



PGS HERITAGE

**PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED EXPANSION OF
THE HEIDELBERG MUNICIPAL CEMETERY LOCATED WITHIN THE LESEDI LOCAL
MUNICIPALITY, SEDIBENG DISTRICT MUNICIPALITY, GAUTENG PROVINCE**

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

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

Disclosure of Vested Interest

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

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ACKNOWLEDGEMENT OF RECEIPT

Report Title	Palaeontological Desktop Assessment for the proposed expansion of the Heidelberg Municipal Cemetery located within the Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province		
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This Palaeontological Impact Assessment report has been compiled considering the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

Table 1 - NEMA Table

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
1.(1) (a) (i) Details of the specialist who prepared the report	Page ii and Section 2 of Report – Contact details and company and Appendix A	-
(ii) The expertise of that person to compile a specialist report including a curriculum vitae	Section 2 – refer to Appendix A	-
(b) A declaration that the person is independent in a form as may be specified by the competent authority	Page ii of the report	-
(c) An indication of the scope of, and the purpose for which, the report was prepared	Section 4 – Objective	-
(cA) An indication of the quality and age of base data used for the specialist report	Section 5 – Geological and Palaeontological history	-
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 9	-
(d) The duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment		Desktop Assessment
(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	Section 1 and 10	

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;		
(g) An identification of any areas to be avoided, including buffers	Section 5	No buffers or areas of sensitivity identified
(h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Section 5 – Geological and Palaeontological history	
(i) A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation	-
(j) A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 1 and 10	
(k) Any mitigation measures for inclusion in the EMPr	Section 11	
(l) Any conditions for inclusion in the environmental authorisation	Section 11	
(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 10	
(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	Section 1 and 10	-

Requirements of Appendix 6 – GN R326 EIA Regulations of 7 April 2017	Relevant section in report	Comment where not applicable.
avoidance, management and mitigation measures that should be included in the EMP, and where applicable, the closure plan		
(o) A description of any consultation process that was undertaken during the course of carrying out the study	N/A	
(p) A summary and copies if any comments that were received during any consultation process	N/A	
(q) Any other information requested by the competent authority.	N/A	
(2) Where a government notice by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines	

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the **Palaeontological Desktop Assessment** (PDA) to assess the proposed expansion of the Heidelberg Municipal Cemetery located within the Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province. To comply with the National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), this PDA is necessary to confirm if fossil material could potentially be present in the planned cemetery area and to evaluate the impact of the proposed development on the Palaeontological Heritage.

The proposed development is underlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website). The Geotechnical Report conducted for this study indicated shallow sandstone bedrock in the northwestern section of the site. These areas are “unsuitable for cemetery development and should be avoided”. The rest of the site is underlain by bedrock overlain by residual and transported deposits. It is very unlikely that these sediments would contain fossils. An overall Very Low has been allocated to the proposed development post-mitigation and it is thus considered that the proposed Heidelberg cemetery project will not lead to detrimental impacts on the palaeontological resources of the area. The development of the development may thus be authorised as the development footprint is not considered sensitive in terms of palaeontological resources.

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

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Appendix A: CV

Palaeontological Desktop Assessment for the proposed *Heidelberg Cemetery Extension*

TERMINOLOGY AND ABBREVIATIONS

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;

Palaeontology

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

Table 2: Abbreviations

Abbreviations	Description
AIA	Archaeological Impact Assessment
ASAP	Association of South African Professional Archaeologists
CRM	Cultural Resource Management
ECO	Environmental Control Officer
EAP	Environmental 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
PDA	Palaeontological Desktop Assessment
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
SAHRIS	South African Heritage Resources Information System

1 INTRODUCTION

PGS Heritage (Pty) Ltd was employed by Marang Environmental and Associates (Pty) Ltd to commence with a Heritage Impact Assessment (HIA) for the proposed extension of the Heidelberg Municipal Cemetery, on the Remainder of Portion 5 of the farm Langlaagte 186 IR in the Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province. In turn Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the Palaeontological Desktop Assessment (PDA) as part of the HIA (Figure1-3).

The Lesedi Local Municipality proposes to extend the current Heidelberg Cemetery onto the rest of the cemetery property (Portion 5 of Langlaagte 186IR) which is about 10 ha in extent and will consequently provide adequate cemetery space for several decades.

The following Geotechnical report was conducted for the project:

Bulala, K., 2020. Geotechnical Investigation for Heidelberg Cemetery Expansion, Gauteng. JG AFRIKA (PTY) LTD.

Twelve trial pits (TP) were excavated for the Geotechnical report. The following results were obtained:

- A silty sand residual sandstone subsoil horizon was profiled across the site in all trial pits except for TP2. The horizon was intercepted from a depth of 0.37m to a maximum depth of 4.50m below NGL. The average thickness of the horizon is 1.56m.
- The ferruginised residual sandstone horizon was encountered in TP4, TP8, TP10, TP11 and TP12. The horizon was generally encountered from a depth of 2.20m, 2.50m, 2.43m, 2.48m and 2.20m below NGL respectively. The average thickness of the horizon is 0.90m. The horizon extended to below the maximum excavation depth of 4.50m below NGL in TP8.
- A dense to very dense ferruginised residual sandstone subsoil horizon was encountered across the site in TP4, TP10, TP11 and TP12 from a depth of 2.48m to 4.50m with an average thickness approximately 1.67m.
- Sandstone bedrock was encountered in TP1, TP2, TP3, TP5, TP6 and TP7 at a minimum depth of 0.84m, 0.30m, 0.80m, 0.88, 1.24m and 2.47m below NGL respectively. Refusal was encountered in the sandstone bedrock at these trial pits. Shallow refusal in sandstone bedrock was observed in the north western section of the site.

Articles referenced by the geotechnical report is:

Hall, B and Hanbury, R (1990), Some Geotechnical Considerations in the Selection of Cemetery Sites. IMIESA, March 1990.

▣ Richards, N.P. and Croukamp, L. (2004). Geotechnical Investigation Guidelines for Cemetery Site Selection. Council for Geoscience.

▣ Dippenaar, M.A, Olivier, J, Lorentz, S, Ubomba-Jaswa, E, Abia, A.L.K, Diamond, R.E. (2018).

Environmental Risk Assessment, Monitoring and Management of Cemeteries. Water Research Commission.

▣ *The Department of Water and Sanitation's National Groundwater Archive borehole (NGA) locations in Gauteng were reviewed for domestic water uses*

According to the above-mentioned literature the ideal cemetery site ought to have the next principal characteristics:

- Gentle slope gradients (ideally 2° to 6°, <2° with sufficient drainage system, but in extreme cases with special precautions required, up to 9° can be tolerated).
- Excavation – Deep soils (minimum 1.8m; 2.4m required for a double burial) that are easily excavated.
- A safe distance away from drainage features – minimum distance required is 150m (Additional distance is required depending on the soil type).
- Limited permeability of the natural soils to prevent surface water migrating through the soils and transporting contaminants to the groundwater (gravels and sands), but also ensuring that the permeability is not too low, thus causing anaerobic conditions (fat clays and elastic silts).
- Water table should be at least 2.5m below the base of the grave.
- Stable sidewalls, that is, not loose sandy collapsing sidewalls.
- Workable soils that will easily backfill the hole, that is, not too clayey that it will clump when backfilling or have abundant cobbles.

The results of the geotechnical report

The presence of shallow sandstone bedrock encountered in the northern side of the site is a cause for concern as this indicates that the buffer zone or zone of aeration is negligible. This increases the potential for groundwater pollution as a result of the concentration of pathogens and other pollutants in the discontinuities of the bedrock materials. **The areas of the site in which the sandstone bedrock was encountered at shallow depths are therefore considered to be unsuitable for cemetery development and should be avoided.**

The underlying bedrock comprises the sandstone which is overlain by residual and transported deposits. Groundwater was not intercepted in all the trial pits.

The investigation has indicated the presence of bedrock conditions at variable depths in the northern portion of the site renders this portion unsuitable for a cemetery site.

The proposed development is suitable with the following conditions:

▣ The excavation of the soil materials present across the site is variable and the following classes have been defined for the subsoil or rock materials encountered during the *geotechnical investigation*. A *“Hard” Excavation Class material, considered unsuitable, for the north western portion of the site*. A *“Soft” Excavation Class for the colluvial and residual soils for the rest of the site;*

- ▣ No groundwater seepage, surface water ponding was encountered during the investigation;
- ▣ Permeability values of the subsoil materials encountered across the site ranged from 1.48x10⁻⁶ to 1.67x10⁻⁶. Based on these values the site is suitable for a cemetery;
- ▣ Based on the permeability values it was also concluded that site was suitably located in respect to the location of a domestic water supply source and drainage features;
- ▣ Basal buffer zones at 2.20m based on fluctuation indications is considered marginally suitable for cemetery site development;
- ▣ According to the soil consistency and the Mod. AASTHO results, the soil workability classifies as *“Excellent to Good”*; and
- ▣ No trench instability was encountered on site; therefore, the site is suitable with regards to the grave stability.

The **site classifies as *“Satisfactory”*** due to the fluctuating water table.

Excavation depths of at least 1.8m are considered suitable for cemetery site selection, although depths of at least 3.0m are preferred to ensure that an adequate soil horizon is present below the graves to act as an aeration zone (Richards and Croukamp, 2004).

Excavation of graves by hand labor methods i.e. pick and shovel will be achievable to the burial depth of 1.80m in TP4 and TP7-TP12. This portion of the site is **suitable for a grave site** development. Medium to hard bedrock strength was encountered at shallow depths in TP1-TP3 and TP5-TP6 (depth range 0.3m to 1.24m). This portion of the site **unsuitable for a grave site** because the material needs a bulldozer with a mass of at least 35 tons when fitted with a single tine ripper and an engine developing approximately 220 kW at the flywheel to be efficiently ripped.

To date no palaeontological study has been conducted for the proposed Heidelberg cemetery extension although a Heritage Impact Assessment was conducted in 2020.

Kitto, J. & Birkholtz, P. October 2020. Heritage Impact Assessment for the Proposed Expansion of the Heidelberg Municipal Cemetery Located within the Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province. Phase 1 Heritage Impact Assessment.

Interim comments on **SAHRA CaseID: 16661** include:

“In terms of palaeontological heritage, the SA Palaeontological Sensitivity Map indicates that the study area has Very High fossil sensitivity, therefore a palaeontological field assessment and protocol for finds is required”.

After consultations with SAHRA it was agreed that a well worded desktop study and protocol for finds would be sufficient for this study. The current Palaeontological Desktop Assessment was thus commissioned.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

This present study has been conducted by Mrs Elize Butler. She has conducted approximately 300 palaeontological impact assessments for developments in the Free State, KwaZulu-Natal, Eastern, Central, and Northern Cape, Northwest, Gauteng, Limpopo, and Mpumalanga. She has an MSc (cum laude) in Zoology (specializing in Palaeontology) from the University of the Free State, South Africa and has been working in Palaeontology for more than twenty-five years. She has 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) since 2006 and has been conducting PIAs since 2014.

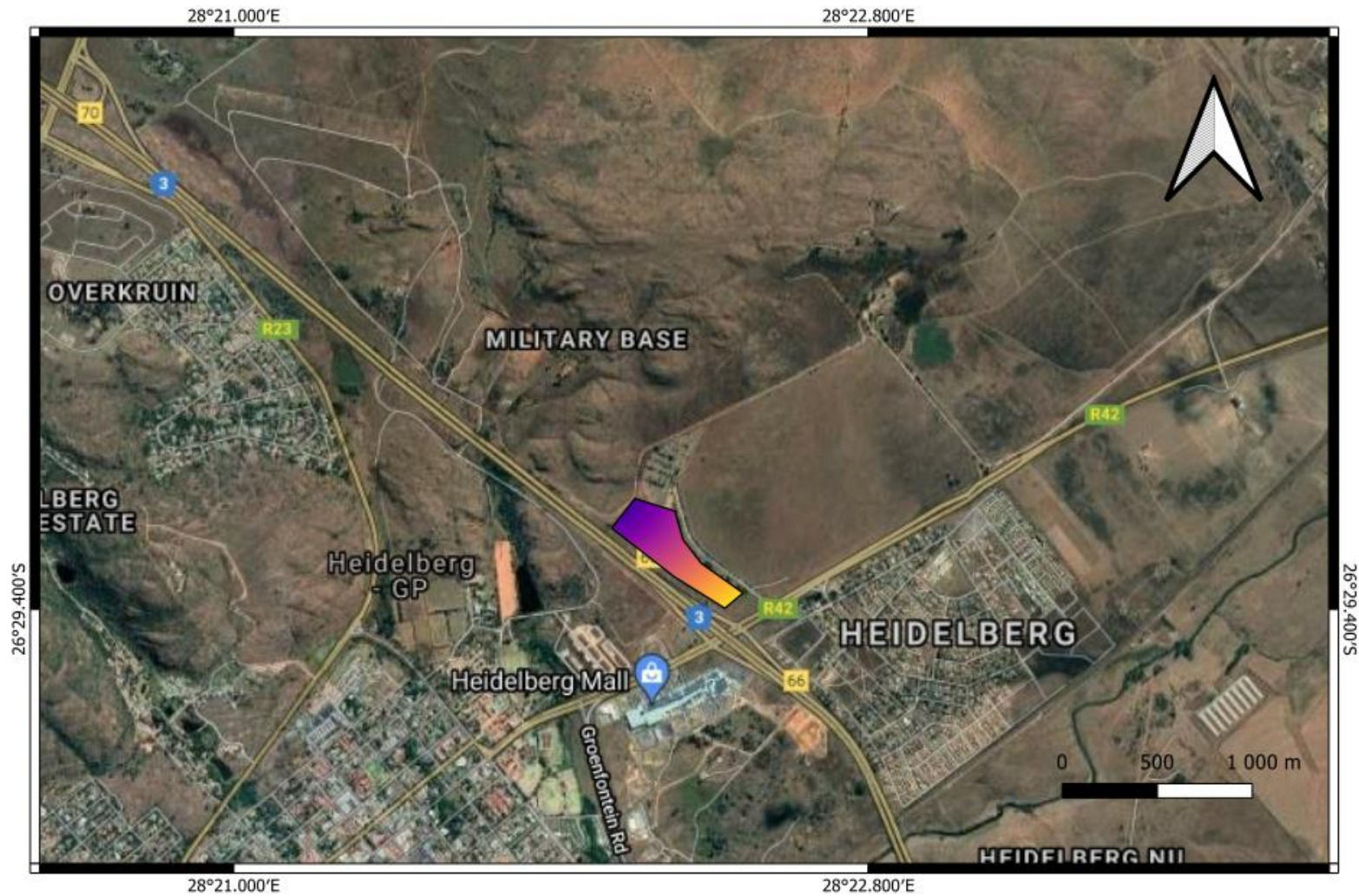


Figure 1: Google Earth (2021) Image of the proposed cemetery extension of the Heidelberg Municipal Cemetery, Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province. The development is indicated in multi-coloured colours.

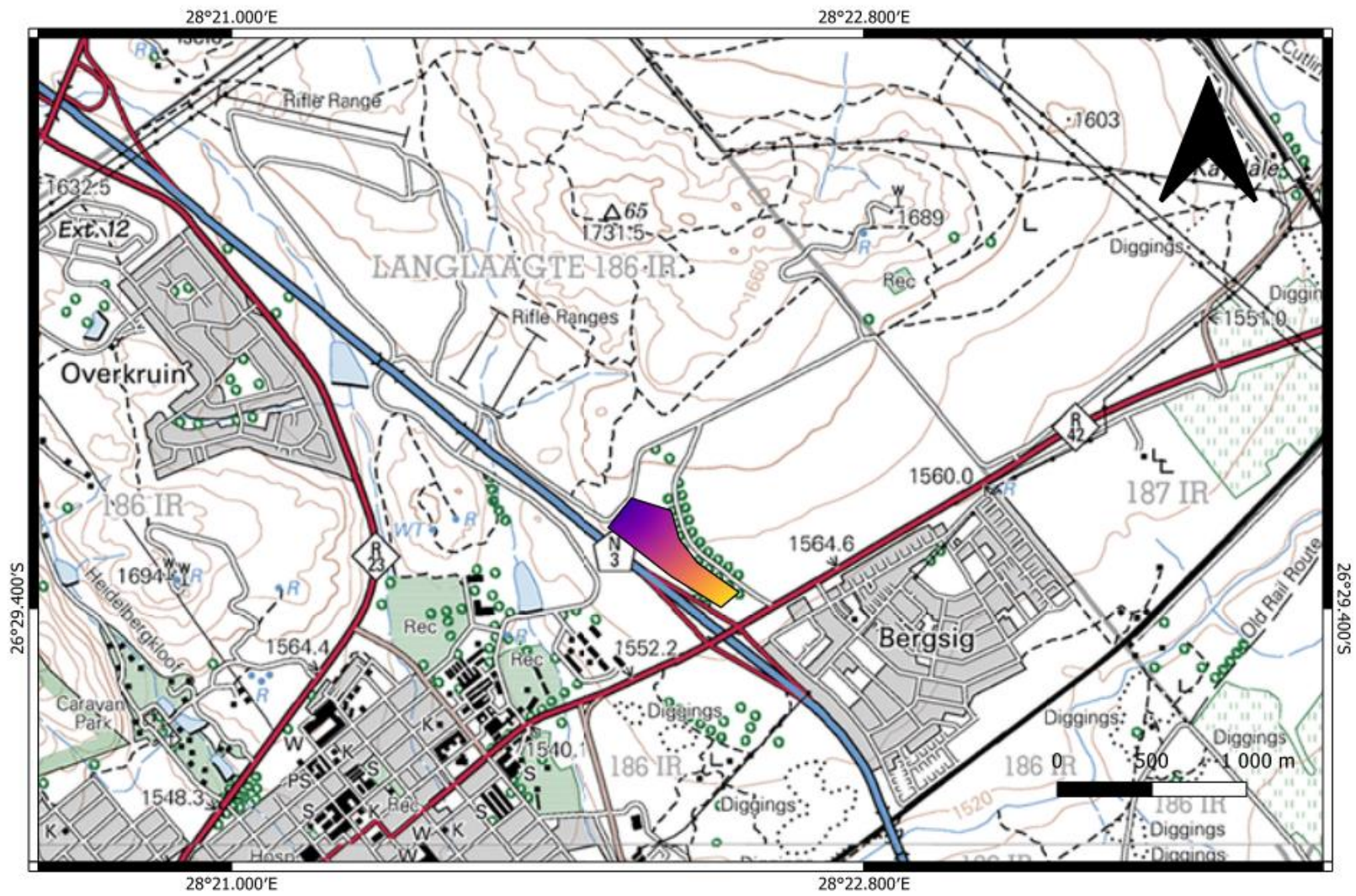


Figure 2: Extract of the 150 000 topographical maps (2628AD) indicating the location of the proposed Heidelberg cemetery extension in multi-coloured colours.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

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

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

- National Environmental Management Act (NEMA) Act 107 of 1998
- National Heritage Resources Act (NHRA) Act 25 of 1999
- Minerals and Petroleum Resources Development Act (MPRDA) Act 28 of 2002
- Notice 648 of the Government Gazette 45421- general requirements for undertaking an initial site sensitivity verification where no specific assessment protocol has been identified.

The next section in each Act is directly applicable to the identification, assessment, and evaluation of cultural heritage resources.

GNR 982 (Government Gazette 38282, 14 December 2014) promulgated under the National Environmental Management Act (NEMA) Act 107 of 1998

- Basic Assessment Report (BAR) – Regulations 19 and 23
- Environmental Impacts Assessment (EIA) – Regulation 23
- Environmental Scoping Report (ESR) – Regulation 21
- Environmental Management Programme (EMPr) – Regulations 19 and 23

National Heritage Resources Act (NHRA) Act 25 of 1999

- Protection of Heritage Resources – Sections 34 to 36
- Heritage Resources Management – Section 38

MPRDA Regulations of 2014

Environmental reports to be compiled for application of mining right – Regulation 48

- Contents of scoping report – Regulation 49
- Contents of environmental impact assessment report – Regulation 50
- Environmental management programme – Regulation 51

- Environmental management plan – Regulation 52

The NEMA (No 107 of 1998) states that an integrated EMP should (23:2 (b)) “...identify, predict and evaluate the actual and potential impact on the environment, socio-economic conditions and cultural heritage”.

In agreement with legislative requirements, EIA rating standards as well as SAHRA policies the following comprehensive and legally compatible PIA report have been compiled.

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.

4 OBJECTIVE

The aim of a Palaeontological Impact Assessment (PIA) 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 is: 1) to

identify the palaeontological importance of the rock formations in the footprint; 2) to evaluate the palaeontological magnitude of the formations; 3) to clarify the **impact** on fossil heritage; and 4) to suggest how the developer might protect and lessen possible damage to fossil heritage.

The palaeontological status of each rock section is calculated as well as the possible impact of the development on fossil heritage by a) the palaeontological importance of the rocks, b) the type of development and c) the quantity of bedrock removed.

When the development footprint has a moderate to high palaeontological sensitivity a field-based assessment is necessary. The desktop and the field survey of the exposed rock determine the impact significance of the planned development and recommendations for further studies or mitigation are made. Destructive impacts on palaeontological heritage usually only occur during the construction phase while the excavations will change the current topography and destruct or permanently seal-in fossils at or below the ground surface. Fossil Heritage will then no longer be accessible for scientific research.

Mitigation usually precede construction or may occur during construction when potentially fossiliferous bedrock is exposed. Mitigation comprises the collection and recording of fossils. Preceding excavation of any fossils a permit from SAHRA must be obtained and the material will have to be housed in a permitted institution. When mitigation is applied correctly, a positive impact as possible because our knowledge of local palaeontological heritage may be increased

The terms of reference of a PIA are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended.
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements.
- Submit a comprehensive overview of all appropriate legislation, guidelines.
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study.
- Description and location of the proposed development and provide geological and topographical maps.
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/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 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The geology of the proposed Heidelberg cemetery extension in the Heidelberg Municipal Cemetery, Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province is shown on the 1:250 000 2628 East Rand Geological Map (1986) (Council of Geoscience, Pretoria) (Figure 3). The proposed development is primarily underlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Vryheid Formation (Ecca Group, Karoo Supergroup) is Very High (Almond and Pether 2008, SAHRIS website).

The Permian Vryheid Formation is internationally renowned for its coal deposits and is known for its rich assemblage of Glossopteris flora which is the source vegetation for this formation. The depth of the Vryheid Formation in the main Karoo Basin may be up to 500 m near Vryheid and New Castle in Kwazulu-Natal (type-locality), where the basin was at its deepest. The Vryheid Formation thins from the north-eastern part of the basin and finally wedges out towards the west, southwest and south (Johnson 2009). This formation forms a part of the Middle Ecca (Kent 1980) and contains the largest coal reserves in South Africa.

Table 3: 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

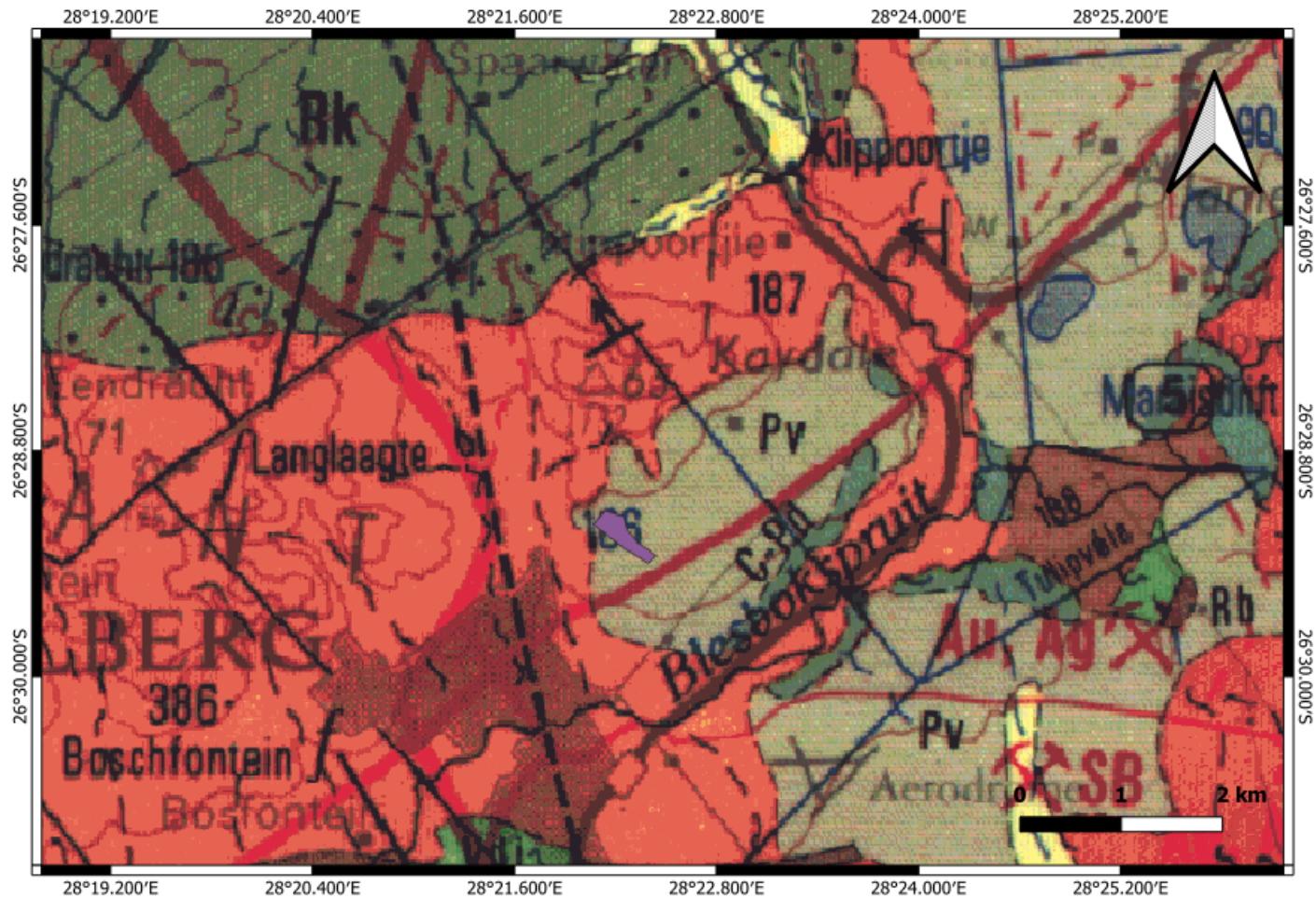
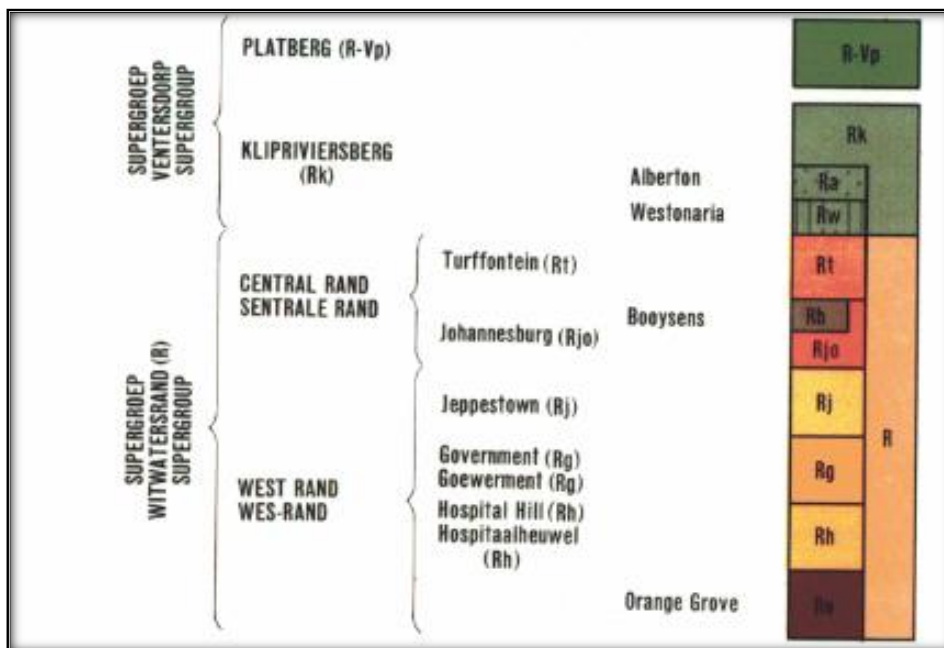
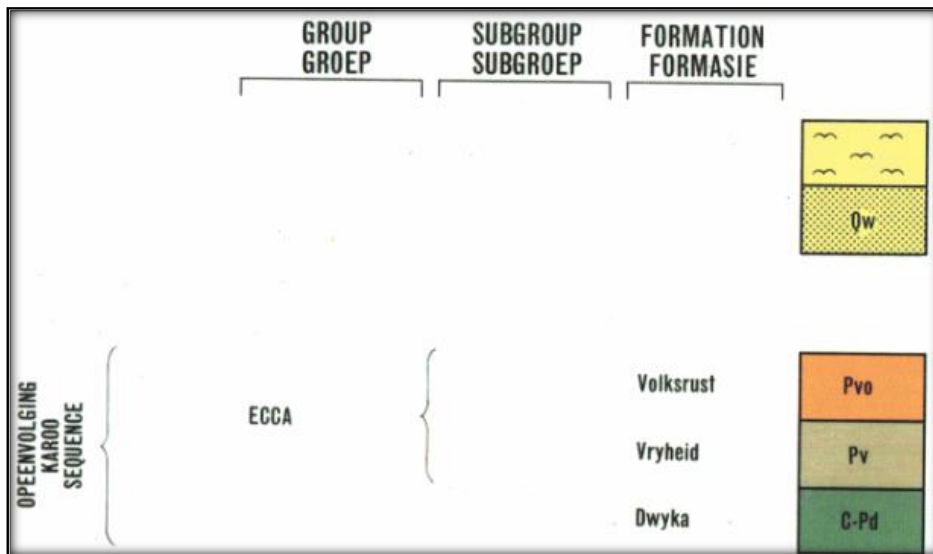


Figure 3: Extract of the 1:250 000 2628 East Rand Geological Map (1986) (Council of Geoscience, Pretoria) indicating the surface geology of the proposed development in purple. The development is underlain by the Vryheid Formation (Pv) of the Ecca Group (Karoo Supergroup).

Legend and short explanation of the 2628 East Rand Geological Map (1986) (Council of Geoscience, Pretoria)



Abbreviation	Group/Formation (Fm)	Lithology
Pv	Vryheid Formation; Ecca Group, Karoo Supergroup	Sandstone, shale, coal
Rt	Turffontein Fm, Central Rand Group, Witwatersrand Supergroup	Quartzite, conglomerate, sandy shale
Ra	Alberton Fm, Klipriviersberg, Ventersdorp Supergroup	Feldspar Porphyry
Rb	Booyens Fm	Shale
Rjo	Johannesburg Fm	Quartzite, conglomerate
Vdi	Diabase	

The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places). The Formation contains up to five (mineable) coal seams. The different lithofacies are mainly arranged in upward-coarsening deltaic cycles (up to 80m thick in the southeast). Fining-upward fluvial cycles, of which up to six are present in the east, are typically sheet-like in geometry, although some form valley-fill deposits. They comprise coarse-grained to pebbly, immature sandstones - with an abrupt upward transition into fine-grained sediments and coal seams (Hancox and Götz, 2014). This formation is known to contain a rich assemblage of Glossopteris flora which is the source vegetation for the Vryheid Formation. Gymnospermous glossopterids dominated the peat and non-peat accumulating of Permian wetlands after continental deglaciation took place (Falcon, 1986c, Greb et al., 2006).

Recent palaeobotanical studies in the Vryheid Formation include that of Adenforff (2005), Bordy and Prefect (2008) and Prefect et al. (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. Azaniodendron fertile, Cyclodendron leslii, Sphenophyllum hammanskraalensis, Annularia sp., Raniganjia sp., Asterotheca spp., Liknopetalon enigmata, Hirsutum sp., Scutum sp., Ottokaria sp., Estcourtia sp., Arberia sp., Lidgetonia sp., Noeggerathiopsis sp., Podocarpidites sp as well as more than 20 Glossopteris species.

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

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material is present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they are usually abundant. According to Bamford it is not feasible to preserve all the sites but in the

interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

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

Geological groups surrounding and underlying the proposed cemetery development includes the Ventersdorp Supergroup Alberton Formation as well as the Witwatersrand Supergroup (Turffontein and Johannesburg Subgroups of the Central Rand Group).

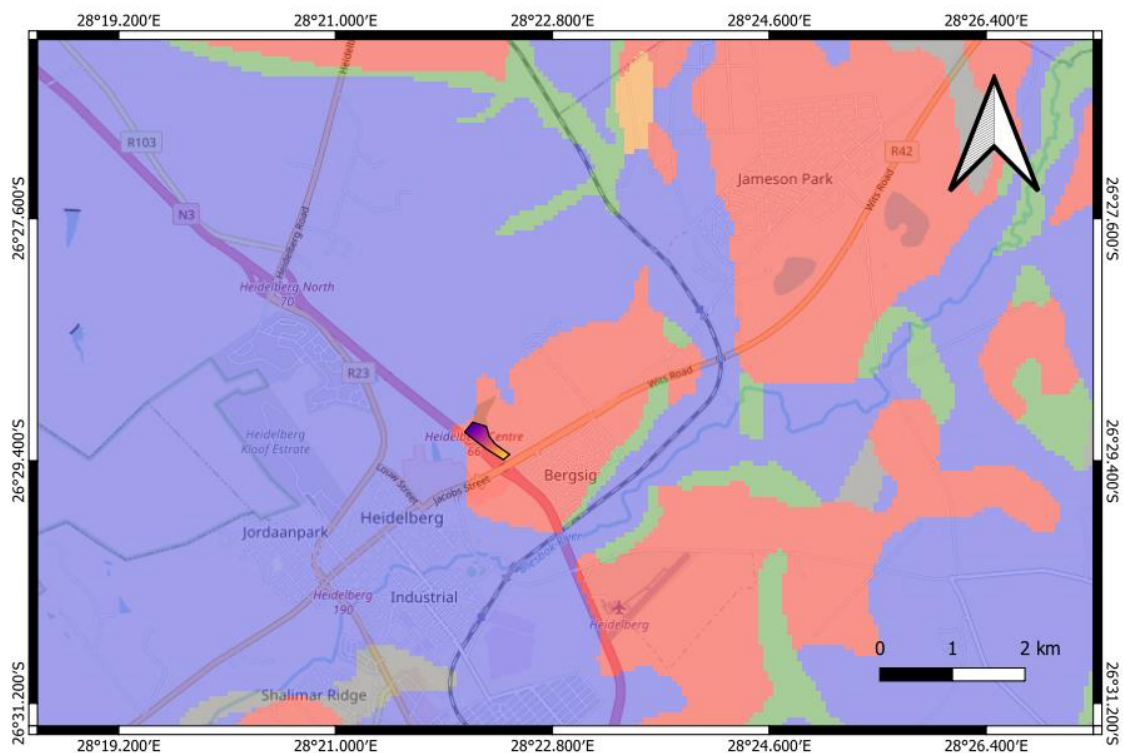


Figure 4: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences) indicating the proposed development in variegated colours.

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.

According to the SAHRIS Palaeo Sensitivity map (Figure 44) there is a Very High chance of finding fossils in the proposed development (red area). However, the Geotechnical Report conducted for this study indicated shallow sandstone bedrock in the northwestern section of the site. These areas are “unsuitable for cemetery development and should be avoided”. The rest of the site is underlain by bedrock overlain by residual and transported deposits. It is very unlikely that these sediments would contain fossils.

6 GEOGRAPHICAL LOCATION OF THE SITE

The proposed Heidelberg Cemetery Extension is situated on the Remainder of Portion 5 of the farm Langlaagte 186 IR in the Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province. The planned development is located on the north-eastern borders of Heidelberg. The development is on vacant land south of the existing cemetery and will provide additional burial capacity (Figure 1-2).

9

Study Area GPS Coordinates -	Northwest point: S 26.486553 E 28.367854	Northeast point: S 26.485833 E 28.370831
	Southwest point: S 26.489943 E 28.373195	Western point: S 26.489301 E 28.374052

7 METHODS

The aim of a desktop study is to evaluate the risk to palaeontological heritage in the proposed development. This includes 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.

7.1 Assumptions and Limitations

When conducting a PIA several factors can affect the accuracy of the assessment. 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 is used to provide information on the existence of fossils in an area which was not yet been documented. When similar Assemblage Zones and geological formations for Desktop studies is used it is generally **assumed** that exposed fossil heritage is present within the footprint.

8 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)
- 1: 250 000 2628 East Rand Geological Map (1986) (Council of Geoscience, Pretoria)
- A Google Earth map with polygons of the proposed development was obtained from PGS Consultants.
- Geotechnical report and associated literature (See Section 1)

9 IMPACT ASSESSMENT METHODOLOGY

9.1 IMPACT ASSESSMENTS

An assessment of the impact significance of the proposed Heidelberg Municipal Cemetery extension, Lesedi Local Municipality, Sedibeng District Municipality, Gauteng Province are resented here:

9.1.1 Nature of the impact

The excavations and site clearance of the Heidelberg Municipal Cemetery extension will involve extensive excavations into the superficial sediment cover (approximately 1.8m). These excavations

will change the existing topography and may destroy and seal-in fossils at or below the ground surface. These fossils will then no longer be available for research.

9.1.2 Sensitive areas

The development footprint is underlain by the Vryheid Formation of the Ecca Group. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website).

9.1.3 Geographical extent of impact

The impact on fossil heritage will be restricted to the excavation phase when new excavations into the overlying sediments take place. The extent of the area of potential impact is thus restricted to the project site and therefore categorised as **the proposed site (1)**.

9.1.4 Duration of impact

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (if fossils are present in the development) the damage or destruction of any palaeontological materials will be **permanent (4)**.

9.1.5 Potential significance of the impact

If the project proceeds without care that fossils could be present in the proposed development the damage to any fossils will be **permanent and irreversible**. Fossils occurring in the development are potentially culturally and scientifically significant and any negative impact on them would be of **high significance**.

9.1.6 Severity / benefit scale

The development will be **beneficial** locally.

A **secondary advantage** of the construction of the project would be that fossils could be uncovered during excavations and made available for scientific research.

9.1.7 Probability of the impact occurring

Although the Palaeontological Sensitivity are very high the probability of significant impacts on fossil heritage during the construction phase are low (graves may not be dug into bedrock).

9.1.8 Damage mitigation, reversal and potential irreversible loss

If fossil material is present in the proposed footprint any negative impact may be mitigated by collecting and description of well-preserved fossils. These actions should take place after vegetation clearance but before the ground is levelled for construction. Excavation of fossil heritage will require a permit from SAHRA, and the material must be housed in a permitted institution.

9.1.9 Degree to which the impact can be mitigated

Mitigation of the damage and destruction of fossil heritage within the planned footprint would entail the collection and describing of fossils. These actions would take place after initial vegetation clearance but before the ground is levelled for construction.

9.1.10 Degree of irreversible loss

Impacts on fossil heritage are irreversible. A positive impact could be brought about by well-documented records and palaeontological studies of any fossils exposed during construction while negative impacts can be limited the application of adequate damage mitigation procedures. If damage mitigation is properly undertaken the impact may be regarded as beneficial.

9.1.11 Degree to which the impact may cause irreplaceable loss of Resources

Stratigraphic and geographical dispersal of fossils in the Vryheid Formation is likely to be of high palaeontological sensitivity, but as the graves will only be dug in superficial deposits not deeper than 1.8m the irreplaceable loss of Resources will be unlikely (2).

9.2 Introduction

PLEASE NOTE:

The impact significance rating process serves two purposes: firstly, it helps to highlight the critical impacts requiring consideration in the management and approval process; secondly, it shows the primary impact characteristics, as defined above, used to evaluate impact significance.

The impacts will be ranked according to the methodology described below. Where possible, mitigation measures will be provided to manage impacts. In order to ensure uniformity, a standard impact assessment methodology will be utilised so that a wide range of impacts can be compared with each other. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

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

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

Table 4: Quantitative rating and equivalent descriptors for the impact assessment criteria

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	Proposed site	Incidental
2	LOW	Study area	Short-term
3	MODERATE	Local	Medium/High-term
4	HIGH	Regional / Provincial	Long-term
5	VERY HIGH	Global / National	Permanent

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

9.3 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1 000 km²) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given below.

Table 5: Description of the significance rating scale

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

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

9.4 Spatial Scale

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

Table 6: Description of the significance rating scale

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible and will be felt at a regional scale (District Municipality to Provincial Level).
3	Local	The impact will affect an area up to 10 km from the proposed site.
2	Study Site	The impact will affect an area not exceeding the property.
1	Proposed site	The impact will affect an area no bigger than the ash disposal site.

9.5 Duration Scale

In order to accurately describe the impact, it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in **Table 7**.

Table 7: Description of the temporal rating scale

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

9.6 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in **Table 8** below.

Table 8: Description of the degree of probability of an impact occurring.

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

9.7 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard “degree of certainty” scale is used as discussed in **Table 9**. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 9: Description of the degree of certainty rating scale

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.

Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.
Don't know	The consultant cannot, or is unwilling, to make an assessment given available information.

9.8 Quantitative Description of Impacts

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

$$\text{Impact Risk} = \frac{(\text{SIGNIFICANCE (5)} + \text{Spatial (2)} + \text{Temporal(5)}) \times \text{Probability(4)}}{5}$$

5

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

Table 10: Example of Rating Scale

Impact	Significance	Spatial Scale	Temporal Scale	Probability	Rating
	Very High	Site	Permanent	Very likely	
Impact	5	2	5	4	3.2

Note: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (4) is divided by 5 to give a probability rating of 0,8. The criteria rating of 4 is then multiplied by the probability rating (0,8) to give the final rating of 3.2.

The impact risk is classified according to five classes as described below.

Table 11: Impact Risk Classes

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

Therefore, with reference to the example above, an impact rating of 3.2 will fall in the **Impact Class 4**, which will be considered to be a **high impact**.

9.9 Impact Assessment Table

Table 12: Impact ratings for the proposed development

IMPACT	IMPACT DIRECTION	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
Pre-Mitigation	Negative	Very High (5)	Study site (2)	Permanent (5)	Unlikely (2)	1.6 Low
Post Mitigation	Neutral	Very High (5)	Study site (2)	Permanent (5)	Practically impossible (1)	0.8 Very Low

Note:

Pre-Mitigation: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (2) is divided by 5 to give a probability rating of 0,4. The criteria rating of 4 is then multiplied by the probability rating (0,4) to give the final rating of 1.6. An impact rating of 1.6 will fall in the **Impact Class 2**, which will be considered to be a **Low** Significance.

Post-Mitigation: The significance, spatial and temporal scales are added to give a total of 12, that is divided by 3 to give a criteria rating of 4. The probability (1) is divided by 5 to give a probability rating of 0,2. The criteria rating of 4 is then multiplied by the probability rating (0,2) to give the final rating of 0.8.

An impact rating of 0.8 will fall in the **Impact Class 1**, which will be considered to be a **Very Low** Significance.

9.10 SUMMARY OF IMPACT TABLES

Only the site will be affected by the proposed development. The proposed development will have a negative impact on Fossil Heritage. The expected duration of the impact is assessed as potentially permanent to long term. The impact could occur. The impact occurring will be Low pre-mitigation and Very Low post-mitigation. As fossil heritage will be destroyed the impact is irreversible. The impact on fossil heritage will be moderate pre-mitigation and very low post-mitigation.

10 FINDINGS AND RECOMMENDATIONS

The proposed development is underlain by the Vryheid Formation (Ecca Group, Karoo Supergroup). According to the PalaeoMap on the South African Heritage Resources Information System (SAHRIS) database, the Palaeontological Sensitivity of the Vryheid Formation is Very High (Almond and Pether 2008, SAHRIS website). The Geotechnical Report conducted for this study indicated that shallow sandstone bedrock was observed in the northwestern section of the site. These areas are “unsuitable for cemetery development and should be avoided”. The rest of the site is underlain by bedrock overlain by residual and transported deposits. It is very unlikely that these sediments would contain fossils. An overall Very Low has been allocated to the proposed development post-mitigation and it is thus considered that the proposed Heidelberg cemetery project will not lead to detrimental impacts on the palaeontological resources of the area. The development of the development may thus be authorised as the development footprint is not considered sensitive in terms of palaeontological resources.

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

11 CHANCE FINDS PROTOCOL

This protocol for finds will only be followed if fossils are uncovered during the process of digging/excavation of a grave.

11.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage

resources include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

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

11.2 Background

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

11.3 Introduction

This informational document is intended for workmen on the cemetery site. It describes the actions to be taken when digging a grave accidentally uncovers fossil material.

It is the responsibility of the site manager 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 site manager, 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.

11.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work that could impact that finding 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 ESO or site manager. The ESO or site manager 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 coordinates.
- 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.

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MEMBERSHIP

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EMPLOYMENT HISTORY

Part time Laboratory assistant Department of Zoology & Entomology
University of the Free State Zoology
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Part time laboratory assistant Department of Virology
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Research Assistant National Museum, Bloemfontein 1993 –
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Principal Research Assistant National Museum, Bloemfontein
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TECHNICAL REPORTS

Butler, E. 2014. Palaeontological Impact Assessment of the proposed development of private dwellings on portion 5 of farm 304 Matjesfontein Keurboomstrand, Knysna District, Western Cape Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Impact Assessment of the proposed consolidation of the proposed Ilima Colliery in the Albert Luthuli local municipality, Gert Sibande District Municipality, Mpumalanga Province. Bloemfontein.

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Butler, E. 2017. Palaeontological Desktop Assessment of the proposed construction of a filling station and associated facilities on the Erf 6279, district municipality of John Taolo Gaetsewe District, Ga-Segonyana Local Municipality Northern Cape. Bloemfontein.

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Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the Sandriver Canal and Klippan Pump station in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed upgrade of the 132kv and 11kv power line into a dual circuit above ground power line feeding into the Urania substation in Welkom, Free State Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment of the proposed Swaziland-Mozambique border patrol road and Mozambique barrier structure. Bloemfontein.

Butler, E. 2017. Palaeontological Impact Assessment of the proposed diamonds alluvial & diamonds general prospecting right application near Christiana on the remaining extent of portion 1 of the farm Kaffraria 314, registration division HO, North West Province. Bloemfontein.

Butler, E. 2017. Palaeontological Desktop Assessment for the proposed development of Wastewater Treatment Works on Hartebeesfontein, near Panbult, Mpumalanga. Bloemfontein.

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Butler, E. 2018. Palaeontological Impact Assessment for the Proposed Landfill Site in Luckhoff, Letsemeng Local Municipality, Xhariep District, Free State. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed development of the new Mutsho coal-fired power plant and associated infrastructure near Makhado, Limpopo Province. Bloemfontein.

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Butler, E. 2018. Palaeontological Desktop Assessment for the proposed Mashishing township establishment in Mashishing (Lydenburg), Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment for the Proposed Mlonzi Estate Development near Lusikisiki, Ngquza Hill Local Municipality, Eastern Cape. Bloemfontein.

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Butler, E. 2018. Palaeontological Desktop Assessment for the proposed electricity expansion project and Sekgame Switching Station at the Sishen Mine, Northern Cape Province. Bloemfontein.

Butler, E. 2018. Palaeontological field assessment of the proposed construction of the Zonnebloem Switching Station (132/22kV) and two loop-in loop-out power lines (132kV) in the Mpumalanga Province. Bloemfontein.

Butler, E. 2018. Palaeontological Field Assessment for the proposed re-alignment and decommissioning of the Firham-Platrand 88kv Powerline, near Standerton, Lekwa Local Municipality, Mpumalanga province. Bloemfontein.

Butler, E. 2018. Palaeontological Desktop Assessment of the proposed Villa Rosa development In the Buffalo City Metropolitan Municipality, East London. Bloemfontein.

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Butler, E. 2018. Palaeontological desktop assessment of the proposed Mookodi – Mahikeng 400kV line, North West Province. Bloemfontein.

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Portion 1 of the Farm Kaffraria 314, Registration Division HO, North West Province. Bloemfontein.

Butler, E. 2018. Palaeontological Impact Assessment of the proposed construction of a new 11kV (1.3km) Power Line to supply electricity to a cell tower on farm 215 near Delportshoop in the Northern Cape. Bloemfontein.

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Butler, E. 2018. Proposed Kalabasfontein Mine Extension project, near Bethal, Govan Mbeki District Municipality, Mpumalanga. Bloemfontein.

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- E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed Waste Rock Dump Project at Tshipi Borwa Mine, near Hotazel, Northern Cape Province:
- E. Butler. 2019.** Palaeontological Exemption Letter for the proposed DMS Upgrade Project at the Sishen Mine, Gamagara Local Municipality, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Integrated Environmental Authorisation process for the proposed Der Brochen Amendment project, near Groblershoop, Limpopo
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed updated Environmental Management Programme (EMPr) for the Assmang (Pty) Ltd Black Rock Mining Operations, Hotazel, Northern Cape
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Kriel Power Station Lime Plant Upgrade, Mpumalanga Province
- E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Kangala Extension Project Near Delmas, Mpumalanga Province.
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed construction of an iron/steel smelter at the Botshabelo Industrial area within the Mangaung Metropolitan Municipality, Free State Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological studies for the proposed agricultural development on farms 1763, 2372 and 2363, Kakamas South settlement, Kai! Garib Municipality, Mgcauw District Municipality, Northern Cape Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for Proposed formalisation of Gamakor and Noodkamp low cost Housing Development, Keimoes, Gordonia Rd, Kai !Garib Local Municipality, ZF Mgcauw District Municipality, Northern Cape Province.
- E. Butler. 2019.** Recommended Exemption from further Palaeontological Studies for proposed formalisation of Blaauwskop Low Cost Housing Development, Kenhardt Road, Kai !Garib Local Municipality, ZF Mgcauw District Municipality, Northern Cape Province.
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed mining permit application for the removal of diamonds alluvial and diamonds kimberlite near Windsorton on a certain portion of Farm Zoelen's Laagte 158, Registration Division: Barkly Wes, Northern Cape Province.
- E. Butler. 2019.** Palaeontological Desktop Assessment of the proposed Vedanta Housing Development, Pella Mission 39, Khâi-Ma Local Municipality, Namakwa District Municipality, Northern Cape.
- E. Butler. 2019.** Palaeontological Desktop Assessment for The Proposed 920 Kwp Groenheuwel Solar Plant Near Augrabies, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment for the establishment of a Super Fines Storage Facility at Amandelbult Mine, Near Thabazimbi, Limpopo Province

- E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Sace Lifex Project, Near Emalahleni, Mpumalanga Province
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Rehau Fort Jackson Warehouse Extension, East London
- E. Butler. 2019.** Palaeontological Desktop Assessment for the proposed Environmental Authorisation Amendment for moving 3 Km Of the Merensky-Kameni 132KV Powerline
- E. Butler. 2019.** Palaeontological Impact Assessment for the proposed Umsobomvu Solar PV Energy Facilities, Northern and Eastern Cape
- E. Butler. 2019.** Palaeontological Desktop Assessment for six proposed Black Mountain Mining Prospecting Right Applications, without Bulk Sampling, in the Northern Cape.
- E. Butler. 2019.** Palaeontological field Assessment of the Filling Station (Rietvlei Extension 6) on the Remaining Portion of Portion 1 of the Farm Witkoppies 393JR east of the Rietvleidam Nature Reserve, City of Tshwane, Gauteng
- E. Butler. 2019.** Palaeontological Desktop Assessment Of The Proposed Upgrade Of The Vaal Gamagara Regional Water Supply Scheme: Phase 2 And Groundwater Abstraction
- E. Butler. 2019.** Palaeontological Desktop Assessment Of The Expansion Of The Jan Kempdorp Cemetry On Portion 43 Of Farm Guldenskat 36-Hn, Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Residential Development On Portion 42 Of Farm Geldunskat No 36 In Jan Kempdorp, Phokwane Local Municipality, Northern Cape Province
- E. Butler. 2019.** Palaeontological Impact Assessment of the proposed new Township Development, Lethabo Park, on Remainder of Farm Roodepan No 70, Erf 17725 And Erf 15089, Roodepan Kimberley, Sol Plaatjies Local Municipality, Frances Baard District Municipality, Northern Cape
- E. Butler. 2019.** Palaeontological Protocol for Finds for the proposed 16m WH Battery Storage System in Steinkopf, Northern Cape Province
- E. Butler. 2019.** Palaeontological Exemption Letter of the proposed 4.5WH Battery Storage System near Midway-Pofadder, Northern Cape Province
- E. Butler. 2019.** Palaeontological Exemption Letter of the proposed 2.5ml Process Water Reservoir at Gloria Mine, Black Rock, Hotazel, Northern Cape
- E. Butler. 2019.** Palaeontological Desktop Assessment for the Establishment of a Super Fines Storage Facility at Gloria Mine, Black Rock Mine Operations, Hotazel, Northern Cape:
- E. Butler. 2019.** Palaeontological Desktop Assessment for the Proposed New Railway Bridge, and Rail Line Between Hotazel And The Gloria Mine, Northern Cape Province
- E. Butler. 2019.** Palaeontological Exemption Letter Of The Proposed Mixed Use Commercial Development On Portion 17 Of Farm Boegoeberg Settlement Number 48, !Kheis Local Municipality In The Northern Cape Province
- E. Butler. 2019.** Palaeontological Desktop Assessment of the Proposed Diamond Mining Permit Application Near Kimberley, Sol Plaatjies Municipality, Northern Cape Province

- E. Butler.** 2019. Palaeontological Desktop Assessment of the Proposed Diamonds (Alluvial, General & In Kimberlite) Prospecting Right Application near Postmasburg, Registration Division; Hay, Northern Cape Province
- E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed diamonds (alluvial, general & in kimberlite) prospecting right application near Kimberley, Northern Cape Province.
- E. Butler.** 2019. Palaeontological Phase 1 Impact Assessment of the proposed upgrade of the Vaal Gamagara regional water supply scheme: Phase 2 and groundwater abstraction
- E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed seepage interception drains at Duvha Power Station, Emalahleni Municipality, Mpumalanga Province
- E. Butler.** 2019. Palaeontological Desktop Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
- E. Butler.** 2019. Palaeontological Phase 1 Assessment letter for the Proposed PV Solar Facility at the Heineken Sedibeng Brewery, near Vereeniging, Gauteng.
- E. Butler.** 2019. Palaeontological field Assessment for the Proposed Upgrade of the Kolomela Mining Operations, Tsantsabane Local Municipality, Siyanda District Municipality, Northern Cape Province, Northern Cape
- E. Butler.** 2019. Palaeontological Desktop Assessment of the proposed feldspar prospecting rights and mining application on portion 4 and 5 of the farm Rozynen 104, Kakamas South, Kail Garib Municipality, Zf Mgcau District Municipality, Northern Cape
- E. Butler.** 2019. Palaeontological Phase 1 Field Assessment of the proposed Summerpride Residential Development and Associated Infrastructure on Erf 107, Buffalo City Municipality, East London.
- E. Butler.** 2019. Palaeontological Desktop Impact Assessment for the proposed re-commission of the Old Balgray Colliery near Dundee, Kwazulu Natal.
- E. Butler.** 2019. Palaeontological Phase 1 Impact Assessment for the Proposed Re-Commission of the Old Balgray Colliery near Dundee, Kwazulu Natal.
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery.
- E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a Proposed New Quarry on Portion 9 (of 6) of the farm Mimosa Glen 885, Bloemfontein, Free State Province
- E. Butler.** 2019. Palaeontological Impact Assessment and Protocol for Finds of a proposed development on Portion 9 and 10 of the Farm Mimosa Glen 885, Bloemfontein, Free State Province
- E. Butler.** 2019. Palaeontological Exemption Letter for the proposed residential development on the Remainder of Portion 1 of the Farm Strathearn 2154 in the Magisterial District of Bloemfontein, Free State
- E. Butler.** 2019. Palaeontological Field Assessment for the Proposed Nigel Gas Transmission Pipeline Project in the Nigel Area of the Ekurhuleni Metropolitan Municipality, Gauteng Province

- E. Butler.** 2019. Palaeontological Desktop Assessment for five Proposed Black Mountain Mining Prospecting Right Applications, Without Bulk Sampling, in the Northern Cape.
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Environmental Authorisation and an Integrated Water Use Licence Application for the Reclamation of the Marievale Tailings Storage Facilities, Ekurhuleni Metropolitan Municipality - Gauteng Province.
- E. Butler.** 2019. Palaeontological Impact Assessment for the Proposed Sace Lifex Project, near Emalaheni, Mpumalanga Province.
- E. Butler.** 2019. Palaeontological Desktop Assessment for the proposed Golfview Colliery near Ermelo, Msukaligwa Local Municipality, Mpumalanga Province
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Kangra Maquasa Block C Mining development near Piet Retief, in the Mkhondo Local Municipality within the Gert Sibande District Municipality
- E. Butler.** 2019. Palaeontological Desktop Assessment for the Proposed Amendment of the Kusipongo Underground and Opencast Coal Mine in Support of an Environmental Authorization and Waste Management License Application.
- E. Butler.** 2019. Palaeontological Exemption Letter of the Proposed Mamatwan Mine Section 24g Rectification Application, near Hotazel, Northern Cape Province
- E. Butler.** 2020. Palaeontological Field Assessment for the Proposed Environmental Authorisation and Amendment Processes for Elandsfontein Colliery
- E. Butler.** 2020. Palaeontological Desktop Assessment for the Proposed Extension of the South African Nuclear Energy Corporation (Necsa) Pipe Storage Facility, Madibeng Local Municipality, North West Province
- E. Butler.** 2020. Palaeontological Field Assessment for the Proposed Piggery on Portion 46 of the Farm Brakkefontien 416, Within the Nelson Mandela Bay Municipality, Eastern Cape
- E. Butler.** 2020. Palaeontological field Assessment for the proposed Rietfontein Housing Project as part of the Rapid Land Release Programme, Gauteng Province Department of Human Settlements, City of Johannesburg Metropolitan Municipality
- E. Butler.** 2020. Palaeontological Desktop Assessment for the Proposed Choje Wind Farm between Grahamstown and Somerset East, Eastern Cape
- E. Butler.** 2020. Palaeontological Desktop Assessment of the Proposed Prospecting Right Application for the Prospecting of Diamonds (Alluvial, General & In Kimberlite), Combined with A Waste License Application, Registration Division: Gordonias And Kenhardt, Northern Cape Province
- E. Butler.** 2020. Palaeontological Impact Assessment for the Proposed Clayville Truck Yard, Ablution Blocks and Wash Bay to be Situated on Portion 55 And 56 Of Erf 1015, Clayville X11, Ekurhuleni Metropolitan Municipality, Gauteng Province
- E. Butler.** 2020. Palaeontological Desktop Assessment for the Proposed Hartebeesthoek Residential Development

E. Butler. 2020. Palaeontological Desktop Assessment for the Proposed Mooiplaats Educational Facility, Gauteng Province

E. Butler. 2020. Palaeontological Impact Assessment for the Proposed Monument Park Student Housing Establishment

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Standerton X10 Residential and Mixed-Use Developments, Lekwa Local Municipality Standerton, Mpumalanga Province

E. Butler. 2020. Palaeontological Field Assessment for the Rezoning and Subdivision of Portion 6 Of Farm 743, East London

E. Butler. 2020. Palaeontological Field Assessment for the Proposed Matla Power Station Reverse Osmosis Plant, Mpumalanga Province.