -Lead Ferrous & base metals: Zn - Zinc
	Ferrous & base metals: Mn - Manganese
	Precious metals: Ag - Silver
	Precious metals: Au - Gold
	Ferrous & base metals: Ni - Nickel
	Ferrous & base metals: Mo – Molybdenum

The area is located approximately 50 kilometers South East of the town of Copperton, and the Prieska base metal mine. The terrain consists of plains and low hills with Cenozoic and Karoo-aged sediments overlying Namaquan granitic gneiss and meta-sediments. The meta-sedimentary packages below the Karoo cover correlate to the Areachap Group that host the zinc – copper deposits at Copperton¹¹.

2 DOCUMENT STRUCTURE

This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended (2017), requirements for specialist reports, Appendix 6, as indicated in the table below.

¹ Information provided by Black Rock (Pty) Ltd

Table 3 - 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 3 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vita	Section 3 – refer to Appendix A	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Section 15.1	-
(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 8 – 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	N/A Desktop	
(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, inclusive of a site plan identifying site alternatives;	Section 11 and 12	
(g) An identification of any areas to be avoided, including buffers	Not identified Section 8	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 8 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 13 – 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 12	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	N/A	Non required

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 11	
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised and	Section 1 and 12	
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities; and		
(n)(ii) If the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 1 and 12	-
(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 was handled as part of the EIA and EMP process.
(p) A summary and copies if any comments that were received during any consultation process	N/A	Not applicable. To date no comments regarding heritage resources that require input from a specialist have been raised.
(q) Any other information requested by the competent authority.	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 6 compliance with SAHRA guidelines	

3 SPECIALIST DETAILS

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-six 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 14 years and has been conducting PIAs since 2014.

4 TERMS OF REFERENCE

The aim of a Palaeontological Desktop Assessment (PDA) is to decrease the effect of the development on potential fossils at the development site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the purpose of the PIA are: 1) to **identify** the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to determine the **impact** on fossil heritage; and 4) to **recommend** how the property developer should guard against and lessen 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 of sensitive areas to be avoided (providing shapefiles/kml's) 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** 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 PROJECT DESCRIPTION

The proposed Prospecting Right area is situated almost 77,3 km south-west of Prieska and 166 km north-west of De Aar in the Pixley ka Seme District (Northern Cape Province) and is approximately 9234,1442 Ha (Nine Thousand Two Hundred and Thirty-Four Hectares) in extent.

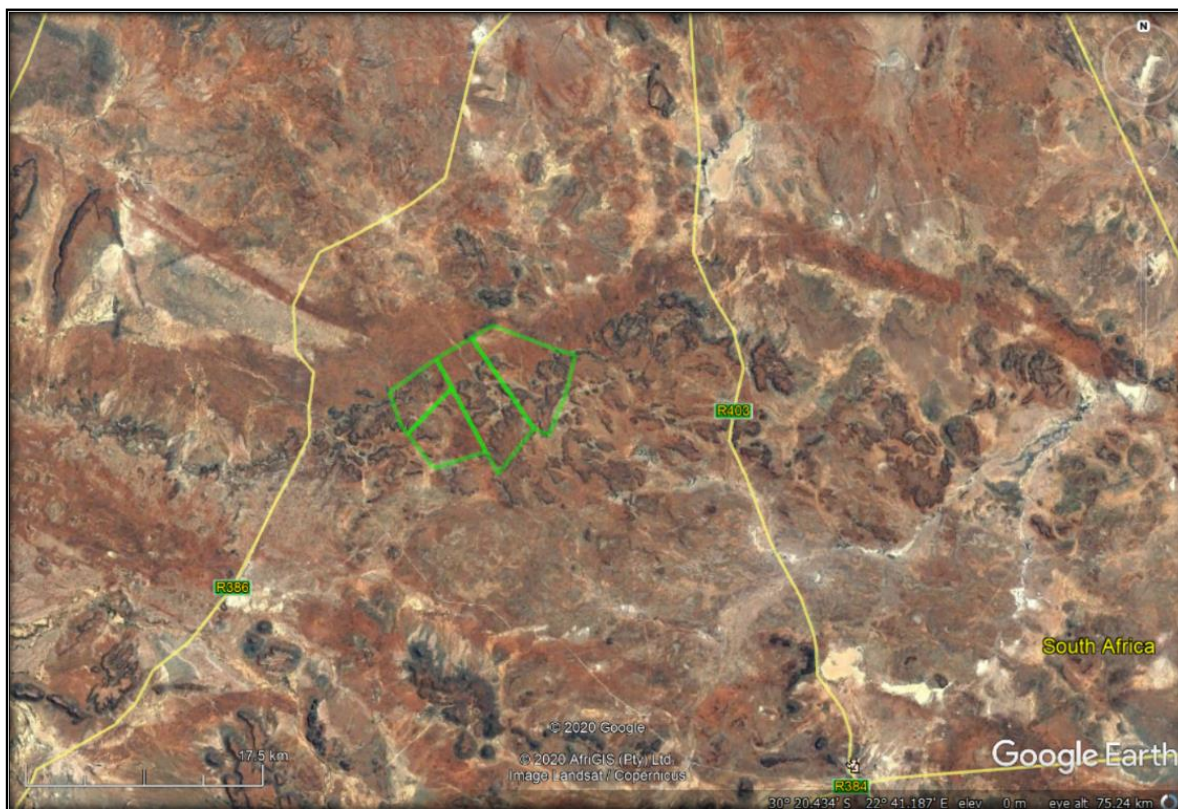


Figure 1: Google Earth Image (2020) of the location of the Black Mountain Koa South Prospecting right Application.

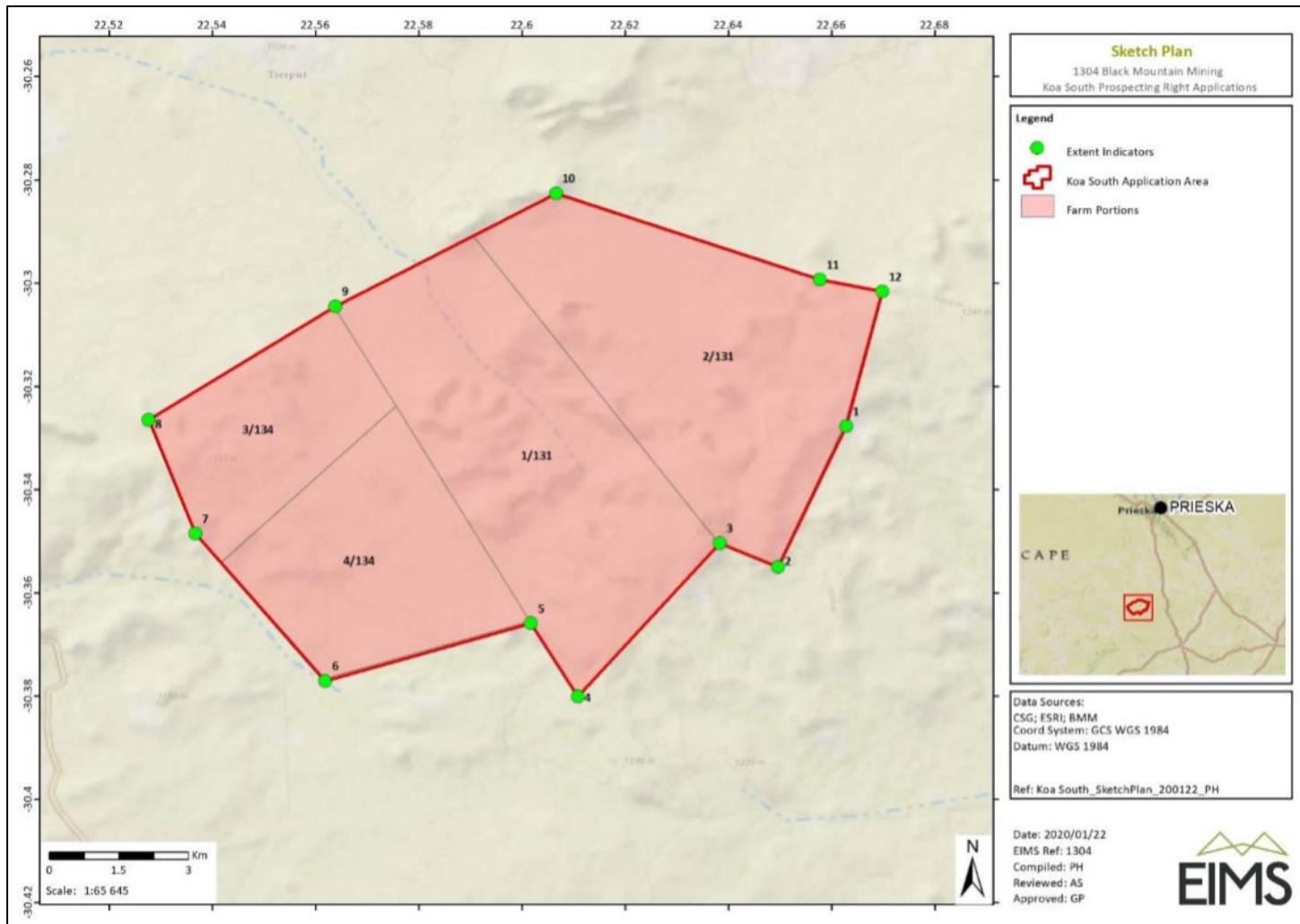


Figure 2: Black Mountain Koa South Prospecting right Application

6 LEGISLATIVE AND POLICY FRAMEWORK

National Heritage Resources Act (25 of 1999)

Cultural Heritage 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 comprise **“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 exceptional and non-renewable and is protected by the NHRA. Palaeontological resources and 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 Palaeontological Impact assessment 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.

7 METHODOLOGY

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This include all trace fossils and fossils. All available information is consulted to compile a desktop study and includes: Palaeontological impact assessment reports in the same area; aerial photos and Google Earth images, topographical as well as geological maps.

8 RECEIVING ENVIRONMENT

8.1 Geological and Palaeontological History

The proposed applications are situated in the semi-arid, flat-lying terrain of the northern part of the Bushmanland Plateau, Northern Cape Province (Figure 2-4). The proposed Prospecting Right Application area is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province; igneous Karoo dolerite, as well as the Prince Albert and Whitehill Formations (Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present.

According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Kalahari Group is Moderate. The igneous rocks of the Bushmanland and Karoo Dolerite is rated as insignificant or zero sensitivity, while the Ecca sediments of the Karoo Supergroup have a High (Prince Albert and Volksrust Formations) to Very High Paleontological Sensitivity (Whitehill Formation).

Bushmanland Group

Inselbergs and ridges are common in this area and consists of bedrock granites, gneisses and metamorphic rocks of the Namaqua Metamorphic Province, Aggeneys Subgroup of the Bushmanland Group. The Aggeneys Subgroup is a meta-volcanosedimentary sequence that overlies the gneiss of the Gladkop Suite (approximately 1800 Ma). The Bushmanland Group was deposited between 1640 and 1200 Ma, in an environment like the present-day Red Sea where active geothermal venting is depositing base metals in clayey muds collecting in hollows on the sea floor (Bailie et al, 2007). The Bushmanland Group sediments were thus deformed and metamorphosed and are thus **unfossiliferous**. Gamsberg is presently a concave synform (sedimentary layers in a concave formation) feature folded into the granitic gneiss. Superimposing the bedrock on the plains are considerable younger deposits where fossils only occur sporadically (Pether, 2013). These sediments will be affected by the mining activities.

The **Ecca Group** of the Karoo Basin is also present in the proposed application area. The Ecca Group consists of 16 formations of which the Prince Albert and Whitehill formations are the most extensive (Johnson, 2006).

The **Prince Albert Formation** is confined to the south-western half of the Karoo Basin. The northern facies are characterised by the predominance of greyish to olive-green, micaceous shale and grey, silty shale, as well as a pronounced transition from the underlying glacial deposits. Dark-grey to black carbonaceous shale and fine- to medium-grained feldspathic arenite and wacke are also present. The southern facies are characterised by the predominance of dark-grey, pyrite-bearing, splintery shale, siltstone and the presence of dark-coloured chert and phosphatic nodules and lenses.

This Formation consists of marine to hyposaline basin plain mudrocks that occur with minor volcanic ashes, iron stones and phosphates. Post-glacial mudrocks is present at the base of the Prince Albert Formation. The fossil assemblage of the Prince Albert Formation is known for its rich assemblages of plant fossils known as the *Glossopteris* flora. This includes petrified wood, roots and palynomorphs which include spores and acritarchs. In rare cases, body fossils of insects have been recovered. Moderately diverse trace fossil assemblages can be present, of which many can be assigned to fish or non-marine arthropod groups like crustaceans, king crabs and predatory water scorpions. These invertebrates could have reached lengths of two meters or more.

This trace fossil assemblage of the non-marine *Mermia* Ichnofacies, is dominated by the ichnogenera *Umfolozia* (arthropod trackways) and *Undichna* (fish swimming trails). Fish coprolites have also been described from this formation. A low diversity marine invertebrate (bivalves, brachiopods, nautiloids), palaeoniscoid fish, sharks and protozoans have been uncovered. There is also a possibility that stromatolites and oolites are preserved. Well-preserved skeletons of the well-known aquatic mesosaurids have been uncovered while amphibians are also recorded from the uppermost Ecca beds.

The mudrocks of the **Whitehill Formation** consist of shale that is very thinly laminated and contains up to 14% carbonaceous material. The Whitehill Formation loses its distinctive lithological character towards the northeast with its lower part containing siltstone and very fine-grained sandstone. Fossil Heritage of the Whitehill Formation includes insects; trace fossils (king crab track ways, as well as possible shark coprolites); mesosaurid reptiles; small eocarid crustaceans, palaeoniscoid fish, palynomorphs (organic-walled pollens and spores); petrified wood (primitive gymnosperms, silicified or calcified); sparse vascular plant remains (*Glossopteris* leaves, lycopodsetc) (Johnson, 2006).

The Volksrust formation is an argillaceous (contains clay) section which interfingers with the overlying Beaufort Group and underlying Vryheid Formation. Approximately 120 km north of Bloemfontein the thickness of this Formation is about 380 m, thinning to about 250 m in the east and 100 m towards the northern borders of the basin.

This formation consists of black to grey silty shale. Bioturbated (reworked soils and sediments), silt and sandstone lenses and beds towards the upper and lower boundaries are usually thin. Carbonate and phosphate beds as well as concretions is common. The large lateral extent as well as the thickness and fine-grained lithology suggests that this formation represents a transgressive open shelf series which largely consists of mud deposited from suspension. The upper and lower margins of this formation most probably have been deposited in lucastrine to lagoonal and shallow coastal embayment environments.

Volksrust Formation Fossils are mainly trace fossils that are recorded from the bedding planes of the shale beds in the formation. The fossils are rarely recorded as they are difficult to find in areas

of deep weathering. If fossils are found, they will contribute considerably to our understanding of the palaeoenvironments in this part of the Karoo Basin.

Fossils from this formation are primarily trace fossils that are recorded from the bedding planes of the shale beds. Finding fossils in this formation is generally very difficult as areas of deep weathering are seldom recorded. The recording of fossils will however contribute significantly to our understanding of the palaeoenvironments in this part of the Karoo Basin (Tavener-Smith, R1988a, 1988b).

The Volkrust Formation is characterised by assemblages of trace fossils although the bivalve *Megadesmus* has been described from the Formation.

Karoo Dolerite Suite.

The Karoo Dolerite Suite is a volcanic suite which consists of igneous rocks and was formed in the Early Jurassic Period (approximately 183 million years ago). This Dolerite Suite characterises a superficial feeder system to the flood basalt eruptions which is the best developed in the Karoo Basin. Flood basalts do not usually form any noticeable volcanic structures but with a succession of eruptions form a suite of fissures of sub-horizontal lava flows that may vary in thickness from a couple of meters to hundreds and even thousands of meters. The Karoo Dolerite Suite is a widespread system of igneous bodies (dykes, sills) that encroached into the sediments of the Main Karoo Basin. Karoo lavas preserved today are erosional remnants of a more extensive lava cap that covered much of southern Africa (Duncan et al, 2006).

Quaternary Deposits

Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group), and alluvial calcretes and gravels are present along shallow drainage lines and around pans and are of generally low palaeontological sensitivity. These sediments are also encountered near the surface in the study area.

The **Kalahari deposits** is approximately Ca 65 – 2.5 million years old (Ma).

The Cenozoic Kalahari Group is the most widespread body of terrestrial sediments in southern Africa. The Cenozoic sands and calcretes of the Kalahari Group range in thickness from a few metres to more than 180m (Partridge et al., 2006). The youngest formation of the Kalahari group is the Gordonia Formation, which is generally termed Kalahari sand and comprises red aeolian sands that cover most of the Kalahari Group sediments. The pan sediments of the area originated from the Gordonia Formation and contain white to brown fine-grained silts, sands and clays. Some of the pans consist of clayey material mixed with evaporates that shows the seasonal effects of shallow saline groundwaters. Quaternary alluvium, aeolian sands, surface limestone, silcrete, and terrace gravels are also included in the Kalahari Group (Kent 1980).

The fossil assemblages of the Kalahari deposits are generally very low in diversity and occur over a wide range and thus the palaeontological diversity of this Group is low. These fossils represent

terrestrial plants and animals with a close resemblance to living forms. Fossil assemblages include bivalves, diatoms, gastropod shells, ostracods and trace fossils.

Table 4: *Ecca Group and Formations. (Modified from Johnson et al, 2006).*

Period	Supergroup	Group	Formation West of 24° E	Formation East of 24° E	Formation Free State / KwaZulu Natal
Permian	Karoo Supergroup	Ecca Group	Waterford Formation	Waterford Formation	Volksrust Formation
			Tierberg / Fort Brown Formation	Fort Brown Formation	
			Laingsburg / Rippon Formation	Rippon Formation	Vryheid Formation
			Collingham Formation	Collingham Formation	Pietermaritzburg Formation
			Whitehill Formation	Whitehill Formation	
			Prince Albert Formation	Prince Albert Formation	Mbizane Formation

SPATIAL SENSITIVITY MAPPING

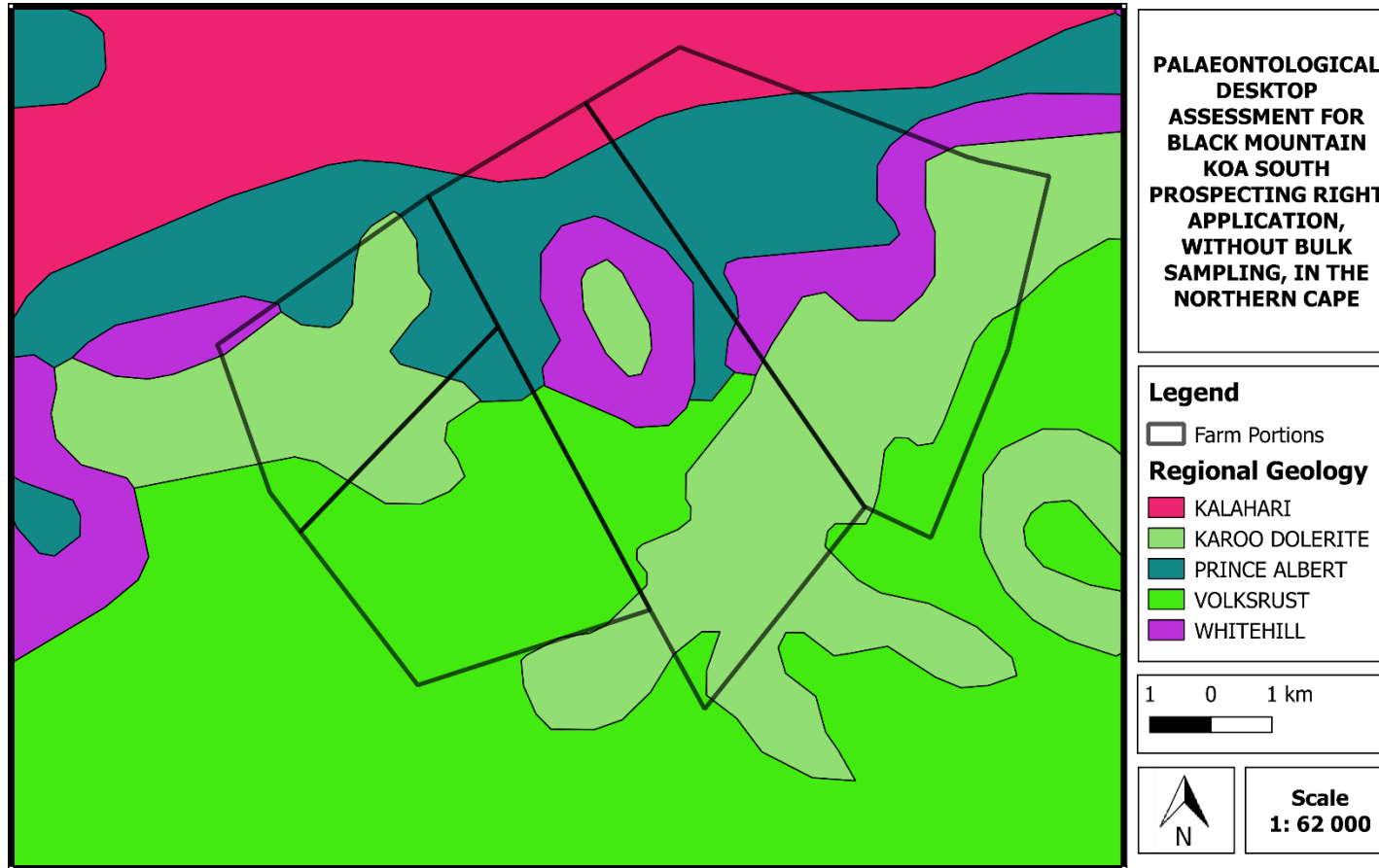


Figure 3. Surface geology of the proposed Black Mountain Koa South Prospecting right Application. Map was drawn by QGIS 2.18.28.

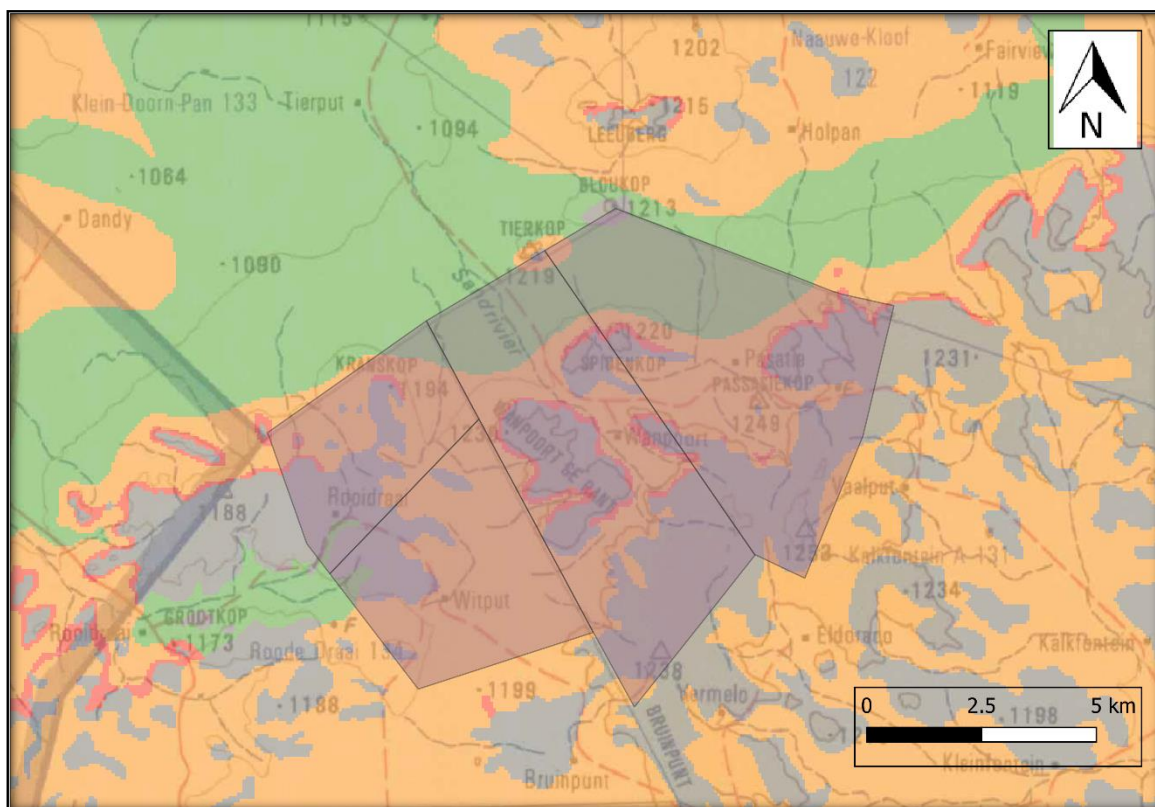


Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed Black Mountain Koa South Prospecting right Application in the Northern Cape.

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

The proposed Koa South Prospecting Right Application area in the Northern Cape is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province, igneous Karoo dolerite, as well as the Prince Albert, White Hill and Volksrust Formations

(Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present. According to the PalaeoMap on the SAHRIS database, the Palaeontological Sensitivity of the Kalahari Group is **Moderate**, the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or **zero** while the Prince Albert and Volksrust Formations has a **High** Palaeontological Sensitivity and the White Hill Formation a **Very High** Sensitivity.

Additional Information Consulted

In compiling this report the following sources were consulted:

- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984)
- A Google Earth map with polygons of the proposed development was obtained from PGS Heritage (Pty) Ltd.

10 IMPACT ASSESSMENT

10.1 Impact Assessment Methodology

The impact significance rating methodology, as provided by EIMS, is guided by the requirements of the NEMA EIA Regulations 2014 (as amended). The broad approach to the significance rating methodology is to determine the environmental risk (ER) by considering the consequence (C) of each impact (comprising Nature, Extent, Duration, Magnitude, and Reversibility) and relate this to the probability/ likelihood (P) of the impact occurring. This determines the environmental risk. In addition, other factors, including cumulative impacts and potential for irreplaceable loss of resources, are used to determine a prioritisation factor (PF) which is applied to the ER to determine the overall significance (S). The impact assessment will be applied to all identified alternatives. Where possible, mitigation measures will be recommended for impacts identified.

Determination of environmental risk

The significance (S) of an impact is determined by applying a prioritisation factor (PF) to the environmental risk (ER). The environmental risk is dependent on the consequence (C) of the particular impact and the probability (P) of the impact occurring. Consequence is determined through the consideration of the Nature (N), Extent (E), Duration (D), Magnitude (M), and reversibility (R) applicable to the specific impact.

For the purpose of this methodology the consequence of the impact is represented by:

$$C = \frac{(E + D + M + R) * N}{4}$$

Each individual aspect in the determination of the consequence is represented by a rating scale as defined in Table 5 below.

Table 5: Criteria for Determining Impact Consequence

Aspect	Score	Definition
Nature	- 1	Likely to result in a negative/ detrimental impact Loss of Fossil Heritage will be negative
	+1	Likely to result in a positive/ beneficial impact
Extent	1	Activity (i.e. limited to the area applicable to the specific activity) Will be conducted in the Development footprint
	2	Site (i.e. within the development property boundary),
	3	Local (i.e. the area within 5 km of the site),
	4	Regional (i.e. extends between 5 and 50 km from the site)
	5	Provincial / National (i.e. extends beyond 50 km from the site)
Duration	1	Immediate (<1 year)
	2	Short term (1-5 years),
	3	Medium term (6-15 years),
	4	Long term (the impact will cease after the operational life span of the project),
	5	Permanent (no mitigation measure of natural process will reduce the impact after construction). The destruction of fossil heritage will be permanent as it is irreplaceable
Magnitude/ Intensity	1	Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
	2	Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
	3	Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),

Aspect	Score	Definition
	4	High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or According to the PalaeoMap on the SAHRIS database, the Palaeontological Sensitivity of the Kalahari Group is Moderate , the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or zero while the Prince Albert and Volksrust Formations has a High Palaeontological Sensitivity and the White Hill Formation a Very High Sensitivity The Magnitude of the Impact occurring will thus be High
	5	Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).
Reversibility	1	Impact is reversible without any time and cost.
	2	Impact is reversible without incurring significant time and cost.
	3	Impact is reversible only by incurring significant time and cost.
	4	Impact is reversible only by incurring prohibitively high time and cost.
	5	Irreversible Impact When Fossil Heritage is destroyed the impact is irreversible

Once the C has been determined the ER is determined in accordance with the standard risk assessment relationship by multiplying the C and the P. Probability is rated/ scored as per Table 6.

Table 6: Probability Scoring

Probability	1	Improbable (the possibility of the impact materialising is very low as a result of design, historic experience, or implementation of adequate corrective actions; <25%),
	2	Low probability (there is a possibility that the impact will occur; >25% and <50%),
	3	Medium probability (the impact may occur; >50% and <75%), Medium probability that the impact will occur
	4	High probability (it is most likely that the impact will occur- > 75% probability), or
	5	Definite (the impact will occur),

The result is a qualitative representation of relative ER associated with the impact. ER is therefore calculated as follows:

$$ER = C \times P$$

Table 7: Determination of Environmental Risk

Consequence	5	5	10	15	20	25
	4	4	8	12	16	20
	3	3	6	9	12	15
	2	2	4	6	8	10
	1	1	2	3	4	5
		1	2	3	4	5
	Probability					

The outcome of the environmental risk assessment will result in a range of scores, ranging from 1 through to 25. These ER scores are then grouped into respective classes as described in Table 8.

Table 8: Significance Classes

Environmental Risk Score	
Value	Description
< 9	Low (i.e. where this impact is unlikely to be a significant environmental risk).
≥9 - <17	Medium (i.e. where the impact could have a significant environmental risk), A Medium Impact
≥17	High (i.e. where the impact will have a significant environmental risk).

The impact ER will be determined for each impact without relevant management and mitigation measures (pre-mitigation), as well as post implementation of relevant management and mitigation measures (post-mitigation). This allows for a prediction in the degree to which the impact can be managed/mitigated.

Impact Prioritisation

Further to the assessment criteria presented in the section above, it is necessary to assess each potentially significant impact in terms of:

1. Cumulative impacts; and
2. The degree to which the impact may cause irreplaceable loss of resources.

To ensure that these factors are considered, an impact prioritisation factor (PF) will be applied to each impact ER (post-mitigation). This prioritisation factor does not aim to detract from the risk ratings but rather to focus the attention of the decision-making authority on the higher

priority/significance issues and impacts. The PF will be applied to the ER score based on the assumption that relevant suggested management/mitigation impacts are implemented.

Table 9: Criteria for Determining Prioritisation

Cumulative Impact (CI)	Low (1)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is unlikely that the impact will result in spatial and temporal cumulative change There are no other mining operations in a 50 km radius and thus the cumulative impact is Low.
	Medium (2)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is probable that the impact will result in spatial and temporal cumulative change.
	High (3)	Considering the potential incremental, interactive, sequential, and synergistic cumulative impacts, it is highly probable/definite that the impact will result in spatial and temporal cumulative change.
Irreplaceable Loss of Resources (LR)	Low (1)	Where the impact is unlikely to result in irreplaceable loss of resources.
	Medium (2)	Where the impact may result in the irreplaceable loss (cannot be replaced or substituted) of resources but the value (services and/or functions) of these resources is limited.
	High (3)	Where the impact may result in the irreplaceable loss of resources of high value (services and/or functions). The loss of fossil Heritage will be irreplaceable

The value for the final impact priority is represented as a single consolidated priority, determined as the sum of each individual criteria represented in Table 9. The impact priority is therefore determined as follows:

$$\text{Priority} = \text{CI} + \text{LR}$$

The result is a priority score which ranges from 3 to 9 and a consequent PF ranging from 1 to 2 (Refer to

Table 10).

Table 10: Determination of Prioritisation Factor

Priority	Ranking	Prioritisation Factor
2	Low	1
3	Medium	1.125
4	Medium	1.25
5	Medium	1.375
6	High	1.5

In order to determine the final impact significance, the PF is multiplied by the ER of the post mitigation scoring. The ultimate aim of the PF is an attempt to increase the post mitigation environmental risk rating by a full ranking class, if all the priority attributes are high (i.e. if an impact comes out with a medium environmental risk after the conventional impact rating, but there is significant cumulative impact potential and significant potential for irreplaceable loss of resources, then the net result would be to upscale the impact to a high significance).

Table 11: Final Environmental Significance Rating

Environmental Significance Rating	
Value	Description
≤ -20	High negative (i.e. where the impact must have an influence on the decision process to develop in the area).
> -20 ≤ -10	Medium negative (i.e. where the impact could influence the decision to develop in the area).
> -10	Low negative (i.e. where this impact would not have a direct influence on the decision to develop in the area).
0	No impact
<10	Low positive (i.e. where this impact would not have a direct influence on the decision to develop in the area).
≥ 10 < 20	Medium positive (i.e. where the impact could influence the decision to develop in the area).

Environmental Significance Rating	
≥ 20	High positive (i.e. where the impact must have an influence on the decision process to develop in the area).

The significance ratings and additional considerations applied to each impact will be used to provide a quantitative comparative assessment of the alternatives being considered. In addition, professional expertise and opinion of the specialists and the environmental consultants will be applied to provide a qualitative comparison of the alternatives under consideration. This process will identify the best alternative for the proposed project.

10.2 Planning Phase Impacts

No Impacts will occur during the Planning Phase

10.3 Construction Phase Impacts

Impact 1 - Prospecting

- *The impact*
Destroy fossil heritage or permanently seal-in fossils at or below the ground surface. These fossils will no longer be available for research.
- *Activities that can potentially contribute to the impact*
The site clearance and excavations of the proposed Koa South Prospecting Area will include drilling into the shallow sediment cover as well as into the underlying bedrock. According to the Geology of the project site there is a Very High possibility of finding fossils.

Mitigation measures

If fossil remains are discovered during any phase of prospecting, either on the surface or exposed by prospecting activities, the **Chance Find Protocol** (which is to be included in the Environmental Management Plan) should be implemented by the ECO in charge of these developments. These discoveries must be secured (*in situ*) and the ECO will have to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a palaeontological specialist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

As only drilling is proposed for this project, it is considered that the Black Mountain Koa South Prospecting Right Application in the Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area if appropriate monitoring is implemented (Chance find Procedures).

Cumulative impacts

No mining activities are present in a 50 km radius and thus the cumulative impact is rated as low.

Irreplaceable loss of Resources

Impacts on fossil heritage are irreversible. Scientifically all well-documented reports and palaeontological studies of any fossils uncovered during prospecting would be a positive impact. A negative impact on the fossil heritage can be limited by the application of adequate damage mitigation procedures. If The chance find Procedure is correctly implemented the benefit scale for the project will lie within the beneficial category.

Impact on Alternatives considered

No Alternatives.

10.4 Operational Phase Impacts

Similar Impacts to the Construction Phase will occur as drilling will occur during this phase

10.5 Decommissioning Phase Impacts

No Impacts will occur during the Planning Phase

10.6 Rehabilitation and Closure Phase Impacts

No Impacts will occur during the Planning Phase

10.7 Summary of Impact Tables

The proposed Prospecting Right Application area in the Northern Cape is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province, igneous Karoo dolerite, as well as the Prince Albert, White Hill and Volksrust Formations (Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present. According to the PalaeoMap on the SAHRIS database, the Palaeontological Sensitivity of the Kalahari Group is Moderate, the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or zero while the Prince Albert and Volksrust Formations has a High Palaeontological Sensitivity and the White Hill Formation a Very High Sensitivity.

The impact is likely to have a negative impact on fossil heritage (-1). The extent of the area of potential impact is restricted to the project site (1). The expected duration of the impact is assessed as potentially permanent to long term (5). The probability of significant impacts on palaeontological heritage during the prospecting phase are high (4). Magnitude is high (4). Impacts on fossil heritage are irreversible (5). The probability of significant impacts on palaeontological heritage during the prospecting phase are thus Low negative.

11 SPECIALIST MANAGEMENT PLAN

11.1 Findings and Recommendations

The proposed Prospecting Right Application area in the Northern Cape is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province, igneous

Palaeontological Desktop Assessment of the proposed Koa South Prospecting Area

Karoo dolerite, as well as the Prince Albert, White Hill and Volksrust Formations (Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present. According to the SAHRIS PalaeoMap, the Palaeontological Sensitivity of the Kalahari Group is Moderate, the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or zero while the Prince Albert and Volksrust Formations has a High Palaeontological Sensitivity and the White Hill Formation a Very High Sensitivity.

If fossil remains are discovered during any phase of prospecting, either on the surface or exposed by prospecting activities, the **Chance Find Protocol** (which is to be included in the Environmental Management Plan) should be implemented by the ECO in charge of these developments. These discoveries must be secured (*in situ*) and the ECO will have to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a palaeontological specialist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

As only drilling is proposed for this project, it is considered that the Black Mountain Koa South Prospecting Right Application in the Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area if appropriate monitoring is implemented (Chance find Procedures).

11.2 Chance Finds Protocol

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

11.3 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.

11.4 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.

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.

11.5 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 fossil materials 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.

- If 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, the developer may continue with the development.

If fossil remains are discovered during any phase of prospecting, either on the surface or exposed by further excavations the **Chance Find Protocol** (which is to be included in the Environmental Management Plan) must be implemented by the ECO in charge of these developments. These discoveries must be secured (*in situ*) and the ECO will have to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a palaeontological specialist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

12 CONCLUSION

The proposed Loa South Prospecting Right Application area in the Northern Cape is completely underlain by basement bedrock of the Bushmanland Group of the Namaqua Metamorphic Province, igneous Karoo dolerite, as well as the Prince Albert, White Hill and Volksrust Formations (Ecca Group) of the Karoo Supergroup. Quaternary to Recent aeolian sediments of the Gordonia Formation (Kalahari Group) are also present. According to the SAHRIS PalaeoMap, the Palaeontological Sensitivity of the Kalahari Group is Moderate, the igneous rocks of the Bushmanland and Karoo Dolerite is insignificant or zero while the Prince Albert and Volksrust Formations has a High Palaeontological Sensitivity and the White Hill Formation a Very High Sensitivity.

If fossil remains are discovered during any phase of prospecting, either on the surface or exposed by prospecting activities, the **Chance Find Protocol** (which is to be included in the Environmental Management Plan) must implemented by the ECO in charge of these developments. These discoveries must be secured (*in situ*) and the ECO will have to alert SAHRA so that appropriate mitigation (documented and collection) can be undertaken by a palaeontological specialist. The specialist would need a collection permit from SAHRA. Fossil material must be curated in an approved collection (museum or university) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

As only drilling is proposed for this project, it is considered that the Black Mountain Koa South Prospecting Right Application in the Northern Cape is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area if the Chance Find Procedure is correctly implemented.

13 ASSUMPTIONS AND LIMITATIONS

When conducting a DIA several factors can affect the accuracy of the assessment. It should be noted that the focal point of geological maps is the geology of the area and the sheet explanations were not meant to focus on palaeontological heritage. Many inaccessible regions of South Africa have not been reviewed by palaeontologists and data is generally based on aerial photographs. Locality and geological information of museums and universities databases have not been kept up to date or data collected in the past have not always been accurately documented.

Comparable Assemblage Zones in other areas are used to provide information on the existence of fossils in an area which has not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies are used it is generally **assumed** that exposed fossil heritage is present within the footprint. In the event that fossil heritage is uncovered in the development footprint the Chance Find Protocol must be implemented

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15 APPENDICES

15.1 Appendix A: Specialist Declaration Form

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;

PALAEONTOLOGICAL CONSULTANT:

CONTACT PERSON:

Banzai Environmental (Pty) Ltd

Elize Butler

Tel: +27 844478759

Email: elizebutler002@gmail.com

SIGNATURE:

A handwritten signature in black ink, appearing to read 'Elize Butler', is positioned to the right of the 'SIGNATURE:' label.

15.2 Appendix B: Specialist CV

Elize Butler – Banzai Environmental

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

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

Principal Research Assistant National Museum, Bloemfontein
and Collection Manager 1998–currently

TECHNICAL REPORTS

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