



KMG
Environmental
Solutions Services

PHASE I PALAEOLOGY IMPACT ASSESSMENT SPECIALIST REPORT

Proposed Aggregate Mining Permit Application on Portion 0 of the Farm 94
Perseverance

Prepared For:

GREENMINED ENVIRONMENTAL (PTY) LTD




APRIL 1, 2026

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DOCUMENT INFORMATION

Item	Description
Project Title	Phase I Palaeontological Impact Assessment for the Proposed Aggregate Mining Permit Application on Portion 0 of Farm 94 Perseverance situated within the Dr Beyers Naude Local Municipality, Sarah Baartman District Municipality, Eastern Cape Province
Project Name	Proposed Aggregate Mining Permit – Farm 94
Study Type	Phase I Palaeontological Impact Assessment (PIA)
Location	Dr Beyers Naudé Local Municipality, Sarah Baartman District Municipality, Eastern Cape Province
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DISCLAIMER

This report has been prepared by KMG Environmental Solutions Services (Pty) Ltd with reasonable skill, care, and diligence in accordance with accepted professional standards and practices applicable at the time of undertaking the study. The findings, interpretations, and conclusions presented herein are based on available information, site observations, and data obtained during the course of the investigation.

The information contained in this report is subject to limitations inherent in the scope of work, time constraints, seasonal conditions, and the availability and reliability of data. As such, the conclusions and recommendations are provided in good faith and are considered appropriate based on the information available at the time of compilation. Should additional information become available, or should site conditions change, KMG Environmental Solutions Services (Pty) Ltd reserves the right to review and, if necessary, amend the findings and recommendations contained in this report.

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All recommendations provided in this report are subject to approval by relevant regulatory authorities and must be implemented in accordance with applicable legislation and best practice standards.

INDEMNITY

KMG Environmental Solutions Services (Pty) Ltd has undertaken this study with due care, diligence, and in accordance with generally accepted professional standards. The information contained in this report is based on site observations, available data, and information supplied by the client and other relevant sources at the time of the assessment.

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ACRONYMS

Acronym	Description
AMS	Assemblage Zone
AZ	Assemblage Zone
BA	Basic Assessment
BAR	Basic Assessment Report
CBA	Critical Biodiversity Area
CGS	Council for Geoscience
DEA	Department of Environmental Affairs (now DFFE)
DFFE	Department of Forestry, Fisheries and the Environment
DMRE	Department of Mineral Resources and Energy
ECO	Environmental Control Officer
ECPHRA	Eastern Cape Provincial Heritage Resources Authority
EIA	Environmental Impact Assessment
EMF	Environmental Management Framework
EMPr	Environmental Management Programme
GIS	Geographic Information System
GN	Government Notice
GNR	Government Notice Regulation
GPS	Global Positioning System
ha	Hectare
HIA	Heritage Impact Assessment
IDP	Integrated Development Plan
I&APs	Interested and Affected Parties
KMG	KMG Environmental Solutions Services (Pty) Ltd
km	Kilometre
m	Metre
m ²	Square Metre
MSA	Mining Study Area
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004)
NEMWA	National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008)
NHRA	National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NWA	National Water Act, 1998 (Act No. 36 of 1998)
PIA	Palaeontological Impact Assessment
PPP	Public Participation Process
SAHRA	South African Heritage Resources Agency
SANS	South African National Standards
SDM	Sarah Baartman District Municipality
ToR	Terms of Reference
WUL	Water Use Licence
WULA	Water Use Licence Application
WWTW	Wastewater Treatment Works
ZoI	Zone of Influence
Biostratigraphy	Correlation and dating of rock layers using fossil content
Dolerite	Igneous rock commonly intruding Karoo formations
Fossiliferous	Containing fossils

Gondwana	Ancient supercontinent comprising southern continents
Karoo Supergroup	Major sedimentary geological sequence in South Africa
Lithology	Physical characteristics of rocks
Mudstone	Fine-grained sedimentary rock
Palaeo	Prefix relating to ancient life or geological past
Palaeontology	Study of fossils and ancient life
Permian	Geological period (~299–252 million years ago)
Sandstone	Sedimentary rock composed mainly of sand-sized particles
Sedimentology	Study of sediment formation processes
Stratigraphy	Study of rock layers and their relationships
Taphonomy	Study of fossilisation processes
Triassic	Geological period following the Permian

TERMS AND DEFINITIONS

Activity

Any action, operation, or development proposed as part of a project that may have an impact on the environment.

Assemblage Zone (AZ)

A biostratigraphic unit characterized by a unique association of fossil species used to define a specific interval of geological time.

Baseline Environment

The existing environmental conditions of an area prior to the commencement of a proposed activity.

Biostratigraphy

The branch of stratigraphy that uses fossil organisms to date and correlate rock strata.

Competent Authority

The government authority responsible for administering and enforcing environmental legislation and granting approvals (e.g., environmental authorisations).

Cumulative Impact

The combined effect of multiple activities or developments on the environment over time and space.

Development Footprint

The total area that will be directly affected by construction or operational activities.

Dolerite

A type of igneous rock commonly occurring as intrusions within sedimentary formations, particularly within the Karoo Supergroup.

Ecological Integrity

The ability of an ecosystem to support and maintain ecological processes and biodiversity over time.

Environment

The surroundings within which humans exist, including land, water, atmosphere, micro-organisms, plant and animal life, and the interrelationships among them.

Environmental Impact

Any change to the environment, whether adverse or beneficial, resulting from a proposed activity.

Environmental Management Programme (EMPr)

A site-specific plan developed to ensure that environmental impacts are managed, mitigated, and monitored during the lifecycle of a project.

Fossil

Any preserved remains, impression, or trace of a once-living organism from a past geological age.

Fossiliferous

Containing or bearing fossils.

Geology

The scientific study of the Earth's physical structure, composition, and processes.

Geological Formation

A body of rock with a consistent set of characteristics that distinguish it from surrounding rock units.

Impact Significance

The importance of an environmental impact, determined by its magnitude, duration, extent, and probability.

Indigenous Vegetation

Plant species that occur naturally in a particular region or ecosystem.

Lithology

The physical characteristics of rocks, including composition, grain size, and texture.

Mitigation Measures

Actions taken to avoid, reduce, or remedy adverse environmental impacts.

Monitoring

The systematic collection of data to evaluate environmental conditions and the effectiveness of mitigation measures.

Palaeontology

The scientific study of prehistoric life through the analysis of fossils.

Palaeontological Impact Assessment (PIA)

A specialist study undertaken to identify, assess, and mitigate impacts on fossil resources resulting from a proposed development.

Permian Period

A geological time period occurring approximately 299 to 252 million years ago, known for significant fossil records within the Karoo Basin.

Project Area

The geographical area within which the proposed development will take place.

Rehabilitation

The process of restoring disturbed land to a stable and productive state, often resembling its natural condition.

Residual Impact

The environmental impact remaining after mitigation measures have been implemented.

Sedimentary Rock

Rock formed by the accumulation and compaction of sediments over time.

Sedimentology

The study of sediment formation, transport, and deposition processes.

Significance Rating

A classification used to determine the severity of an environmental impact based on defined criteria.

Site Sensitivity

The degree to which an area is susceptible to environmental disturbance.

Stratigraphy

The study of rock layers (strata) and their chronological relationships.

Study Area

The broader area considered during the assessment, including both the project site and surrounding environment.

Taphonomy

The study of processes affecting organic remains from death to fossilisation.

Teekloof Formation

A geological formation within the Beaufort Group of the Karoo Supergroup, known for its fossil-bearing potential.

Terrestrial Fossils

Fossils of organisms that lived on land.

Triassic Period

The geological period following the Permian, approximately 252 to 201 million years ago.

Zone of Influence (ZoI)

The area within which a project may directly or indirectly affect environmental receptors.

EXECUTIVE SUMMARY

KMG Environmental Solutions Services (Pty) Ltd was appointed by Greenmined Environmental (Pty) Ltd, on behalf of Power Construction (Pty) Ltd, to undertake a Phase 1 Palaeontological Impact Assessment (PIA) for the proposed aggregate mining permit application on Portion 0 of Farm 94 Perseverance, located approximately 10 km south of Aberdeen within the Dr Beyers Naudé Local Municipality, Sarah Baartman District Municipality, Eastern Cape Province.

The assessment was conducted in accordance with the requirements of the South African Heritage Resources Agency (SAHRA) and Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999). The purpose of the study was to identify and assess the potential impacts of the proposed mining activities on palaeontological resources and to recommend appropriate mitigation measures to ensure compliance with applicable legislation.

The proposed development entails the extraction of aggregate material over an approximate area of 5 hectares using conventional mining methods, including drilling, blasting, excavation, crushing, and transportation. Associated infrastructure will include access roads, stockpile areas, plant equipment, and support facilities. The operational lifespan of the project is anticipated to be approximately two years, with potential for extension.

A detailed desktop review and field-based assessment were undertaken in accordance with SAHRA minimum standards for palaeontological studies. The study area is underlain by the Teekloof Formation of the Beaufort Group within the Karoo Supergroup, a geological unit widely recognized for its high palaeontological sensitivity. The area is associated with the Late Permian Cistecephalus Assemblage Zone, which is known to contain a diverse range of fossil material, including terrestrial vertebrates such as dicynodonts, pareiasaurs, gorgonopsians, and therocephalians, as well as aquatic organisms, trace fossils, and plant remains.

Despite the high regional palaeontological sensitivity, no fossils were identified during the site inspection conducted on 10 April 2026. The absence of observed fossils is attributed to surface conditions and the nature of overlying sediments. However, it is widely recognized that fossil material within the Beaufort Group is often preserved in subsurface strata, particularly within mudrocks and palaeosol layers, and may only become exposed during excavation activities.

The impact assessment indicates that the potential impact of the proposed development on palaeontological resources is of moderate significance. This is primarily due to the likelihood of encountering fossil material during excavation, coupled with the irreversible nature of impacts should significant fossils be disturbed or destroyed. The spatial extent of the impact is expected to be localized within the development footprint, while the duration of impact is considered long-term to permanent where fossil resources are affected.

In order to manage and mitigate potential impacts, the implementation of a Chance Find Protocol is strongly recommended. This protocol requires that all construction personnel be informed of the possibility of encountering fossil material and outlines procedures to be followed in the event of such discoveries. These include the immediate cessation of work in the affected area, notification of the relevant heritage authority (ECPHRA), and assessment by a qualified palaeontologist. Where necessary, appropriate mitigation measures such as fossil sampling, documentation, and rescue excavation must be undertaken under permit.

Based on the findings of this assessment, it is the opinion of the specialist that the proposed development may be authorised, provided that the recommended mitigation measures are implemented and strictly adhered to. With the

inclusion of these measures, the residual impact on palaeontological resources is expected to be low and acceptable within the context of the development.

Overall, the study concludes that while the site falls within an area of high palaeontological sensitivity, the absence of surface fossil material and the manageable nature of potential impacts support the feasibility of the proposed mining activity, subject to compliance with heritage legislation and the adoption of appropriate environmental management practices.

DECLARATION OF INDEPENDENCE

This report has been compiled by Dr Nonhlanhla Vilakazi, of the University of Johannesburg, sub-contracted by KMG Environmental Solutions Services. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision-making process for the Project.

I, Dr Nonhlanhla Vilakazi, hereby declare that:

- I am an independent specialist with the relevant qualifications and experience to undertake the Palaeontological Impact Assessment for the proposed aggregate mining permit application on Portion 0 of Farm 94 Perseverance, Eastern Cape Province.
- I have no financial or personal interest in the proposed development other than fair remuneration for professional services rendered.
- I have no vested interest in the outcome of this assessment and will not be influenced by any party in the execution of my duties.
- I have undertaken this study in accordance with the applicable legislation, including the National Heritage Resources Act, 1999 (Act No. 25 of 1999), and the guidelines of the South African Heritage Resources Agency (SAHRA).
- The information presented in this report is, to the best of my knowledge, true, accurate, and complete.
- All findings, recommendations, and conclusions expressed in this report are based on scientific principles, professional judgment, and available information at the time of the study.
- I acknowledge that I may be held liable for any misrepresentation of facts or failure to comply with applicable legislation and professional standards.
- I confirm that this report complies with the requirements of Appendix 6 of the Environmental Impact Assessment Regulations, 2014 (as amended).

Specialist: Dr Nonhlanhla Vilakazi Signature:



EXPERTISE OF SPECIALIST

The Paleontologist Consultant: Dr Nonhlanhla Nonny Vilakazi
Qualifications: PhD (Wits University) 2015

Experience: 10 years of research and lecturing in Palaeontology 16 years
PIA studies.

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1. INTRODUCTION

1.1 BACKGROUND

KMG Environmental Services (Pty) was appointed by Greenmined Environmental (Pty) Ltd on behalf of Power Construction (Pty) Ltd to conduct a Phase 1 Palaeontological Impact Assessment (PIA) to assess the potential palaeontological impacts of the proposed mining development. The proposed project is located on Portion 0 of Farm 94 Perseverance within the Sarah Baartman District Municipality., in the Eastern Cape Province. The site is located approximately ±10 km south of the town of Aberdeen in the Eastern Cape Province and can be accessed via the R61 provincial road. Power Construction (Pty) Ltd intends to apply for a Mining Permit to mine aggregate from an area of approximately 5 ha, located on Portion 0 of the Farm 94, Aberdeen Rd, Eastern Cape Province.

The proposed laydown area and access road is planned over an area previously used for the same purpose. The mining method will make use of drilling and blasting in order to loosen the hard rock; the material will then be loaded and hauled to the crushing plant where it will be screened to various sized stockpiles. The mineral will be stockpiled within the designated mining area until it is removed from site. The mineral will be stockpiled until it is transported from site using tipper trucks. All mining related activities will be contained within the approved mining permit boundaries. The mining operation will cover an extent of approximately 5 ha and is expected to be active for at least two years, with the possibility of a further three-year extension subject to permit renewal. The aggregate to be won from the borrow pit will support local demand for planned wind farm projects, as well potentially supplying the local construction industry in and around the Aberdeen area. The mining activities will consist of the following:

- Stripping and stockpiling of topsoil;
- Drilling
- Blasting;
- Excavating; Crushing, screening, stockpiling, and transporting of material;
- Replacing to Progressive sloping, landscaping, and rehabilitation of mined areas;
- Replacing topsoil and re-establishing vegetation upon closure.

The mining site will contain the following:

- Drilling equipment;
- Excavating equipment;
- Earth moving equipment;
- Static crushing and screening plants.
- Access Roads; • Site Office (Containers);
- Site vehicles;
- Parking area for visitors and site vehicles;
- Vehicle service area; • Wash bay;
- Workshop (Containers);
- Salvage Yard;
- Bunded diesel and oil storage facilities;
- Generator on bunded area;
- Ablution Facilities (Chemical Toilets);
- Weigh Bridge; and
- Demarcated general and hazardous waste area.

The proposed project will not require any additional electricity connections, as all power needs will be met through on-site generators and/or solar power. Access to the proposed mining area will be via an existing gravel road branching from the R63. A short entrance road and internal haul roads will be constructed to provide access to the mining footprint. Haul roads will be progressively extended as mining advances and will be rehabilitated as part of the final reinstatement of the area, unless otherwise requested by the landowner. Trucks transporting aggregate to end users will make use of the R63 provincial road.

The survey was conducted in accordance with the South African Heritage Resources Agency (SAHRA) Minimum Standards for a Palaeontology Study. The minimum standards clearly specify the required contents of the report of this nature. The study aimed to identify and document any palaeontological resources that may be affected by the proposed development, these will in turn assist the developer in ensuring proper conservation measures in line with the National Heritage Resource Act, 1999 (Act 25 of 1999).

1.2 SITE DESCRIPTION

The site is located approximately ± 10 km south of the town of Aberdeen in the Eastern Cape Province and can be accessed via the R61 provincial road. The project area falls under the jurisdiction of the Dr Beyers Naudé Local Municipality, within the Sarah Baartman District Municipality. This District Municipality is one of 46 district municipalities in South Africa. Covering 34% of the entire Eastern Cape Province's geographical footprint, the Sarah Baartman District is the largest of the district municipalities in the Eastern Cape and wholly surrounds Nelson Mandela Bay

2. APPLICABLE LEGISLATION

2.1 Constitution of the Republic of South Africa, Act 108 of 1996

Section (24) establishes the right of everyone to an environment not harmful to their health or well-being and to a protected environment for the benefit of present and future generations.

Everyone has the right to have the environment protected, for the benefit of present and future generations through reasonable legislative and other measures that—

- i. prevent pollution and ecological degradation;
- ii. promote conservation; and
- iii. secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development.

2.2 National Environmental Management Act, No. 107 of 1998

The proposed road diversion constitutes activities listed under the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), requiring Environmental Authorisation (EA) prior to commencement. The report identifies triggers under Listing Notice 1 (Activities 12, 19, 24, 27, 30, and 56) and Listing Notice 3 (Activities 4, 12, 14, and 18).

The EIA Regulations set out the procedures for the EA application, while the National Environmental Management Act (NEMA) provides the principles guiding environmental protection and cooperative governance.

2.3 National Heritage Resources Act, No. 25 of 1999

This Act provides for the preservation of heritage resources that are places or objects of cultural importance according to the law, including places or objects of aesthetic, architectural, geographical, scientific, social, spiritual, linguistic, and technological value.

Permits are required for the disturbance, demolition, or destruction of any heritage site, archaeological site or palaeontological site, burial site, grave, or public monument or memorial that may be found during the construction process.

The Act sets out what is defined as a cultural heritage resource, the criteria for determining its importance, and lists specific activities that may require specialist study of cultural heritage. In this context, the categories of developments listed in Section 38 (1) of the NHRA are:

- The construction of a road, wall, powerline, 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 the site;
- Development exceeding 5 000 m² in extent;
- Involving three or more existing erven or subdivisions thereof;
- Involving three or more subdivisions thereof which have been consolidated within the past five years;
- Costs of which will exceed a sum set in terms of regulations by the South African Heritage Resources Agency (SAHRA);
- The rezoning of a site exceeding 10 000 m²;
- Any other category of development provided for in regulations by SAHRA.

All excavation-related activities are to be stopped if any objects are exposed during such activities. The palaeontologist must be called to the site for inspection and potential rescue. Under no circumstances may any item be damaged or removed without the permission of the South African Heritage Resources Agency

2.4 Compliance with Appendix 6 of the Environmental Impact Assessment Regulations, 2014 (as amended)

In accordance with the requirements of the National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and the Environmental Impact Assessment (EIA) Regulations, 2014 (as amended), this specialist report complies with Appendix 6 of Government Notice Regulation (GNR) 326 of 2014 (as amended).

Table 1 : NEMA and EIA Regulations (2014, as amended) – Appendix 6 Requirements for Specialist Reports

Requirements of Appendix 6 – Government Notice (GNR) 326 of 2014 (as amended)	Relevant Section in Report	Comments where not applicable
1.(1)(a)(i) Details of the specialist who prepared the report – Contact details	Document Information Table	–
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A & Appendix B	–
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Appendix A: Specialist Declaration	–
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4: Methods and Terms of Reference	–
(cA) An indication of the quality and age of base data used for the specialist report	Section 5: Geology and Palaeontology	–
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Section 7: Impact Assessment	–
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 4 & Section 5	Site visit conducted on 10 April 2026 for approximately 6 hours during the wet season. Palaeontological assessment is not significantly influenced by seasonal variations
(e) A description of the methodology adopted in preparing the report or carrying out the specialised process, inclusive of equipment and modelling used	Section 3: Assessment Methodology and Section 4: Methods and Terms of Reference	–
(f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives	Section 5 and Section 7	–

(g) An identification of any areas to be avoided, including buffers	Section 7	Site visit did not reveal any areas requiring avoidance or buffers
(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	–
(i) A description of any assumptions made and any uncertainties or gaps in knowledge	Section 8: Assumptions and Uncertainties	–
(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 7, Section 8, and Section 9	–
(k) Any mitigation measures for inclusion in the EMPr	Section 9: Recommendations	–
(l) Any conditions for inclusion in the environmental authorisation	Section 9: Recommendations	–
(m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 10: Chance Find Protocol	–
(n)(i) A reasoned opinion as to whether the proposed activity, activities or portions thereof should be authorised	Section 11: Conclusion	–
(n)(iA) A reasoned opinion regarding the acceptability of the proposed activity or activities	Section 11: Conclusion	–
(n)(ii) If the opinion is that the proposed activity should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 9 and Section 10	–

3. ASSESSMENT METHODOLOGY

In compliance with the NHRA Act No. 25 of 1999 and SAHRA Guidelines:

- Identify, map and provide background to palaeontological finds/localities within the vicinity of the affected area via desktop assessment.
- Provide an assessment, with Field Rating criteria, of the significance of palaeontological resources in the region via desktop assessment.
- Identify and map all possible palaeontological finds/localities within the affected footprint via pedestrian survey.
- Provide an assessment with Field Rating criteria of the potential impact by the development on palaeontological resources within the affected area.

- Provide appropriate mitigation measures and recommendations for palaeontological resources identified within the area of impact, including provision of identification training workshops to ECOs, chance find protocols, and monitoring procedures.

4. METHODS AND TERMS OF REFERENCE

The Terms of Reference (ToR) for this study were to undertake a Palaeontological Impact Assessment (PIA) and provide feasible management measures to ensure compliance with the requirements of the South African Heritage Resources Agency (SAHRA).

The methods employed to address the Terms of Reference included:

- a. Consultation of geological maps, literature, palaeontological databases, and both published and unpublished records to determine the likelihood of fossils occurring within the affected area. Sources included records housed at the University of Cape Town and the SAHRA database.
- b. Where necessary, site visits undertaken by a qualified palaeontologist to identify any fossils present and assess their significance.
- c. Where appropriate, the collection of unique or rare fossil material, subject to obtaining the necessary permits, for storage and curation at a recognised repository (not applicable to this assessment).
- d. Determination of the scientific importance and representativity of fossil material to establish whether such material may be preserved, sampled, or, where of low significance, allowed to be disturbed (not applicable to this assessment).

5. GEOLOGY AND PALAEOLOGY

The proposed mine falls within the Teekloof formation of the Beaufort group within the Karoo Sequence.

5.1 GEOLOGICAL CONTEXT

The sedimentary sequence of South Africa's Karoo Basin is regarded as the most extensive and stratigraphically comprehensive megasequence of southwestern Gondwana, containing sediments from the Late Carboniferous to the Middle Jurassic. The Permian-Triassic Beaufort Group of the Karoo Basin, consisting of four lithological groups, is primarily recognized for its depiction of southwestern Gondwanan terrestrial ecosystems and their corresponding climates (Catuneanu et al., 1998; Catuneanu and Elango, 2001; Neveling et al., 2002; Rubidge et al., 2015). The Karoo Basin developed north of the Cape Fold Belt in southwestern Gondwana during the Late Carboniferous (Johnson, 1991; Smith, 1995; Catuneanu et al., 1998). The predominantly sedimentary fill has significant asymmetry with a maximum cumulative thickness of 12 km in the southwest, progressively diminishing towards the northeast. The southern segment of the basin, situated between present-day 31° S and 34° S, is regarded as proximal to the Cape Fold Belt, whilst the northern segment (north of 31° S) is deemed distal and features a significantly thinner stratigraphic sequence. The Karoo Supergroup comprises four stratigraphic groups: Dwyka, Ecca, Beaufort, and Stormberg. Alongside the lithostratigraphic divide of the Beaufort Group, the prevalence of numerous tetrapod fossils has facilitated a biostratigraphic division (Rubidge, 1995; van der Walt et al., 2010)

5.1.1 THE BEAUFORT GROUP

The Beaufort Group consists of the lower Adelaide and upper Tarkastad Subgroups (SACS, 1980), with the latter characterized by a higher sandstone-to-mudstone ratio. The demarcation between the two subgroups may be traced over the Karoo Basin, with the exception of the northern and central Free State Province. In the Free State,

Theron (1970) tentatively categorized the Beaufort Group into four formations: the Lower, Northern, Middle, and Upper Beaufort formations. In the northeastern Free State and KwaZulu-Natal provinces, Groenewald (1989) identified a sequence of sedimentary strata overlying the Ecca Group, which he designated as the Normandien Formation. Rubidge (1995) identified the Normandien Formation as equivalent to the Balfour Formation, the highest unit of the Adelaide Subgroup in the southern region of the basin.

5.1.2 ADELAIDE SUBGROUP

The Adelaide Subgroup is situated in the southern region of the basin and comprises the Abrahamskraal formation, along with the underlying Teekloof (western facies) and Middleton (eastern facies) formations (Johnson et al., 1996, 2006; Day and Rubidge, 2014). The Permian fluvio-lacustrine Lower Beaufort Group was deposited during multiple second-order tectonic unloading and loading processes of the Cape Fold Belt, leading to uplift and subsequent subsidence in the southern main Karoo Basin (Catuneanu et al., 1998). The lithology of the Adelaide Subgroup comprises an upward-fining sequence of alternating mudstones and sandstones deposited in lacustrine, fluvial, and floodplain environments, which supported flora including cordaitaleans, glossopterids, ginkgophytes, ferns, lycopods, and sphenophytes (Plumstead, 1969; Anderson and Anderson, 1985; Bamford, 2004; Rubidge, 2005; Tankard et al., 2009).

5.1.3 TEEKLOOF FORMATION

Paiva (2015) asserts that the Teekloof Formation mostly consists of floodplain complex deposits, prominently visible in the hillsides, valley gorges, and road cuts of the region. The exposed sandstone complexes typically measure 6 meters in thickness and range from 60 to 100 meters in width, forming extensive ribbons and slender sheets. While dolerite intrusions are prevalent in this stratigraphic region, places with diminished dolerite concentration have facilitated the preservation of architectural structures in the sandstones and fossil remains. Comparable to the higher Abrahamskraal Formation, the floodplain-associated sandstones of the lower Teekloof Formation exhibit a tabular, sheet-like structure, characterized by slender, sheet-like bodies. The surface boundaries, predominantly of third order, are primarily linear and non-erosive. Erosive, uneven borders with down-scouring (about 15 cm relief) are also prevalent in these sandstones.

5.1.4 DOLERITE

Perseverance Farm contains dolerite intrusions. This constitutes a crucial source for the production of road materials, including both natural gravel aggregate and crushed rock aggregate. The Karoo Dolerite Suite, albeit a distinct geological entity, has significant petrographic variety, mostly attributable to its vast expanse (>500,000km²) and the many lithologies into which these hypabyssal rocks were intruded. Minor hypabyssal intrusions exhibit significant alterations in texture and both primary and secondary mineralogy within a singular intrusion (Leyland et al., 2016).

5.2 PALAEOONTOLOGICAL CONTEXT

According to the latest biostratigraphic map of the Main Karoo Basin by Van der Walt et al. (2010), the study area probably falls within the Late Permian Cistecephalus Assemblage Zone. Multiple authors (Kitching 1977, Keyser & Smith 1977, Anderson & Anderson 1985, Smith & Keyser 1995, MacRae 1999, Cole et al. 2004, Rubidge et al. 1995, 2005, Smith et al. 2012; Almond 2012 & 2014) suggest several major fossil categories may occur here. These include isolated petrified bones and rare articulated skeletons of terrestrial vertebrates. Such vertebrates include true reptiles, such as large herbivorous pareiasaurs like *Pareiasaurus* and small insectivorous owenettids. The area may also contain therapsids or 'mammal-like reptiles,' including diverse herbivorous dicynodonts, notably *Cistecephalus*, *Oudenodon*, and *Aulacephalodon*. A wide range of flesh-eating gorgonopsians, such as *Lycaenops*, and insectivorous therocephalians, such as *Ictidosuchoides*, might also be found. Aquatic vertebrates such as large temnospondyl amphibians (*Rhinesuchus*, usually disarticulated) and palaeoniscoid bony fish (*Atherstonia*, *Namaichthys*), are often represented by scattered scales, rather than intact specimens. Freshwater bivalves (*Palaeomutela*), trace fossils such as worm, arthropod, and tetrapod burrows and trackways (e.g., *Aulacephalodon*), coprolites (fossil droppings), and plant roots are also possible discoveries. Lastly, vascular plant

remains may occur, including leaves, twigs, roots, and silicified woods ("Dadoxylon") of the Glossopteris Flora, especially glossopterid trees and arthropytes (horsetails), though such plant material is typically sparse and fragmentary. The most significant fossil material pertaining to biostratigraphically important tetrapod remnants is typically located inside overbank mudrocks. Conversely, fossils embedded in channel sandstones (such as channel lag breccio-conglomerates composed of reworked mudflakes and calcrete nodules) are typically fragmented and water-worn (Smith & Keyser 1995, Smith 1993). Numerous fossils are discovered in conjunction with ancient soils (palaeosol layers), typically identifiable by bedding-parallel accumulations of calcrete nodules. The fossil bones are predominantly solitary and disarticulated, often permineralized and encased in a layer of calcrete, which often exhibits brown weathering. Fossil bones lodged in mudrocks near significant dolerite intrusions may undergo heat metamorphism; for instance, bones in the Graaff-Reinet District may have a smooth, white "porcellanite" hue, whereas bones found near Bedford may seem black (Smith & Keyser 1995).

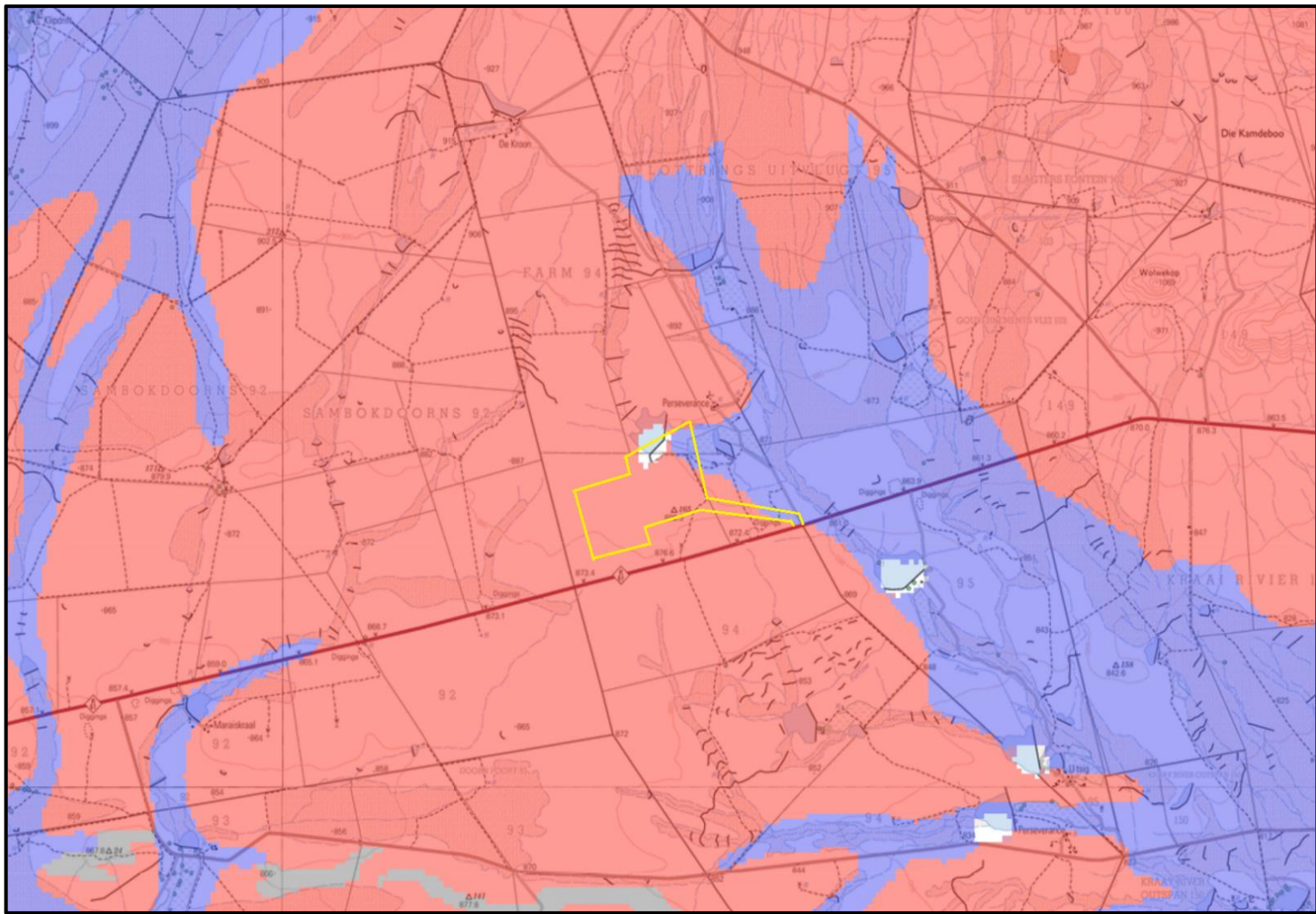


Figure 3 : A Paleo-Sensitivity Map for the proposed development. The area is on the yellow portion, signifying its sensitivity as an area of very high to low sensitivity (where the proposed mine is marked by a yellow line, polygon).

6. SITE OVERVIEW

Photos showing the site in question (site inspection conducted on 10 April 2026). Yellowish to red sediment can be seen in some of the images below. It should be noted that no fossils were found in the area during the site visit.



Figure 4 : Photo showing an overview of some shale overlying the area.



Figure 5 : Photo showing alluvial gravels



Figure 6 : Photo showing weathered sandstone found in the area.



Figure 7 : Photo showing the yellowish sandstone typical of the area



Figure 8 : Photo showing the yellowish decalcified sediment typical of the area

7. IMPACT ASSESSMENT

An assessment of the potential impacts on palaeontological resources was undertaken using established criteria for evaluating the severity, duration, spatial scale, and probability of impacts. This assessment also incorporates findings from the environmental screening report, which identifies the study area as having section of **very high palaeontological sensitivity** with sections of **very low palaeontological sensitivity** and overlapping environmental sensitivities, including terrestrial biodiversity and aquatic ecological support areas

An assessment of the potential impacts on possible palaeontological resources considers the criteria encapsulated in Table below.

Table 2 : Criteria for Assessing Impacts (Part A: Definition and Criteria)

Criteria	Rating	Description
Severity/Nature	H	Substantial deterioration. Recommended levels often violated.
	M	Moderate/measurable deterioration. Occasional exceedance of limits.
	L	Minor deterioration. Within acceptable limits.
	L+	Minor improvement.
	M+	Moderate improvement.
	H+	Significant improvement.
Duration	L	Short-term (reversible)
	M	Medium-term (life of project)
	H	Long-term/permanent
Spatial Scale	L	Localised (within site boundary)
	M	Local (beyond site boundary)
	H	Regional/national
Probability	H	Definite
	M	Possible
	L	Unlikely

Table 3 : Impact Assessment (Part B: Assessment)

Criteria	Rating	Description
Severity/Nature	H	–
	M	Loose sediment does not preserve fossils; however, fossils may be exposed during excavation. This results in a moderate impact
	L	–
	L+	–
	M+	–
	H+	–
Duration	L	–
	M	–
	H	Impacts on palaeontological resources are permanent and irreversible once fossil material is destroyed or removed.
Spatial Scale	L	–
	M	Impacts are expected to be localised within the mining footprint , although the significance of fossils extends beyond the site due to their scientific value.
	H	–

Probability	H	–
	M	It is likely that fossils may be encountered in the loose soils, sands, or underlying mudrock. There is a possibility that sediments of the Teekloof Formation may contain fossil fauna; therefore, a Fossil Chance Find Protocol should be included in the EMPr
	L	–

8. ASSUMPTIONS AND UNCERTAINTIES

The assessment of palaeontological resources within the study area is based on available geological information, published literature, and site observations. It is assumed that the fossil potential of the formations present within the study area is consistent with that of the broader region, particularly the Teekloof Formation of the Beaufort Group, which is known to contain fossil material.

The study assumes that fossil occurrences within the site may include intermittent terrestrial vertebrate remains, such as isolated petrified bones and rare articulated skeletons, as well as aquatic organisms, trace fossils, and plant material. However, such fossil material is typically unevenly distributed and may occur at varying depths within the subsurface.

A key uncertainty relates to the inherent limitation of surface-based assessments. The absence of visible fossil material during the site visit does not preclude the presence of significant palaeontological resources beneath the surface. Fossils are often preserved within subsurface mudrocks or palaeosol layers and may only become exposed during excavation or drilling activities.

The predictability of fossil occurrence is further limited by geological variability and the presence of localized depositional environments that may concentrate or preserve fossil material. Additionally, factors such as dolerite intrusions may influence the preservation state of fossils through thermal alteration.

The successful identification and recovery of fossil material are dependent on the recognition of such material during excavation activities. This introduces uncertainty, as fossil material may be overlooked without proper awareness and monitoring procedures in place.

It is therefore assumed that, although no fossils were identified during the field survey, there remains a reasonable likelihood that palaeontological material may be encountered during the construction and operational phases of the project. For this reason, the implementation of a Chance Find Protocol and appropriate monitoring measures is considered essential to manage potential risks.

9. RECOMMENDATIONS

Based on the findings of the Phase 1 Palaeontological Impact Assessment, the study area is considered to have a high palaeontological sensitivity due to its association with the Teekloof Formation of the Beaufort Group. Although no fossils were identified during the site visit, the potential for subsurface fossil material remains significant.

It is therefore recommended that the proposed development may proceed, subject to the implementation of appropriate mitigation measures to safeguard potential palaeontological resources..

The following recommendations are provided:

- A Fossil Chance Find Protocol must be implemented as part of the Environmental Management Programme (EMPr) and strictly adhered to throughout all phases of site preparation, excavation, and mining.
- All personnel involved in ground disturbance activities, including contractors and the Environmental Control Officer (ECO), must be made aware of the potential presence of fossil material and trained to recognise possible palaeontological finds.
- A qualified palaeontologist must be placed on a call-out basis, and, where feasible, periodic monitoring should be undertaken during the initial stages of excavation, particularly in areas where deeper geological layers are exposed.
- Should any fossil material be encountered during excavation, drilling, or blasting activities:
 - Work in the immediate area must cease immediately;
 - The site must be secured to prevent disturbance;
 - The ECO must be notified;
 - The Eastern Cape Provincial Heritage Resources Authority (ECPHRA) must be informed without delay;
 - A qualified palaeontologist must assess the find and recommend appropriate mitigation.
- Where fossil material is deemed to be of scientific importance, mitigation measures must include:
 - Documentation and recording of the find;
 - Controlled excavation where necessary;
 - Collection and curation of fossil material at an approved repository;
 - Compliance with permitting requirements from ECPHRA.
- If the palaeontological specialist determines that the material is of low significance, development activities may resume once clearance is granted.
- A monitoring programme may be required depending on the nature and frequency of fossil finds during excavation.
- All mitigation measures must be implemented in compliance with the National Heritage Resources Act, 1999 (Act No. 25 of 1999), and SAHRA guidelines.

With the implementation of these measures, the potential impact on palaeontological resources can be effectively reduced from moderate to low significance.

It is therefore the opinion of the specialist that the proposed development can be authorised, provided that all recommended mitigation measures are implemented and adhered to.

10. CHANCE FIND PROTOCOL

A Chance Find Protocol must be implemented during all phases of site preparation, excavation, and mining activities to ensure that any palaeontological resources encountered are appropriately managed in accordance with the National Heritage Resources Act, 1999 (Act No. 25 of 1999).

The following procedures must be followed in the event that potential fossil material is discovered:

- All site personnel must be made aware of the possibility of encountering fossil material and must be briefed on the identification of such resources prior to commencement of construction or mining activities.
- If any suspected fossil material is identified during excavation, drilling, blasting, or any ground disturbance activities, work in the immediate vicinity of the find must cease immediately.
- The Environmental Control Officer (ECO) or responsible site manager must be informed without delay.
- The ECO or responsible person must notify the Eastern Cape Provincial Heritage Resources Authority (ECPHRA) of the discovery.
- A qualified palaeontologist must be appointed to assess the find and determine its scientific significance.
- In the case of a significant in situ fossil discovery, the affected area must be demarcated and protected to prevent disturbance until the specialist assessment is completed.
- Following inspection, the palaeontologist will provide one of the following recommendations:
 - The material is of no scientific significance, and work may proceed without further mitigation.
 - The material is of moderate significance, and a representative sample should be collected for further study and curation at a recognised repository, subject to obtaining the required permits.
 - The material is of high scientific importance, requiring controlled excavation, documentation, and removal under permit before development activities can continue.
- Where significant fossil material is identified, a monitoring programme may be implemented in consultation with the palaeontologist to oversee further excavation activities.
- All fossil material collected must be curated at an approved repository in accordance with SAHRA and ECPHRA requirements.

The implementation of this protocol will ensure that any palaeontological resources encountered during the project are managed responsibly and in compliance with applicable heritage legislation, thereby minimising potential impacts on scientifically valuable resources.

11. CONCLUSION

The Phase 1 Palaeontological Impact Assessment undertaken for the proposed aggregate mining permit application on Portion 0 of Farm 94 Perseverance indicates that the study area is underlain by geological formations of the Beaufort Group, specifically the Teekloof Formation, which is known to possess high palaeontological sensitivity.

Although no fossil material was observed during the site inspection, it is well established that fossil resources within this formation are often preserved within subsurface strata and may only become exposed during excavation activities. As such, the absence of surface fossils does not negate the potential for significant palaeontological resources to occur within the project area.

The assessment has determined that the potential impact of the proposed mining activities on palaeontological resources is of moderate significance, primarily due to the possibility of encountering fossil material during ground disturbance and the irreversible nature of impacts should such material be damaged or destroyed.

However, the spatial extent of the impact is expected to be localised within the development footprint, and the implementation of appropriate mitigation measures will significantly reduce the potential risk.

Provided that the recommended mitigation measures are strictly implemented—particularly the Fossil Chance Find Protocol, awareness training of site personnel, and the involvement of a qualified palaeontologist where required—the residual impact on palaeontological resources is expected to be low and acceptable.

It is therefore concluded that the proposed development may be authorised, subject to compliance with the National Heritage Resources Act, 1999 (Act No. 25 of 1999), and adherence to all recommended mitigation and monitoring measures.

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