Palaeontological Impact Assessment for the mining right application for farm Palmietfontein 208JP, WSW of Pilansberg, Northwest Province

Desktop Study

For

Prescali Environmental Consultants (Pty) Ltd

01 October 2018

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Prescali Environmental Consultants (Pty) Ltd, 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

Signature: [Signature]

Prof Marion Bamford
Executive Summary

A palaeontological Impact Assessment was requested for the mining permit application for Portion 6 of the farm Palmietfontein 208JP (Moses Kotane Local Municipality, Bojanala District Municipality, Magisterial District of Mankwe) in the North West Province. 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 of a mining area, as requested by SAHRA (CaseID: 12852).

The site lies on non-fossiliferous ancient volcanic rocks of the Vlakfontein Subsuite and on sandstones of the Magaliesberg Formation, Pretoria Group representing an ancient shoreline. Although trace fossils of microbial activity have been described from one locality to the east of Pretoria, over 100km distant, in the Magaleieburg Formation, it is extremely unlikely that they are widespread or even recognisable as their interpretation is debatable. It is the opinion of the palaeontologist that this mining project would not impact on the fossil heritage.
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1. Background

A Palaeontological Impact Assessment was requested for the farm Palmietfontein. A Mining Permit Application is in progress for Portion 6 of the farm Palmietfontein 208JP (Moses Kotane Local Municipality, Bojanala District Municipality, Magisterial District of Mankwe) in the North West Province. Chrome, nickel and other platinum group elements will be mined.

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 of a mining area. A desktop study has been requested by SAHRA (CaseID: 12852).

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

<table>
<thead>
<tr>
<th>A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:</th>
<th>Relevant section in report</th>
</tr>
</thead>
<tbody>
<tr>
<td>Details of the specialist who prepared the report</td>
<td>Appendix A</td>
</tr>
<tr>
<td>The expertise of that person to compile a specialist report including a curriculum vitae</td>
<td>Appendix A</td>
</tr>
<tr>
<td>A declaration that the person is independent in a form as may be specified by the competent authority</td>
<td>Page 1</td>
</tr>
<tr>
<td>An indication of the scope of, and the purpose for which, the report was prepared</td>
<td>Section 1</td>
</tr>
<tr>
<td>The date and season of the site investigation and the relevance of the season to the outcome of the assessment</td>
<td>N/A</td>
</tr>
<tr>
<td>A description of the methodology adopted in preparing the report or carrying out the specialised process</td>
<td>Section 2</td>
</tr>
<tr>
<td>The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure</td>
<td>Section 2</td>
</tr>
<tr>
<td>An identification of any areas to be avoided, including buffers</td>
<td>N/A</td>
</tr>
<tr>
<td>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;</td>
<td>N/A</td>
</tr>
<tr>
<td>A description of any assumptions made and any uncertainties or gaps in knowledge;</td>
<td>Section 5</td>
</tr>
<tr>
<td>A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment</td>
<td>Section 4</td>
</tr>
<tr>
<td>Any mitigation measures for inclusion in the EMPPr</td>
<td>N/va</td>
</tr>
<tr>
<td>Any conditions for inclusion in the environmental authorisation</td>
<td>N/va</td>
</tr>
<tr>
<td>Any monitoring requirements for inclusion in the EMPPr or environmental authorisation</td>
<td>Section 8</td>
</tr>
</tbody>
</table>
A reasoned opinion as to whether the proposed activity or portions thereof should be authorised | N/A

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 EMPt, and where applicable, the closure plan | N/A

A description of any consultation process that was undertaken during the course of carrying out the study | N/A

A summary and copies if any comments that were received during any consultation process | N/A

Any other information requested by the competent authority. | N/A

Figure 1: Google Earth map of the proposed site for the mine on Farm Palmietfontein 208 JP, red, central (and yellow arrow), to the south west of the Pilansberg National Park. Map supplied by Prescali.

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

The proposed mining right area is to the west of the Pilansberg complex and falls on rocks of the Vlakfontein Subsuite and Magaliesberg Formation.

![Geological map of the area around the Pilansberg National Park. The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.](image)
Table 2: Explanation of symbols for the geological map and approximate ages (Cawthorn et al., 2006. Erikssen et al., 2006. Johnson et al., 2006). SG = Supergroup; Fm = Formation.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Group/Formation</th>
<th>Lithology</th>
<th>Approximate Age</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q</td>
<td>Kalahari Group</td>
<td>Alluvium, sand, calcrete</td>
<td>Ca last 25 Ma</td>
</tr>
<tr>
<td>Mp</td>
<td>Pilanesberg Complex or Pilanesberg Syenite</td>
<td>Syenite, green and white foyaite, dolerite dykes, lava, tuff</td>
<td>Ca 1500 – 1200 Ma</td>
</tr>
<tr>
<td>Vbi</td>
<td>Bierskraal Magnetite Gabbro, Upper Zone of the Rustenburg Layered Suite, western limb of Bushveld Complex</td>
<td>Magnetite gabbro</td>
<td>Ca 2050 Ma</td>
</tr>
<tr>
<td>Vvi</td>
<td>Villa Nora Gabbro</td>
<td>Gabbro, anorthosite</td>
<td>Ca 2050 Ma</td>
</tr>
<tr>
<td>Vpy</td>
<td>Pyramid Gabbronorite, Main Zone of the Rustenburg Layered Suite, western limb of the Bushveld Complex</td>
<td>Gabbro, norite</td>
<td>Ca 2050 Ma</td>
</tr>
<tr>
<td>Vvl</td>
<td>Vlakfontein Subsuite, Rustenburg Layered Suite, Bushveld Complex</td>
<td>Bronzitie, harzburgite, norite</td>
<td>&gt;2050 Ma</td>
</tr>
<tr>
<td>Vmg</td>
<td>Magaliesberg Fm, Pretoria Group</td>
<td>Sandstone, sandy shoreline</td>
<td>Ca 2100 Ma</td>
</tr>
<tr>
<td>Vsi</td>
<td>Silverton Fm, Pretoria Group, Transvaal SG</td>
<td>Shale, basalt, tuff</td>
<td>Ca 2222 Ma</td>
</tr>
<tr>
<td>Vda</td>
<td>Daspoort Fm, Pretoria Group, Transvaal SG</td>
<td>Sandstone, mudrock</td>
<td>Ca 2222 Ma</td>
</tr>
</tbody>
</table>

The oldest rocks in the area are three formations from the Pretoria Group which is part of the Transvaal Supergroup, namely the Dasport, Silverton and Magaliesberg Formations form a sequence, and represent rocks that are over 2060 million years old (Figure 2, Table 2). Comprising sandstone and mudrock, the Daspoort Formation has been interpreted as representing distal fan, fluvial braid-plain, braid-delta facies with a transgressive epeiric sea to the east. In the Silverton Formation there are relatively deep water facies, transgressive epeiric sea facies and evidence of volcanic activity mainly in the east in form of tuffs. The overlying Magaliesberg Formation represents a regressive sandy shoreline with braid-delta and high energy tidal flats (Erikssen et al., 2006).

Other rocks in the region are western exposures of the Rustenburg Layered Suite of the Bushveld Complex, the Vlakfontein Subsuite and the Pyramid Gabbro-Norite. These are igneous rocks that have been highly metamorphosed with a complex history that is still debated (Cawthorn et al., 2006). They contain some of the Platinum Group Elements so are of economic importance.
Dominating the geology of the area are a variety of volcanic rocks comprising the Pilanesberg Alkaline Province or “alkaline igneous complex” because the rocks are under-saturated in silica and it is of great interest to petrologists (Vervoord, 2006).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for development is partly on the Vlakfontein Subsuite of the Bushveld Complex and is igneous in origin so does not preserve fossils of any kind. The rest of the project site lies on the Magaliesberg Formation of the Pretoria Group. These rocks are ancient, much older than the origin of body fossils, but there were microbes present. To the east of Pretoria some trace fossils of microbial activity have been described by Bosch and Erikssen (2017). These are called *Manchuriophycus* and look like sinuous tubes in the hard sandstone and occur with ripple marks or mudcracks (the latter two are not considered to be fossils or trace fossils). The interpretation, however, is debatable.

![Figure 3: SAHRIS palaeosensitivity maps for the site for the Palmietfontein 208 JP mining right application shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.](image-url)

The rocks of the Bushveld Complex, the Vlakfontein Subsuite, the Pyramid Gabbronorite and Bierskraal Magnetite Gabbro are plutonic rocks and do not contain any fossils. The volcanic rocks of the Pilanesberg Complex do not contain any fossils either.

From the SAHRIS map above the area is indicated as moderately sensitive (green) and insignificant (grey) so a desktop study is presented here. The area has been disturbed from
previous mining and agricultural activities and so any surface activities will not have any impact on any potential fossils

4. Impact assessment

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

<table>
<thead>
<tr>
<th>TABLE 3A: CRITERIA FOR ASSESSING IMPACTS</th>
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<tbody>
<tr>
<td><strong>PART A: DEFINITION AND CRITERIA</strong></td>
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<tr>
<td>Criteria for ranking of the SEVERITY/NATURE of environmental impacts</td>
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<td>Criteria for ranking the DURATION of impacts</td>
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<tr>
<td>Criteria for ranking the SPATIAL SCALE of impacts</td>
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<tr>
<td>PROBABILITY (of exposure to impacts)</td>
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<table>
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<tr>
<th>TABLE 3B: IMPACT ASSESSMENT</th>
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<tr>
<td><strong>PART B: ASSESSMENT</strong></td>
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<tr>
<td>SEVERITY/NATURE</td>
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<td>DURATION</td>
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<td>SPATIAL SCALE</td>
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</table>
Based on the nature of the project, surface activities would not impact upon the fossil heritage if preserved in the development footprint. The geological structures suggest that the rocks are mostly much too old to contain fossils. There is an extremely small chance that trace fossils of microbial activity could occur on the palaeo-shoreline of the Magaliesberg Formation as these have been observed from a farm to the east of Pretoria. The interpretation of these fossils is highly debatable and they are unlikely to be recognised. 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 gabbro, norite, gneiss, sandstones, shales and sands are typical for the country and do not contain fossil plant, insect, invertebrate and vertebrate material. Although trace fossils of microbial activity have been described from one locality to the east of Pretoria, over 100km distant, it is extremely unlikely that they are widespread or even recognisable. The project would not impact on the fossil heritage.

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 volcanic rocks or surface soils of the Quaternary. There is an extremely small chance that trace fossils may occur in the sandstones and quartzites of the Magaliesberg Formation. This formation is extensive and predates the origin of any body fossils. These trace fossils are also of debatable interpretation. Based on these facts, it is the opinion of the palaeontologist that the project will not impact on the palaeontological heritage and the project should proceed.
7. References


Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2018

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-
Telephone : +27 11 717 6690
Fax : +27 11 717 6694
Cell : 082 555 6937
E-mail : marion.bamford@wits.ac.za; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:

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

<table>
<thead>
<tr>
<th>Degree</th>
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<tbody>
<tr>
<td>Honours</td>
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<tr>
<td>Masters</td>
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<td>1</td>
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<tr>
<td>PhD</td>
<td>10</td>
<td>2</td>
</tr>
<tr>
<td>Postdoctoral fellows</td>
<td>9</td>
<td>3</td>
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</table>

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 – Cretaceous Research: 2014 -

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

xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 28;
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)