The Proposed Development of Mashimong Park on Erf 892, City of Ekurhuleni Metropolitan Municipality.

City of Ekurhuleni Metropolitan Municipality, Gauteng Province

Farm: Kaalfontein 131-IR

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***Palaeontological Impact Assessment: Phase 1 Field Study***

Facilitated by: Information Decision Systems (Pty) Ltd

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2019/03/20

Ref: GAUT 002/18-19/E0125

**B. Executive summary**

Outline of the development project: Information Decision Systems (Pty) Ltd has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Phase 1 Field Study of the suitability of The Development of Mashimong Park, Erf 892, Tembisa, City of Ekurhuleni Metropolitan Municipality in the Gauteng Province on the Farm Kaalfontein 131-IR.

The applicant, City of Ekurhuleni Metropolitan Municipality proposes to upgrade an existing public park northwest of Kempton Park and has identified the need for the development of a multi-purpose recreational park that will provide facilities to the community of Tembisa. The Mashimong Park area is situated in a medium to high density residential area with informal businesses supporting the living conditions. The proposed development aims at formalising the park which will provide the community with recreational facilities.

The Project includes one Option (see google.earth image):
Option 1: A roughly rectangular area blocked in green situated between Reverent R.T.J. Namane and Andrew Mapheto (M18) Roads to the northwest and Polaris Road to the west, Freedom Road to the east and Naiad Road to the south as an existing park in Tembisa. The park is 13800 $m^2$ in size.

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.

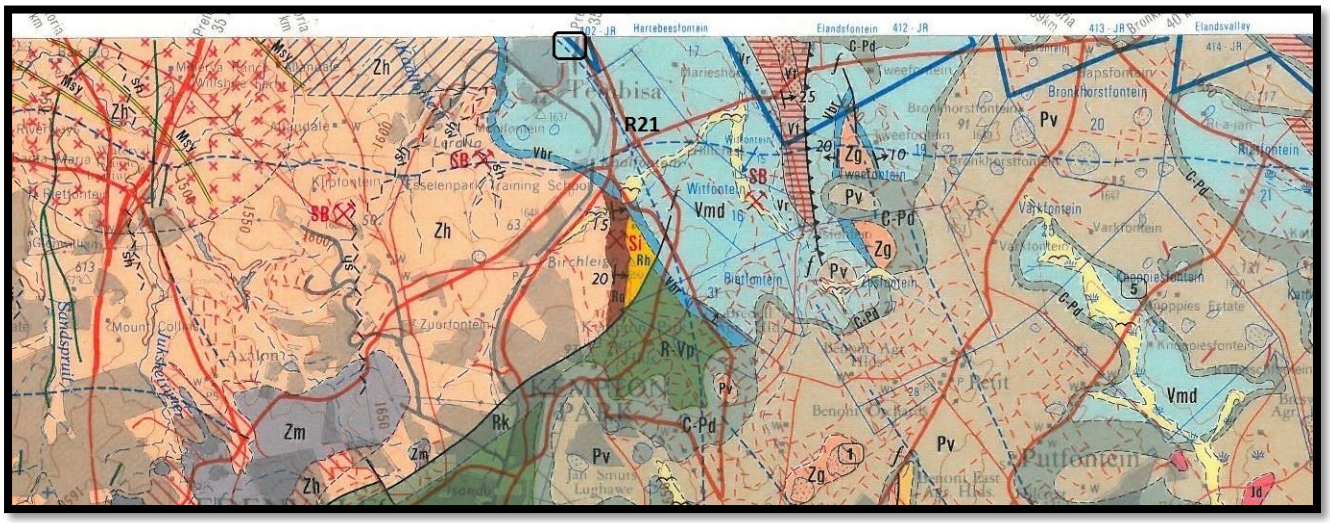
Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act (Act No.25 of 1999):

(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) and the 1:250 000 (2628) Geological Map of the East Rand (Keyser *et al.*1986).

**Figure 3:** The geology of the development area.




*Legend to Map and short explanation.*
Vt – Shale, siltstone, conglomerate in places (brown). Time Ball Hill, Pretoria Group, Transvaal Supergroup. Vaalian.
Vr – Quartzite (yellow), chert breccia, conglomerate [:::] light blue. Rooihoogte Formation, Pretoria Group, Transvaal Supergroup.
Vmd – Dolomite, chert [=] (blue), Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.
Vbr – Quartzite, conglomerate, shale, dolomitic limestone (dark blue), Black Reef Formation.
---f--- – (black) Fault.
⊥ 15 - Strike and dip of bed.
-^-^- - Thrust fault (black).
….. – Linear structure (Landsat and aeromagnetic).
------ - Concealed geological boundary.
□ – Approximate position of development (in black on the Figure).

Mining Activities
SB – Building Sand.
The mining activities have no influence on the development.

*Palaeontology* – Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

Summary of findings (1d): The Palaeontological Impact Assessment: Phase 1: Field Study was undertaken on 13 March 2019 in the summer in dry and hot conditions (Appendix 6 of Act, 1(d)), and the following is reported:
The development is taking place on the dolomites of the Malmani Subgroup, Chuniespoort Group of the Transvaal Supergroup with a **HIGH** sensitivity.

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. The east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Pretoria and Chuniespoort Groups as well as other smaller groups (Kent 1980, Snyman 1996). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. Three prominent ridges are present from the oldest to the youngest, the Time Ball Hill, Daspoort and Magaliesberg Formations (Norman and Whitfield 2006).

The Chuniespoort Group is made up of chemical and biochemical sediments such as dolomite, chert, limestone and banded iron formation, carbonaceous shale is also present. At the top of the Malmani Subgroup is the Duitschland Formation underlain by the Penge and Monte Christo Formations. Sandstone is mostly absent. It is this formation that has great economic value for its lead, zink, dolomite, and manganese (Kent 1980, Snyman 1996). Fluorspar, concrete aggregate, iron ore and managanese is also mined from this formation. Cave formation in the dolomite is a major concern in developing areas, especially in the 1500m thick dolomite of the Malmani Subgroup. Chemical sediments such as fine grained limestone and dolomite is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. The Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccias similar to the Malmani dolomite.

*Field observation* - The park is being used by vagrants for sleeping, there is also a tent, brick-making, and play-park present. Grass, rubbish, weeds, trees and a river points to the fact that outcrops will not be present as the site has already been developed into a park in the past. Most of the development activities such as paving and grass planting will have no impact on the palaeontology.

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 sedimentary rocks the palaeontological sensitivity can generally be LOW to VERY HIGH, and here locally **HIGH** for the Chuniespoort Group (SG 2.2 SAHRA APMHOB, 2012).

Recommendation:

The impact of the development on fossil heritage is **HIGH** 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.

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

| Rock Unit | Significance/vulnerability | Recommended Action |
|---|---|---|
| Chuniespoort Group | High | Desktop study is required and based on the outcome of the desktop study, a field assessment is likely. |

The Project includes one Option (see google.earth image):
Option 1: A roughly rectangular area blocked in green situated between Reverent R.T.J. Namane and Andrew Mapheto (M18) Roads to the northwest and Polaris Road to the west, Freedom Road to the east and Naiad Road to the south as an existing park in Tembisa. The park is 13800 $m^2$ in size.

Only one Option is viable as the park is already in existence.

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

1. Threats are earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, digging of foundations, the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic, and human disturbance.
2. The overburden and inter-burden must always be surveyed for fossils during construction or prospecting. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden during construction not to intrude fossiliferous layers. This can be done by the Environmental Control Officer.
3. Care must be taken during the dolomite risk assessment according to SANS 1936-1 (2012) as stromatolites may be present.

Recommendations:

1. Mitigation may be needed if a fossil is found.
2. No consultation with parties was necessary.
3. Alternatives will not be feasible. The Park already exists.
4. The development may go ahead with caution, if a fossil is found, all construction must stop, and SAHRA must be notified. The Environmental Control Officer must familiarise him- or herself with the Malmani Subgroup fossils.
5. The walk through did not find stromatolite fossils or dolomite outcrops.
6. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to monitor 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 with a 30 m barrier, 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 (for training of ECO and advisory) during the digging and excavation (ground breaking) phase of the development.

Stakeholders: Developer – City of Ekurhuleni Metropolitan Municipality.
Environmental – Information Decision Systems (Pty) Ltd., P.O. Box 689, Rivonia, 2128. Tel: 087 353 2576.
Landowner – City of Ekurhuleni Metropolitan Municipality.

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**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 R326 of 7 April 2017) of the Environmental Impact Assessment Regulations (see Appendix 2). The report is also in accordance with the SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.

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 or construction phase it may be necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA).

The applicant, Ekurhuleni Metropolitan Municipality has identified the need for the development of a multi-purpose recreational park that will provide facilities to the community of Tembisa. The Mashimong Park area is situated in a medium to high density residential area with informal businesses supporting the living conditions. The proposed development aims at formalising the park which will provide the community with recreational facilities. This existing park in Tembisa is much degraded, even the river which traverses the park is degraded due to erosion and pollution.

Local benefits of the proposed development include benefits to the local economy through possible job creation and local supplier procurement during the construction phase as well as during the operational phase of the development, i.e. maintenance of the park.

**Figure 1:** Regional context (van Schalkwyk).

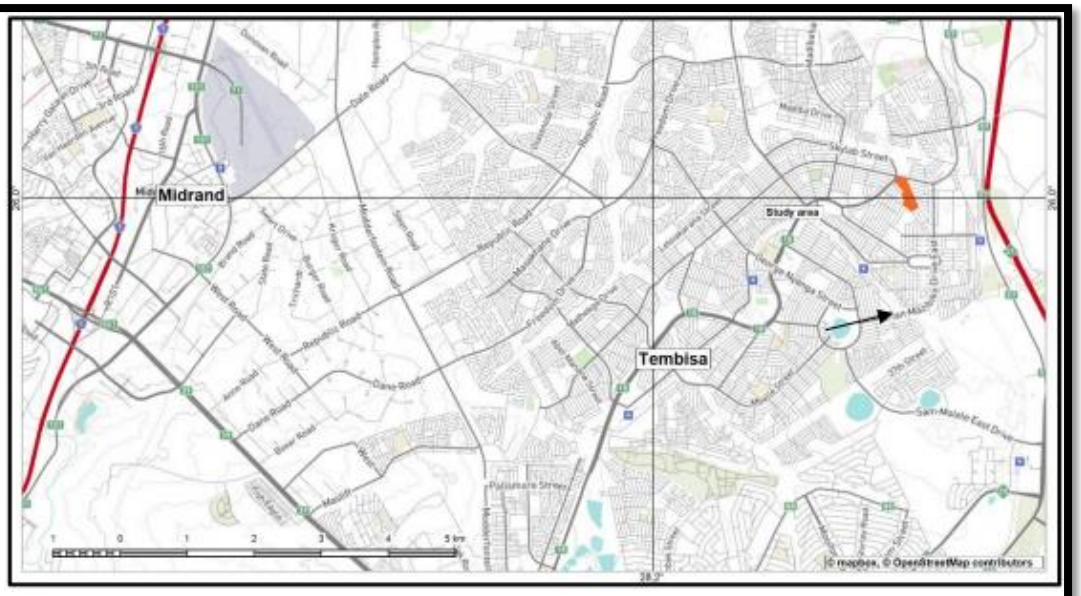


Figure 3. Location of the study area in regional context.
(Study area = orange polygon)

The following infrastructure is anticipated;

1. Roads,
2. Buildings (caretaker, guard, ablution, lapa),
3. Fitness track, gym and play area,
4. Water services, storm water management system,
5. Parking areas,
6. Agriculture,
7. Amphitheatre, and
8. And associated infrastructure such as electricity lines, fencing, picnic area and botanic garden.

The Project includes one Option (see google.earth image):
Option 1: A roughly rectangular area blocked in green situated between Reverent R.T.J. Namane and Andrew Mapheto (M18) Roads to the northwest and Polaris Road to the west, Freedom Road to the east and Naiad Road to the south as an existing park in Tembisa. The park is 13800 $m^2$ in size.

Rezoning/ and or subdivision of land: From Undetermined to Park.
Name of Developer and Environmental Consultant: City of Ekurhuleni Metropolitan Municipality and Information Decision Systems (Pty) Ltd.
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 12 years she carried out field work in the Western Cape, Eastern Cape, North West, Northern 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 24 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 Development of Mashimong Park, Erf 892, Tembisa, City of Ekurhuleni Metropolitan Municipality in the Gauteng Province will be situated on the Farm Kaalfontein 131-IR.

Depth is determined by the depth of foundations, footings and channels of the related infrastructure to be developed and the thickness of the formation. It can be verified with test pit results.

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**Figure 2:** Google.earth image showing location (Information Decision Systems).


The site is underlain by the Transvaal Supergroup rocks.

**F. Description of the Geological Setting**

Description of the rock units:

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the northeastern section. The east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three

groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980, Snyman 1996). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group. Three prominent ridges are present from the oldest to the youngest, the Time Ball Hill, Daspoort and Magaliesberg Formations (Norman and Whitfield 2006).

The Pretoria Group consists predominantly of quartzite and shale, together with a prominent volcanic unit, minor conglomerate, chemical and volcanic members. It comprises the Hekpoort Andesite, Dullstroom Basalt, Time Ball Hill, Silverton, and Magaliesberg Quartzite Formations as well as several smaller formations (in total 15) and overlies the Chuniespoort Group (Kent 1980). Both the shale and quartzite of the Pretoria Group are utilised in the building industry (Snyman 1996). The Time Ball Hill shale Formation is known to contain 'algal microfossils' diagenetic in origin. Stromatolites as they are known are preserved in the subordinate carbonate rocks (Kent 1980). The Pretoria Group is clastic sedimentary in nature (Eriksson 1999). The pile of sedimentary rocks, mainly mudstones and quartzites with some basalt can collectively reach a thickness of up to 5 km (Visser 1989).

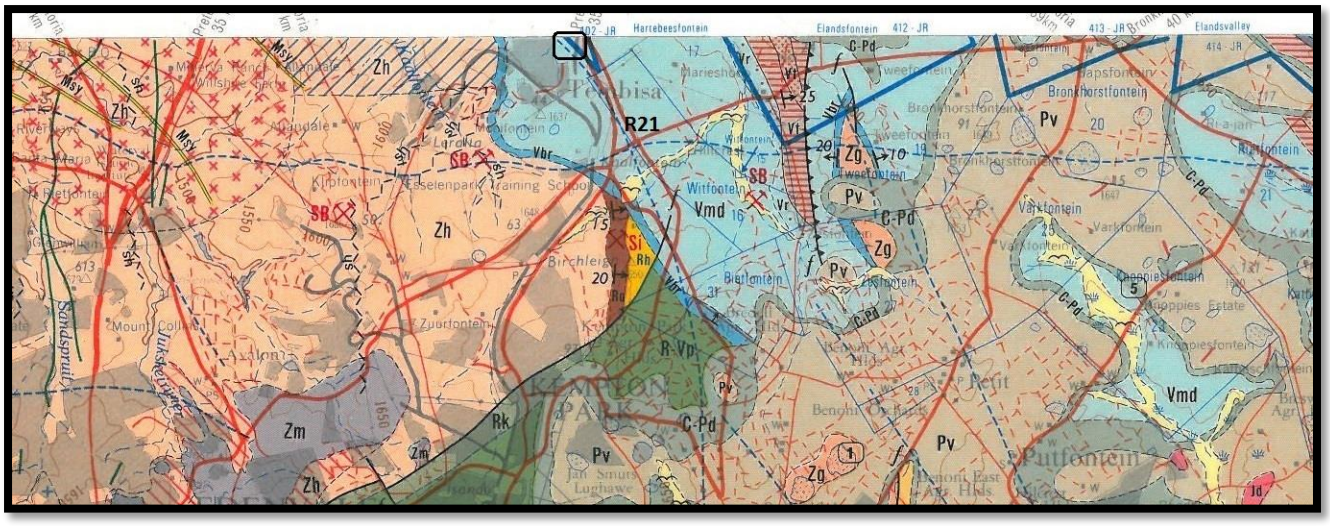
The Chuniespoort Group is made up of chemical and biochemical sediments such as dolomite, chert, limestone and banded iron formation, carbonaceous shale is also present. At the top of the Malmani Subgroup is the Duitschland Formation underlain by the Penge and Monte Christo Formations. Sandstone is mostly absent. It is this formation that has great economic value for its lead, zinc, dolomite, and manganese (Kent 1980, Snyman 1996). Fluorspar, concrete aggregate, iron ore and manganese is also mined from this formation. Cave formation in the dolomite is a major concern in developing areas, especially in the 1500m thick dolomite of the Malmani Subgroup. Chemical sediments such as fine grained limestone and dolomite is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. The Malmani dolomites are home to most of the cave systems that has yielded hominin fossils such as those at Mokopane's cave, also home to Middle and Late Stone Age cultures. This cave and the caves in the Cradle of Humankind, near Johannesburg, provided a refuge for man's distant ancestors. The breccia yielded internationally renowned hominins.

The Rooihoogte Formation (Vr) sits at the base of the Pretoria Group and is quite thin (10 – 150 m). The chert is present as boulders or a breccia. It is often lumped with the Time Ball Hill Formation (Visser 1989).

The Black Reef Formation (Vbr) of the Transvaal Supergroup consists of quartzite with lenses of grit and conglomerate. Shale is always present, particularly near the top close to the contact with the overlying dolomite (Kent 1980). It is Vaalian in age and not very thick, only up to 500m in the north-east. It contains a fair amount of gold and the limestone is mined (Snyman 1996). The Black Reef Formation is known for stromatolite carbonates and fossiliferous Late Cenozoic cave breccia similar to the Malmani dolomite. Algal microfossils are reported from shales and are probably from diagenetic origin. Stromatolites are preserved in the subordinate carbonate rocks.

Algal microfossils are reported from shales and are probably from diagenetic origin. Stromatolites are preserved in the subordinate carbonate rocks.

**Figure 3:** The geology of the development area (Keyser *et al.*1986).




*Legend to Map and short explanation.*

Vt – Shale, siltstone, conglomerate in places (brown). Time Ball Hill, Pretoria Group, Transvaal Supergroup. Vaalian.

Vr – Quartzite (yellow), chert breccia, conglomerate [:::] light blue. Rooihoogte Formation, Pretoria Group, Transvaal Supergroup.

Vmd – Dolomite, chert [=] (blue), Malmani Subgroup, Chuniespoort Group, Transvaal Supergroup. Vaalian.

Vbr – Quartzite, conglomerate, shale, dolomitic limestone (dark blue), Black Reef Formation.

---f--- – (black) Fault.

-^-^-^ - Thrust fault (black).

⊥ 15 - Strike and dip of bed.

------ - Concealed geological boundary.

□ – Approximate position of road development (in black on the Figure).

Mining Activities

SB – Building Sand.

The mining activities have no influence on the development.

**Field Observation.**

The park is being used by vagrants for sleeping, there is also a tent, brick-making, and play-park present. Grass, rubbish, weeds, trees and a river points to the fact that outcrops will not be present as the site has already been developed into a park in the past. Most of the development activities such as paving and grass planting will have no impact on the palaeontology.

**Figure 4:** View of property with degraded river.


**Figure 5:** View of property showing tent and weeds. No visible dolomites.

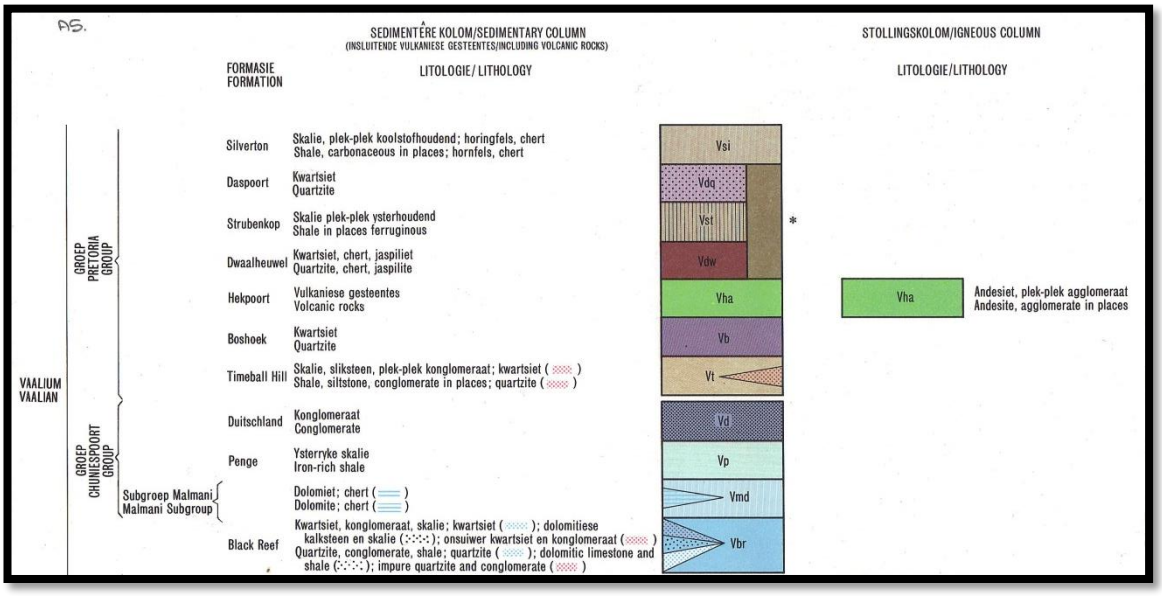

**Figure 6:** View towards play area.


**Figure 7:** View from one of the entrances. The pathways aren't paved.


The Project includes one Option (see google.earth image):
Option 1: A roughly rectangular area blocked in green situated between Reverent R.T.J. Namane and Andrew Mapheto (M18) Roads to the northwest and Polaris Road to the west, Freedom Road to the east and Naiad Road to the south as an existing park in Tembisa. The park is 13800 $m^2$ in size.

As the park is in existence, there is no other Options, therefore the palaeontological impact remains **HIGH**.

**Figure 8:** Lithostratigraphic column of the geology of the site (Muntingh 1992).




It is recommended to wait for the response from SAHRA on the (this report) Phase 1: Field study.

**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).

Chemical sediments such as fine grained limestone and dolomite is made up of deposits of organically derived carbonate shells, particles or precipitate. Dolomite is magnesium-rich limestone formed from algal beds and stromatolites. These Early Proterozoic Transvaal stromatolitic dolomites formed and released free oxygen at around 2900 – 2400 Ma. Stromatolites are common in the Malmani dolomites, accepted to be the fossil remnants of the simplest single-celled organisms. They are finely layered, concentric, mound-like structures formed by microscopic algal organisms (Norman and Whitfield 2006). Chert may contain fossils such as echinoids or sponges if nodular, although not common and is rated unlikely.

Cyanobacteria have been described from the gold bearing conglomerates of the Witwatersrand Supergroup (MacRae 1999). These are significant recordings as it gives a possible indication of very early life forms, possibly ancient lichens that existed up to 2900 million years ago. These structures are for example associated with the Carbon Leader Seam in the Carletonville Goldfield, with native gold visible to the naked eye. Very large stromatolites can be found in the Campbell Rand Subgroup in the North West Province (Groenewald and Groenewald 2014).

**Figure 9:** Example of a stromatolite present in dolomite (Photograph: E. Butler).

Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago (Groenewald and Groenewald 2014). Caves in the Malmani dolomite (Vmd) of the Transvaal Supergroup provided a refuge for man's distant ancestors (Norman and Whitfield 2006). These caves are also home to Middle and Late Stone Age cultures. The cave breccia in the Cradle of Humankind, near Johannesburg, yielded internationally renowned hominins such as *Australopithecus africanus and robustus* and extinct mammals and other fauna. The caves are actively being researched and excavated and this has led to many international collaborations. The caves are filled with sediments from the Kalahari Group.

In the rocks overlying the Black Reef Formation there is evidence for life on an abundant scale as cyanobacteria came to dominate the shallow sea forming stromatolites of varying shapes. Large, elongate stromatolite domes can be seen at Boetsap in the North West Province (McCarthy and Rubidge 2005) and the algal microfossils reported from the Time Ball Hill Formation shales are probably of diagenetic origin (Eriksson 1999).

The Time Ball Hill Formation (Vt), Transvaal Supergroup is present in the Pretoria Group. Nixon *et al.* (1988) described the black shales south-west of Potchefstroom as consisting of overlapping laminated basal mounds which are stromatolitic as well as spheroidal possible planktonic fossil algae. These can range in size from 3.5 - 17 mm in height and up to 10 mm in diameter and can be present in the development area.

**Table 1:** Taken from Palaeotechnical Report (Groenewald and Groenewald 2014).

| Group/ supergroup | Subgroup | Formation | Lithology | Fossil Heritage | Comment |
|---|---|---|---|---|---|
| | | Timeball Hill (Vt; Vtl) | Klapperkop (Vkp) | Lacustrine and fluvio-deltaic mudrocks with diamictite, conglomerates, quartzite, minor lavas. Shale, siltstone, conglomerate, quartzite | Stromatolites | Included within top of Transvaal Supergroup but now regarded as separate succession |
| | | Rooihoogte (Vt) | | Basal breccio-conglomerates, quartzites, mudrocks, carbonates (alluvial fan, lakes, karst infill) | No fossils recorded | |
| CHUNESPOORT | | Duitschland (Vd) | | Conglomerate | No fossils recorded | Good examples of stromatolites in Cradle of Humankind region<br><br>ALERT FOR POTENTIALLY FOSSILIFEROUS LATE CAENOZOIC CAVE BRECCIAS WITHIN "TRANSVAAL DOLOMITE" OUTCROP AREA (breccias not individually mapped) |
| | | Penge (Vp) | | Iron-rich shale | Stromatolites | |
| | Malmani (Vm; Vmd; Vma) | | | Stromatolitic carbonates (limestones / dolomites), minor secondary cherts, mudrocks including carbonaceous shales | Range of shallow marine to intertidal stromatolites (domes, columns etc), organic-walled microfossils | |
| | | Black Reef (Vbr) | | Siliciclastic sediments (mature sandstones plus minor mudrocks, conglomerates) deposited during a fluvial to shallow marine transition | Possible equivalent of Black Reef Fm in N. Cape (Vryburg Formation) contains stromatolitic carbonates | |

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 sedimentary rock strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally **HIGH** for the Chuniespoort Group, Transvaal Supergroup.

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

| Rock Unit | Significance/vulnerability | Recommended Action |
|---|---|---|
| Chuniespoort Group | High | Desktop study is required and based on the outcome of the desktop study, a field assessment is likely. |

Databases and collections: Ditsong: National Museum of Natural History and the National Museum of Bloemfontein.
Impact: **HIGH** for the Chuniespoort Group, Transvaal Supergroup. 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 field study was undertaken on 13 March 2019. A literature survey is included and the study relied on literature, geological maps, google.maps and google.earth images. 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 (Power Shot SX620HS). It was not necessary to use a Global Positioning System (GPS) (Garmin eTrex 10) to records outcrops where not covered with topsoil, subsoil, overburden, and vegetation.

The area is large, it was criss-crossed on foot, rock outcrops are not present on the surface. SAHRA Document 7/6/9/2/1 only requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops, if none then it is not recorded on a GPS. An archaeozoologist can be used to survey any quaternary or tertiary material for more recent fossil material. Isolated occurrences of rocks usually do not constitute an outcrop. Fossils can occur in dongas, as nodules, in fresh rock exposures, and in riverbeds. Finding fossils require the experience and technical knowledge of the professional palaeontologist, but that does not mean that an amateur can't find fossils. The geology is used to predict what type of fossil and zone will be found in any particular region.

Assumptions and Limitations (Appendix 6 of Act 1i):-
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. Inaccessibility of site.
7. 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 2: 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 3: 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 2 heritage resources.
Local authorities identify and manage Grade 3 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.

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.

Stromatolites are likely to be present in the dolomites. 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).

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

**Figure 10**: 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, and it is not necessary to request a Phase 2 Palaeontological Impact Assessment: Mitigation to determine whether the development will affect fossiliferous outcrops. The palaeontological sensitivity is **HIGH** so caution is recommended. A Phase 2 Palaeontological Mitigation will only be required if a fossil is found during construction (for example a stromatolite). Fossils were not found during the walk through.

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

c. Preferred choice: Option 1, the impact on the palaeontological heritage is **HIGH.** 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.

d. 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.

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 Appendix 3.
c. Areas that may need a permit: Yes, if a fossil is found (Section G).
d. Permits for mitigation: Needed from SAHRA/PHRA.

**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 Field Study was provided by the Environmental Consultant. All technical information was provided by Information Decision Systems (Pty) Ltd.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed (see Recommendation B).
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. Especially 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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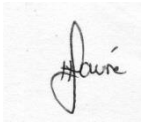
**Declaration / Disclaimer** (1b)

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.

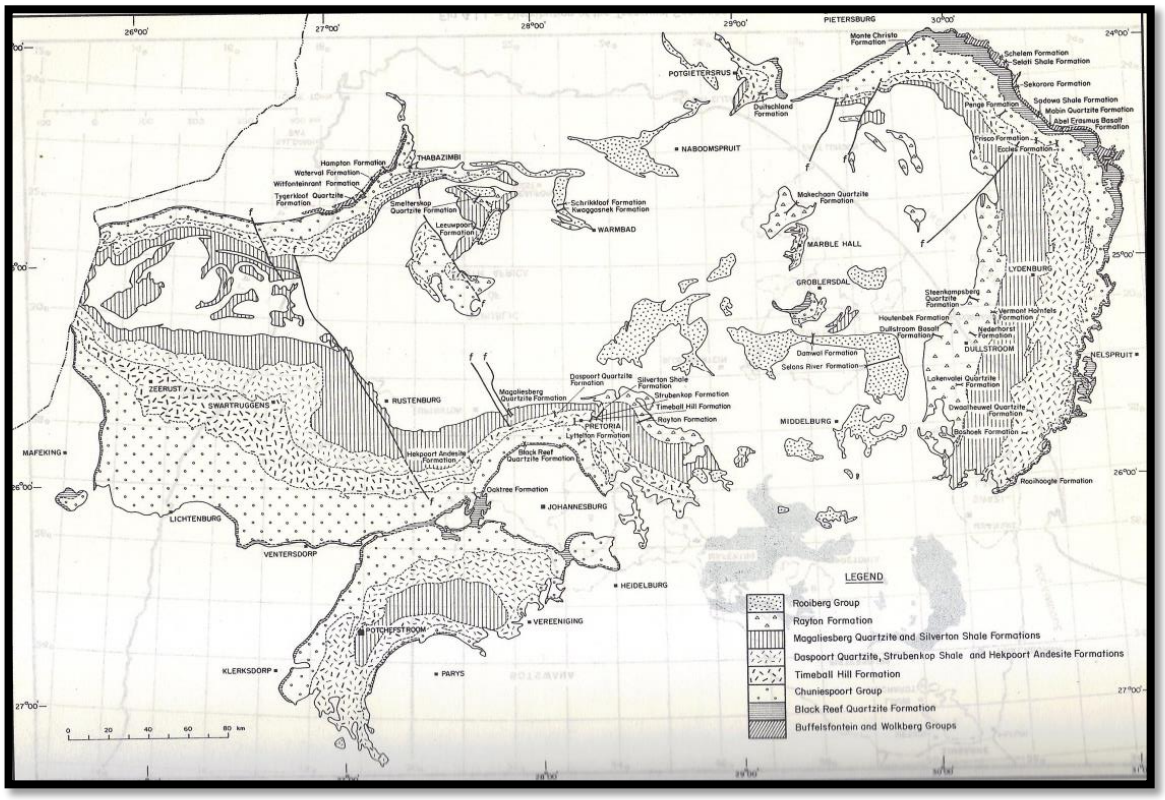
It may be possible that the field study may have missed palaeontological resources in the Project Area as the presence of outcrops are not known and may only be found once development commences.

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



Heidi Fourie
2019/03/20

Apppendix 1: Geology of the Transvaal Supergroup (Kent 1980).




Appendix 2:

**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 | Concerns/threats |
| | 1(n)ii | Concerns/threats |
| | 1(o) | Concerns/threats |
| | 1(p) | Concerns/threats |
| 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) | Recommendation |
| | 1(m) | Sampling and collecting |
| | 1(k) | Sampling and collecting |
| Declaration | 1(b) | Declaration |
| Appendix 1 | 1(k) | Protocol for finds |
| | 1(m) | Protocol for finds |
| | 1(q) | Protocol for finds |

Appendix 3: Protocol for Chance Finds and Management Plan.

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 / ECO on site and

should not be attempted by the layman / developer. The ECO should familiarise him- or herself with the applicable formations and its fossils. The Evolutionary Studies Institute, University of the Witwatersrand has good examples of fossils that can be studied. As part of the Environmental Authorisation conditions, an Environmental Control Officer (ECO) will be appointed to monitor 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 with a 30 m barrier and the construction workers must be informed that this is a no-go area. Therefore the EMPr must be updated to include the involvement (training of ECO) of a palaeontologist during the digging and excavation (ground breaking) phase of the development. The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities. A regular monitoring presence over the period during which excavations are made, by either the palaeontologist / palaeobotanist, is generally not practical.

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.

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).

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; see Report, or any other fossiliferous layer ranked as **VERY HIGH or HIGH**.
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work. The area needs to be fenced off.
4. A Palaeobotanist / palaeontologist (contact SAHRIS for list) / ECO 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 / ECO 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 / ECO must do an investigation (a minimum of once a week).
8. At this stage the palaeontologist / palaeobotanist / ECO 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. Using 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 are 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.