Proposed upgrading of the 66 kV network to a 132 kV network in the Hotazel, Kuruman and Kathu area

Ga-Segonyana -, Joe Morolong - and Gamagara Local Municipalities, John Taolo Gaetsewe District Municipality, Northern Cape Province

Farm: Existing servitude

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Palaeontological Impact Assessment: Phase 1: Field Study

Facilitated by: Zitholele Consulting

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Tel: 011 207 2060

2018/03/22

Ref: DEA 14/12/16/3/3/1/1367

B. Executive summary

Outline of the development project: Zitholele Consulting has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Paleontological Impact Assessment (PIA), Phase 1: Field Study of the suitability of the Proposed upgrading of the 66 kV network to a 132 kV network in the Hotazel, Kuruman and Kathu area, Ga-Segonyana -, Joe Morolong – and Gamagara Local Municipalities, in the John Taolo Gaetsewe District Municipality, Northern Cape Province.

The applicant, Eskom Holdings SOC Limited proposes to upgrade the 66 kV line to a 132 kV power line in the existing servitude.

The Project includes several Alternatives (see Figure 1):
Up to four Alternatives were considered for each section and the Preferred Alternatives between substations are:
Alternative 1: Pink line.
Alternative 3: Orange line.
Alternative 4: Blue line.
Alternatives have already been granted authorisation. There are six Substations planned of which two will be new and four will be extended adjacent to its present locality or upgraded.

Legal requirements:-

The **National Heritage Resources Act (Act No. 25 of 1999) (NHRA)** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

"palaeontological" means 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 traces.

For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

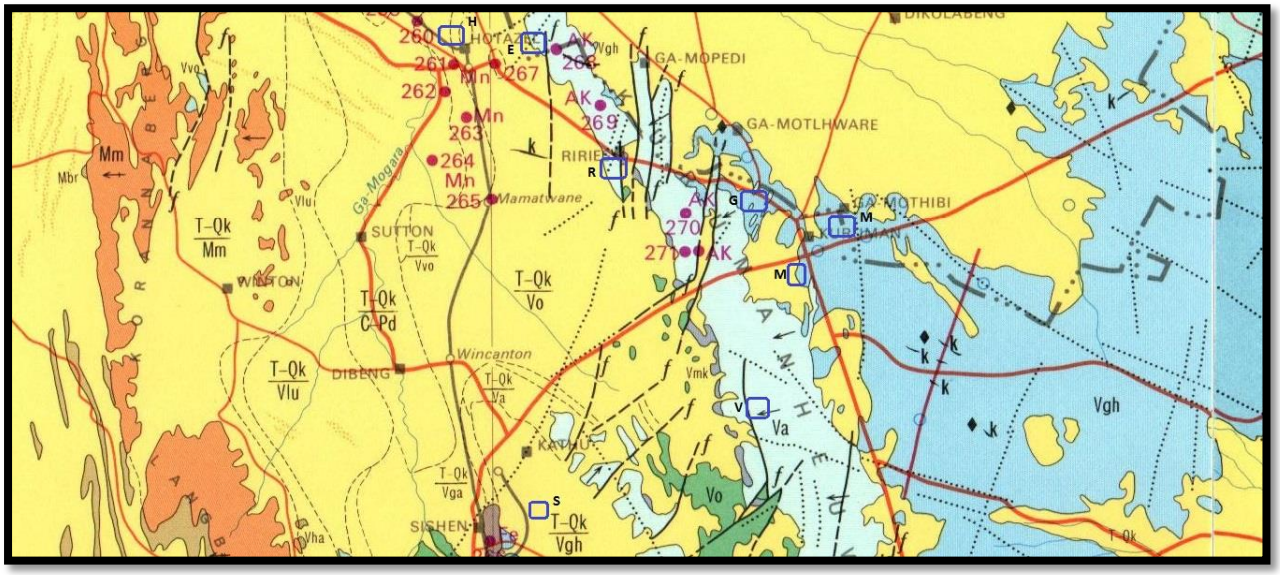
A Palaeontological Impact Assessment is generally warranted where rock units of LOW to VERY HIGH palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):
(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999).
Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m² in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:
The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984).

Figure 3: The geology of the development area.



Legend to Map and short explanation.
T-Qk/Vo – Sand, limestone (yellow). Kalahari Group with a sub outcrop of Vo below.
Vmk – Diamictite, jaspilite, sandstone (dark purple). Makganyeni Formation, Griqualand West Basin, Transvaal Supergroup.
Va – Jaspilite (light blue). Asbestos Hills (Iron Formation), Griquatown Group, Griqualand West Basin, Transvaal Supergroup.
Vgh – Dolomite, limestone, chert (blue). Ghaap Plateau Formation, Campbell Group, Griqualand West Basin, Transvaal Supergroup.
Vo – Andesite (green). Ongeluk Formation, Cox Group, Griqualand West Basin, Transvaal Supergroup.
---f--- – (black) Fault.
……. – Lineament.

□ – Approximate position of Substations with letters indicating which one.

Mining Activities

AK – Crocodolite Fe – Iron Mn – Manganese.

Summary of findings: The Palaeontological Impact Assessment: Phase 1: Field Study was undertaken in March 2018 in the summer in wet and hot conditions (Appendix 6 of Act, 1(d)), and the following is reported:

The development is taking place on the Kalahari Group (T-Qk) with underlying Griqualand West Basin rocks, Transvaal Supergroup of Vaalian age.

The Kalahari deposits extend in age down to at least the Late and probably the Early Tertiary (65 million years ago). Fossils are scarce, and are of terrestrial plants and animals with close affinity to living forms. Included in the Kalahari Group are the Quaternary alluvium, terrace gravels, surface limestone, silcrete, and aeolian sand. Four major types of sands have been delineated (Kent 1980).

The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). A thick cover of Kalahari reddish sand blankets most outcrops and is dominated by the typical Kalahari thornveld (Norman and Whitfield 2006). The Kalahari Group is underlain by the Uitenhage and Zululand Groups (McCarthy and Rubidge 2005).

The Griqualand West Basin, Transvaal Supergroup consists mainly of sediments of chemical origin together with lavas and subordinate clastic sediments. The basal unit, the Vryburg Formation lies unconformably on the granite and rocks of the Ventersdorp Supergroup. It is followed by the Campbell Group which consists of the Schmidtsdrif Formation and the upper Ghaap Plateau Formation. There are also two formations in the Griquatown Group, namely, the Asbestos Hills and Koegas Formations. The Gamagara Formation follows and is located on the Maremane Anticline, it is overlain by the Makganyene Formation. The Cox Group consists of the lower Ongeluk Formation and the upper Voëlwater Formation. It attains a maximum thickness of 4500 m (Kent 1980, Snyman 1996).

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, the palaeontological sensitivity can generally be LOW to VERY HIGH, and here locally **HIGH** for the Kalahari Group and **MODERATE** for the Griqualand West rocks (SG 2.2 SAHRA APMHOB, 2012) (Groenewald and Groenewald 2014).

Recommendation:

The impact of the development on fossil heritage is **HIGH and MODERATE** and therefore a field survey or further mitigation or conservation measures were necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment was done. Fossils were not found during the walk through.

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Kalahari Group	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Griqualand West Basin	Moderate	Desktop study is required

The Kalahari Group is present here in the development area. Groenewald & Groenewald (2014) rates this Group as having a high palaeontological significance due to the significant fossil remains of Cenozoic aged terrestrial organisms that have been recorded from the sedimentary rocks. These fossils are important indicators of palaeo-environmental conditions. Therefore a **HIGH** status is allocated.

The Project includes several Alternatives (see Figure 1):
Up to four Alternatives were considered for each section and the Preferred Alternatives between substations are:
Alternative 1: Pink line.
Alternative 3: Orange line.
Alternative 4: Blue line.
Alternatives have already been granted authorisation. There are six Substations planned of which two will be new and four will be extended adjacent to its present locality or upgraded.

Concerns/threats to be added to the EMPr (1g,1ni,1nii,1o,1p):

1. The overburden and inter-burden must always be surveyed for fossils. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.
2. Threats are earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic and human disturbance.

The recommendations are:

1. Mitigation is needed if fossils are found, permission needed from SAHRA.
2. No consultation with parties was necessary.
3. The development may go ahead with caution, but the ECO must survey for fossils before or after blasting or excavating in line with the legally binding Environmental Management Programme (EMPr) this must be updated to include the involvement of a palaeontologist/ archaeozoologist when necessary.
4. The EMPr already covers the conservation of heritage and palaeontological artefacts that may be exposed during construction activities. The protocol is to immediately cease all construction activities if a fossil is unearthed and contact SAHRA for further investigation. It is recommended that the EMPr be updated to include the involvement (pre-construction training of ECO) of a palaeontologist/archaeozoologist during the digging and excavation phase of the development and ECO to visit site bi-weekly during construction and keep a photographic record.
5. Care must be taken during the dolomite risk assessment according to SANS 1936-1 (2012) as stromatolites may be present.
6. Authorisation has already been granted in 2015 and construction has begun.

Stakeholders: Developer – Eskom Holdings SOC Limited, Northern Cape Operating Unit, 4 George Street, Kimberley, 8301.
Environmental – Zitholele Consulting, P.O. Box 6002, Halfway House, 1685, Tel. 011 207 2060.
Landowner – Several.

C. Table of Contents

D. Background information on the project

Report

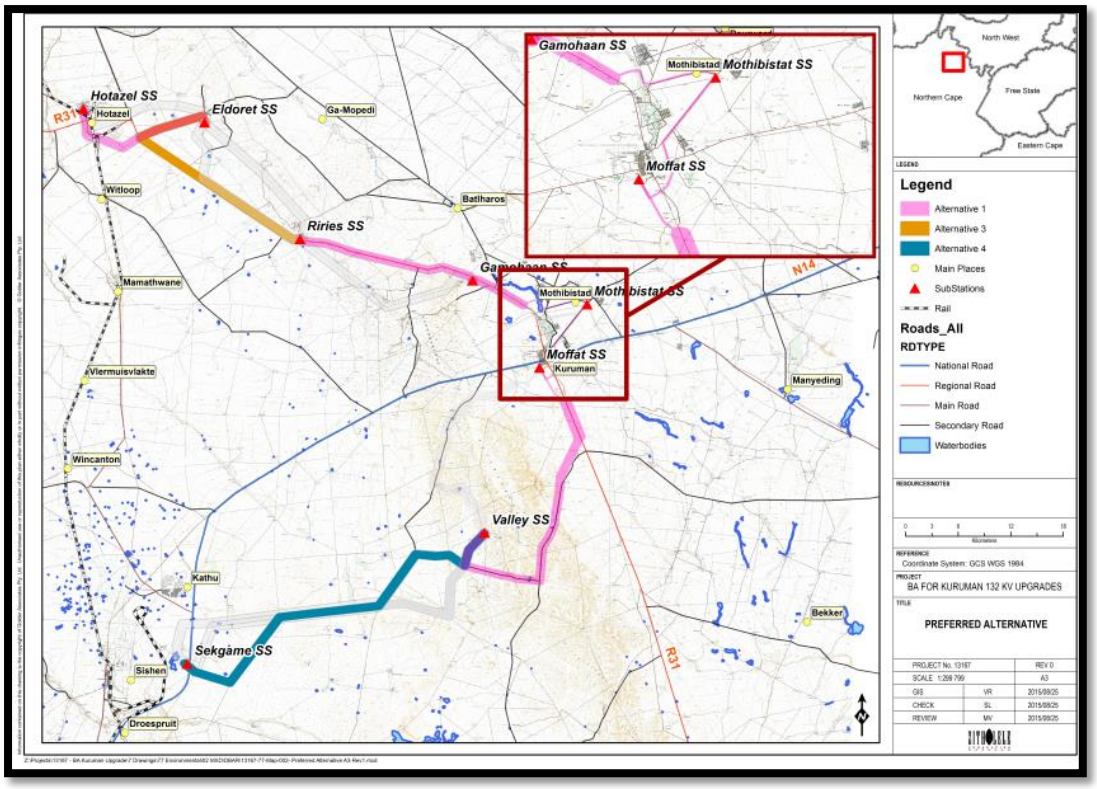
This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R38282 of 4 December 2014) of the Environmental Impact Assessment Regulations (see Appendix 1).

Outline of development

This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase it is necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA).

The applicant, Eskom Holdings SOC Limited proposes to upgrade the existing line to strengthen the national grid in the Northern Cape and also to provide a ring feed to reduce power outages for the region when there is an outage on a section of the line.

Figure 1: Topographic map showing location (Zitholele).



The following infrastructure is anticipated:

1. Road,
2. 314 Pylons, towers, etc. 200-300 m apart,
3. Fencing and gates,
4. New Substations,
5. And associated infrastructure such as electricity lines.

The Project includes several Alternatives (see Figure 1):
Up to four Alternatives were considered for each section and the Preferred Alternatives between substations are:
Alternative 1: Pink line.
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Alternative 4: Blue line.
Alternatives have already been granted authorisation. There are six Substations planned of which two will be new and four will be extended adjacent to its present locality or upgraded.

Rezoning/ and or subdivision of land: No, existing servitudes will be used.
Name of Developer and Consultant: Eskom Holdings SOC Limited and Zitholele Consulting.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a palaeontological impact assessment to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.
Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research (now ESI), University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. For the past twelve years she carried out field work in the Eastern Cape, Limpopo, Mpumalanga, Gauteng and Free State Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 23 years.

Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act (Act No. 25 of 1999). An electronic copy of this report must be supplied to SAHRA.

E. Description of property or affected environment

Location and depth:

The proposed upgrade of the 66 kV network to a 132 kV network in the Hotazel, Kuruman and Kathu area, will be situated on existing servitudes in the Ga-Segonyana -, Joe Morolong – and Gamagara Local Municipalities, in the John Taolo Gaetsewe District Municipality, Northern Cape Province.

Depth is determined by the related infrastructure such as the foundations. Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot. Geological maps do not provide depth or superficial cover, it only provides mapable surface outcrops. The Kalahari Group reaches thicknesses of 280 m.

In the Gamohaan – Mothibestad region, the Kalahari gravels reach depths of 0.00-3.30 m, with the aeolian sands a depth of 0.00-3.00 m, the Pedogenic soils reach depths of 0.00-1.50 m and contain calcretes, and the dolomites can be found at a depth of 2.00 m. In the Hotazel to Eldoret region the Dune soils reach depths of 0.00-3.30 m with the Kalahari sands a depth of 0.00-1.12 m, with the calcrete at 0.00-1.70m and residual dolomite is present.

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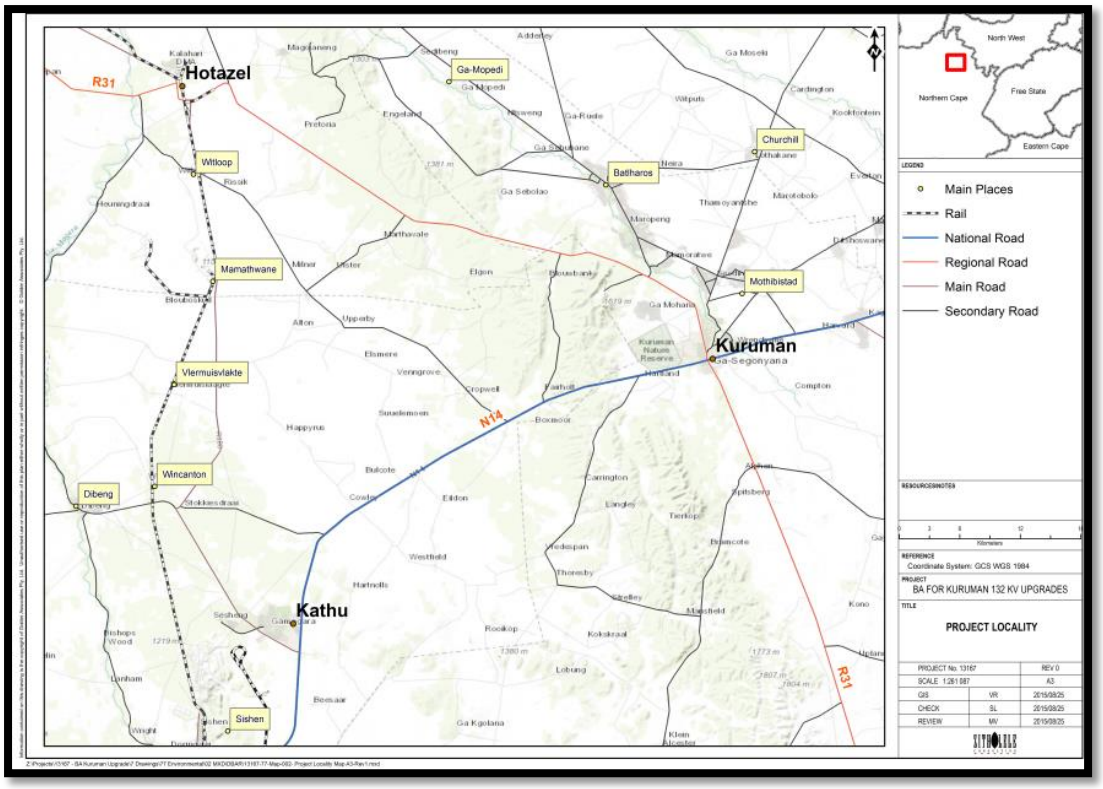
Alternatives have already been granted authorisation. There are six Substations planned of which two will be new and four will be extended adjacent to its present locality or upgraded.

Figure 2: Location map of development area (Zitholele).



The site is underlain by the Kalahari Group rocks and Griqualand West Basin rocks.

F. Description of the Geological Setting

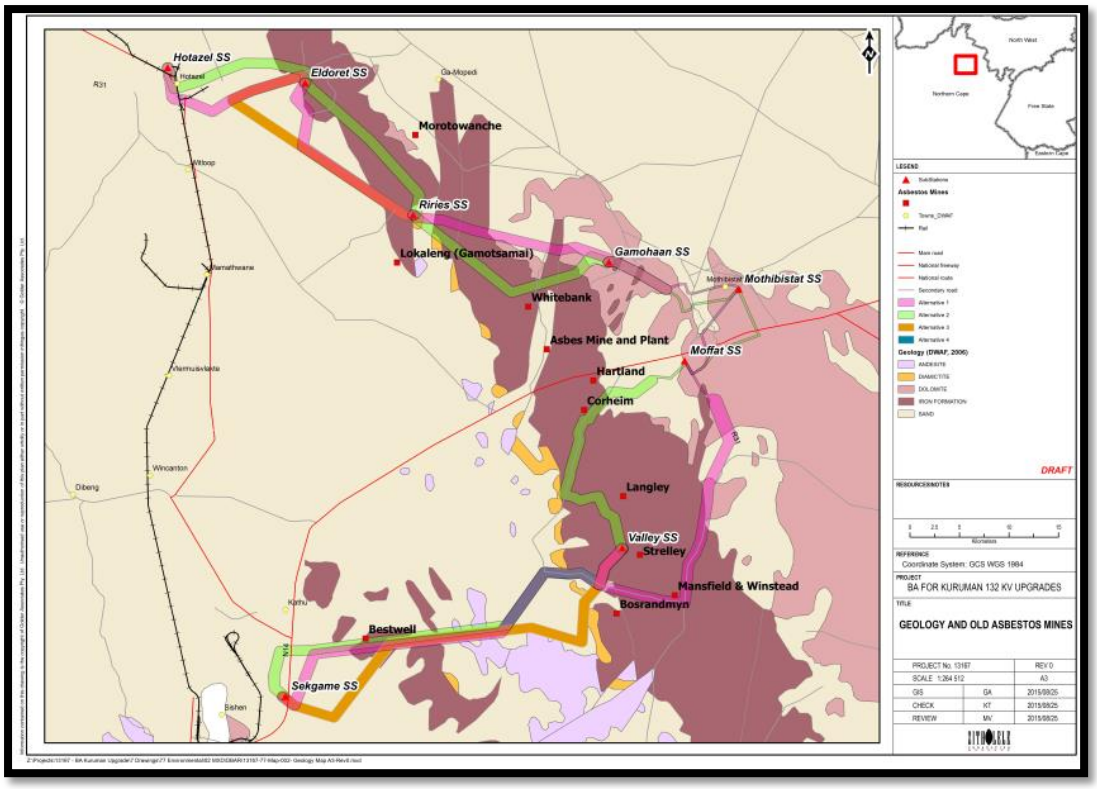
Description of the rock units:

Over areas totalling fully 40% of Southern Africa the 'hard rocks', from the oldest to the Quaternary, are concealed by normally unconformable deposits – principally sand, gravel, sandstone, and limestone. Inland deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, no clear-cut dividing line between the Tertiary and Quaternary successions could be established (Kent 1980). The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996).

The Kalahari deposits extend in age down to at least the Late and probably the Early Tertiary (65 million years ago). Fossils are scarce, and are of terrestrial plants and animals with close affinity to living forms. Included in the Kalahari Group are the Quaternary alluvium, terrace gravels, surface limestone, silcrete, and aeolian sand. Four major types of sands have been delineated (Kent 1980, Visser 1989).

The alluvium sands were deposited by a river system and reworked by wind action (Snyman 1996). A thick cover of Kalahari reddish sand blankets most outcrops and is dominated by the typical Kalahari thornveld (Norman and Whitfield 2006). The Kalahari Group is underlain by the Uitenhage and Zululand Groups (McCarthy and Rubidge 2005).

Figure 3: Geology of the area (Zitholele)



Legend to Map.

T-Qk/Vo – Sand, limestone (yellow). Kalahari Group.

Va – Iron Formation, jaspilite (maroon). Asbestos Hills, Griquatown Group, Griqualand West, Transvaal Supergroup.

Vgh – Dolomite, limestone, chert (pink). Ghaap Plateau Formation, Campbell Group, Griqualand West, Transvaal Supergroup.

Vo – Andesite (purple). Ongeluk Formation, Cox Group, Griqualand West, Transvaal Supergroup.
Formation.

Vmk – Diamictite, jaspilite, sandstone (Orange). Makganyeni Formation.

---f--- – (black) Fault.

……. – Lineament.

The Griqualand West Basin consists mainly of sediments of chemical origin together with lavas and subordinate clastic sediments. The basal unit, the Vryburg Formation lies unconformably on the granite and rocks of the Ventersdorp Supergroup. It is followed by the Campbell Group which consists of the Schmidtsdrif Formation and the upper Ghaap Plateau Formation (Visser 1989). There are also two formations in the Griquatown Group, namely, the Asbestos Hills and Koegas Formations. The Gamagara Formation follows and is located on the Maremane Anticline, it is overlain by the Makganyene Formation. The Cox Group consists of the lower Ongeluk Formation and the upper Voëlwater Formation. It attains a maximum thickness of 4500 m (Kent 1980, Snyman 1996). Almond and Pether (2009) referred to this as the Griqualand Basin within the Transvaal Supergroup.

The Vryburg Formation constitutes the lowermost formation of the Griqualand West basin / Supergroup. It unconformably overlies pre-Griqualand West rocks, and is conformably overlain by the Schmidtsdrif Formation. An age of 2300 ± 50 Ma was obtained. It consists essentially of quartzitic sandstone, mudrock and siltstone, with andesitic/basaltic lava present in places. This formation is not thicker than 900 m and often covered with Karoo Supergroup and Kalahari Group sediments. It is correlated with the Black Reef Series in the Transvaal

Supergroup (Smit, *et al.* 1991). Smit *et al.* (1991) recognised five members, the Kalkput Quartzite, Geelbeksdam, Rosendal, Waterloo and Oceola.

Groenewald and Groenewald (2014) placed the Ghaap Plateau as a Group in the Transvaal Supergroup with the Campbell Group as a subgroup. The Ghaap Plateau was deposited as a thick layer of carbonaceous sediments in extensive shallow basins. It consists of carbonates, siliclastics and iron formations. The age is Late Archaean, Early Proterozoic.

The Ongeluk Formation of the Cox Group was deposited under water and reaches a thickness of between 400 and 900 m. Manganese is present in the Voëlwater Formation (Snyman 1996). The Ongeluk Formation is basal and is mainly volcanic. An upper Voëlwater Formation (Visser 1989).

Asbestos is present as blue asbestos in the Asbestos Hill Formation, together with the Gamagara formation it is mined at Sishen (Snyman 1996). This formation forms the hills in the south and the Kuruman Hill in the north (Visser 1989).

Field Observations:

Figure 4: View of one of the already dug holes that will accommodate a monopole. The holes are dug 3 x 3 x3 m.

Figure 5: View of one of the already planted monopoles.

Figure 6: View of the calcrete present onsite. This is mostly found towards Hotazel.

Figure 7: Several of the existing substations will be moved to supply uninterrupted power. This is the Eldoret SS site.

Figure 8: Area where the Kuruman power line will be erected. The area is densely vegetated with large thorn bushes and shrubs.

It is recommended to wait for the response from SAHRA on the Field Study (this report), and if a Phase 2: Field study is recommended then SAHRA protocol must be followed. Alternatives will not be feasible.

Hotazel Substation: Present on the sands of the Kalahari Group. This substation will not expand beyond its perimeter and therefore the construction will have zero impact on the Heritage.
Eldoret Substation: Present partly on the Asbestos Hills Formation and Kalahari Group.
Riries Substation: Present on the Asbestos Hills Formation.
Gamohaan Substation: Present on the dolomite of the Ghaap Plateau.
Mothibestad Substation: Present on the Ghaap Plateau.
Moffat Substation: Present partly on the Kalahari Group and Ghaap Plateau.
Valley Substation: Present on the Asbestos Hills Formation.
Sekgame Substation: This is where the line will end. Construction will take place here, however this project has been undertaken under a separate project. This project has been registered on SAHRIS (Case No. 7920).

G. Background to Palaeontology of the area

Summary: When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB, 2012).

'Algal microfossils' have been reported from shales and are probably of diagenetic origin (Eriksson 1999). Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago. Significant fossil remains of Cenozoic aged terrestrial organisms have been recorded from the sedimentary rocks of the Kalahari Group. These fossils are rarely found and are allocated a **HIGH** palaeontological sensitivity as they are important indicators of palaeo-environmental conditions (Groenewald and Groenewald 2014).

Figure 9: Example of a Stromatolite (Photograph: E. Butler).

The more recent Phanerozoic deposits (Cenozoic) are of importance in the study of life during the last 300 million years. Large areas in the western part of the Province are underlain by Cenozoic (Tertiary, Quaternary) deposits of the Kalahari Group. The Ghaapplato is known for stromatolites and cyanobacterial microfossils. Very large stromatolites have been described from the Campbell Rand Subgroup of the Ghaap Group (Groenewald and Groenewald 2014). Almond and Pether (2009) described a range of shallow marine and lacustrine stromatolites, oőlites, pisolites in carbonates, filamentous and coccoid organic walled microfossils is siliciclastic / carbonates as well as cherts of banded iron form.

Table 1: Taken from Palaeotechnical Report (Almond and Pether 2009).

Subgroup/ sequence	Group	Formation	Fossil Heritage	Comment
Tertiary-Quaternary	Kalahari	-	Terrestrial organisms	Trace fossils, ostracods, bivalves, gastropod shells, diatoms
Griqualand West SG	Campbell	Ghaapplato (Vgh)	Stromatolites	Cyanobacterial microfossils are present
-	Griquastad	Asbestos Hills	Stromatolites	Cynanobacterial microfossils are present

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally **HIGH** for the Kalahari Group and **MODERATE** for the Griqualand West Basin.

Table 2: Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Kalahari Group	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Griqualand West Supergroup	Moderate	Desktop study is required

The Kalahari Group is present here in the development area. Groenewald & Groenewald 2014 rates this Group as having a high palaeontological significance due to the significant fossil remains of Cenozoic aged terrestrial

organisms that have been recorded from the sedimentary rocks. These fossils are important indicators of palaeo-environmental conditions. Therefore a **HIGH** status is allocated.
Databases and collections: Ditsong: National Museum of Natural History.
Impact: **HIGH** for the Kalahari Group and **MODERATE** for the Griqualand West Basin. There are significant fossil resources that may be impacted by the development and if destroyed are no longer available for scientific research or other public good.

H. Description of the Methodology (1e)
The palaeontological impact assessment Phase 1: Field Study was undertaken in March 2018. The walk through of the affected portion was done and photographs (in 20 mega pixels) were taken of the site with a digital Canon camera (PowerShot SX620HS). A Global Positioning System (GPS (Garmin eTrex 10) was used to record the outcrops. A literature survey is included and the study relied on literature, geological maps, google.maps and google.earth images. No fossils were found.

Assumptions and Limitations (Appendix 6 of Act 1(i):-
The accuracy and reliability of the report may be limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. Insufficient data from developer and exact lay-out plan for all structures.

A Phase 1 Palaeontological Impact Assessment: Field Study will include:

1. Recommendations for the future of the site.
2. Background information on the project.
3. Description of the property of affected environment with details of the study area.
4. Description of the geological setting and field observations.
5. Background to palaeontology of the area.
6. Field Rating.
7. Stating of Significance (Heritage Value).

A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.
National Estate: 3 (2) (f) archaeological and palaeontological sites,
(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,

Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;
(b) Grade 11: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 111: Other heritage resources worthy of conservation.
SAHRA is responsible for the identification and management of Grade 1 heritage resources.
Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 11 heritage resources.
Local authorities identify and manage Grade 111 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.
Archaeology, palaeontology and meteorites: Section 35.
(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

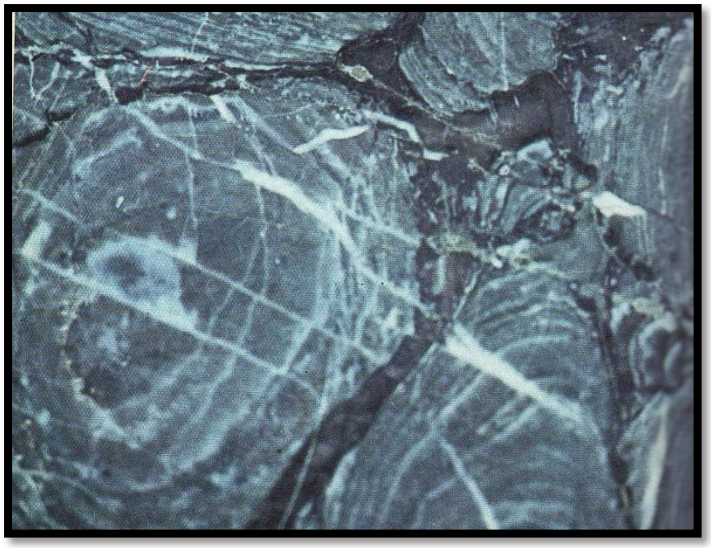
Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

I. Description of significant fossil occurrences (1f)

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

Stromatolites are likely to be present. These structures range from a centimetre to several tens of metres in size. They are the result of algal growth in shallow water, indicating a very rich growth that would have caused an enrichment in the amount of oxygen in the atmosphere (Groenewald and Groenewald 2014).

Figure 9: Thin section of a stromatolite (De Zanche and Mietto 1977).



The threats are:- earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation (1j,1l)

a. There is no objection (see Recommendation B) to the development, it was necessary to request a Phase 1 Palaeontological Impact Assessment: Field study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is **HIGH and MODERATE**. A Phase 2 Palaeontological Mitigation may be required if a Phase 1 Palaeontological Assessment identifies a fossiliferous formation (for example breccia), **but no fossils were found**. Care must be taken during the dolomite risk assessment according to SANS 1936-1 (2012) as stromatolites may be present.

b. This project may benefit the economy, the growth of the community and social development in general.

c. Preferred choice: The impact on the palaeontological heritage is **HIGH** for the Kalahari Group. Care must be taken during the grading of roads, digging of foundations and removing topsoil, subsoil and overburden (see Executive Summary) or blasting of bedrock. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting SAHRA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures. It is recommended that the EMPr be updated to include the involvement (pre-construction training of ECO) of a palaeontologist/archaeozoologist during the digging and excavation phase of the development and ECO to visit site bi-weekly during construction and keep a photopgraphic record.

Sampling and collecting (1m,1k):

Wherefore a permit is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

a. Objections: Cautious. See heritage value and recommendation.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: Yes.
d. Permits for mitigation: Needed from SAHRA/PHRA if fossils are found.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
b. All information needed for the Phase 1: Field Study was provided by the Consultant. All technical information was provided by Zitholele Consulting.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures, for example, shallow caves.
e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment and adjacent areas as well as for safety and security reasons.

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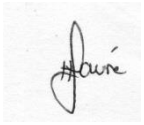
Declaration (Disclaimer) (1b)

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

It may be possible that the field study may have missed palaeontological resources in the Project Area as the presence of outcrops are not known and may only be found once development commences.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.



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Heidi Fourie
2018/03/22

Appendix 1:

Table 3: Listing points in Appendix 6 of the Act and position in Report.

Section	Point in Act	Heading
B	1(c)	Outline of development project
	1(d)	Summary of findings
	1(g)	Concerns/threats:
	1(n)i	"
	1(n)ii	"
	1(o)	"
	1(p)	"
D	1(h)	Figures
	1(a)i	Terms of reference
H	1(e)	Description of Methodology
	1(i)	Assumptions and Limitations
I	1(f)	Heritage value
J	1(j)	Recommendation
	1(l)	"
	1(m)	Sampling and collecting
	1(k)	"
Declaration	1(b)	Declaration
Appendix 1	1(k)	Protocol for finds
	1(m)	"
	1(q)	"

Appendix 2: Management Plan and Protocol for Finds.

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is LOW; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to oversee the construction activities in line with the legally binding Environmental Management Programme (EMPr) so that when a fossil is unearthed they can notify the relevant department and specialist to further investigate. When a fossil is found the area must be fenced-off and the construction workers must be informed that this is a no-go area. Therefore the EMPr must be updated to include the involvement of a palaeontologist during the digging and excavation (ground breaking) phase of the development.

The EMPr already covers the conservation of heritage and palaeontological artefacts that may be exposed during construction activities. The protocol is to immediately cease all construction activities if a fossil is unearthed and contact SAHRA for further investigation. It is recommended that the EMPr be updated to include the involvement (training/site visit) of a palaeontologist / archaeozoologist during the digging and excavation phase of the development. The ECO should familiarise him- or herself with the Ecca Group formations and its fossils. The Evolutionary Studies Institute, University of the Witwatersrand has good examples of Ecca Group Fossils.

The developer must survey the areas affected by the development and indicate on plan where the construction / development / mining will take place. Trenches have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give an indication of the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during mining or excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).
3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining/ construction/ development operations and dig representative trenches and if possible supply geological borehole data.
2. Fossils likely to occur are for example the fossil plants from the Vryheid Formation, these are present in the grey shale (or any other fossiliferous layer ranked as VERY HIGH or HIGH) or invertebrates from the Volksrust Formation (or any other fossiliferous layer).
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work.
4. A Palaeobotanist / palaeontologist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
5. If the palaeontologist / palaeobotanist is satisfied that no fossils will be destroyed or have removed the fossils, development and removing of the topsoil can continue.

6. After this process the same palaeontologist / palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
7. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the palaeontologist / palaeobotanist must do an investigation (a minimum of once a week).
8. At this stage the palaeontologist / palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the palaeontologist / palaeobotanist.

Fossil excavation if necessary during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.
3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Use Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material should reveal any fossils sandwiched between the layers.

SAHRA Documents:
Guidelines to Palaeontological Permitting Policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.
Palaeotechnical Reports for all the Provinces.