Prospecting Rights Application on remaining extent and portion 1 of the Farm Bakhoutrantje 205JP, near Rustenburg, North West Province

PALAEONTOLOGICAL DESKTOP STUDY

Compiled by: Dr JF Durand (Sci.Nat.)

For:

Mosikwe Investments (Pty) Ltd
advkgoroeadira@gmail.com

5 May 2019

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1. Executive Summary

The area that will be impacted by this development is underlain in part by Vaalian aged (2.65 – 2.05 Ga) sedimentary rocks of the Magaliesberg Formation of the Pretoria Group of the Transvaal Supergroup that may contain fossilised bacteria and bacterial mats.

Pyroxenite and norite of the Rustenburg Suite of the Bushveld Igneous Complex also occur in the study site however. Due to contact thermal metamorphosis caused by the intrusion of these igneous rocks of the Bushveld Igneous Complex into the sedimentary rocks of the Pretoria Group, the chances of finding intact fossils of bacteria and microbial mats in these sedimentary rocks are very small.

The palaeontological potential of the undifferentiated Quaternary-aged sediments, covering the main part of the study site, is very small.

The ECO should take responsibility of monitoring the excavations and development onsite. If a significant find is made the procedure stipulated under Procedure for Chance Palaeontological Finds (p.15-16) should be followed which includes the safeguarding of the exposed fossils and the contacting of a palaeontologist for further advice.

2. Introduction

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area that may be impacted by the proposed development.

The purpose of this document is to detail the probability of finding fossils in the study area and whether, if indeed there are fossils, what the impact of the mining activities will be on the fossils and fossil sites.

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in inter alia the origin of dinosaurs, mammals and humans. Fossils are also used to identify rock strata and determine the geological context of the subregion with other continents and played a crucial role in the discovery of Gondwanaland and the formulation of the theory of plate tectonics. Fossils are also used to study evolutionary relationships, sedimentary processes and palaeoenvironments.

South Africa has the longest record of palaeontological endeavour in Africa. South Africa was even one of the first countries in the world in which museums displayed fossils and palaeontologists studied earth history. South African palaeontological institutions and their vast fossil collections are world-renowned and befittingly the South African Heritage Act is one of the most sophisticated and best considered in the world.

Construction in fossiliferous areas may be mitigated in exceptional cases but there is a protocol to be followed.

This is a Desktop Study that was prepared in line with Regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involved an overview of the literature on the palaeontology and associated geology of the area.

3. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
- (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
- (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation form the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa’s unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage 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.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports. The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them. The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A **Palaeontological Desktop Study** – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos

, etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of 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 project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the 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 Phase 2 may be implemented.

A **‘Phase 3’ Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

4. Details of study area and the type of assessment:

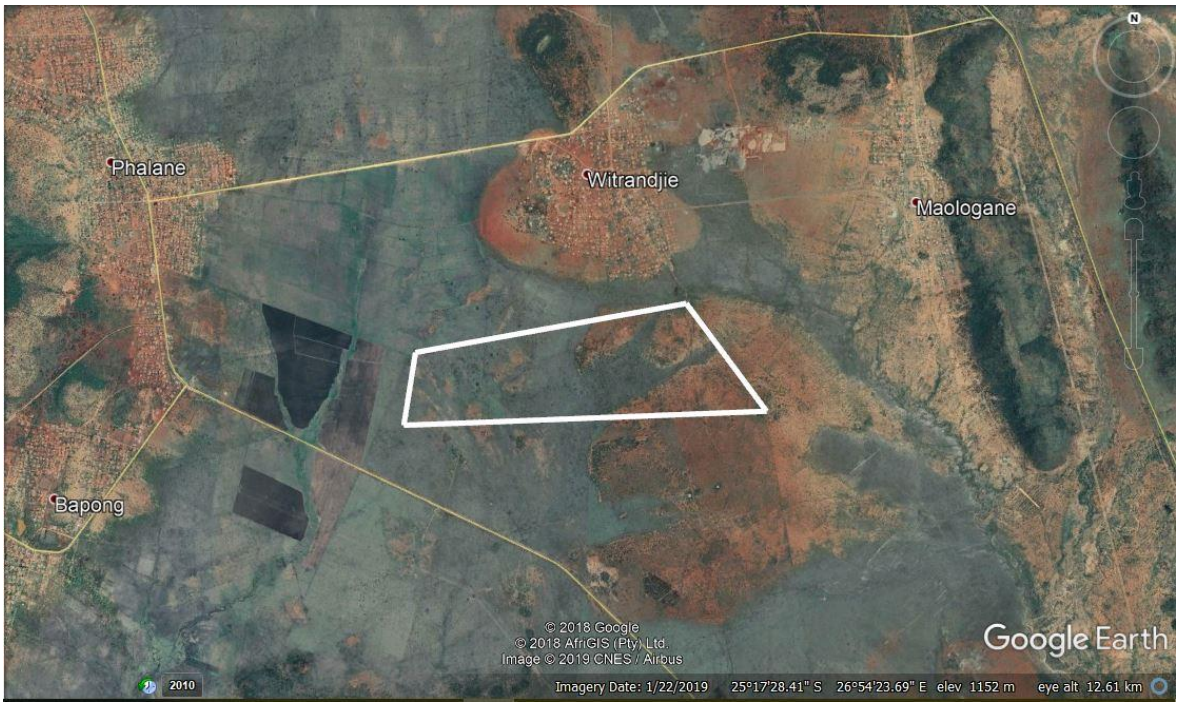


Figure 1: Google Earth photo indicating the study area (white polygon)

The study site is situated on Remaining Extent and Portion 1 of the Farm Bakhoutrantje 205JP, near Rustenburg, North West Province (Fig. 1). It is situated 2.5 km west of the westerly rim of the Pilanesberg Complex.

The study site was used for farming and lies between the townships of Bapong, Phalane, Witrandjie and Maologane.

The relevant literature and geological maps for the study site, in which the development is proposed to take place, have been studied for a Desktop Study.

5. Geological setting of the study area

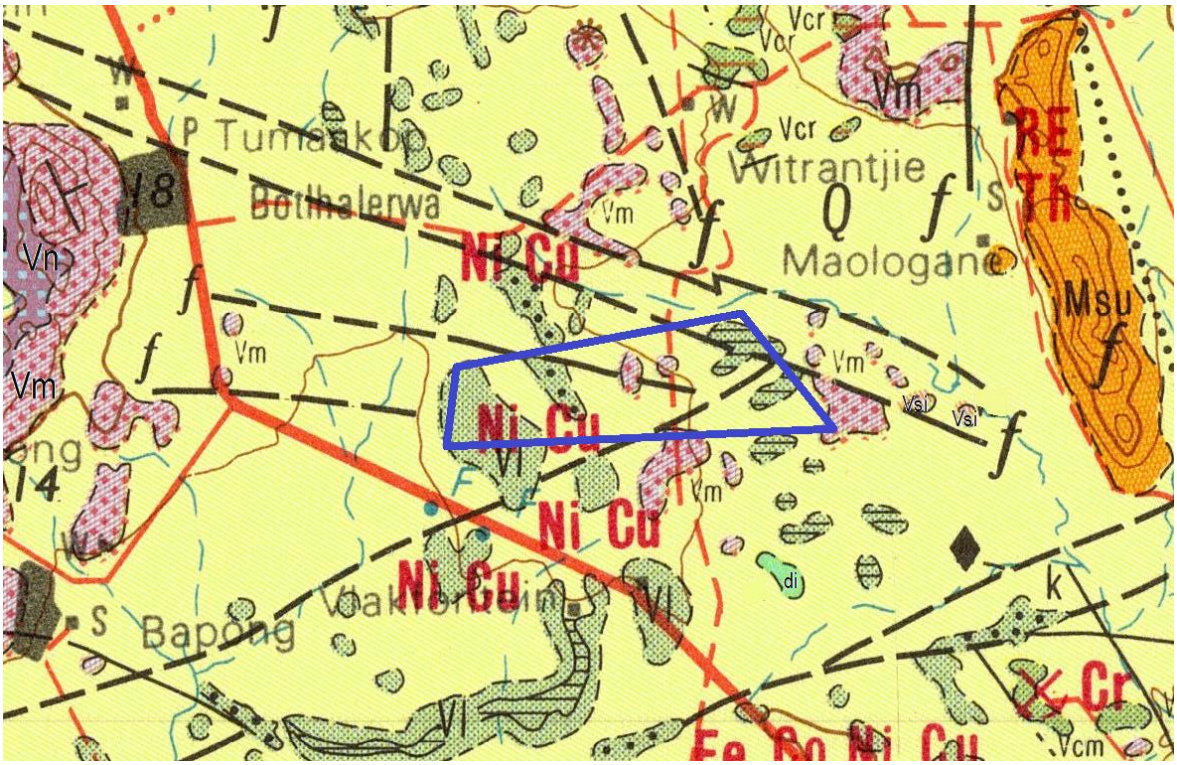


Figure 2: Geological map of study site (blue polygon) and surroundings (adapted from the Rustenburg 2526 1:250 000 Geology Map)

GEOLOGICAL MAP LEGEND

	Lithology	Stratigraphy				Age
Q	Undifferentiated surface deposits					Quaternary
Msu	Syenite	Sun City Syenite	Pilanesberg Complex			Mokolian
di	Diabase					Vaalian-Mogolian
Vcm	Norite	Mathlagame Norite-anorthosite		Rustenburg Layered Suite	Bushveld Igneous Complex	Vaalian
Vcr	Pyroxenite	Ruighoek Pyroxenite				
Vl	Pyroxenite; dunite, harzburgite; norite	Tweelaagte, Makgope, Eerlyk Bronzitite; Groenfontein Harzburgite, Kroondal Norite				
Vn	Mainly norite with minor pyroxenite	Kolobeng Norite				
Vm	Quartzite	Magaliesberg Formation	Pretoria Group	Transvaal Supergroup		
Vsi	Slate, shale, hornfels	Silverton Formation				

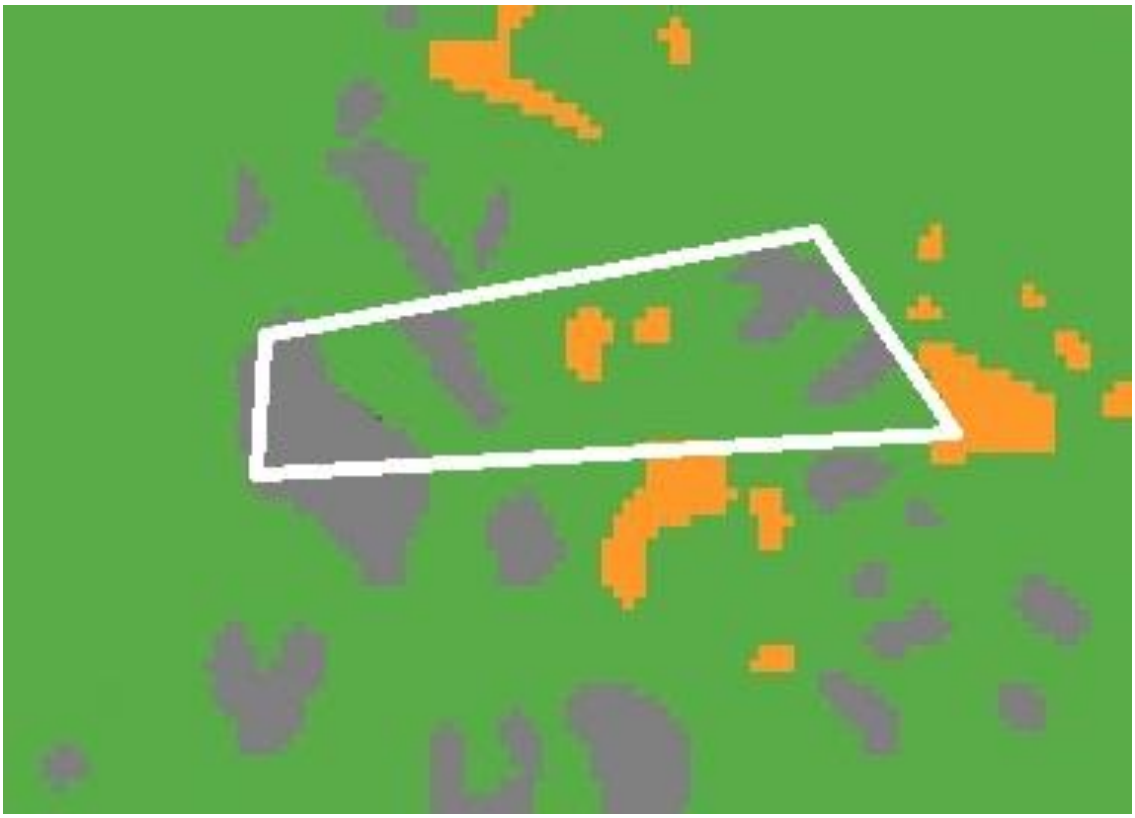
Outcrops of pyroxenite, norite and quartzite occur in the study area. The pyroxenite and norite form part of the Rustenburg Suite of the Bushveld Igneous Complex, while the quartzite forms part of the Magaliesberg Formation of the Pretoria Group of the Transvaal Supergroup (Fig. 2).

The quartzites of the Magaliesburg Formation also outcrop on the eastern and southern borders of the study site and probably extend further laterally under the Quaternary-aged undifferentiated sediments that cover most of the study area.

The Bushveld Igneous Complex intruded into the older Transvaal Sequence approximately 2.1 Ga ago. This caused the argillaceous and arenaceous elements of the Transvaal Group rocks to be mineralised into metagreywacke, metaquartzite, hornfels, leptite and granulite (Cawthorn et al., 2009).

The study site lies approximately 2.5 km west of the western margin of the Pilanesberg Complex, represented by the Sun City Syenite in the study area.

6. Palaeontological potential of the study site



Colour	Palaeontological Significance	Action
ORANGE	HIGH	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely.
GREEN	MODERATE	Desktop study is required.
GREY	INSIGNIFICANT / ZERO	No palaeontological studies are required.

Figure 3: Palaeosensitivity map of the study site (white polygon) and surroundings (SAHRA, 2019)

The proposed development will take place in an area that is considered to include rocks of High Palaeontological Sensitivity (see Fig. 3). Microbial mat structures (desiccated mats sometimes resemble trace fossils) have been reported from the Pretoria Group sedimentary rocks elsewhere (Eriksson *et al*., 2012).

The Magaliesberg Formation was set down over the Silverton Formation during a period of sea level regression. Sediments – mostly sand, but also mud and silt - were set down in terrestrial to shallow water environments in the form of fluvial and

deltaic deposits (Eriksson *et al*., 2009). The quartzite-dominated Magaliesburg Formation is more resistant to weathering than the mudstone and shale dominated underlying Silverton Formation which contributes greatly to the hilly landcape of the study area.

Although there are no reports of fossil discoveries from the study area fossils of microbial mats have been described from fossil localities in the Magaliesberg Formation elsewhere (Parizot *et al*., 2005; Bosch & Eriksson, 2008).

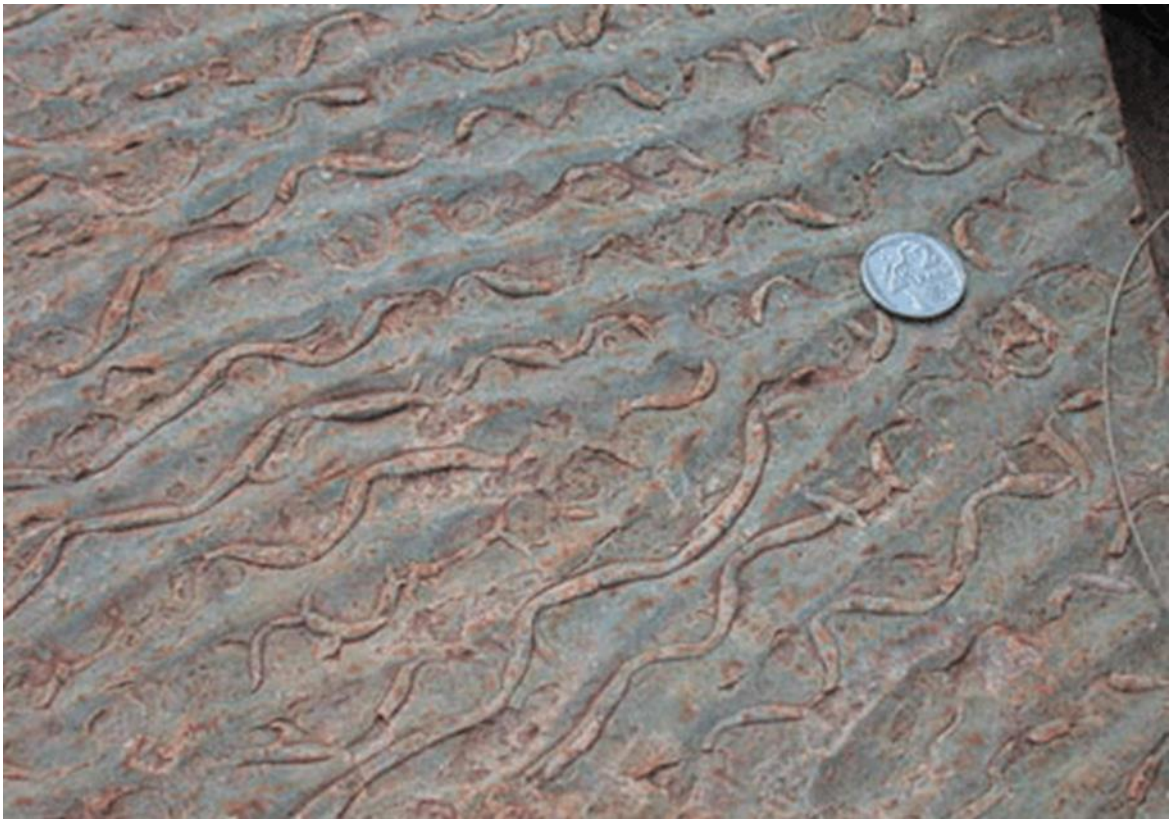


Figure 4: *Manchuriophyscus* (from: Bosch & Eriksson (2008). Picture by Pieter Bosch) https://www.researchgate.net/publication/304076637_ Synaeresis_Crack_Polygons/figures?lo=1

These microbial mats, that were related to those forming stromatolite domes, covered the shallow sea floor in areas where there was sufficient sunlight to support photosynthesis. The microbial mats bound sediment particles together to form firm surfaces that resisted reworking when gentle currents swept across them. Ripple marks were preserved in areas where they were covered by the microbial mats. Wrinkle structures and sinuous cracks named *Manchuriophycus* occur in places between the ripple marks (see Fig. 4) (Bosch & Eriksson, 2008) while very thin rolled-up carbon-rich fragments of presumably broken-up microbial mats could also be found in these sediments (see Fig, 5) (Eriksson *et al*., 2007).

Figure 5: Rolled-up microbial mat fragments (from: Eriksson *et al*., 2007). https://www.researchgate.net/publication/259343767_Mat-destruction_features/figures?lo=1)

Rocks of the Bushveld Igneous Complex and diabase intrusions are exposed at several places in the study area (see Fig. 2). It is expected that these igneous intrusions could have destroyed the fossils in the adjacent Transvaal Supergroup rocks during contact thermal metamorphosis (Cawthorn *et al*., 2009).

The main part of the study area is covered in undifferentiated Quaternary-aged sediments. These are considered to be of Moderate Palaeontological Sensitivity (Fig. 3). Groenewald & Groenewald (2014) mention that there may be a wide diversity of fossil and sub-fossil material present in these sediments that could include mammal, reptile and bird bones and eggs. The sediments in the study area have a very low palaeontological sensitivity however and no fossils have been reported from the study area.

References:

Bosch, P. & Eriksson, P. (2008). A note on two occurrences of inferred microbial mat features preserved in the c. 2.1 Ga Magaliesberg Formation (Pretoria Group, Transvaal Supergroup) sandstones, near Pretoria, South Africa. South African Journal of Geology 111: 251-262.

Cawthorn, R.G.; Eales, H.V.; Walraven, F.; Uken, R. & Watkeys, M.K. (2009).The Bushveld Complex. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 261-281. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

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Eriksson, P.G.; Bartman, R.; Catuneanu, O.; Mazumder, R. & Lenhardt, N., (2012). A case study of microbial mats-related features in coastal epeiric sandstones from the Palaeoproterzoic Pretoria Group, Transvaal Supergroup, Kaapvaal craton, South Africa); the effect of preservation (reflecting sequence stratigraphic models) on the relationship between mat features and inferred palaeoenvironment. Sedimentary Geology 263:67-75.

Eriksson, P.G.; Porada, H.; Banerjee, S.; Bougourgri, E.; Sarkar, S. & Bumby, A.J. (2007). Mat-destruction features. In: Schieber, J., Bose, P.K., Eriksson, P.G., Banerjee, S., Sarkar, S., Altermann, W. and Catuneanu, O. (Eds.) Atlas of microbial mat features preserved within the clastic rock record, p. 76-105. Elsevier.

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Parizot, M.; Eriksson, P.G.; Aifa, T.; Sarkar, S.; Banerjee, S.; Catuneanu, O.; Altermann, W.; Bumby, A.J.; Bordy, E.M.; Van Rooy, J.L. & Boshoff, A.J. (2005). Suspected microbial mat-related crack-like sedimentary structures in the Palaeoproterozoic Magaliesberg Formation sandstones, South Africa. Precambrian Research 138: 274-296.

7. Conclusion and recommendations:

Rocks of the Magaliesburg Formation of the Pretoria Group outcrop in the central part of the study area and probably underlies a more extensive section of the central part of the study site that is currently covered by Quaternary sediments. Stromatolites and microfossils have been reported in the Pretoria Group rocks elsewhere. However, the sedimentary rocks of the region have been subjected to extensive thermal metamorphosis from the intrusion of diabase and the Bushveld Igneous Complex into the Transvaal Supergroup that probably destroyed these delicate fossils in the region.

In the rare event of a significant fossil find during excavations or other development at the study site, the ECO should follow the following Chance Find Procedure:

PROCEDURE FOR CHANCE PALAEONTOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.

2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.

3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.

4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.

5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

a. The material is of no value so development can proceed, or:

b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

8. Declaration of Independence:

I. Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.

Palaeontological specialist:
Dr JF Durand (Sci. Nat.)
BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP), Higher Education Diploma (RAU), PhD Palaeontology (WITS)