Mobile Seasonal Tented Camps in the Kruger National Park

Bushbuckridge Local Municipality, Ehlanzeni District Municipality, Mpumalanga Province

Farm: Tshokwane - Dijon 335-KU, Besancon 333-KU, Toulon 348-KU Satara: Rietspruit 148-KU, Brixton 154-KU, Athlone 155-KU

Fourie, H. Dr heidicindy@yahoo.com

079 940 6048

Palaeontological Impact Assessment: Phase 1: Field Study

Facilitated by: Zunckel Ecological and Environmental Services

7 Annthia Road,

Hilton

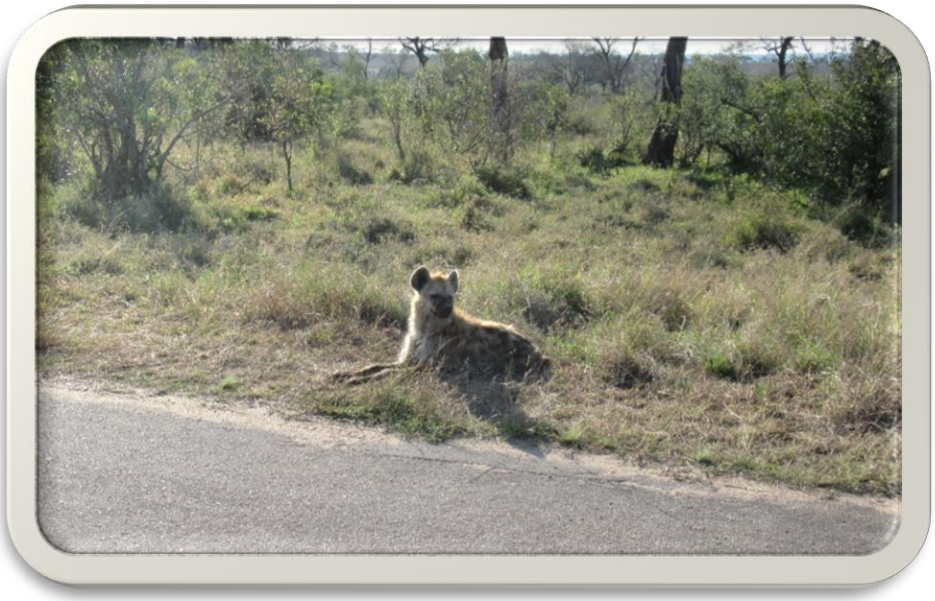
3245

Tel: 033 343 1739

2022/08/05

Ref: Pending

Hyaena



B. Executive summary

Outline of the development project: Zunckel Ecological and Environmental Services has facilitated the appointment of Dr H. Fourie, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Phase 1: Field Study of the proposed Mobile Seasonal Tented Camps in the Kruger National Park in the Bushbuckridge Local Municipality, Ehlanzeni District Municipality, Mpumalanga Province on Farm: Tshokwane - Dijon 335-KU, Besancon 333-KU, Toulon 348-KU Satara: Rietspruit 148-KU, Brixton 154-KU and Athlone 155-KU.

The applicant, BidCo (Pty) Ltd., wants to establish two seasonal mobile tented camps in the Kruger National Park and operate them for the five months of the dry season according to a PPP Agreement with SANParks.

The Project includes one locality Option each and two Alternatives each (see Figure 2):
Option 1: The Tshokwane tented camp will be situated to the south of Satara on the rivers Ripape and Nwaswitsontso; and north of Tshokwane. Farms present: Besancon 333-KU and Dijon 335-KU.
Option 2: The Satara tented camp will be situated to the north of the Satara Rest Camp on the river Mavumbye. Farms present: Rietspruit 148-KU and Athlone 155-KU.
Alternative: Both camps have a preferred and Alternative Option which will be used (Figure 1).

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.

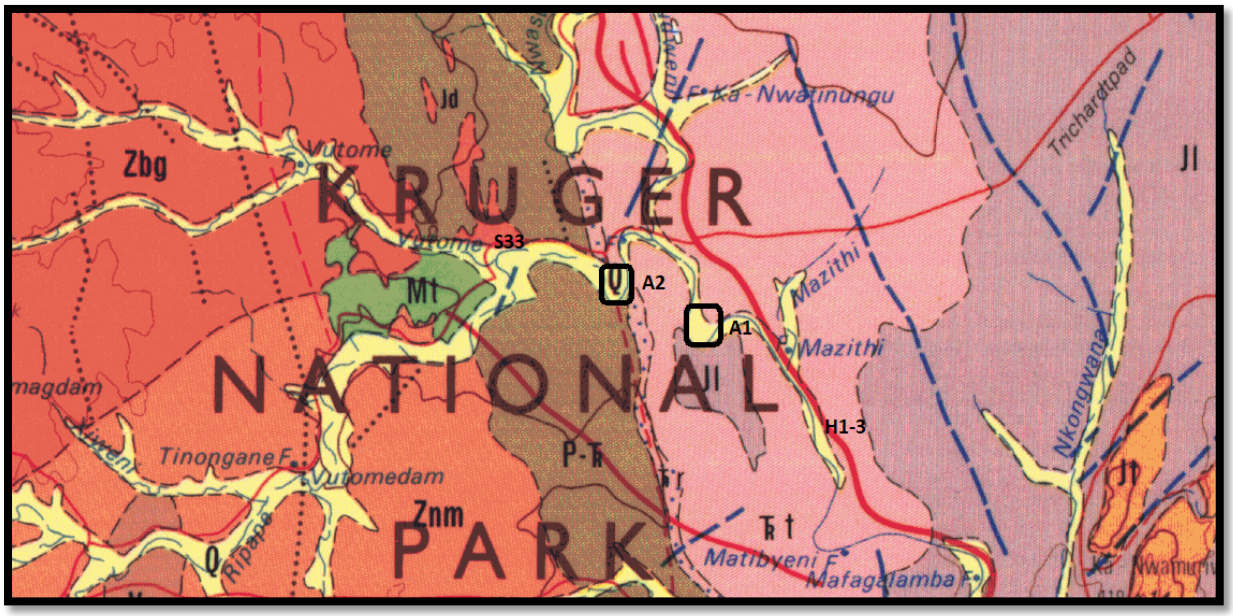
A Palaeontological Impact Assessment is generally warranted where rock units of **LOW** to **VERY HIGH** palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution 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) 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 (1 ha) in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims (**1c)** 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 geological map of 2430 Pilgrims Rest (Walraven 1986).

Tshokwane



Satara

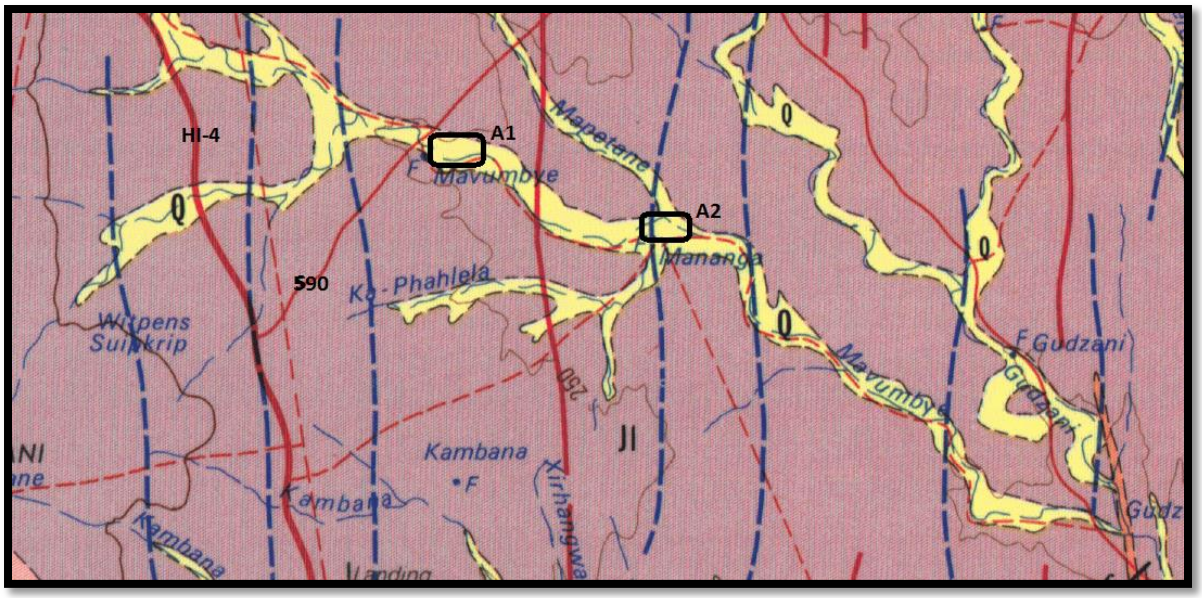


Figure: The geology of the development area.

Legend to Figure and short explanation.

Q – Surficial deposit including alluvium and scree (yellow). Quaternary.

Jl – Brown to green glassy basalt, porphyritic, or amygdaloidal in places (purple). Letaba Formation, Karoo Supergroup. Jura.

TRt – Buff to white, fine-grained, massive sandstone with irregular limestone nodules in places (pink). Tshipise Member, Clarens Formation, Karoo Supergroup. Trias.

P-TR – Cross-bedded quartzitic sandstone, pebbly near base, gritty sandstone, shale (brown). Undifferentiated, Karoo Supergroup. Trias.

Mt – Medium- to coarse-grained gabbro, olivine gabbro and quartz gabbro (green). Timbavati Gabbro. Mokolian.

Znm – Quartz-microcline-plagioclase-biotite migmatite and gneiss with abundant mafic and ultramafic xenoliths; locally recrystallized (:::) (orange). Nelspruit Suite. Zwazian.

Zbg – Grey to pale-brown, medium- to coarse-grained quartz-feldspar-biotite gneiss with subordinate mafic to ultramafic xenoliths (red). Zwazian age rocks.

---f--- – (black) Fault.

……. – Undifferentiated linear structure.

□ – Approximate position of Mobile Tented Camps (in black on figure).

Summary of findings: The Palaeontological Impact Assessment: Phase 1: Field Study was undertaken in July 2022 in winter in dry and cold conditions (Appendix 6 of Act, **1(d)**). As this is a field study the season has an influence on the outcome. The following is reported:

The development is taking place on the Quaternary, Karoo Supergroup and Timbavati sediments. The Zwazian age sediments have a zero palaeontological significance and therefore do not require further action.

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).

Here in the Kruger National Park and northern Limpopo the Clarens Formation is represented by the lowermost Red Rocks Member that shows diagnostic calcareous concretions ranging in diameter from around 1-10 cm. They're unusual in sometimes having fine crystals of calcite in the centre. The grey to mauve sandstone is fine-grained and devoid of any visible bedding (Norman 2013). The second member is the Tshipise Member also present here consisting of white and cream coloured sandstone with calcrete nodules, it reaches a thickness of 300 m in the west (Visser 1989).

To the north of Swaziland, the strata underlying the Clarens Formation have not been differentiated (undifferentiated P-TR) on the published maps (Johnson *et al.* 2006). The sandstones are pinkish to yellowish, with an estimated thickness of some 140 m in the Komatipoort coalfield.

Field Observation – The site visit was conducted by being accompanied by an armed Ranger. The sites are large, but accessible. Trees, lush grass, dangerous animals and the rivers are present. The tented camp at Tshokwane will be situated on sensitive palaeontology, but the Satara tented camp will be situated on Swazian very low sensitivity Letaba basalt. Fossils were not found on the walk-through as outcrops are scares and difficult to spot amongst the lush grass (Figures 5 – 16).

Palaeontology - 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 in the development **HIGH** and **LOW** (SG 2.2 SAHRA APMHOB, 2012) (Almond and Pether 2009).

The Quaternary Formation to Holocene may contain fossils, but not in this area. A wide range of possible fossil remains, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g. calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. Stromatolite structures range from a centimetre to several tens of metres in size (Groenewald and Groenewald 2014).

Aeolianites, belonging to the Jurassic aged Clarens Formation and Tshipise Member contain petrified logs, trace fossils of insects (including controversial fossil termitaria) and dinosaur trackways (possibly *Massospondylus, Syntarsus, / Coelophysis).* Freshwater crustaceans, primitive bony fish (*Semionotus*), crocodylomorphs, early mammals, coprolites, eggshell fragments are also present in the playa lakes (Groenewald and Groenewald 2014).

Recommendation:
The impact of the development on the fossil heritage is **HIGH** and therefore a Phase 1 Palaeontological Impact Assessment: Field Study was recommended. If fossils are found during excavating, grading, or clearing a Phase 2: Mitigation will be necessary (according to SAHRA protocol). The protocol for a Chance Find is attached.

The Project includes two locality Options with two Alternatives each (see Figure 1):
Option 1: The Tshokwane tented camp will be situated to the south of Satara on the rivers Ripape and Nwaswitsontso; and north of Tshokwane. Farms present: Besancon 333-KU and Dijon 335-KU.
Option 2: The Satara tented camp will be situated to the north of the Satara Rest Camp on the river Mavumbye. Farms present: Rietspruit 148-KU and Athlone 155-KU.
Alternative: Both camps have a preferred and Alternative Option which will be used (Figure 1).

As the Satara sites are on the Letaba basalts either Alternatives Mavumbye and Managa will work. For the Tshokwane Option both Alternatives Ripape and Nwaswitsonto may impact on the project as the palaeontological sensitivity is **HIGH**. Alternative 1, the Nwaswitsonto site is situated close to the Quaternary in the riverbed and the Tshipise Member. Alternative 2, the Ripape site is also close to the Quaternary in the riverbed and also situated on the Tshipise Member and has a concealed geological boundary with the Undifferentiated Karoo underneath. Alternative 2 may have the least impact as the road may be closer and should be used as a Preferred.

Concerns/threats to be added to the EMPr (**1k,l,m**):

1. The overburden and inter-burden must always be surveyed for fossils. Special care must be taken during the clearing, digging, grading, 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 the sealing-in, disturbance, damage or destruction of the fossils by development, vehicle traffic, and human disturbance.

The recommendations are (**1g)**:

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 after breaking ground in line with the legally binding Environmental Management Programme (EMPr) this must be updated to include the involvement of a palaeontologist when necessary.
4. The EMPr already covers the conservation of heritage and palaeontological material that may be exposed during construction activities. The protocol is to immediately cease all construction activities if a fossil is unearthed, construct a 30 m no-go barrier, and contact SAHRA for further investigation.

Stakeholders: Developer – BidCo (Pty) Ltd.
Environmental – BidCo. P.O. Box 1081, Somerset West, Western Cape, 7129. Tel: 071 688 8201.
Landowner – SANParks.

C. Table of Contents

A. Title page	1
B. Executive Summary	2
C. Table of Contents	6
D. Background Information on the project	7
E. Description of the Property or Affected Environment	9
F. Description of the Geological Setting	10
G. Background to Palaeontology of the area	20
H. Description of the Methodology	22
I. Description of significant fossil occurrences	25
J. Recommendation	25
K. Conclusions	26
L. Bibliography	26
Acknowledgement	27
Declaration	27
Appendix 1: Exampleas of Quaternary age fossils	29
Appendix 2: Table (Appendix 6 of Act)	29

Appendix 3: Management Plan and Protocol for Chance Finds 30
Appendix 4: Impact Statement 32

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 bold in text). It is also in compliance with SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15 (**2)**.

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. Depending on the presence or absence of fossils in the pre-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, BidCo (Pty) Ltd. wants to establish two seasonal mobile tented camps in the Kruger National Park and operate them for the five months of the dry season.

The dry season is from May to September and one site will be 10 km. to the north-west of the Tshokwane Picnic site and approximately 10 km. to the north-east of the Satara Rest Camp, respectively. The camps will be established in April to be operated from the beginning of May until the end of September each year, and will then be dismantled in October. All of the camp infrastructure will be removed from the sites at the end of each season. Recycling will be employed to deal with waste. Electricity will be provided with low decibel diesel generators and solar packs.

Local benefits of the proposed development include benefits to the local economy. The plan is to boost visitation and provide more accommodation with added job creation.

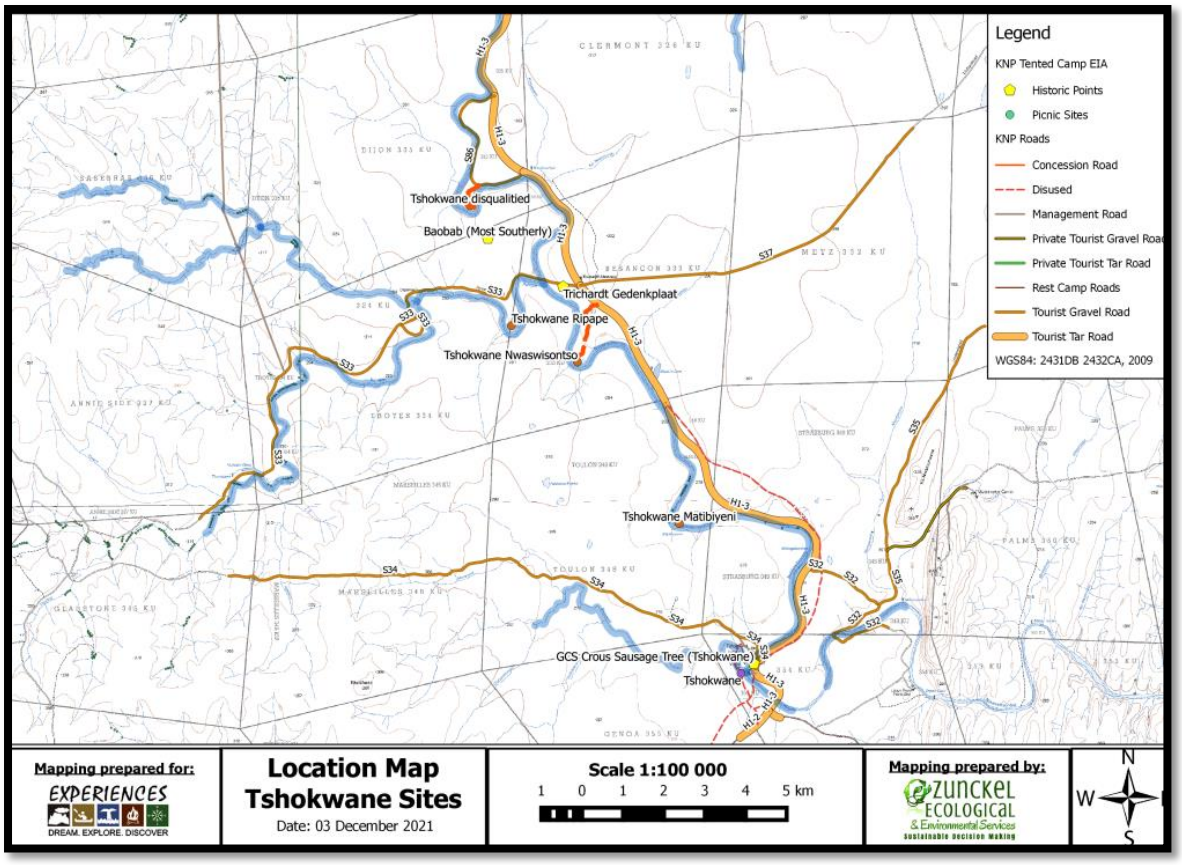


Figure 1a: The location of the preferred and alternative camp sites north of Tshokwane (Zunckel).

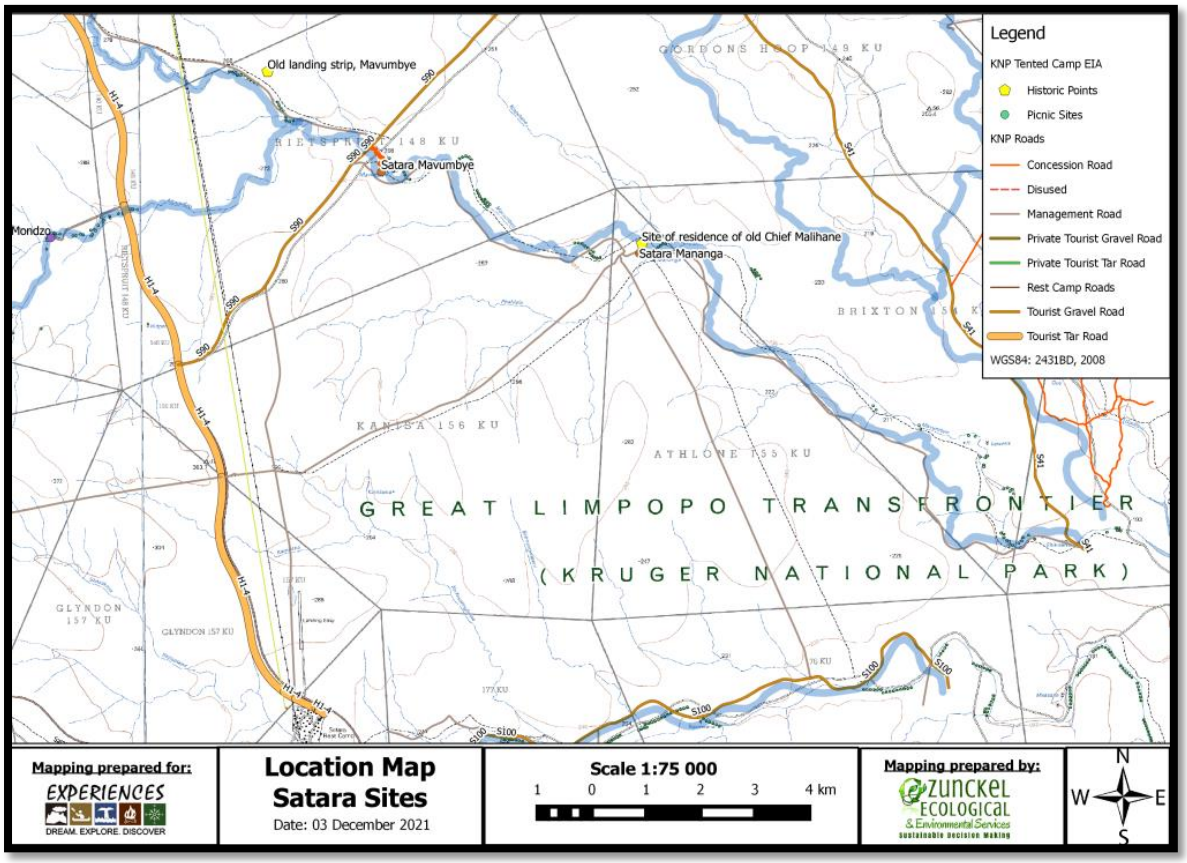


Figure 1b: The location of the preferred and alternative camp sites north of Satara (Zunckel).

The following infrastructure is anticipated:

1. Each camp will consist of 30 two-bed guest tents
2. A communal lounge/dining Bedouin tent
3. A kitchen tent and storage area
4. Tents to accommodate 20-25 staff, a staff lounge/dining tent
5. Parking and access for minivan and trailer and other vehicles
6. Laundry, gas and supply delivery/collection areas
7. Access road and fence

The Project includes one locality Option each with two Alternatives each (see Figure 1):
Option 1: The Tshokwane tented camp will be situated to the south of Satara on the rivers Ripape and Nwaswitsontso; and north of Tshokwane. Farms present: Besancon 333-KU and Dijon 335-KU.
Option 2: The Satara tented camp will be situated to the north of the Satara Rest Camp on the river Mavumbye. Farms present: Rietspruit 148-KU and Athlone 155-KU.
Alternative: Both camps have a preferred and Alternative Option which will be used (Figure 1).

Rezoning/ and or subdivision of land: No.
Name of Developer and Consultant: BidCo (Pty) Ltd. and Zunckel Ecological & Environmental Services.
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.
*Short Curriculum vitae (**1ai,ii**):* 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 17 years (since 2005) she carried out field work in the Eastern Cape, Limpopo, Mpumalanga, Gauteng, Free State and Kwazulu Natal Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 28 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 Mobile Seasonal Tented Camps in the Kruger National Park will be situated in the Bushbuckridge Local Municipality, Ehlanzeni District Municipality, Mpumalanga Province on Farm: Tshokwane - Dijon 335-KU, Besancon 333-KU, Toulon 348-KU Satara: Rietspruit 148-KU, Brixton 154-KU and Athlone 155-KU.

Depth is determined by the related infrastructure, such as the foundations to be developed and the thickness of the formation. 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 mappable surface outcrops. The depth of the Tsiphise Member is 150 m deep.

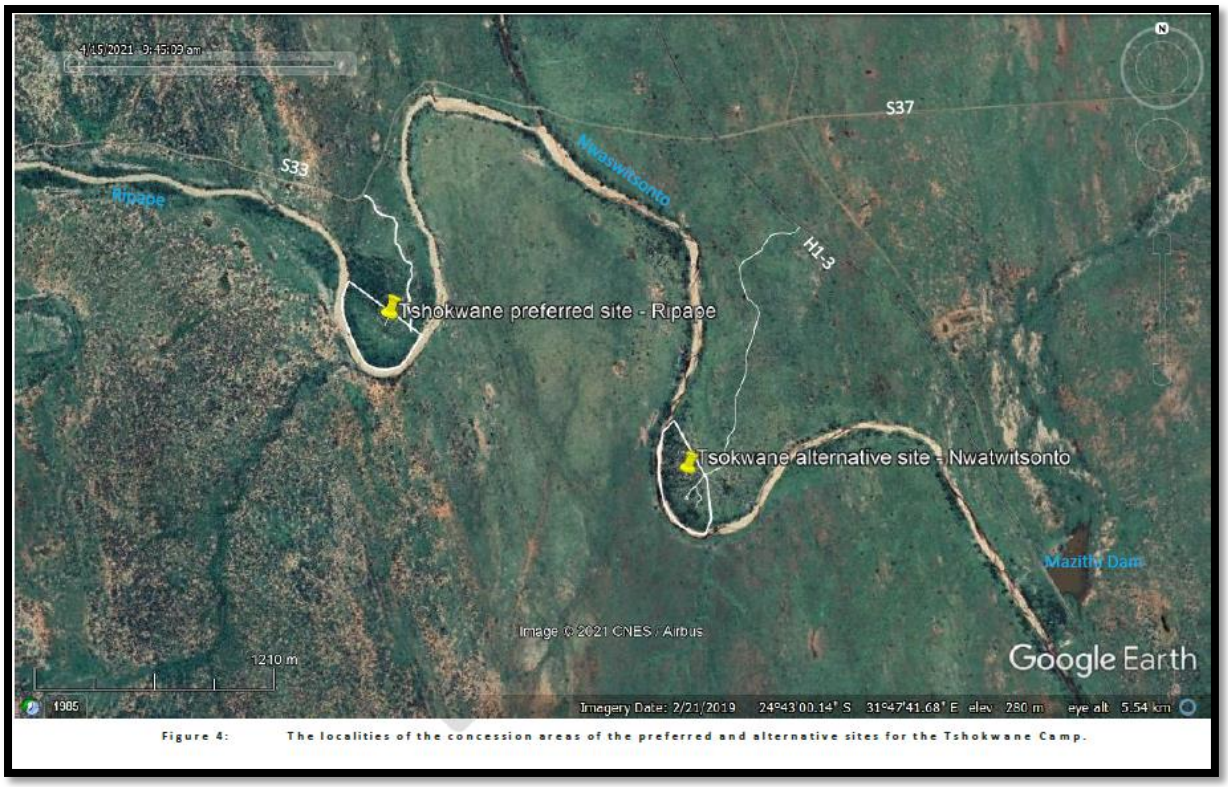


Figure 2a: Location on Google Earth of Tshokwane (Zunckel).

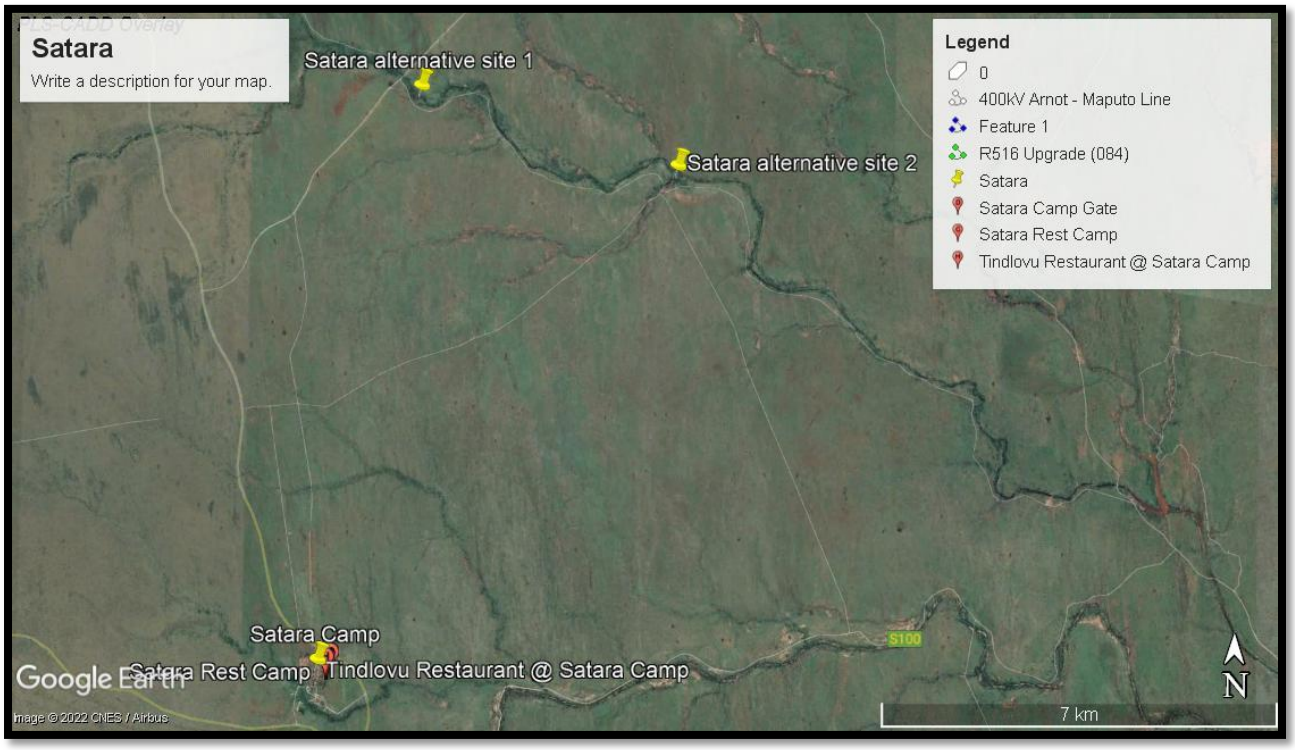


Figure 2b: Location on Google Earth of Satara (Zunckel).

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

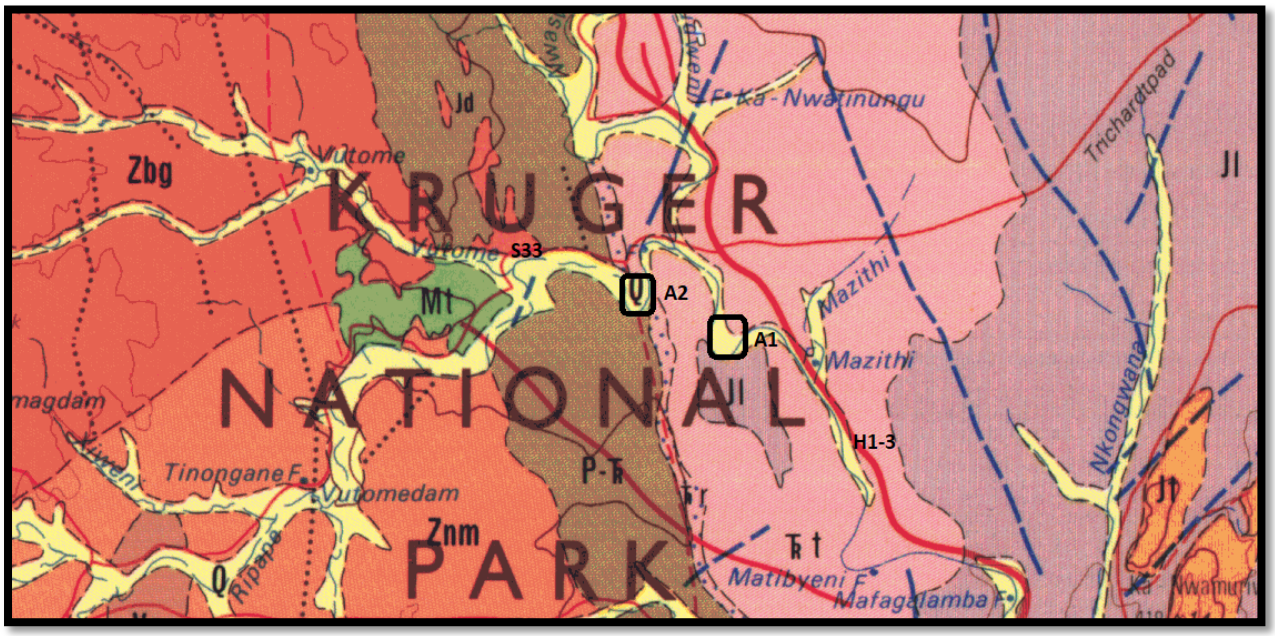
deposits are much more extensive than marine deposits and are terrestrial and usually unfossiliferous. Some of these deposits date back well into the Tertiary, whereas others are still accumulating. Owing to the all-to-often lack of fossils and of rocks suitable for radiometric or palaeomagnetic dating, 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 Muzi Formation is only visible in a few localities as it is mostly covered by the Bluff Formation. It is probably Pliocene to Pleistocene in age and it is no more than 50 m. thick (Kent 1980). This formation occurs in the north of KwaZulu-Natal near the Mozambique border (Visser 1989).

The Karoo Supergroup is renowned for its fossil wealth (Kent 1980, Visser 1989). Large areas of the southern African continent are covered by the Karoo Supergroup. It covers older geological formations with an almost horizontal blanket. Several basins are present with the main basin in the central part of south Africa and several smaller basins towards Lebombo, Springbok Flats and Soutpansberg. An estimated age is 150 – 180 Ma. and a maximum thickness of 7000 m is reached in the south. Three formations overlie the Beaufort Group, they are the Molteno, Elliot and Clarens Formations. At the top is the Drakensberg Basalt Formation with its pillow lavas, pyroclasts, and basalts (Kent 1980, Snyman 1996). The Beaufort Group is underlain by the Ecca Group which is underlain by the Dwyka Group.

The Lebombo Group is divided into three formations with the Mashikiri Formation at the base, followed by the Letaba Formation, Sabie River Formation, Jozini Formation, Mbuluzi Formation and at the top the Movene Formation (Johnson 2006). The Letaba Formation formed a continues lava field across much of southern Africa. Above these basalts lie the Jozini Formation which forms the Lebombo Mountains (Norman, N. and Whitfield, G. 2006). A maximum thickness of 3 600 m. is reached with an age of 177 ± 9 million years.

The Tshokwane Granophyre (Jt) is present here with syenite and granophyre rocks.

Tshokwane



Satara

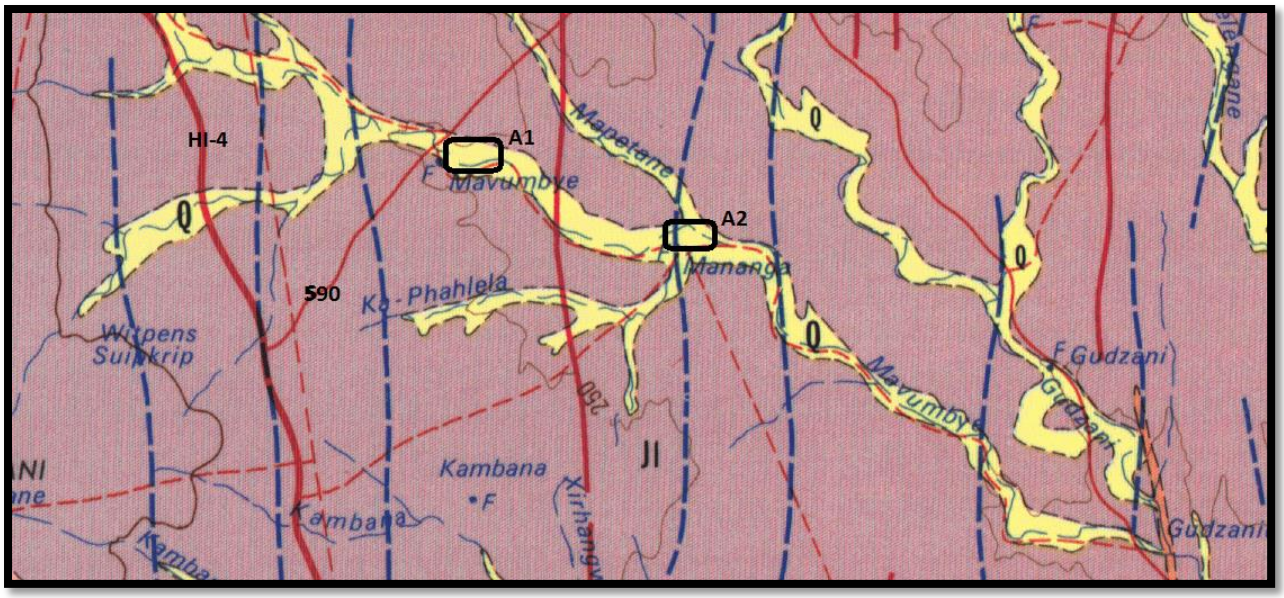


Figure 3: Geology of the area (Pilgrims Rest 2430) (**1h**).

Legend to Figure and short explanation.

Q – Surficial deposit including alluvium and scree (yellow). Quaternary.

Jl – Brown to green glassy basalt, porphyritic, or amygdaloidal in places (purple). Letaba Formation, Karoo Supergroup. Jurassic.

TRt – Buff to white, fine-grained, massive sandstone with irregular limestone nodules in places (pink). Tshipise Member, Clarens Formation, Karoo Supergroup. Trias.

P-TR – Cross-bedded quartzitic sandstone, pebbly near base, gritty sandstone, shale (brown). Undifferentiated, Karoo Supergroup. Trias.

Mt – Medium- to coarse-grained gabbro, olivine gabbro and quartz gabbro (green). Timbavati Gabbro. Mokolian.

Znm – Quartz-microcline-plagioclase-biotite migmatite and gneiss with abundant mafic and ultramafic xenoliths; locally recrystallized (:::) (orange). Nelspruit Suite. Zwazian.

Zbg – Grey to pale-brown, medium- to coarse-grained quartz-feldspar-biotite gneiss with subordinate mafic to ultramafic xenoliths (red). Zwazian age rocks.

---f--- – (black) Fault.

……. – Undifferentiated linear structure.

□ – Approximate position of mobile tented camps (in black on figure).

<u>Mining Activities in study area on Figure above</u>

None.

The mining past and present has no influence on this development.

Here in the Kruger National Park and northern Limpopo the Clarens Formation is represented by the lowermost Red Rocks Member that shows diagnostic calcareous concretions ranging in diameter from around 1-10 cm. They're unusual in sometimes having fine crystals of calcite in the centre. The grey to mauve sandstone is very fine-grained and devoid of any visible bedding (Norman 2013). The second member is the upper <u>Tshipise Member</u> also present here consisting of white and cream coloured sandstone with calcrete nodules, it reaches a thickness of 300 m in the west (Visser 1989). In its type area the Tshipise Member reaches a thickness of 150 m. The Tshipise sandstone outcrops cover much of the northern part of the basin and characteristically form flat-topped koppies. Caves are also common and it lies within the Tshipise basin (Johnson *et al.* 2006).

To the north of Swaziland, the strata underlying the Clarens Formation have not been differentiated (undifferentiated P-TR) on the published maps. The sandstones are pinkish to yellowish, with an estimated thickness of some 140 m in the Komatipoort coalfield. (Johnson *et al.* 2006).

The Timbavati Gabbro comprises a number of mafic and ultramafic intrusions into granitic, gneissic and magmatic Archaean basement rocks of the Mpumalanga Lowveld. It crops out as a series of small hills and ridges in the western half of the Kruger National Park from the Shingwidzi River in the north to the Crocodile River in the south – a distance of approximately 270 km. Estimates of the thickness of the sills vary from around 200 m to between 300 and 480 m. It represents part of the Umkondo magmatic event, the Umkondo Igneous Province (Anhaeuser 2006).

The Nelspruit Batholith (Nelspruit Suite) extends up to 80 km north of the Baberton Greenstone Belt. Two minor intrusions known as the Hebron and Berlin plutons occur. A large volume of magma was required to form the batholith. Age is estimated at 3104 to 3105 million years (Robb *et al.* 2006).

Field Observation: The site visit was conducted by being accompanied by an armed Ranger. The sites are large, but accessible. Trees, lush grass, dangerous animals and the rivers are present. The tented camp at Tshokwane will be situated on sensitive palaeontology, but the Satara tented camp will be situated on Swazian very low sensitivity Letaba basalt. Fossils were not found on the walk-through as outcrops are scares and difficult to spot amongst the lush grass (Figures 5 – 16).

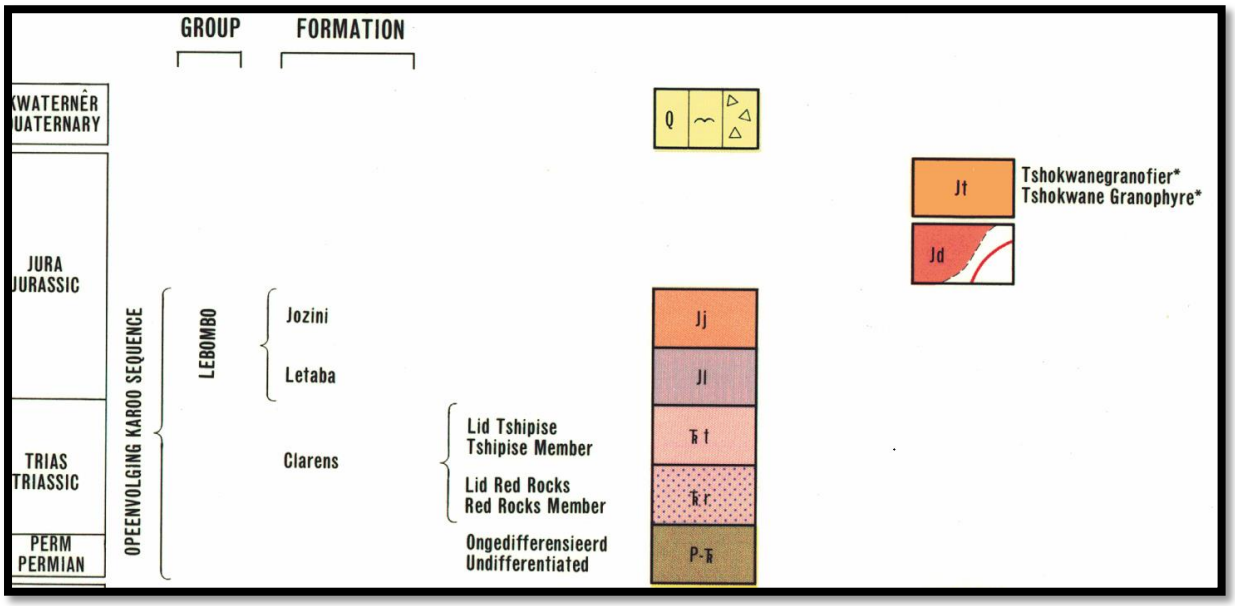


Figure 4: Figure to show lithology.

Figure 5: Tshokwane Nwaswitsonto camp site, general view of Alternative 1.

Figure 6: Cream coloured sandstone boulders are isolated and scattered at Tshokwane Nwaswitsonto.

Figure 7: Area on S33 where track may be made for the Tshokwane Nwaswitsonto camp site.

Figure 8: Tshokwane Ripape Alternative 2 camp site showing lush grass, bushes and trees with very few isolated rocks.

Figure 9: Tshokwane Ripape camp site, typical view with lush grass and trees.

Figure 10: Tshokwane area to show typical cave forming of the Clarens Fromation. This is close to the S33 road.

Figure 11: Satara Mananga camp site Alternative 2.

Figure 12: Satara Mananga camp site, general view of Alternative 2.

Figure 13: Satara Mananga camp site Alternative 1 with very little outcrops, mostly isolated boulders.

Figure 14: Basalt boulders from the Letaba Formation at Satara Mavumbye camp site.

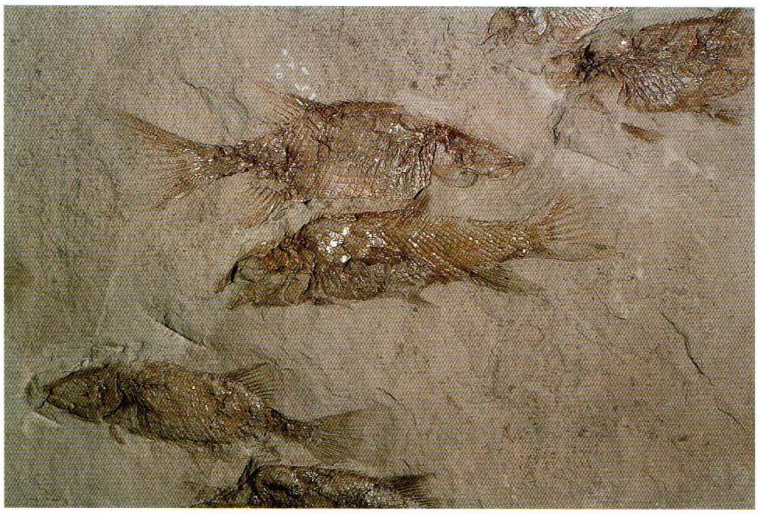
Figure 15: Area across river at Satara Mavumbye camp site.

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).

The Quaternary Formation to Holocene may contain fossils, but not in this area. A very wide range of possible fossil remains, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g. calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. Stromatolite structures range from a centimetre to several tens of metres in size (Groenewald and Groenewald 2014).

Aeolianites, belonging to the Jurassic aged Clarens Formation and Tshipise Member contain petrified logs, trace fossils of insects (including controversial fossil termitaria) and dinosaur trackways (possibly *Massospondylus, Syntarsus, / Coelophysis).* Freshwater crustaceans, primitive bony fish (*Semionotus*), crocodylomorphs, early mammals, coprolites, eggshell fragments are also present in the playa lakes (Groenewald and Groenewald 2014).

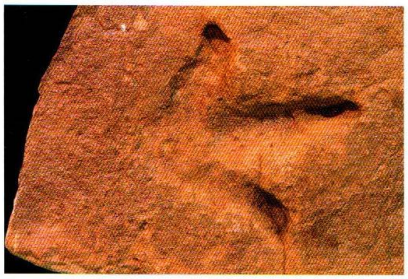


Semionotis capensis from the Clarens Formation on the farm Daskop, Free State Province. These fish existed some 180 million years ago in small oasis-type lakes in an essentially sand dune dominated desert setting, and died when the small water bodies periodically dried up.
Specimen at the top 170 mm long.
In the Museum of Natural History, Pretoria.
Photograph C.S. MacRae

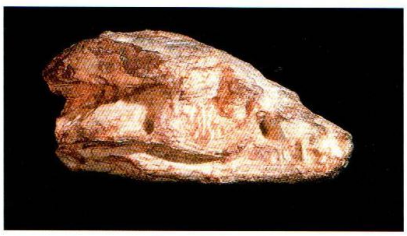
List of fossils of the *Massospondylus* Assemblage Zone

From Kitching and Raath, 1984

VERTEBRATES	
Pisces	*Ceratodus* sp., *Semionotus capensis*
Amphibia	Brachyopid
Amniota	
Saurischia:	*Massospondylus carinatus* , *Syntarsus* sp. (?*rhodesiensis*), dinosaur eggs indet.
Ornithischia:	*Fabrosaurus australis*, *Lycorhinus angustiden*, *Heterodontosaurus tucki*, *Abrictosaurus consors*, *Geranosaurus atavus*, *Lanasaurus scapridens*
Thecodontia:	*Sphenosuchus acutus*, *Pedeticosaurus leviseurusi*
Crocodilia:	*Orthosuchus stormberg*, *Baroqueosuchus haughtoni*
Chelonia:	*Australochelys africanus*
Synapsida	
Cynodontia:	*Pachygenalus monus*
Tritylodontia:	*Tritylodon longaevus*, *Trithelodon riconoi*
Mammalia	
Eotheria:	*Megazostrodon rudnerae*, *Erythrotherium parringtoni*
PLANT FOSSILS	Silicified wood



Dinosaurs were present during Clarens Formation times, although their bones were not often fossilized. Tracks produced by these reptiles have been preserved on a number of surfaces in the Clarens Formation. This typical three-toed footprint was collected near Leribe in Lesotho. Imprint 110 mm across.
In the East London Museum.
Photograph C.S. MacRae



Protosuchus, from the *Tritylodon* Acme Zone, was a small armoured primitive crocodilian that probably scavenged and opportunistically hunted on the dry Elliot Formation floodplains. Note the characteristic sharp, peg-like teeth.
Skull 50 mm long.
In the Bernard Price Institute for Palaeontological Research, Johannesburg.
Photograph C.S. MacRae

Figure 16: Examples of Clarens Formation fossils (MacRae 1999).

Table 1: Taken from Palaeotechnical Report (Groenewald 2012) **(1cA, 1cB)**.

mmm; Q-a; Q-sc; Q8. Several symbols used for alluvium, colluvium and scree		Recent sandy and clayey deposists along water courses	Wide range of fossils possible, including mammalian bones and teeth, tortoise remains, ostrich egg etc	Alluvial deposits associated with recent water courses of main rivers and streams. These sediments are presently not well studied and records of fossil occurrences are mainly associated with archaeological reports	

INTRUSIVE ROCKS	TSHOKWANE GRANOPHYRE (Jts)		Syenite (Jt; J2) Ijolite (J3) (Jts)		Syenite, granophyre	No fossils recorded	
KOMATIPOORT SUITE (Jkg; Jk)			Jk1; Jk2		Granophyre and Gabbro	No fossils recorded	
KAROO (Undifferentiated Karoo (P-TR; C-Ak))	DOLERITE (Jd)				Dolerite intrusions Early Jurassic 183 2 Ma	No fossils recorded	Karroo-Ferrar igneous intrusions associated with Early Jurassic global mass extinction event
	LEBOMBO		Josini (Jj) Letaba Sabi River (J; Jl; Jle)		Up to 13 km of volcanic rocks (basic and acid lavas) and rare interbedded sandstones. Early Jurassic 183 2 Ma	Fossils might occur within thin sedimentary intervals (e.g. plants, traces, bones)	
			Clarens (TR; TRc) (Probably Upper Elliot and Clarens)	Tshipise (Jt)	Cream-coloured aeolian sandstone, playa lake deposits ("Cave Sandstone") Clarens of Main Karoo Basin	Aeolianites contain petrified logs, trace fossils of insects (including controversial fossil termitaria), dinosaur trackways (possibly ***Massospondylus, Syntarsus / Coelophysis***).	Stratigraphic context of dinosaur fossils often unclear in the literature. Note revised stratigraphy and correlations with Main Karoo Basin proposed in recent papers on Tuli Basin by E. Bordy (UCT): Upper Unit P-Trkb in part Red Rocks Member (Elliot Fm)
				Red Rocks (Jrr)	Pale red argillaceous sandstone with calcareous concretions (fluvial / sabkha setting). White silcrete at top of succession, beneath Tshipise Mb Prob. Upper Elliot of Main Karoo Basin	Skeletal remains of dinosaurs (***Massospondylus***), possible dinosaur eggshells, dinosaur and other tracks, trace fossils of insects and root casts	

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**.

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

Rock Unit	Significance/vulnerability	Recommended Action
Q	Low	Protocol for Chance Finds
Letaba	Low	Protocol for Chance Finds
Tshipise	High	Desktop study and field assessment may be required
Undifferent	High	Desktop study and field assessment may be required
Timbavati	Very Low	No action required
Nelspruit	Very Low	No action required

Databases and collections: Ditsong: National Museum of Natural History.
Impact: **VERY LOW**, **LOW** and **HIGH**. 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.

Option 1: The Tshokwane tented camp will be situated to the south of Satara on the rivers Ripape and Nwaswitsontso; and north of Tshokwane. Farms present: Besancon 333-KU and Dijon 335-KU.
Option 2: The Satara tented camp will be situated to the north of the Satara Rest Camp on the river Mavumbye. Farms present: Rietspruit 148-KU and Athlone 155-KU.
Alternative: Both camps have a preferred and Alternative Option which will be used (Figure 1).

As the Satara sites are on the Letaba basalts either Alternatives Mavumbye and Managa will work. For the Tshokwane Option both Alternatives Ripape and Nwaswitsonto may impact on the project as the palaeontological sensitivity is **HIGH**. Alternative 1, the Nwaswitsonto site is situated close to the Quaternary in the riverbed and the Tshipise Member. Alternative 2, the Ripape site is also close to the Quaternary in the riverbed and also situated on the Tshipise Member and has a concealed geological boundary with the Undifferentiated

Karoo underneath. Alternative 2 may have the least impact as the road may be closer and should be used as a Preferred.
All the land involved in the development was assessed **(ni,nii)** and none of the property is unsuitable for development (see Recommendation B).

H. Description of the Methodology (1e)
The palaeontological impact assessment: field study was undertaken in July 2022. A Phase 1: Field Study will entail a walkthrough of the affected portion with photographs (in 20 mega pixels) taken of the site with a digital camera (Canon PowerShot SX620HS). A Global Positioning System (GPS (Garmin eTrex 10) can be used to record the outcrops. A literature survey is included and the study relied on literature, geological maps, google.maps and google.earth images. A tablet **could not** be used for navigation to and on-site due to the lack of satellite signal.

SAHRA Document 7/6/9/2/1 only requires track records/logs from archaeologists not palaeontologists as palaeontologists concentrate on outcrops which may be recorded on a GPS. 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 of the region is used to predict what type of fossil and zone will be found in any particular region. An archaeozoologist can be called upon to assess more recent quaternary and tertiary deposits.

Assumptions and Limitations **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. Inaccessibility of site.
7. Insufficient data from developer and exact lay-out plan for all structures.
8. A lack of satellite signal for accurate navigation.

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

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.

The Quaternary Formation to Holocene may contain fossils, but not in this area. A very wide range of possible fossil remains, though these are often sparse, such as: mammalian bones and teeth, tortoise remains, ostrich eggshells, non-marine mollusc shells, ostracods, diatoms, and other micro fossil groups, trace fossils (e.g. calcretised termitaria, rhizoliths, burrows, vertebrate tracks), freshwater stromatolites, plant material such as peats, foliage, wood, pollens, within calc tufa. Stromatolite structures range from a centimetre to several tens of metres in size (Groenewald and Groenewald 2014).

Aeolianites, belonging to the Jurassic aged Clarens Formation and Tshipise Member contain petrified logs, trace fossils of insects (including controversial fossil termitaria) and dinosaur trackways (possibly *Massospondylus, Syntarsus, / Coelophysis).* Freshwater crustaceans, primitive bony fish (*Semionotus*), crocodylomorphs, early mammals, coprolites, eggshell fragments are also present in the playa lakes (Groenewald and Groenewald 2014).

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, clearing, and human disturbance. See Description of the Geological Setting (F) above.

J. Recommendation (1o,p,q)

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 ascertain if fossils are present. If fossils are found during excavating, clearing, or grading a Phase 2: Mitigation will be necessary. The palaeontological sensitivity is **HIGH** and fossils (invertebrates) may be present.
b. This project may benefit the economy, the growth of the Park and social development of the community in general.
c. Preferred choice: Both Options with both Alternatives are presented and possible.
d. 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 (not necessarily done for this project). The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting SAHRA must be notified (not necessarily done for this project). All grading activities must be stopped, a 30 m no-go barrier constructed and a palaeontologist should be called in to determine proper mitigation measures.
e. No consultation with parties was necessary (**1o,p,q).**

f. This report must be submitted to SAHRA together with the HIA.

Sampling and collecting:
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 Palaeontological Impact Assessment Study was provided by the Consultant. All technical information was provided by Zunckel Ecological & Environmental Services.
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 clearing, digging and excavating, SAHRA must be notified. All development activities must be stopped, a 30 m no-go barrier constructed, 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 (fossils) and adjacent areas as well as for safety and security reasons.

L. Bibliography

ALMOND, J., PETHER, J, and GROENEWALD, G. 2013. South African National Fossil Sensitivity Map. SAHRA and Council for Geosciences.

ANHAEUSER, C.R. 2006. 4. Ultramafic and Mafic Intrusions of the Kaapvaal Craton. *Geology of South Africa.* Pp 95-135.

DE ZANCHE, V. and MIETTO, P. 1977. *The World of Fossils.* Sampson Low Guides, Berkshire, Printed in Italy, Pp 256.

GROENEWALD, G. and GROENEWALD, D. 2014. SAHRA Palaeotechnical Report of the Mpumalanga Province. South African Heritage Resources Agency, Pp 1-20.

JOHNSON, M.R., VAN VUUREN, C.J., COLE, D.I., DE V WICKENS, H. CHRISTIE, A.D.M., ROBERTS, D.L., AND BRANDL, G. 2006. 22 Sedimentary Rocks of the Karoo Supergroup, *Geology of South Africa,* Council for Geoscience, Pretoria. Pp 461 – 200.

KENT, L. E., 1980. Part 1: Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia and the Republics of Bophuthatswana, Transkei and Venda. SACS, Council for Geosciences, *Stratigraphy of South Africa. 1980. South African Committee for Stratigraphy.* Handbook 8, Part 1, Pp 690.

KEYSER, A.W., MACRAE, C.S., VILJOEN, M.J., WINTERBACH, D.J. and WORST, B. 1992. Some superlatives of geology in southern Africa. Presented by The Geological Society of South Africa on occasion of the 29th International Geological Congress, Kyoto, Japan. Pp 20.

MCCARTHY, T and RUBIDGE, B. 2005. *The Story of Earth Life: A southern African perspective on a 4.6-billion-year journey.* Struik. Pp 333.

NORMAN, N. 2013. *Geology off the beaten track: exploring South Africa's hidden treasures.* De Beers, Struik, Pp 1-256.

NORMAN, N. and WHITFIELD, G., 2006. *Geological Journeys.* De Beers, Struik, Pp 1-320.
PARTRIDGE, T.C., BOTHA, G.A. and HADDON, I.G. 2006. *Geology of South Africa, 29: Cenozoic Deposits of the Interior. Pg 20.*
ROBB, L.J., BRANDL, G. ANHAEUSER, C.R. and POUJOL, M. 2006. 3. Archaean Granitoid Intrusions. *Geology of South Africa.* Pp 57-95.
SG 2.2 SAHRA APMHOB Guidelines, 2012. Minimum standards for palaeontological components of Heritage Impact Assessment Reports, Pp 1-15.
SNYMAN, C. P., 1996. *Geologie vir Suid-Afrika*. Departement Geologie, Universiteit van Pretoria, Pretoria, Volume 1, Pp. 513.
VAN DER WALT, M., DAY, M., RUBIDGE, B. S., COOPER, A. K. & NETTERBERG, I., 2010. Utilising GIS technology to create a biozone map for the Beaufort Group (Karoo Supergroup) of South Africa. *Palaeontologia Africana,* **45:** 1-5.
VISSER, D.J.L. (ed) 1984. Geological Map of South Africa 1:100 000. South African Committee for Stratigraphy. Council for Geoscience, Pretoria.
VISSER, D.J.L. (ed) 1989. *Toeligting: Geologiese kaart (1:100 000). Die Geologie van die Republieke van Suid Afrika, Transkei, Bophuthatswana, Venda, Ciskei en die Koningkryke van Lesotho en Swaziland*. South African Committee for Stratigraphy. Council for Geoscience, Pretoria, Pp 494.
WALRAVEN, F. 1986. 1:250 000 Geological Map of Pilgrims Rest 2430. South African Committee for Stratigraphy. Council for Geoscience, Pretoria.

Acknowledgement
With thanks to my assistant Candice Devenish, the team from SANParks, including Shanè Gertze, Naki Namethe, Julie Bryden, Rob Thomson, Robert Bryden; the two Rangers, Sipho and Rhanos; Lysta Stander from SA Experiences; and Kevan Zunckel from Zunckel Ecological & Environmental Services.

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.

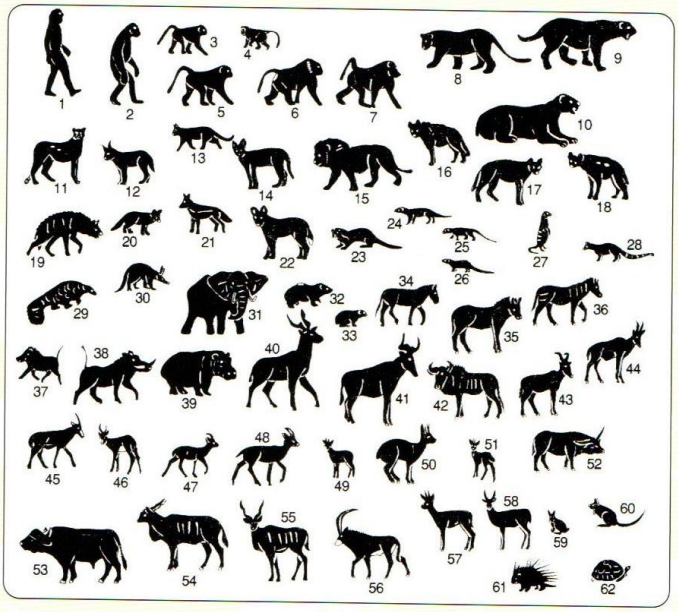
It may be possible that the Desktop Study may have missed palaeontological resources in the project area as the presence of outcrops are not known or visible due to vegetation while others may lie below the overburden of earth and may only be found once development commences.
This report may not be altered in any way and any parts drawn from this report must make reference to this report.

<u>POPI Act 2013 Statement</u>
It provides that everyone has the right to privacy and includes a right to protection against the unlawful collection, retention dissemination and use of personal information contained in this document and pertains to the phone and contact details, signature and contents.

As per the Declaration Section none of the information may be shared without the permission of the author.

Heidi Fourie
2022/08/05

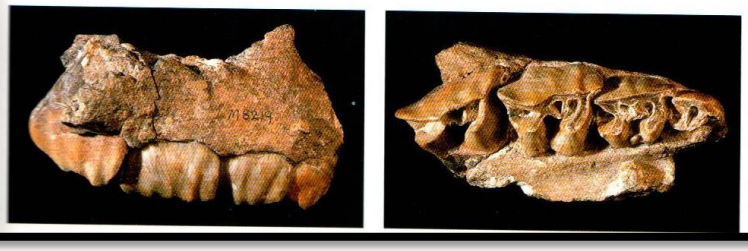
Appendix 1: Examples of Quaternary age fossils (MacRae 1999)



Silhouette representation of the larger vertebrates whose remains are represented in Members 1-3 of the Swartkrans site on the outskirts of the town of Krugersdorp. Numbers after each taxon comprise minimum numbers of individuals represented in the remains of the lower bank (Member 1), hanging remnant (Member 1), Member 2 and Member 3 respectively.
Courtesy of Dr C.K. Brain.
Museum of Natural History, Pretoria

FAUNA FROM MEMBERS 1 - 3, SWARTKRANS (Makapanian Mammal Age)
Courtesy Dr B. Brain, - Museum of Natural History, Pretoria

1: *Homo erectus* (man) 1,3,2,0. **2**: *Australopithecus robustus* (robust apeman) 13,87,17,9. **3**: *Parapapio jonesi* 0,8,0,0. **4**: *Cercopithecoides* sp. 1,0,0,0. **5**: *Papio hamadryas robinsoni* 6,38,8,11. **6**: *Theropithecus oswaldi danieli* 1,17,1,14. **7**: *Dinopithecus ingens* 1,26,0,0. **8**: *Panthera pardus* (leopard) 4,12,2,5. **9**: *Dinofelis* sp. (false sabre-toothed cat) 0,1,0,0. **10**: *Megantereon* sp. (dirk-toothed cat) 0,1,0,1. **11**: *Acinonyx jubatus* (cheetah) 0,1,0,1. **12**: *Felis caracal* (caracal) 1,0,0,0. **13**: *Felis lybica* (African wild cat) 0,0,0,1. **14**: *Felis serval* (serval) 1,0,0,0. **15**: *Panthera leo* (lion) 1,1,0,0. **16**: *Hyaena brunnea* (brown hyaena) 1,4,2,3. **17**: *Chasmaporthetes nitidula* (hunting hyaena) 2,8,1,2. **18**:*Crocuta crocuta* (spotted hyaena) 0,2,1,1. **19**: *Proteles* sp. (large fossil aardwolf) 1,1,0,1. **20**: *Vulpes* sp. (fox) 0,2,0,3. **21**: *Canis mesomelas* (black-backed jackal) 3,4,4,5. **22**: Large canid gen. and sp. indet. 0,0,1,1. **23**: *Aonyx capensis* (Cape clawless otter) 2,0,1,2. **24**: *Atilax* sp. (water mongoose) 0,0,1,1. **25**: *Cynictis penicillata* (yellow mongoose) 0,0,1,1. **26**: *Herpestes ichneumon* (large grey mongoose) 1,0,0,0. **27**: *Suricata suricatta* (suricate) 0,0,2,1. **28**: *Genetta tigrina* (large-spotted genet) 0,0,0,1. **29**: *Manis* sp. (pangolin) 0,0,0,1. **30**: *Orycteropus afer* (antbear) 1,0,1,1. **31**: cf. *Elphas* sp. 2,0,0,1. **32**: *Procavia transvaalensis* (large fossil dassie) 3,8,3,5. **33**: *Procavia antiqua* (fossil dassie) 17,16,10,11. **34**: *Hipparion lybicum steytleri* (three-toed horse) 1,1,1,1. **35**: *Equus capensis* (giant Cape horse) 2,6,3,5. **36**: *Equus burchelli* (Burchell's zebra) 0,0,0,1. **37**: *Phacochoerus* sp. (warthog) 1,0,3,1. **38**: cf. *Tapinochoerus meadowsi* (large fossil pig) 1,7,1,1. **39**: *Hippopotamus* sp. (hippopotamus) 1,0,0,1. **40**: Giraffid 0,1,1,1. **41**: *Megalotragus* sp. (giant hartebeest) 0,3,1,3. **42**: *Connochaetes* sp. (wildebeest) 7,19,7,7. **43**: Medium alcelaphine: *Alcelaphus* sp. or *Beatragus* sp. (hartebeest) 3,22,3,6. **44**: *Rabaticerus porrocornutus* 0,2,0,0. **45**: *Damaliscus* sp. (blesbok) 2,4,6,6. **46**: *Antidorcas marsupialis australis* (springbok) 11,0,10,18. **47**: *Antidorcas recki* 0,6,2,1. **48**: cf. *Gazella* sp. (gazelle) 5,6,5,14. **49**: *Oreotragus oreotragus* (klipspringer) 1,0,0,1. **50**: *Oreotragus major* (fossil klipspringer) 0,1,0,0. **51**: *Raphicerus campestris* (steenbok) 1,0,1,3. **52**: *Makapania* sp. (musk ox) 0,3,0,0. **53**: *Syncerus* sp. (buffalo) 2,3,2,3. **54**: *Taurotragus oryx* (eland) 0,0,1,1. **55**: *Tragelaphus strepsiceros* (kudu) 0,4,0,1. **56**: *Hippotragus* cf. *niger* (sable) 0,0,1,3. **57**: *Pelea* sp. (rhebck) 0,2,0,2. **58**: *Redunca arundinum* (reedbuck) 0,1,0,0. **59**: Lagomorph gen. and sp. indet. (hare) 9,0,4,7. **60**: *Pedetes* sp. (springhare) 1,0,1,1. **61**: *Hystrix africaeaustralis* (porcupine) 2,2,1,2. **62**: *Chelonia* indet. (tortoise) 1,0,2,2.



Left: Teeth of the white rhino *Ceratotherium simum* from Makapansgat. **Right**: View from above shows the sharp cutting edges of the tooth row of this predominant grazer. Specimen 170 mm long.
In the collection of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, Johannesburg.
Photograph C.S. MacRae

Appendix 2: Table listing points in Appendix 6 of the Act and position in Report (in bold).

Section in Report	Point in Act	Requirement

B	1(c)	Scope and purpose of report
B	1(d)	Duration, date and season
B	1(g)	Areas to be avoided
D	1(ai)	Specialist who prepared report
D	1(aii)	Expertise of the specialist
F Figure 3	1(h)	Map
F	1(ni)	Authorisation
F	1(nii)	Avoidance, management, mitigation and closure plan
G Table 1	1(cA)	Quality and age of base data
G Table 2	1(cB)	Existing and cumulative impacts
G	1(f)	Details or activities of assessment
G	1(j)	Description of findings
H	1(e)	Description of methodology
H	1(i)	Assumptions
J	1(o)	Consultation
J	1(p)	Copies of comments during consultation
J	1(q)	Information requested by authority
Declaration	1(b)	Independent declaration
Appendix 2	1(k)	Mitigation included in EMPr
Appendix 2	1(l)	Conditions included in EMPr
Appendix 2	1(m)	Monitoring included in EMPr
D	2	Protocol or minimum standard

Appendix 3: Management Plan and Protocol for Chance Finds (**1k,l,m)**.

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. 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 material that may be exposed during construction activities.

- 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.
- If fossils have already been found they must be kept in a safe place for further inspection.
- The ECO should familiarise him- or herself with the formations and its fossils. A site visit after blasting, drilling, clearing or excavating is recommended and the keeping of a photographic record when feasible.
- Most museums and universities have good examples of 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. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work.
3. 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.
4. 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.
5. 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.
6. 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).

7. 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.

Appendix 4: Impact Statement

The development footprint is situated on a geological layer a high palaeontological sensitivity. The nature of the impact is the destruction of Fossil Heritage. Loss of fossil heritage will have a negative impact. The extent of the impact only extends in the region of the development activity footprint and may include transport routes. The expected duration of the impact is assessed as potentially permanent. The intensity/magnitude of the impact is moderate as it may continue in a modified way. The probability of the impact occurring will be high.

In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be permanent. The loss of resources occurs but natural cultural and social processes continue, albeit in a modified manner. With Mitigation the impact will be low and the cumulative impact is low. Impacts on palaeontological heritage during the construction and preconstruction phase could potentially occur but are regarded as having a moderate possibility. The significance of the impact occurring will be S = (2+5+8)4

60 Medium (30-60).