

**Palaeontological Impact Assessment for the  
Prospecting Rights Application on Farms Walton 390  
and Erith 389, north of Kathu,  
Northern Cape Province**

**DESKTOP STUDY (PHASE 1)**

**04 July 2021**

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## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf  
Experience: 32 years research; 24 years PIA studies

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Archaeological and Heritage Services (Pty) Ltd, Pretoria, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

A handwritten signature in blue ink, appearing to read 'M Bamford', with a horizontal line underneath it.

Signature:

## **Executive Summary**

A palaeontological Impact Assessment was requested for the proposed prospecting rights application on Farms Walton 390 and Erith 389 about 15 km north of Kathu and about 25 km west of Kuruman, Northern Cape.

To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The sites for prospecting lie on the ancient and non-fossiliferous strata of the Transvaal Supergroup (below ground), and the Quaternary aeolian sands that are potentially fossiliferous. Fossils could be found in palaeo-spring and palaeo-pan sites but none is visible from the satellite imagery. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required unless fossils are found once drilling or excavations for the prospecting activities have commenced.

## Table of Contents

|  |    |
|--|----|
| Expertise of Specialist.....                     | 2  |
| Declaration of Independence.....                 | 2  |
| 1. Background.....                               | 5  |
| 2. Methods and Terms of Reference .....          | 7  |
| 3i. Project location and geological context..... | 6  |
| 3ii. Palaeontological context .....              | 9  |
| 4. Impact assessment .....                       | 10 |
| 5. Assumptions and uncertainties.....            | 13 |
| 6. Recommendation.....                           | 13 |
| 7. References.....                               | 13 |
| 8. Chance Find Protocol .....                    | 13 |
| Appendix A (examples of fossils) .....           | 14 |
| Appendix B (short CV of specialist) .....        | 15 |

# 1. Background

Alet Maritz Mynbou (Pty) Ltd intend to submit a Prospecting Rights application for portions of the Farms Walton 390 (northeast section) and Erith 389 (western half) in the Kuruman area. The farms are adjacent to each other and about 15 km north of Kathu alongside the R380 (Figure 1), in the Northern Cape Province.

A Palaeontological Impact Assessment was requested for the project. In order to comply with the regulations of the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed application and is presented herein.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (amended 2017)

|     | <b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>   | <b>Relevant section in report</b> |
|-----|--|-----------------------------------|
| ai  | Details of the specialist who prepared the report  | Appendix B                        |
| aii | The expertise of that person to compile a specialist report including a curriculum vitae   | Appendix B                        |
| b   | A declaration that the person is independent in a form as may be specified by the competent authority  | Page 2                            |
| c   | An indication of the scope of, and the purpose for which, the report was prepared  | Section 1                         |
| ci  | An indication of the quality and age of the base data used for the specialist report: SAHRIS palaeosensitivity map accessed – date of this report  | Yes                               |
| cii | A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change  | Section 5                         |
| d   | The date and season of the site investigation and the relevance of the season to the outcome of the assessment   | N/A                               |
| e   | A description of the methodology adopted in preparing the report or carrying out the specialised process   | Section 2                         |
| f   | The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure   | Section 4                         |
| g   | An identification of any areas to be avoided, including buffers  | N/A                               |
| h   | A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers; | N/A                               |
| i   | A description of any assumptions made and any uncertainties or gaps in knowledge;  | Section 5                         |

|     |  |                       |
|-----|--|-----------------------|
| j   | A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment  | Section 4             |
| k   | Any mitigation measures for inclusion in the EMPr  | Section 7, Appendix A |
| l   | Any conditions for inclusion in the environmental authorisation  | N/A                   |
| m   | Any monitoring requirements for inclusion in the EMPr or environmental authorisation   | Section 7, Appendix A |
| ni  | A reasoned opinion as to whether the proposed activity or portions thereof should be authorised  | N/A                   |
| nii | If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan | N/A                   |
| o   | A description of any consultation process that was undertaken during the course of carrying out the study  | N/A                   |
| p   | A summary and copies if any comments that were received during any consultation process  | N/A                   |
| q   | Any other information requested by the competent authority.  | N/A                   |

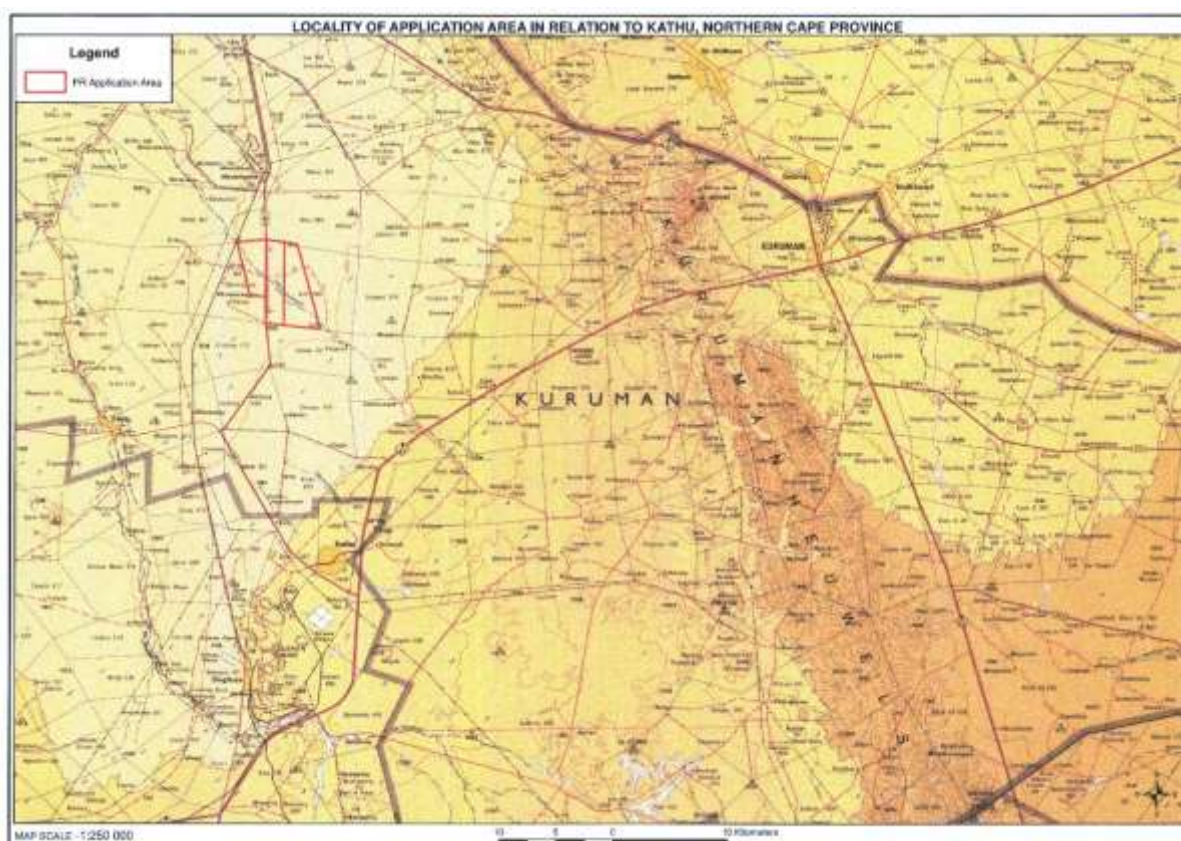


Figure 1: Annotated topographic map of the proposed Prospecting Rights Application on Farms Walton 390 and Erith 389 (Kuruman area). Map supplied by E Matenga.

## 2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

## 3. Geology and Palaeontology

### i. Project location and geological context

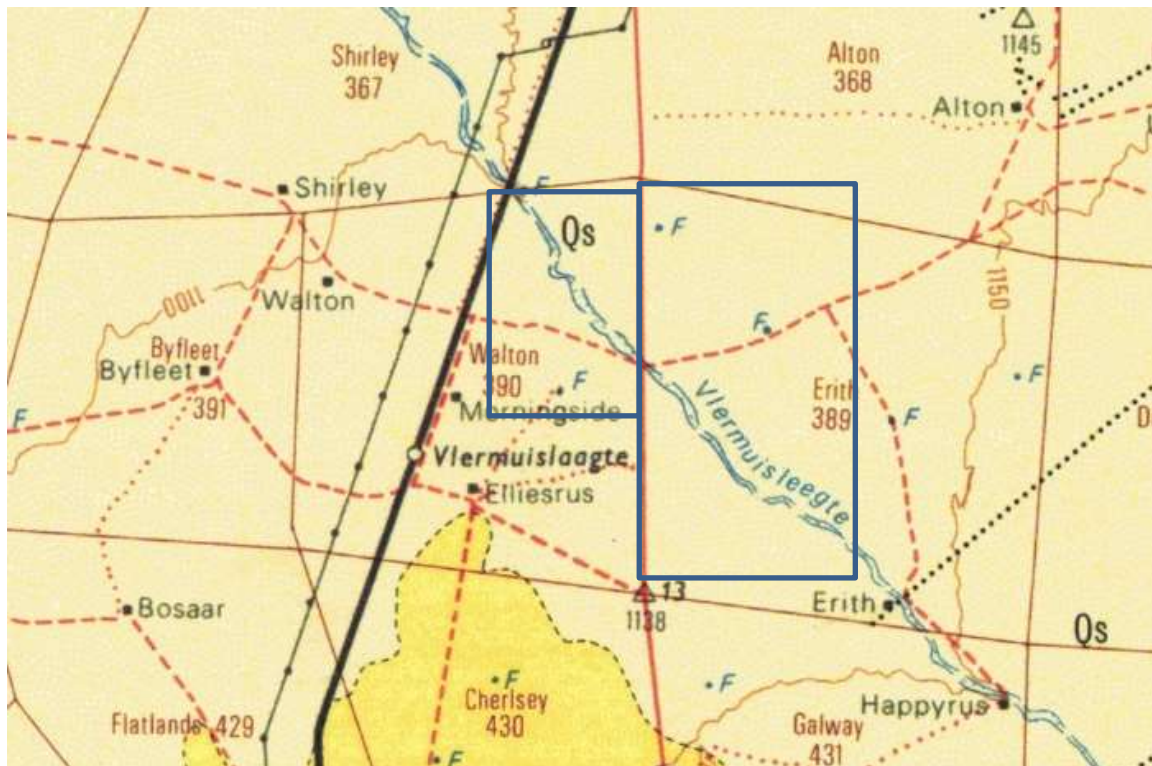


Figure 2: Geological map of the area around the Farms Walton 390 and Erith 389. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2722 Kuruman.

Table 2: Explanation of symbols for the geological map and approximate ages (Partridge et al., 2006; Zeh et al., 2020). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

| Symbol | Group/Formation           | Lithology                         | Approximate Age               |
|--------|---------------------------|-----------------------------------|-------------------------------|
| Qs     | Quaternary Kalahari sands | Aeolian sand, flesh coloured      | Neogene, ca 2.5 Ma to present |
| Tl     | Tertiary limestone        | Surface limestone, sand, calcrete | Tertiary ca 65 – 5 Ma         |

The farms lie in the Griqualand West Basin of the Transvaal Supergroup. These underlying strata have a complex structure with a double plunging syncline so parts of the sequence are exposed to the north and south of this locality (Beukes et al., 2016). This central part is covered by the aeolian Kalahari sands so the depth and extent of the Hotazel Formation, that has bands of iron and manganese, cannot be determined from the surface (Figure 3).

The Late Archaean to early Proterozoic **Transvaal Supergroup** is preserved in three structural basins on the Kaapvaal Craton (Eriksson et al., 2006). In South Africa are the Transvaal and Griqualand West Basins, and the Kanye Basin is in southern Botswana. The Griqualand West Basin is divided into the Ghaap Plateau sub-basin and the Prieska sub-basin. Sediments in the lower parts of the basins are very similar but they differ somewhat higher up the sequences. Several tectonic events have greatly deformed the south western portion of the Griqualand West Basin between the two sub-basins

The Transvaal Supergroup comprises one of world’s earliest carbonate platform successions (Beukes, 1987; Eriksson et al., 2006; Zeh et al., 2020). In some areas there are well preserved stromatolites that are evidence of the photosynthetic activity of blue green bacteria and green algae. These microbes formed colonies in warm, shallow seas.

These rocks represent on a very large scale, a sequence of sediments filling the basins under conditions of lacustrine, fluvial, volcanic and glacial cycles in a tectonically active region. The predominantly carbonaceous sediments are evidence of the increase in the atmosphere of oxygen produced by algal colony photosynthesis, the so-called Great Oxygen Event (ca 2.40 – 2.32 Ga) and precursor to an environment where diverse life forms could evolve. The Neoproterozoic-Paleoproterozoic Transvaal Supergroup in South Africa contains the well-preserved stromatolitic Campbellrand - Malmani carbonate platform (Griqualand West Basin – Transvaal Basin respectively), which was deposited in shallow seawater shortly before the Great Oxidation Event (GOE).

Based on the early works of Leicester King, Partridge and Maud (1987, 2000) developed a model of three African Erosion Surfaces for southern Africa, from the Cretaceous to the Pliocene. During the Cretaceous Africa was very high, averaging about 2500-2000m above sealevel but the rifting apart of Gondwanaland and formation of the Atlantic and Indian Oceans, coastal erosion was rapid and the escarpment rapidly receded about 120km inland along the east and south coasts, but only 50km along the west coast. The newly exposed



surface was called the African Erosion Surface. Their model has been challenged and modified by a number of researchers (Burke, 2011; Braun et al., 2014) who propose that mantle plumes caused uplift of the continent during the late Cretaceous, followed by erosion and further uplift about 30-20 million years ago, The newer interpretations have been followed here.

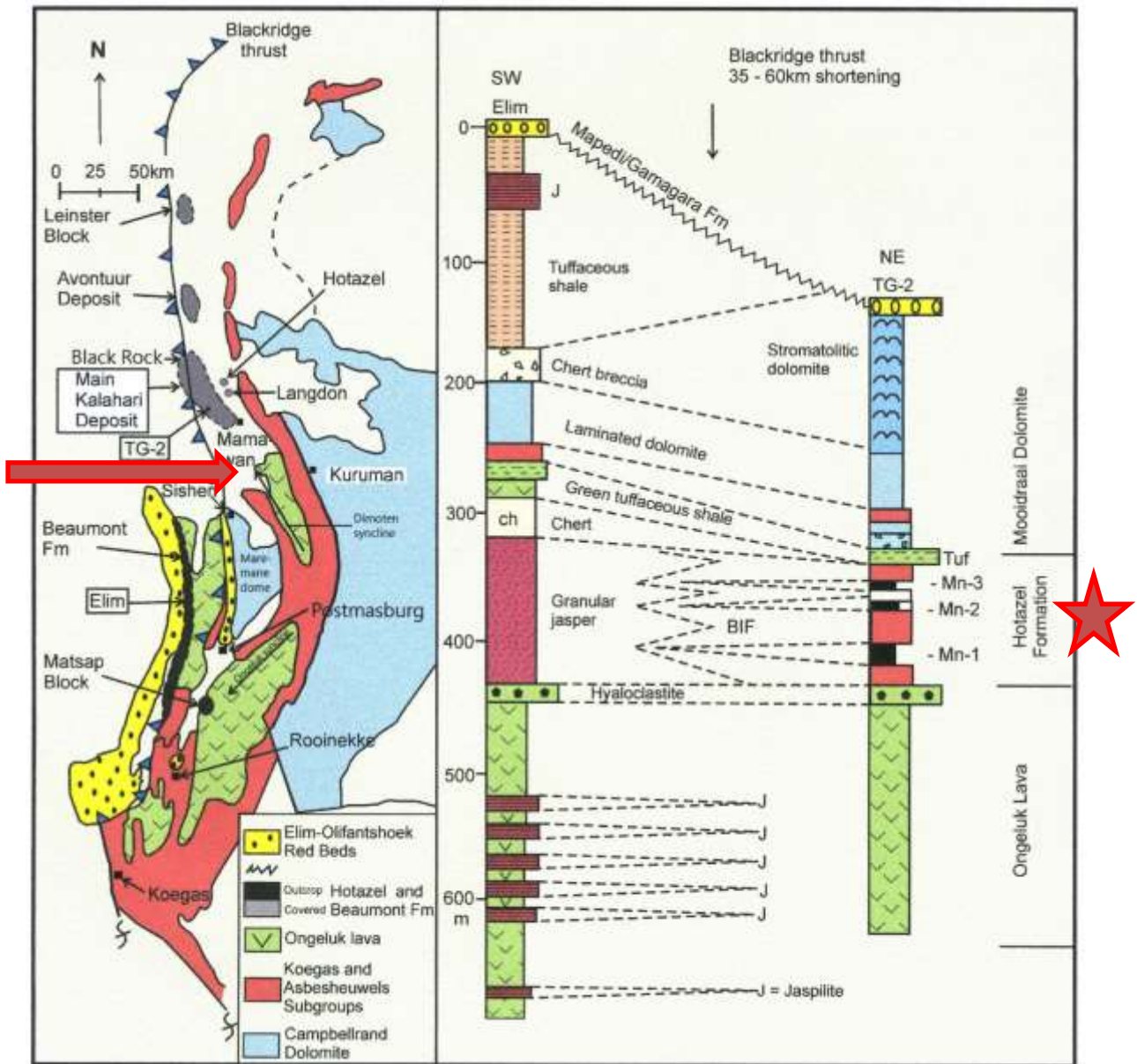


Figure 3: The Kalahari Manganese Field in the Griqualand Basin with the location of the Farms Walton and Erith indicated by the large red arrow. (Fig. 4 of Beukes et al., 2016).

**Quaternary Kalahari sands** overlie the whole farm. Haddon and McCarthy (2005) proposed that the Kalahari basin formed as a response to down-warp of the interior of the southern Africa, probably in the Late Cretaceous. This, along with possible uplift along epeirogenic axes, back-tilted rivers into the newly formed Kalahari basin and deposition of the Kalahari Group sediments began. Sediments included basal gravels in river channels, sand and finer

sediments. A period of relative tectonic stability during the mid-Miocene saw the silcretisation and calcretisation of older Kalahari Group lithologies, and this was followed in the Late Miocene by relatively minor uplift of the eastern side of southern Africa and along certain epeirogenic axes in the interior. More uplift during the Pliocene caused erosion of the sand that was then reworked and redeposited by aeolian processes during drier periods, resulting in the extensive dune fields that are preserved today.

There are numerous pans in the Kalahari, generally 3–4 km in diameter (Haddon and McCarthy, 2005). According to Goudie and Wells (1995) there are two conditions required for the formation of pans. Firstly, the fluvial processes must not be integrated, and second, there must be no accumulation of aeolian material that would fill the irregularities or depressions in the land surface. Favoured materials or substrates for the formation of pans in South Africa are Dwyka and Ecca shales and sandstones (ibid).

Most pans in the Kalahari Basin are filled by a layer of clayey sand or calcareous clays and are flanked by lunette dunes formed as a result of deflation of the pan floor during arid periods (Lancaster, 1978a, b; Haddon and McCarthy, 2005). At some localities in the south western Kalahari spring-fed tufas have formed at the margins of pans during periods where groundwater discharge was high (Lancaster, 1986). These tufas may contain evidence of algal mats and stromatolites and may also be associated with calcified reed and root tubes (Lancaster, 1986). Many of the pans are characterised by diatomaceous earth, diatomite or kieselguhr, a white or grey, porous, light-weight, fine-grained sediment composed mainly of the fossilised skeletons of diatoms. Associated with some palaeo-pans and palaeo-springs are fossil bones, root casts, pollen and archaeological artefacts. Well-known sites are Florisbad and Deelpan in the Free State, Wonderkrater in Limpopo and Bosluispan in the Northern Cape. In this region under study is the Kathu Complex.

## ii. Palaeontological context

The underlying Ongeluk Formation lavas and the Hotazel Formation iron and manganese deposits do not preserve fossils. Although the Mooidraai Dolomites (Fig 3) might preserve trace fossils of stromatolites, they seem to occur east of the site.

In the overlying Kalahari sands there is a chance that fossil may occur but only in certain features. Palaeo-pans and palaeo-springs are visible in satellite imagery because of their topography and often are associated with lunette dunes. Vegetation changes are also common. No such features are seen in the Google Earth images. Aeolian sediments that cover most of the region, do not preserve fossils because they have been reworked and windblown

The Kathu Complex includes the excavated sites of Kathu Pan1 (KP1), Kathu Townlands and Bestwood 1 (BW 1). At Kathu Pan, evidence of early hominin occupation has been observed at multiple locations within the pan, but ESA deposits have only been excavated at KP 1. Stratum 4a at KP1 was dated by a combination of OSL and ESR/U-series to ca. 500 k BP. The

lithic assemblage from St. 4a is characterized by a prepared core technology that produced both blades and points, and has been attributed to the Fauresmith industry. The lithic assemblage of the underlying St. 4b at Kathu Pan 1 is characterized by well-made handaxes, some bones and other tools (Beaumont, 2004; Walker et al., 2014; Lukich et al., 2020).



Figure 4: SAHRIS palaeosensitivity map for the site for the proposed Prospecting Rights on parts of Farms Walton 390 and Erith 389 shown within the blue rectangles. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

#### 4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

**TABLE 3A: CRITERIA FOR ASSESSING IMPACTS**

| PART A: DEFINITION AND CRITERIA   |          |  |
|---|----------|--|
| <b>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</b> | <b>H</b> | Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action. |
|   | <b>M</b> | Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.   |

|  |           |  |
|--|-----------|--|
|  | <b>L</b>  | Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints. |
|  | <b>L+</b> | Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.                                     |
|  | <b>M+</b> | Moderate improvement. Will be within or better than the recommended level. No observed reaction.   |
|  | <b>H+</b> | Substantial improvement. Will be within or better than the recommended level. Favourable publicity.  |
| <b>Criteria for ranking the DURATION of impacts</b>      | <b>L</b>  | Quickly reversible. Less than the project life. Short term   |
|  | <b>M</b>  | Reversible over time. Life of the project. Medium term   |
|  | <b>H</b>  | Permanent. Beyond closure. Long term.  |
| <b>Criteria for ranking the SPATIAL SCALE of impacts</b> | <b>L</b>  | Localised - Within the site boundary.  |
|  | <b>M</b>  | Fairly widespread – Beyond the site boundary. Local  |
|  | <b>H</b>  | Widespread – Far beyond site boundary. Regional/ national  |
| <b>PROBABILITY (of exposure to impacts)</b>              | <b>H</b>  | Definite/ Continuous   |
|  | <b>M</b>  | Possible/ frequent   |
|  | <b>L</b>  | Unlikely/ seldom   |

**TABLE 3B: IMPACT ASSESSMENT**

| <b>PART B: ASSESSMENT</b> |           |   |
|---------------------------|-----------|---|
| <b>SEVERITY/NATURE</b>    | <b>H</b>  | -   |
|                           | <b>M</b>  | -   |
|                           | <b>L</b>  | Aeolian sands do not preserve any fossils, but palaeo-pans or palaeo-spring might; so far there are no records from the footprint so it is very unlikely that fossils occur on the site. The impact would be very unlikely.                             |
|                           | <b>L+</b> | -   |
|                           | <b>M+</b> | -   |
|                           | <b>H+</b> | -   |
| <b>DURATION</b>           | <b>L</b>  | -   |
|                           | <b>M</b>  | -   |
|                           | <b>H</b>  | Where manifest, the impact will be permanent.   |
| <b>SPATIAL SCALE</b>      | <b>L</b>  | Since the only possible fossils within the area would be fossil bones, plants (and artefacts) from the late Quaternary, the spatial scale will be localised within the site boundary.   |
|                           | <b>M</b>  | -   |
|                           | <b>H</b>  | -   |
| <b>PROBABILITY</b>        | <b>H</b>  | -   |
|                           | <b>M</b>  | -   |
|                           | <b>L</b>  | It is extremely unlikely that any fossils would be found in the loose aeolian sand that covers the region, but if pans or springs are present they might entrap fossils. Therefore, a Fossil Chance Find Protocol should be added to the eventual EMPr. |

Based on the nature of the project, surface activities may impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are either much too old to contain fossils or have been wind transported. Only such geomorphological features such as palaeo-pans or paleo-springs might entrap fossils. No such feature is visible in the satellite imagery. Since there is an extremely small chance that fossils may be disturbed a Fossil Chance Find Protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

## 5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the quartzites, sandstones, shales and sands are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. The loose sands of the Tertiary and Quaternary period would not preserve fossils. Only palaeo-pans or palaeo-springs could preserve fossils but no such feature is evident.

## 6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the Quaternary aeolian sands. There is a very small chance that fossils may occur in pans or springs but none is evident. Nonetheless, a Fossil Chance Find Protocol should be added to the EMP: if fossils are found once drilling or excavations for prospecting have commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

## 7. References

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## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the excavations / drilling activities begin.**

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (plants, insects, bone) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 5, 6). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.

6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then no site inspections by the palaeontologist will be necessary. A final report by the palaeontologist must be sent to SAHRA once the project has been completed and only if there are fossils.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

### **Appendix A – Examples of fossils from the Tertiary and Quaternary.**



Figure 5: Examples of fossils bones from a Quaternary deposit. Note their fragmentary nature.



Figure 6: Examples of silicified wood from Late Tertiary alluvial deposit.

## Appendix B – Details of specialist

### Curriculum vitae (short) - Marion Bamford PhD June 2021

#### I) Personal details

Surname : **Bamford**  
First names : **Marion Kathleen**  
Present employment : Professor; Director of the Evolutionary Studies Institute.  
Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-  
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## ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:

1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.

1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.

1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.

1986-1989: PhD in Palaeobotany. Graduated in June 1990.

## iii) Professional qualifications

*Wood Anatomy Training (overseas as nothing was available in South Africa):*

1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps

1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer

1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

## iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa

Royal Society of Southern Africa - Fellow: 2006 onwards

Academy of Sciences of South Africa - Member: Oct 2014 onwards

International Association of Wood Anatomists - First enrolled: January 1991

International Organization of Palaeobotany – 1993+

Botanical Society of South Africa

South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016

SASQUA (South African Society for Quaternary Research) – 1997+

PAGES - 2008 –onwards: South African representative

ROCEEH / WAVE – 2008+

INQUA – PALCOMM – 2011+onwards

## vii) Supervision of Higher Degrees

All at Wits University

| Degree               | Graduated/completed | Current |
|----------------------|---------------------|---------|
| Honours              | 11                  | 2       |
| Masters              | 11                  | 4       |
| PhD                  | 11                  | 4       |
| Postdoctoral fellows | 13                  | 2       |

## viii) Undergraduate teaching

Geology II – Palaeobotany GEOL2008 – average 65 students per year

Biology III – Palaeobotany APES3029 – average 25 students per year

Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology;

Micropalaeontology – average 2-8 students per year.

## ix) Editing and reviewing

Editor: *Palaeontologia africana*: 2003 to 2013; 2014 – Assistant editor

Guest Editor: *Quaternary International*: 2005 volume

Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –

Review of manuscripts for ISI-listed journals: 25 local and international journals

## **x) Palaeontological Impact Assessments**

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics
- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- NababEEP Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
- Remhoogte PR 2019 for A&HAS
- Bospoort Agriculture 2019 for Kudzala
- Overlooked Quarry 2019 for Cabanga
- Richards Bay Powerline 2019 for NGT
- Eilandia dam 2019 for ACO

- Eastlands Residential 2019 for HCAC
- Fairview MR 2019 for Cabanga
- Graspan project 2019 for HCAC
- Lielifontein N&D 2019 for EnviroPro
- Skeerpoort Farm Mast 2020 for HCAC
- Vulindlela Eco village 2020 for 1World
- KwaZamakhule Township 2020 for Kudzala
- Sunset Copper 2020 for Digby Wells
- McCarthy-Salene 2020 for Prescali
- VLNR Lodge 2020 for HCAC
- Madadeni mixed use 2020 for EnviroPro

#### **xi) Research Output**

Publications by M K Bamford up to June 2021 peer-reviewed journals or scholarly books: over 150 articles published; 5 submitted/in press; 10 book chapters.

Scopus h-index = 29; Google scholar h-index = 35; -i10-index = 92

Conferences: numerous presentations at local and international conferences.

#### **xii) NRF Rating**

NRF Rating: B-2 (2016-2020)

NRF Rating: B-3 (2010-2015)

NRF Rating: B-3 (2005-2009)

NRF Rating: C-2 (1999-2004)