NGT ESHS Solutions

PROJECT TITLE:
BASIC ASSESSMENT REPORT FOR THE PROPOSED DEVELOPMENT OF A SMME TRAINING CENTRE AND YOUTH ENTERPRISE PARK ON ERF 1977 EDENDALE-CC LOCATED IN THE MSUNDUZI LOCAL MUNICIPALITY, PIETERMARITZBURG, KWAZULU-NATAL PROVINCE, SOUTH AFRICA

PROJECT REFERENCE NUMBER:
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SPECIALIST REPORT:

A Desktop Palaeontological Impact Assessment For The Proposed Development Of A Smme Training Centre And Youth Enterprise Park On Erf 1977 Edendale-Cc Located In The Msunduzi Local Municipality, Pietermaritzburg, Kwazulu-Natal Province, South Africa

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ACKNOWLEDGEMENT OF RECEIPT

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HAND SIGN:	

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DECLARATION OF INDEPENDENCE

Marion Bamford for NGT has compiled this report. 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.

CONSULTANT:	**NGT Holdings (Pty) Ltd**
SPECIALIST NAME	Prof Marion Bamford
QUALIFICATIONS	BSc, BSC Honours, MSc, PhD (Wits, 1990)
ASSOCIATION/PROFESSIONAL BODY	FRSSAf, mASSAf, PSSA, SASQUA
YEARS OF EXPERIENCE IN THE INDUSTRY	22
SIGNATURE (HAND SIGNATURE ON APPROVAL BY CLIENT)	

EXECUTIVE SUMMARY

A Palaeontological Impact Assessment was requested for the proposed development of a SMME Training Centre and Youth Enterprise Park on Erf 1977 Edendale-CC located in Imbali Township within Msunduzi Local Municipality within Umgungundlovu District in KwaZulu-Natal Province, South Africa. 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.

Conclusions:

The proposed site lies on the Volksrust Formation, Adelaide Subgroup of the Karoo Supergroup. It is predominantly argillaceous (clay) and represents a transgressive open shelf sequence composed mostly of muds deposited from suspension (northern and western parts). Fossils are extremely rare in this lithology and apart from one possible marine bivalve (Cairncross *et al.,* 2005) nothing much has been reported. The dolerite dykes and overlying sands do not preserve fossils (central and south parts).

Recommendations:

A Fossil Chance Find protocol should be followed once excavations for foundations and infrastructure commences, and if any fossils are discovered by the responsible person in charge, then they should be rescued and put aside for a professional palaeontologist to assess. As far as the palaeontology is concerned the project may proceed.

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LIST OF ABBREVIATIONS

ACRONYMS	DESCRIPTION
AUTHORITIES	
ASAPA	Association of South African Professional Archaeologists
AMAFA	Amafa KwaZulu-Natali
DEA	Department of Environmental Affairs
HESQ	HESQ Consultants (PTY) LTD
KZN-EDTEA	Department of Economic Development, Tourism and Environmental Affairs
MLM	Msunduzi Local Municipality
NGT	Nurture, Grow, Treasure
SADC	Southern African Developing Community
SAHRA	South African Heritage Resources Agency
DISCIPLINE	
AIA	Archaeological Impact Assessment
ARCH	Archaeological
BAR	Basic Assessment Report
BEL	Built Environment & Landscape
CRM	Cultural Resource Management
ESA	Early Stone Age
EAP	Environmental Assessment Practitioner
EIAs	Environmental Impact Assessment
EMPr	Environmental Management Programme
EIA	Early Iron Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
LIA	Late Iron Age
LSA	Late Stone Age
MIA	Middle Iron Age
MSA	Middle Stone Age
PIA	Paleontological Impact Assessment
RQC	Review and Quality Control
SMME	Small, Medium, Micro Enterprises
LEGAL	
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
ZNHB	KwaZulu-Natal Heritage Bill
KZNHA	KwaZulu-Natal Heritage Act

TERMS AND DEFINITIONS

Archaeological resources

These include:

- Material remains resulting from human activities which are in a state of disuse and are in or on land and which are older than 100 years including artefacts, human and hominid remains and artificial features and structures;
- Rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- Wrecks, being any vessel or aircraft, or any part thereof which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- Features, structures and artefacts associated with military history which are older than 75 years and the site on which they are found.

Palaeontological

This means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in the change to the nature, appearance or physical nature of a place or influence its stability and future well-being, including:

- Construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- Carrying out any works on or over or under a place;

- Subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- Constructing or putting up for display signs or boards; any change to the natural or existing condition or topography of land;
- And any removal or destruction of trees, or removal of vegetation or topsoil.

Heritage resources: This means any place or object of cultural significance.

1. INTRODUCTION

The Msunduzi Municipality, commonly known as Pietermaritzburg or the "City of Choice" is located along the N3 at a junction of an industrial corridor 80 km inland from Durban along the major road route between the busiest harbour in South Africa and the industrial hub of Johannesburg. The project area falls within the Greater Edendale Area where there is high unemployment and much illegal or informal business. To improve the quality of life and create more value chain business opportunities in the Imbali precinct area, the proposed development on municipal land has been planned (see TOR document for details). The project will be on Erf 1977, Edendale CC, and has several phases of development.

A Palaeontological Impact Assessment (PIA) was requested for the propose development of a Small, Medium, Micro Enterprises (SMME) Training Centre and Youth Enterprise Park. The development is located in the Imbali Township in MLM within UMgungundlovu District in KwaZulu-Natal Province, South Africa. The project area is located on Erf 1977 Edendale-CC in the Msunduzi Municipality. The client is submitting various required applications, along with the required environmental authorisation application. 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 PIA was completed for the proposed development.

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

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Appendix B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority	Page **Error! Bookmark not defined.**
An indication of the scope of, and the purpose for which, the report was prepared	Section **Error! Reference source not**

	found.
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section 3.2 **Error! Reference source not found.**
An identification of any areas to be avoided, including buffers	N/A
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
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
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
Any mitigation measures for inclusion in the EMPr	n/a
Any conditions for inclusion in the environmental authorisation	n/a
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8
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	N/A

should be included in the EMPr, and where applicable, the closure plan	
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 Msunduzi Youth Enterprise Park (turquoise rectangle). Map supplied by NGT.

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.

3. GEOLOGY AND PALAEONTOLOGY

3.1. Project location and geological context

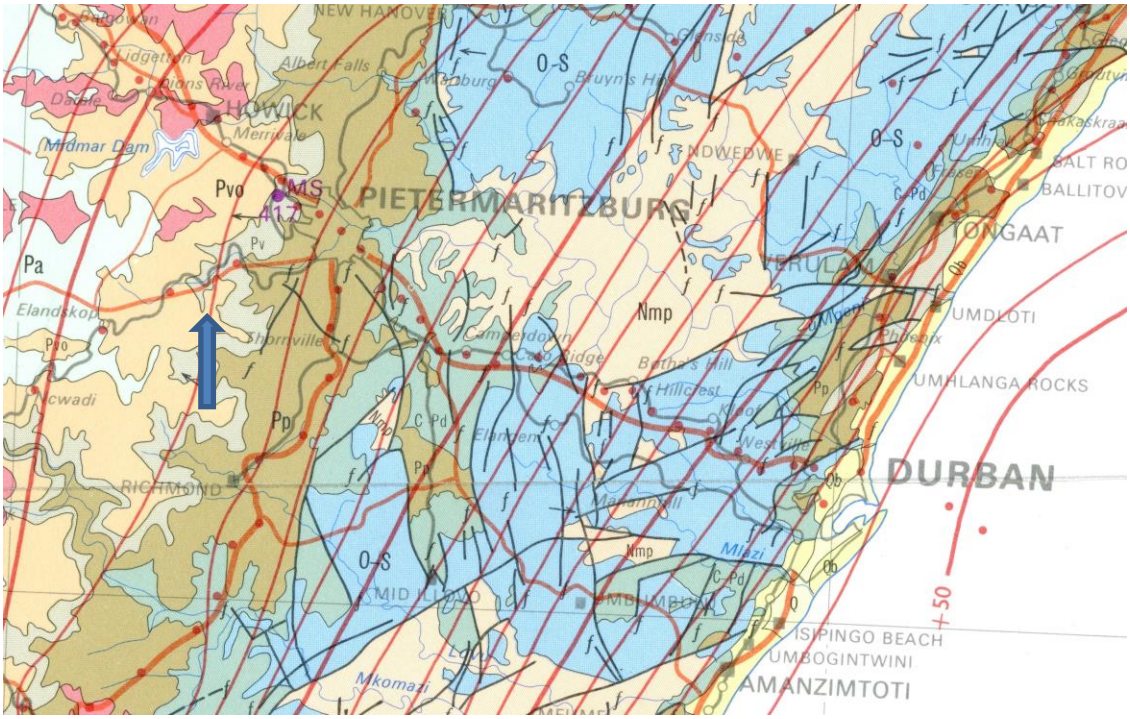

Figure 2: Geological map of the area around Pietermaritzburg (Msinduzi). The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 25 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Pa	Adelaide Subgroup, lower Beaufort Group	Sandstone, mudrock	Late Permian Ca 266 – 251 Ma
Pvo	Volksrust Fm, Adelaide Subgroup, Beaufort Group	Shales,	(late Permian) Guadlupian, Capitanian to Lopingian, Wuchiapingian; Ca 266 – 256

Symbol	Group/Formation	Lithology	Approximate Age
			Ma
Pv	Vryheid Fm, Ecca Group	Sandstone, shale, coal	(Mid late Permian), Guadalupian, Wordian; Ca 269-266 Ma
Pp	Pietermaritzburg Fm, Lower Ecca Group, Karoo Supergroup	Shales	early Permian, Early Ecca, ca 290 Ma
C-Pd	Dwyka	Tillite, sandstone, mudstone shale	Late Carboniferous – early Permian
O-S	Westville Member, Mariannhill Fm, Natal Group	Matrix supported conglomerate; Quartzitic sandstone, arkose, shale	Ordovician-Silurian
Nmp	Mapumulo Group, Mzumbe Terrane, Namaqua-Natal Province	Gneiss, granulite	Ca 2000 Ma with younger intrusions ca 1200-1030 Ma

The oldest rocks in the area are gneiss and granulite of the Mapumilo Group, Namaqua-Natal Province, that are about 2 000 million years old (Ma).

The Dwyka Group sediments unconformably overlie the Natal Group rocks (Johnson *et al.,* 2006). This group comprises a number of different facies (massive diamictites, stratified diamictites, conglomerates, sandstones, mudrocks) and represent a series of ice formation and melts (Johnson *et al.,* 2006; Isbell *et al*,. 2012) that occurred throughout Gondwana during the Carboniferous to Early Permian when the polar ice cap formed and melted.

Pietermaritzburg Formation shales and mudrocks represent a major post glacial transgression with widespread carbonate concretions, lenses and beds indicating relatively shallow water possibly on an unstable shelf (Johnson et al., 2006). The top of the formation has coarser sediments that indicate shoreline progradation.

There are three Karoo Supergroup formations represented in the area and they are the oldest Pietermaritzburg Fm, next the Vryheid Fm and the younger Volksrust Fm (Table 2). They indicate the gradual infilling of the Karoo Basin with fine-grained deltaic sediments settling in the inland sea/lake from erosion of the surrounding highlands, namely the Cargonian Highlands to the north (and the Cape Fold Mountains to the south). The Vryheid Fm swamps eventually produced the KwaZulu-Natal coalfields and the overlying Volksrust Fm was deposited afterwards as a transgression sequence.

3.2. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4. Mapumulo gneisses and granites are igneous and would not preserve any fossils. Conglomerates and sands are reworked and do not contain primary fossils. Furthermore, the Natal group rocks are too old for body fossils as they had not evolved by then (Plumstead, 1969). Jurassic dolerite does not preserve fossils as it is igneous in origin and would have destroyed any fossils that might have occurred in the Karoo sediments through which they intruded. The aeolianites and sands of the Berea and Bluff Quaternary sediments do sometimes preserve fossils but along the Natal coast these are restricted to the Port Durnford Formation which does not occur in this site.

Shallow water sediments of the Pietermaritzburg Formation comprise heavily bioturbated mudrocks and invertebrate trace fossils on the bedding planes of carbonate cemented mudrock (Johnson *et al.,* 2006). Since this area is heavily vegetated and prone to flooding none of the primary structures would be preserved.

The Volksrust Formation is predominantly argillaceous (clay) and represents a transgressive open shelf sequence composed mostly of muds deposited from suspension. There is evidence that the upper and lower layers of the Volksrust Formation were deposited in lacustrine, to lagoonal and shallow coastal embayment settings (Johnson *et al.,* 2006). Fossils are extremely rare in this lithology and apart from one possible marine bivalve (Cairncross *et al.,* 2005) nothing much has been reported. In contrast the older Vryheid Formation has a patchy but significant fossil record with a variety of plant impressions from the *Glossopteris* flora (Plumstead, 1969; Anderson and Anderson, 1985).

The Msundizi Youth Enterprise Park will be situated on the shales of the Volksrust Formation which is not fossiliferous. The other lithologies will not be affected by this project.

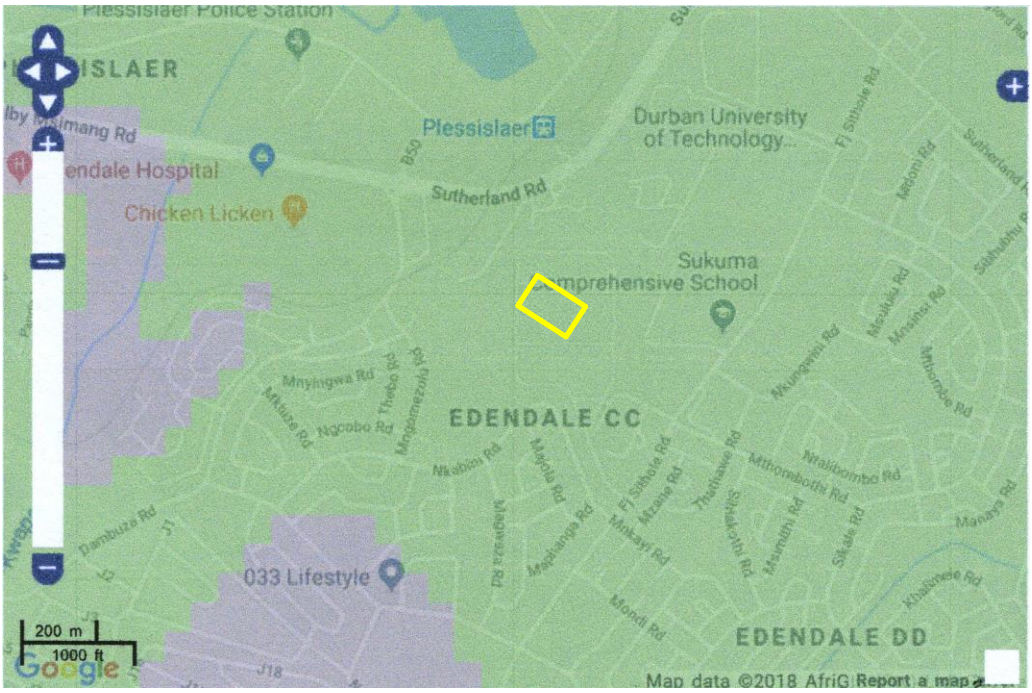

Figure 3: SAHRIS palaeo-sensitivity maps for the site for the proposed Msunduzi Youth Enterprise Park shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; bl

From the SAHRIS palaeo-sensitivity map above all of the area is indicated as moderately sensitive (green) so a desktop study is presented here. The Volksrust Formation shales in most cases are not fossiliferous.

4. IMPACT ASSESSMENT

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in **Error! Reference source not found.** and Table 4:

Table 3: Criteria for assessing impacts

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

Table 4: Impact Assessment

PART B: Assessment		
SEVERITY/NATURE	**H**	-
	M	-
	L	So far there are no records from the Volksrust Fm of plant or animal fossils in this region, so it is very unlikely that fossils occur on the site. The impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since only the possible fossils within the area would be fossil plants from the *Glossopteris* flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the rocks sand that will be mined. Nonetheless a 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 but the area has already been disturbed by urban development. The geological structures suggest that the rocks are either much too old to contain fossils or the sedimentary rocks represent a transgressive open shelf sequence and do not preserve fossils. Since there is an extremely small chance that fossils

from the Volksrust Formation may be disturbed a 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 gneisses, granites, sandstones, shales and sands are typical for the country and rarely contain fossil plant material. The sands of the Quaternary period and dolerites of the Jurassic period would not preserve fossils.

6. RECOMMENDATION

Based on experience and the lack of any previously recorded fossils from the area, it is unlikely that any fossils would be preserved in the overlying dolerites of the Jurassic or in the loose sands of the Quaternary. There is an extremely small chance that fossils may occur in the shales of the late Permian Volksrust Formation, so a Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced then they should be rescued, and a palaeontologist called to assess and collect a representative sample.

7. REFERENCES

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Cairncross, B., Beukes, N.J., Coetzee, L.L., Rehfeld, U., 2005. The Bivalve Megadesmus from the Permian Volksrust Shale Formation (Karoo Supergroup), northeastern Karoo Basin, South Africa: implications for late Permian Basin development. South African Journal of Geology 108. 547-556.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Reimold, W.U., 2006. Impact structures in South Africa. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 629-650.

8. APPENDIX A - CHANCE FIND PROTOCOL

Monitoring Programme for Palaeontology – to commence once the building and infrastructure excavations begin.

1. The following procedure is only required if fossils are seen on the surface and when 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 (shells, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the mining 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. This information will be built into the EMPr'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 the site inspections by the palaeontologist will not be necessary. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the excavations have finished, then no further monitoring is required.

9. APPENDIX B – 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-
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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	6	1
Masters	8	1
PhD	10	2
Postdoctoral fellows	9	3

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)

NRF Rating: C-2 (1999-2004)