

**DESKTOP PALAEOLOGICAL
ASSESSMENT AND CHANCE FIND
PROTOCOL FOR THE PROPOSED NKOMAZI
GAME RESERVE (PTY) LTD PROJECT.
MACADAMIA FARMING ADJACENT TO
NKOMAZI GAME RESERVE, NEAR
TJAKASTAD, MPUMALANGA PROVINCE**

FOR

CORE Environmental Services

DATE: 13 December 2020

By

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EXECUTIVE SUMMARY

Dr Gideon Groenewald was appointed to undertake a Desktop Palaeontological Assessment Survey and to develop a Chance Find Protocol document (CFP) for the proposed Nkomazi Game Reserve Macadamia Agricultural Project in the Albert Luthuli Local Municipality of the Gert Sibande District Municipality in the Mpumalanga Province.

This Desktop Survey is done as preparation of a Chance Find Protocol since very large parts of this development fall in areas underlain by geological formations with a known low to very low sensitivity for Palaeontological Heritage.

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017). In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts on Palaeontological Heritage within the development footprint.

The development site applicable to the application for the proposed Nkomazi Game Reserve Macadamia Agricultural Project in the Albert Luthuli Local Municipality of the Gert Sibande District Municipality in the Mpumalanga Province is underlain by Swazian aged metamorphic rocks of the Barberton Supergroup and granites of the Kaap Valley Granite Suite. No significant fossils are expected from the areas underlain by granite.

If by any chance, excavation expose fossils, it will be very important that a suitably qualified Palaeontological Specialist be appointed to do a Phase 1 PIA and to implement the Chance Find Protocol document included in this report (Appendix A). The CFP document must then be included as part of the EMPr of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a low and very low palaeontological sensitivity is allocated to the study area.

- No further mitigation for Palaeontological Heritage is recommended. If, however, any observations of possible fossils are made, the developer must appoint a suitably qualified palaeontologist to implement the Chance Find Protocol (Appendix A).

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INTRODUCTION

Dr Gideon Groenewald was appointed to undertake a Desktop Palaeontological Assessment Survey and to develop a Chance Find Protocol document (CFP) for the proposed Nkomazi Game Reserve Macadamia Agricultural Project in the Albert Luthuli Local Municipality of the Gert Sibande District Municipality in the Mpumalanga Province.

This Desktop Survey is done as preparation of a Chance Find Protocol since very large parts of this development fall in areas underlain by geological formations with a known low to very low sensitivity for Palaeontological Heritage.

Legal Requirements

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 (revised 2017). In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts on Palaeontological Heritage within the development footprint.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

It is an explicit statement in terms of this report, that the developer is aware of important geological features in this region and that the known geo-sites are being avoided with no impact that will cause damage to known geological heritage sites in this region.

Aims and Methodology

A desktop investigation is often the only opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports" the aims of the Palaeontological Impact Assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/ or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to a field investigation, a preliminary assessment (Desktop Study) of the topography and geology of the study area is made, using appropriate 1:250 000 geological information (2530 Barberton) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) are identified within the study area and the known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas are identified within the development footprint to focus the field investigator's time and resources. The aim of the Desktop Survey is to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the minimal extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/ VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008) and Groenewald et al., (2014)	
RED	Very high palaeontological sensitivity/ vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, Desktop Survey, Phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and Phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High palaeontological sensitivity/ vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, Desktop Survey and Phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate palaeontological sensitivity /vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example, areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, Desktop Survey and Phase I PIA (ground proofing of Desktop Survey) compulsory.

<p>BLUE</p>	<p>Low palaeontological sensitivity/ vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a Desktop Survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. Collection of a representative sample of potential fossiliferous material recommended. At least a Desktop Survey and Chance Find Protocol are compulsory. The Chance Find Protocol must be included in the EMPr for the project.</p>
<p>GREY</p>	<p>Very low palaeontological sensitivity/ vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during emplacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a</p>

	<p>palaeontologist must be appointed to do a Desktop Survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least a Desktop Survey and Chance Find Protocol document is compulsory. The Chance Find Protocol must be included in the EMP of the project.</p>
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When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, palaeontological mitigation measures must be incorporated into the Environmental Management Plan (EMP). A suitably qualified palaeontologist must clear all projects falling on low to very low palaeontological sensitive geology.

Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA and the Kingdom of Lesotho. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous “drift” (soil, alluvium etc.).

Proposed Development

According to the final Scoping Report, Nkomazi Game Reserve (Pty) Ltd is proposing to clear vegetation to establish an agricultural area for the purpose of macadamia farming.

The project will include the following:

- Clearance of approximately 2000 hectares of indigenous vegetation.
- Construction of 3 dehusking plants

In accordance with the National Environmental Management Act 107 of 1998, GNR 983 of 2014 (as amended in 2017), an Environmental Authorisation (EA) is required before any clearance activities can take place. Nkomazi Game Reserve (Pty) Ltd subsequently appointed **Core Environmental Services** to apply for the EA by means of conducting a Scoping and Environmental Impact Assessment process as regulated within General Notice Regulation 982, 2014 (as amended in 2017).

The development falls along the R541 near Badplaas, Mpumalanga Province, in rural undisturbed terrain underlain by sandy and clayey soils of mainly deeply weathered rocks of the Barberton Supergroup (Figure 1).

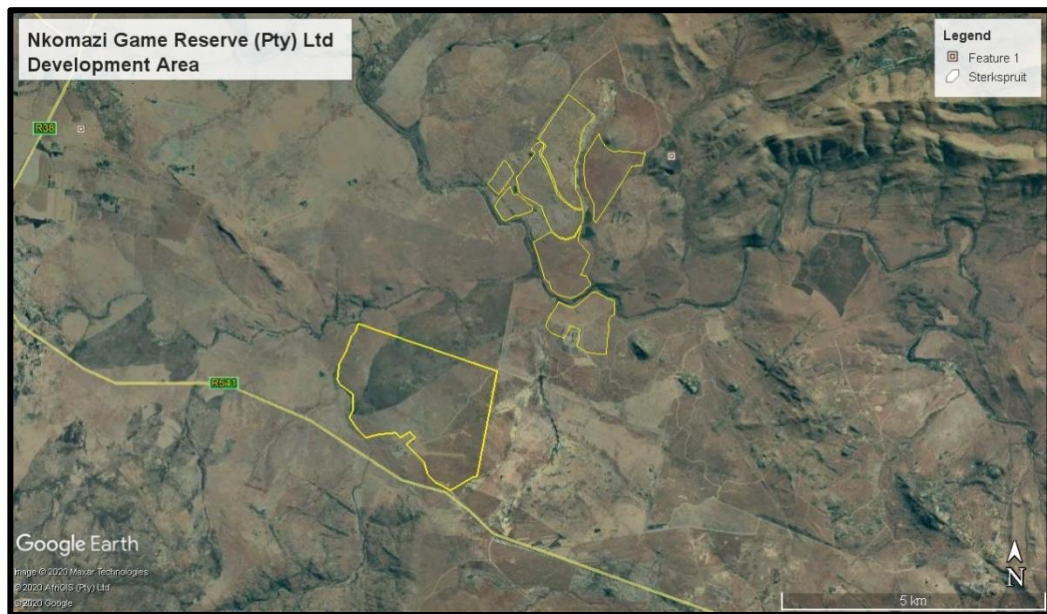


Figure 1. Locality of the Study Area for the Nkomazi Game Reserve Agricultural Project delineated in yellow polygons

GEOLOGY

The study area is underlain predominantly by Swazian aged rocks of the Kaapvaal Craton and the site is underlain by granite and other igneous and metamorphic rocks that are part of the well-known Barberton Mountainland geological heritage site in South Africa. (Figure 2).

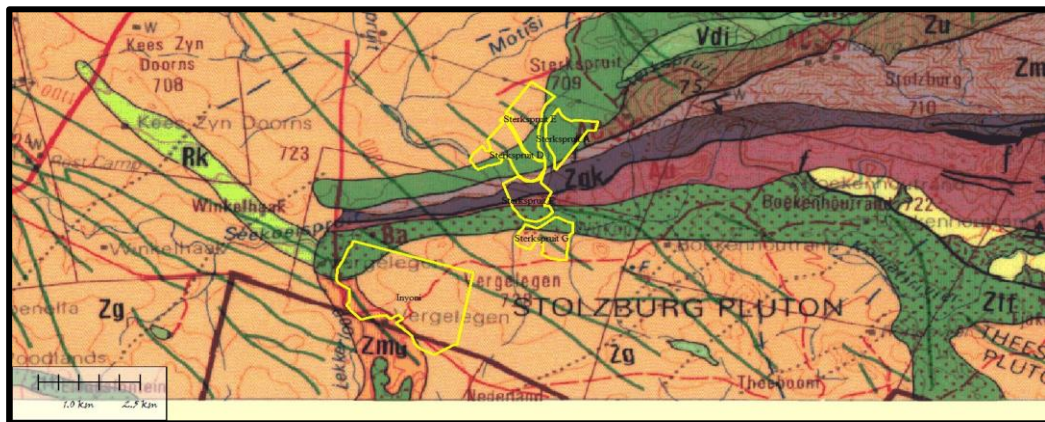


Figure 2 Geology of the region where the Nkomazi Game Reserve Project is planned

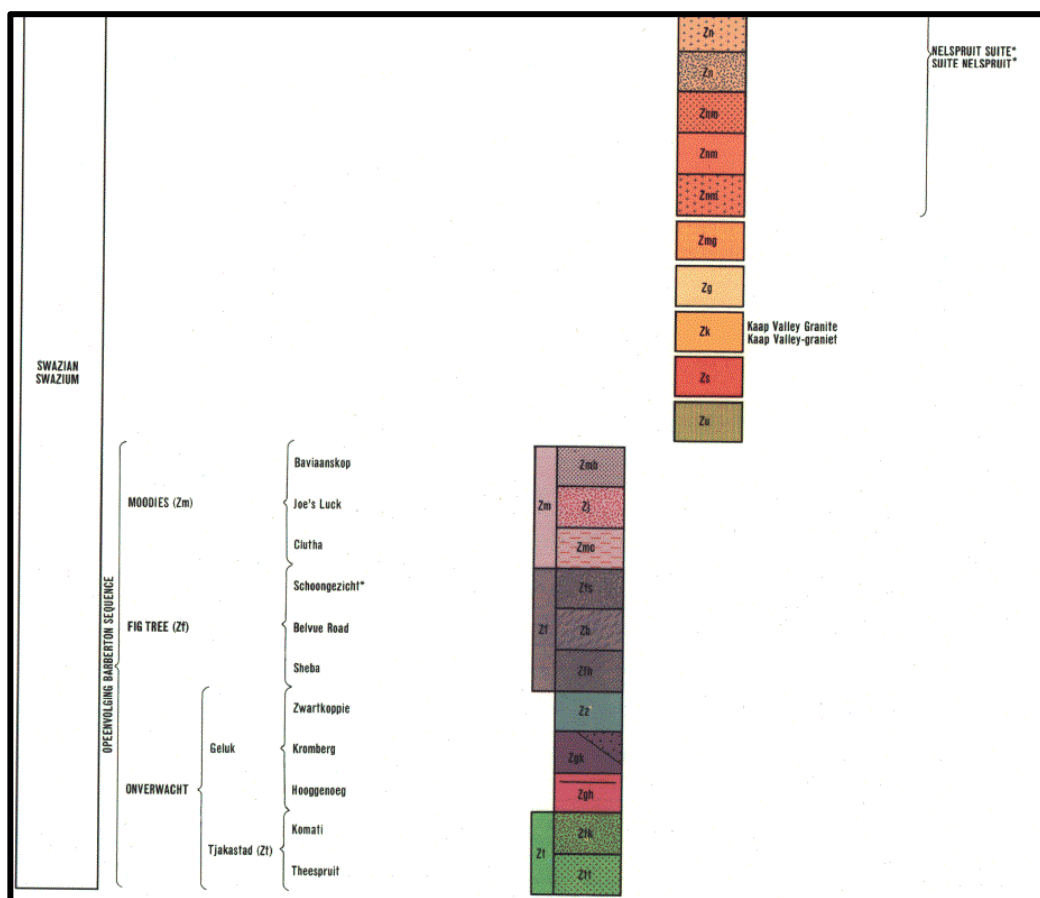


Figure 3 Geological Legend

Barberton Supergroup

Onverwacht Group

Tjakastad Subgroup (Zt)

The Tjakastad Subgroup is undifferentiated in the northern part of the study area and consists mainly of metamorphic rocks such as schists, banded iron formation as well as komatiite, tholeiite and chemical sediment.

Theespruit Formation (Ztt)

The Swazian aged Theespruit Formation is represented by various mafic and ultramafic schists, interlayered with banded iron formation and ferruginous black, white and grey chert as well as acidic volcanic rocks (Johnson et al, 2009).

Geluk Subgroup

Hooggenoeg Formation (Zgh)

The Swazian aged Hooggenoeg Formation is represented by mafic to felsic volcanic rocks, porphyry, shale, komatiitic lava, rhyodactic tuff and agglomerate with chert-carbonate layers (Johnson et al, 2009).

Kromberg Formation (Zgk)

The Swazian aged Kromberg Formation consist of mafic and felsic lava, tuff, agglomerate, chert shale carbonate rocks and ultramafic lava (Johnson et al, 2009).

Moodies Group

Clutha Formation (Zmc)

The Swazian aged Clutha Formation consists primarily of shale, quartzite conglomerate and jaspilite, representing a sedimentary sequence of Swazian age in South Africa (Johnson et al, 2009).

Kaap Valley Granite

A differentiate of the Swazian aged Kaap Valley Granite (unit Zu) consists of serpentinitised dunite, harzburgite, orthopyroxinite and websterite, gabbro and anorthosite (Johnson et al, 2009).

The southern part of the study area is underlain by rocks of the Swazian aged Kaap Valley Granite (Zg) which is a biotite-trandhjemite gneiss (Johnson et al, 2009).

PALAEONTOLOGY

Barberton Supergoup

Onverwacht Group

Tjakastad Subgroup (Zt)

The Swazian aged Tjakastad Subgroup is a unit of highly metamorphosed interbedded sedimentary rocks and although difficult to define, can contain micro-fossils of bacteria that are important indicators

of palaeo-environments in the Swazian aged sedimentary basins of Southern Africa. The fact that the fossils, if present, will be very small, makes it extremely unlikely that this development will have any meaningful impact on the fossils of this group of rocks.

Geluk Subgroup

The Swazian aged Geluk Subgroup consists of metamorphosed volcanic rocks, with subordinate chert bands and due to the igneous nature of the rocks it is unlikely that any significant fossils will be present in these rocks.

Moodies Group

The Moodies Group of rocks is known for the micro-fossils described from the highly metamorphosed sedimentary sequences (MacRae, 1999; McCarthy and Rubidge, 2005). These micro-fossils of cyanobacteria are very important indicators of palaeo-environments but will not be observed with the naked eye and therefore will not have any impact on the developments for this project.

Kaap Valley Granite

The igneous nature of the Kaap Valley Granite as well as associated granitic units, will exclude the presence of any form of life. It is, however, important to note that termitaria that are frequently found in the quaternary sediments that form part of the surface deposits and regolith of the granite can contain significant grave sites of Modern Man (Watson, 1967; Wylie, Walsh and Yule, 1987).

PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews as well as information gathered during the desktop investigation. The desktop investigation confirms that the study area is underlain by relatively deep (>2m) clay soil associated with the weathering of sedimentary as well as igneous rocks of the Barberton Supergroup. The Palaeontological Heritage of this geological unit is of international importance, albeit only observed during microscopic observations during research projects related specifically to the rock units in the study area. The aims of the

proposed development by Nkomazi Game Reserve (Pty) Ltd will not have a significant impact on the known Palaeontological Heritage of this region (Figure 4).

Swazian		INTRUSIVE ROCKS		Z; Zg; Zgh; Zhd; Zhe; Zmg; Zgg; Zs; Zu; Zn; Znm; Zk; Zs; Zu; Z-Rg; Zkv; Zne1; Zne2; Rcu; Rry; Sss; Z7; Zkv; Z8; Z8S	Granites and Gneiss	No fossils recorded	
Swazian		MOODIES (Zm)		Zmb; Zj; Zmc; Zc; Zbv	Predominantly volcanic igneous rocks, plus some igneous intrusions, minor sediments such as banded iron formation, chert, quartzite, conglomerate, schists	Archaean microfossils and microbial trace fossils (bacterial borings) have been recorded from cherts and volcanic glasses in the Fig Tree Group & Onverwacht Group of Barberton. Stromatolites were recorded from the Fig Tree Group.	"Fly speck carbon" in sedimentary Uitkyk Fm of the Pietersburg Greenstone Belt, Limpopo, may be fossilised microbes, or alternatively of inorganic origin (e.g. an inorganic precipitate induced by radioactive irradiation).
		FIG TREE (Zf)		Zfs; Zb; Zfh; Zsh; Zbe			
		ONVERWACHT (Zo; Zo1)		Zr; Zgk; Zh; Zh1; Zh2; Zh3; Zk; Zt; Zts; Za; Zgh; Zlt; Z11; Zth; Zth1; Zzw; Zkr; Zkr1; Zs; Z36; Z37			
	OTHER GREENSTONE COMPLEXES	Giyani (Sutherland) Belt (Zgi; Zgi1; Zgi2; Zgi3; Zgi4; Zgi5; Z57; Z58) Murchison Belt (Zmu)			Predominantly volcanic igneous rocks, plus some igneous intrusions, minor sediments such as banded iron formation, chert, quartzite, conglomerate, schists. Rocks usually tectonised, highly metamorphosed. Early to Mid Archaean (Swazian - Randalian) 3.5 – 3 Ga Basic intrusions dated 3.5 Ga and younger	Archaean microfossils and microbial trace fossils (bacterial borings) have been recorded from cherts and volcanic glasses	Greenstone Belts provide samples of the oldest known crustal rocks, including minor marine and terrestrial sediments, but the rocks here are usually highly deformed and metamorphosed.

Figure 4. Summary of known recordings of Palaeontological Heritage elements in the Barberton Supergroup (Groenewald et al, 2014)

Due to the fact that the fossils are only observed during very detailed research making use of electron microscopes, the areas underlain by the Onverwacht and Moodies Groups of the Barberton Supergroup have a low palaeontological sensitivity. No outcrops of the moderately sensitive Fig Tree Group are present on the farms, but it is of importance to note these recordings for future reference if any excavations do expose rocks with indications of preserved stromatolites.

The palaeontological sensitivity of the Nkomazi Game Reserve (Pty) Ltd agricultural project is limited to areas with low and very low impact values (Figure 5).

The chance find of fossils is low to very low and the basic actions needed to be taken if any observations of a chance find is made is summarized in the Chance Find Protocol (Appendix A).

If any observations of fossils or any rock samples with suspicious structures are observed, a suitably qualified palaeontologist must be appointed to confirm the palaeontological significance of the observations.

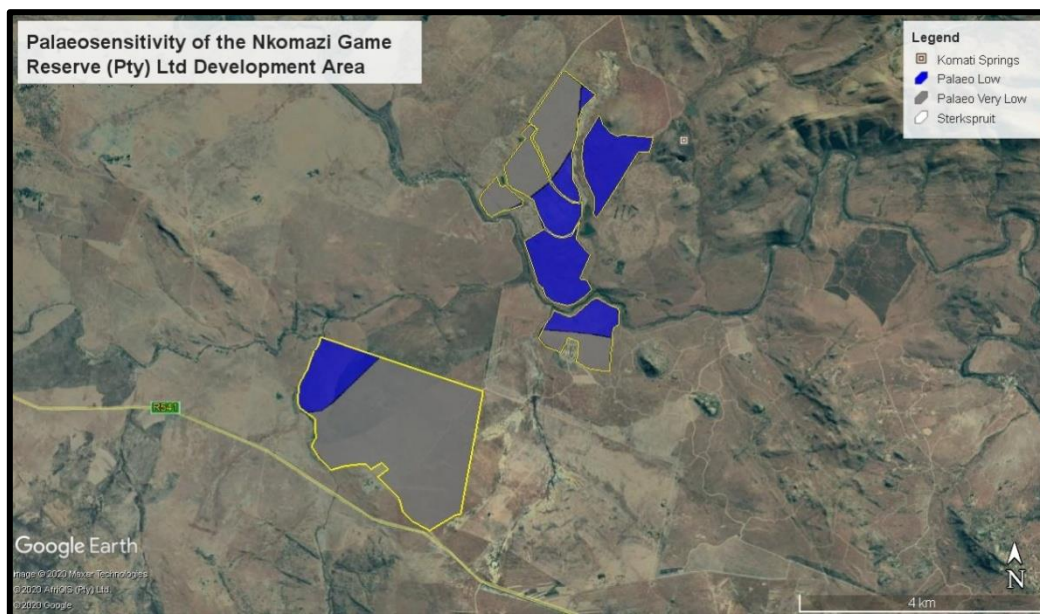


Figure 5 Palaeontological sensitivity of the rock formations underlying the Nkomazi Game Reserve (Pty) Ltd agricultural development area. For colour coding see Table 1.

CONCLUSION

The development site applicable to the application for the proposed Nkomazi Game Reserve Macadamia Agricultural Project in the Albert Luthuli Local Municipality of the Gert Sibande District Municipality in the Mpumalanga Province is underlain by Swazian aged metamorphic rocks of the Barberton Supergroup and granites of the Kaap Valley Granite Suite. No significant fossils are expected from the areas underlain by granite.

If, by any chance, excavation expose fossils, it will be very important that a suitably qualified palaeontological specialist be appointed to do a Phase 1 PIA and to implement the Chance Find Protocol document included in this report (Appendix A). The CFP document must then be included as part of the EMP of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a low and very low palaeontological sensitivity is allocated to the study area.

- No further mitigation for Palaeontological Heritage is recommended. If however any observations of possible fossils are made, the developer must appoint a suitably qualified palaeontologist to implement the Chance Find Protocol (Appendix A).

REFERENCES

Groenewald G.H., Groenewald D.P. and Groenewald S.M., 2014. *Palaeontological Heritage of the Free State, Gauteng, Limpopo, Mpumalanga and North West Provinces.* Internal Palaeotechnical Reports, SAHRA.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of Palaeontological Heritage Assessment services. There are no circumstances that compromise the objectivity of my performing such work.



Dr Gideon Groenewald
Geologist

Appendix A: Chance Find Protocol

Province: Mpumalanga Province

Responsible Heritage Authority: South African Heritage Resources Agency (SAHRA) – Case ID: 15371

Nokukhanya Khumalo Tel: 021 462 4502; Email: nkhumalo@sahra.org.za

Rock units: Onverwacht and Moodies Groups, Barberton Supergroup

Potential fossils: Mico-fossils and bacterial borrowing, only recorded during specialist Electron-microscope research. “Speckled chert” observations.

Protocol to be followed by the ECO or designated person if fossils are discovered during clearing or excavation operations:

1. Alert the site foreman and stop work in the immediate area. Safeguard the site using bunting tape/ fence etc.
2. Record the following information:
 - a. Accurate location information of material i.e. GPS location/ describe and mark on site map
 - b. Context i.e. position of fossil relative to rock units, depth below surface
 - c. Photographs of material *in situ* with a scale bar and from multiple angles. Contextual photographs showing the geology (rock layering etc.) are also important. Photographs of putative fossil material can be sent to the palaeontologist for preliminary assessment.
3. Alert the Heritage Management Authority and project palaeontologist (if appointed) who will advise on the necessary mitigation.
4. If required, a suitably qualified palaeontologist needs to be appointed as soon as possible by the developer. They will advise on mitigation measures and assist with obtaining the necessary permits.
5. Ensure the fossil(s) is/ are safeguarded until the go ahead is given by the Heritage Management Authority for work to resume.
6. Liaise with the appointed palaeontologist for periodic inspections of the site.

Functional responsibilities of the specialist palaeontologist:

1. Assist with the application for the relevant permit and provide the developer with the necessary mitigation measures. Provide on-site training of the ECO and other environmental staff.
2. Record, describe and collect any significant fossil remains, together with relevant contextual data on the stratigraphy and sedimentology as well as taphonomy.
3. Adhere to best international practice for palaeontological fieldwork and Heritage Management Authority minimum standards.
4. Ensure that fossils are curated in an approved repository together with the relevant collection data.
5. Submit Palaeontological Mitigation report to the Heritage Resources Authority.
6. Submit annual permit reports to the relevant Heritage Resources Authority as per the permit conditions.