Palaeontological Impact Assessment for the proposed Prospecting on the Remainder and Portions 3, 4, 5, 6, 7, 8 & 10 of Farm Ezelsfontein 214, Namakwaland Magisterial District, Northern Cape Province

Desktop Study (Phase 1)

For

ASHA Consulting (Pty) Ltd

13 November 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 ASHA Consulting (Pty) Ltd, Muizenburg, 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: 

Executive Summary

A Palaeontological Impact Assessment was requested for the proposed prospecting rights on the Remainder and Portions 3, 4, 5, 6, 7, 8 & 10 of Farm Ezelsfontein 214, Namakwaland Magisterial District, Northern Cape Province (SAHRA Case Id: 17227.

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 development.

The proposed site lies on the non-fossiliferous granites of the Kamieskroon Ridge and on possibly fossiliferous rocks of the Nama Group (Schwarzrand Formation) that has trace fossils, stromatolites and Ediacaran marine faunal remains in the same formation in Namibia and theh Vioolsdrif area. No fossils have been recorded in this area but there is a small chance that they could occur here. Therefore a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no further palaeontological impact assessment is required unless fossils are found by the prospectors / drillers / environmental officer/ other designated responsible person once drilling activities have commenced. As far as the palaeontology is concerned, the project should be authorised.

Table of Contents

1. Background

The Farm Ezelsfontein 214 lies within the granite hills of the northernmost Kamiesberg, although an area of Nama sediments (sandstone, shale and limestone) is present. The general area has been the site of many copper mining ventures since the mid-19th century, although none occurs within the present study area. The mountains have much exposed granite (and other rocks in the central part of the study area), while the valleys tend to be filled with alluvium. Vegetation is sparse but denser than in areas farther from the escarpment. Traces of earlier mining are abundant in the landscape but seem to be absent from the present study area. The R355 traverses the southern part of the study area and leads to the escarpment and down the Spektakel Pass that starts in the far western part of the study area (Figures 1, 2)

Project description

The application (DMRE ref no.: NC30/5/1/1/2/12852PR) involves prospecting for copper, tungsten and a wide variety of other minerals. The prospecting work will occur in three phases and will include the following tasks:

Proposed prospecting methods (see section 6 for detailed description of these methods)
(a) Desktop study work and assessment of historical data
(b) Geological field mapping (optional)
(c) Geophysics
(d) Soil Sampling programmes (optional)
(e) Initial Diamond core (or reverse-circulation) drilling to identify the presence of mineralisation
(f) Consolidation and interpretation of data; possible geological modelling
(g) Resource Diamond (or reverser-circulation) drilling (if warranted)
(h) Mineral Resource estimation (if warranted)
(i) Pre-feasibility studies (if warranted)
(j) Rehabilitation programmes
(k) Closure if warranted
(l) Mineral right, environmental and legal work and reporting
(m) Raising of finance and associated reporting

A laydown and storage area may be required (only for core drilling) but no other infrastructure, accommodation, etc will be developed as part of this prospecting project and no processing plant or other related services will need to be developed. Existing roads and tracks will be used as far as possible but from time to time the drilling rig will need to cross undisturbed ground to reach drill sites. Reverse circulation drilling does not require the ground to be cleared, but core drilling will require a clear area of 160 m^2. All damaged areas will be rehabilitated after drilling.

A Palaeontological Impact Assessment was requested by SAHRA (Case ID: 17227) for the Ezelsfontein prospecting rights proposal although the area is shown as having very low to insignificant palaeosensitivity on their SAHRIS map. 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 development and is reported herein.

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

	A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:	**Relevant section in report**
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 1
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 8, 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 8, Appendix A
ni	A reasoned opinion as to whether the proposed activity or portions thereof should be authorised	Section 6

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	Sections 6, 8
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: Google Earth map to show the location of the project site in relation to other landmarks, West of Springbok, Northern Cape Province, with the section shown by the red outline. Map supplied by ASHA.

Figure 2: Google Earth map to show the boundary of the prospecting area, the boundary of Farm Ezelsfontein 214, red outline.

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

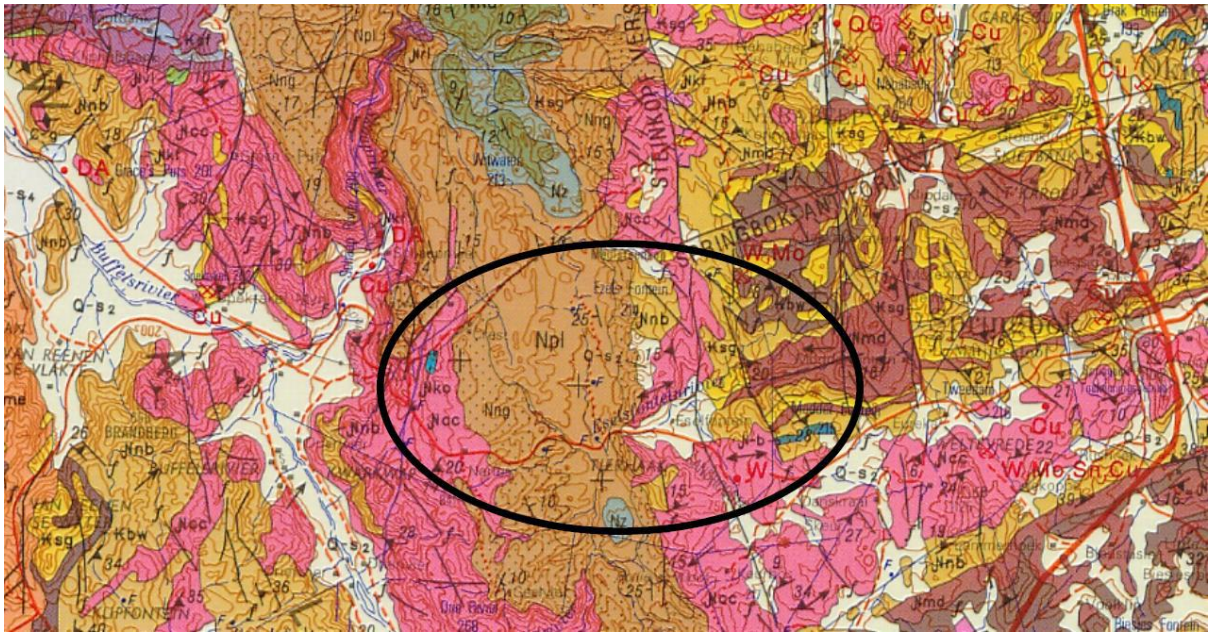

Figure 3: Geological map of the area around the Farm Ezelsfontein 214. The prospecting area is within the black outline. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2916.

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

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 2.5 Ma to present
Npl/Nsc	Schwarzrand Subgroup, Nama Group	Shales, sandstones, limestone	Neoproterozoic to Early Cambrian, ca 550-540 Ma
Nnb	Nababeep Gneiss, Little Namaqualnd Suite	Gneiss	Ca 1200 – 1000 Ma
Ncc	Concordia Granite, Spektakel Suite	Granite	Ca 1200 – 1000 Ma

The Namibian Era and Cambrian Period are represented in South Africa, north of the 32°S line by the rocks of the Richtersveld Suite, the Gariep Supergroup and the Nama and Vanrhynsdorp Groups. South of the 32° line this period is represented by the Malmesbury, Cango Caves, Kaaimans, Gamtoos and Kansa Groups (Gresse et al., 2006). These successions are related to the opening of oceanic basins following the breakup of a Mesoproterozoic supercontinent and subsequent Pan-African orogenesis that lead to a system of Neoproterozoic mobile belts that surround and weld together older cratons on the African continent (ibid). The northern Gariep Belt and southern Saldania Belt are generally composed of low-grade, metamorphosed volcanic sedimentary successions, intruded by syn- to post-orogenic granitoids. They are also associated with foreland and molasses

deposits, namely the Nama and Vannrhynsdorp Groups. The Nama and Vanrhynsdorp Groups are dated to about 550-530 Ma (Gresse et al., 2006; Jensen et al., 2018).

Richtersveld Suite (pre-orogenic)
There are four major intrusive bodies in the Richtersveld region, the Sjambok River, Xaminxaip-Black Face Mountain, Klipbokkop and Rooiberg intrusions. Ranging in age from 1200-1000 Ma, they have various mafic compositions and intruded through the 1900-1700 Ma Vioolsdrift Suite granitoids.

Gariep Supergroup (Pan-African Orogenic Belt)
The Gariep Supergroup forms a well-exposed metavolcanic-sedimentary succession in the Richtersveld region of the Northern Cape Province. Subsequent tectonic activity, faulting and folding has extensively deformed these rocks.

Figure 4: Stratigraphic profile of the Nama Group in the Vioolsdrif-Springbok area. (From Gresse et al., 2006, Fig 14; updated from Jensen at al., 2018 and Darroch et al., 2020)

	sG,	Formation	Member	Lithology	Fossils	Location
Nama Group	Schwarzrand	Urusis	Huns	limestone	Stromatolites *Cloudina*	West of Vioolsdrift
			Naseep	sandstone, shale, limestone		
		Nudaus	Vingerbreek	shale, siltstone	*Neonereites* Vendotaenids *Psammichnite*s Scratch circles*	Between Steinkopf and Springbok *Vioolsdrif
			Niederhagen	sandstone	*Arumberia*	
	Kuibis	Zaris	Urikos	shale		
			Mooifontein	limestone shale	*Cloudina* Stromatolites	Vioolsdrif, sporadic bioherms west of Springbok
		Dabis		cross-bedded sandstone, shale alt.		Not in SA

Nama Group (Post orogenic and foreland deposits of the Pan African Belts – p. 412+)
The Nama foreland Basin stretched for more than 1000km from north to south along the western edge of the Kalahari Craton and comprised three distinct basins, separated by west-east ridges (Gresse et al., 2006). From north to south, they are the Zaris, Witputs and Vanrhynsdorp basins. The Zaris Basin is in northern Namibia and separated from the Witputs Basin by the Osis Ridge; the Witputs Basin in southern Namibia and northern South

Africa includes the Orange River and is separated from the Vanrhynsdorp Basin by the Kamieskroon Ridge (Figure 5)

The Vanrhynsdorp Group sediments occur in the Vanrhynsdorp Basin. Only part of the Nama Group occurs in the Witputs Basin with the Kuibis and Schwarzrand Subgroups exposed in the Nient Nababeep Plateau between Vioolsdrif and Springbok, and west of Upington (Figure 1 from Gresse et al. 2006). See Figures 4, 5 here for fossil occurrences and locations in the Witputs Basin.

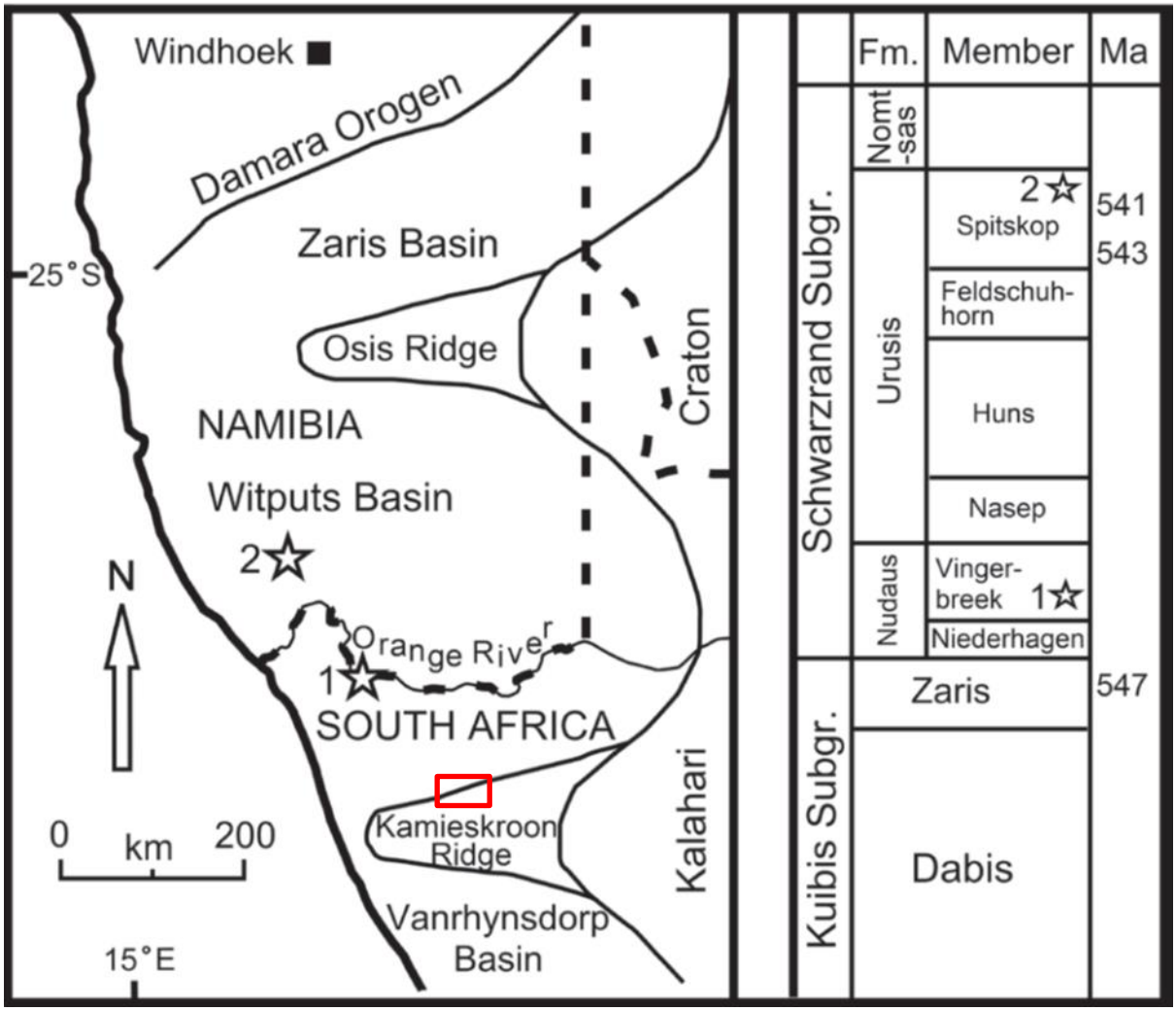

Figure 5: Diagram of the west coast of South Africa – Namibia to show the extent of the Nama foreland basin (From Fig. 7 of Jensen et al., 2018). Red outline shows location of Ezelsfontein Farm.

ii. Palaeontological context

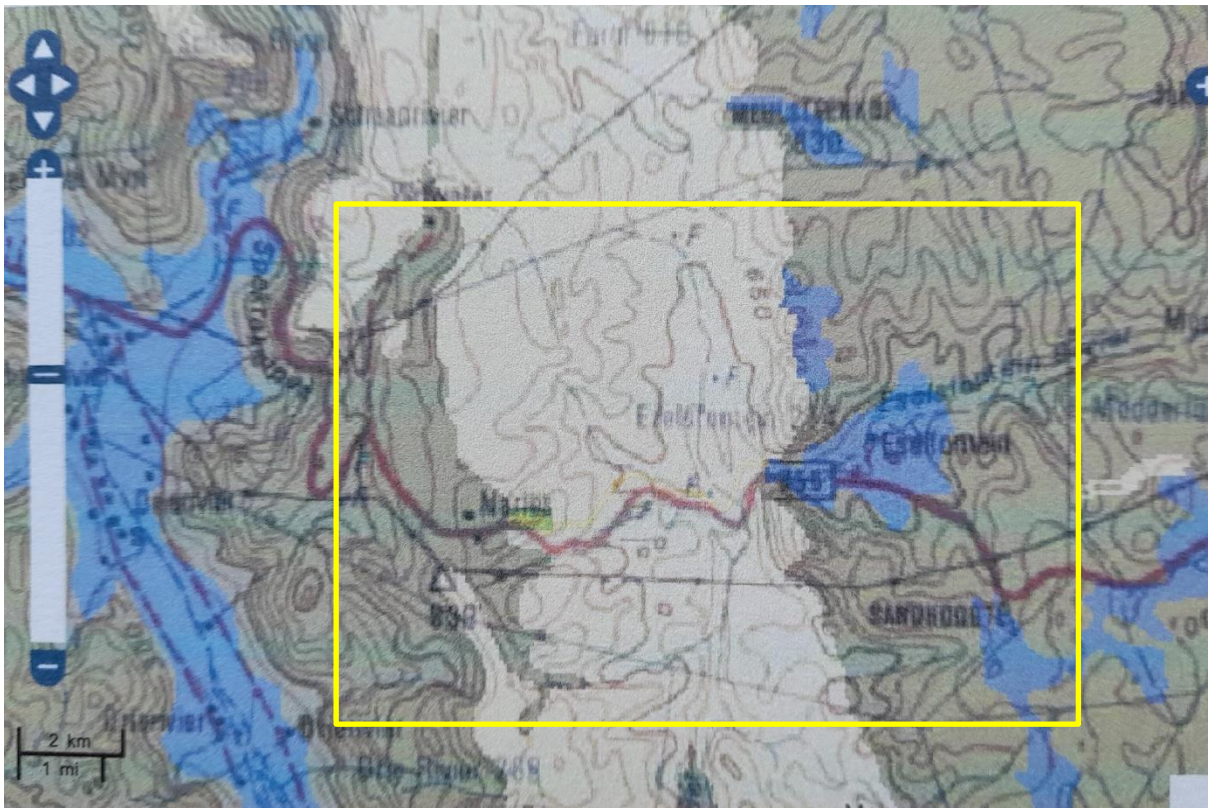

Figure 6: SAHRIS palaeosensitivity map for the site for the proposed prospecting rights application on Farm Ezelsfontein 214, west of Springbok shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above (Figure 6) the area is indicated as predominantly white (unknown/unmapped) and grey or blue for the granites. The white area corresponds to the Schwarzrand Subgroup (Nama Group).

From the literature on the Nama Group, there are sporadic occurrences of a number of trace fossils (stromatolites, burrows, worm tracks, unknown tracks) and some Ediacaran (Naman) skeletal fossils such as *Cloudina* and *Namacalathus* (Gresse et al. 2006, Almond 2009) in the South African exposures. More recently, so-called “scratch circles” have been described from near Vioolsdrif in South Africa (Jensen et al., 2018; Figure 5, stars). By far the most abundant fossils occur in the Namibian deposits of the Nama Group (Gresse et al., 2006; Jensen et al., 2018; Darroch et al., 2021).

As described in the introduction and geology sections, the Farm Ezelsfontein lies on the Kamieskroon Ridge that divides the Witputs and Vanrhynsdorp basins (see Figure 5) and by virtue of its topography, the ridge will not have basin sediments. As shown in Figure 4 above, the records of fossils are mostly in the area between Steinkopf and Springbok (north-

east of the Farm), and Vioolsdrif (north of the Farm). There are no published records of fossils on the Ezelsfontein Farm.

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		
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 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	Granites do not preserve any fossils; so far there are no records from the Nama Group of trace or skeletal 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 the only possible fossils within the area would be trace fossils or early skeletal fossils from the Nama Group in the shales or limestones, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	-
	L	It is extremely unlikely that any fossils would be found in the loose sand that covers the area, or in the drill holes for exploration/prospecting. Nonetheless 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 might preserve trace fossils. Since there is an extremely small chance that fossils from the Nama Group might 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 granites, gneisses, limestone, sandstones, shales and sands are typical for the country and the age, and only shells or limestones might preserve Nama Group (Ediacaran) trace fossils or fauna. From the geology, it is unlikely that fossils occur in the area but this is not known for certain.

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 rocks of the Kamieskroon Ridge as this divides the basin, and Nama Group fossils occur to the north of it, and Vanrhynsdorp Group fossils to the south. The prospecting activities involve drilling small diameter holes through the sediments to the rocks below so the footprint of each hole is very small relative to the whole area. Nonetheless, there is a very small chance that fossils may occur in the shales and limestones of some members of the Nama Group, so a Fossil Chance Find Protocol (Section 8; Appendix A) should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once drilling has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. As far as the palaeontological heritage is concerned, the project should be authorised.

7. References

Almond, J.E. 2009. Contributions to the palaeontology and stratigraphy of the Alexander Bay sheet area (1: 250.000 geological sheet 2816). 117 pp. Unpublished report for the Council for Geoscience. Natura Viva cc, Cape Town.

Buatois, L.A., Almond, J., Mángano, M.G., Jensen, S., Germs, G.J.B., 2018. Sediment

disturbance by Ediacaran bulldozers and the roots of the Cambrian explosion. Scientific Reports 8, 4514. https://doi.org/10.1038/s41598-018-22859-9.

Darroch, S.A.F., Cribb, A.T., Buatois, L.A., Germs, G.J.B., Kenchington, C.G., Smith, E.F., Helke, H., O'Neil, G.R., Schiffbauer, J.G., Maloney, K.M., Racicot, R.A., Turk, K.A., Gibson, B.M., Almond, J., Koester, B., Boag, T.H., Tweedt, S.M., Laflamme, M., 2021. Ediacaran roots of the Cambrian explosion. Earth-Science Reviews 212 (2021) 103435.

Gresse, P.G., von Veh, M.W., Frimmel, H.E., 2006. Namibian (Neoproterozoic) to Early Cambrian Successions. 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 395-420.

Jensen, S., Högström, A.E.S., Almond, J., Taylor, W.L., Meinhold, G., Høyberget, M., Ebbestad, J.O.R., Agić, H. & Palacios, T. 2018. Scratch circles from the Ediacaran and Cambrian of Arctic Norway and southern Africa, with a review of scratch circle occurrences. Bulletin of Geosciences 93(3), 287–304.

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 (stromatolites, burrows, tracks or traces) should be put aside in a suitably protected place. This way the project activities will not be interrupted.
3. Photographs of similar fossils must be provided to the developer to assist in recognizing the trace fossil and Ediacaran (Naman) fauna in the shales or limestones (for example see Figures 7, 8). 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 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. Trace fossil or marine 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 Nama Group.

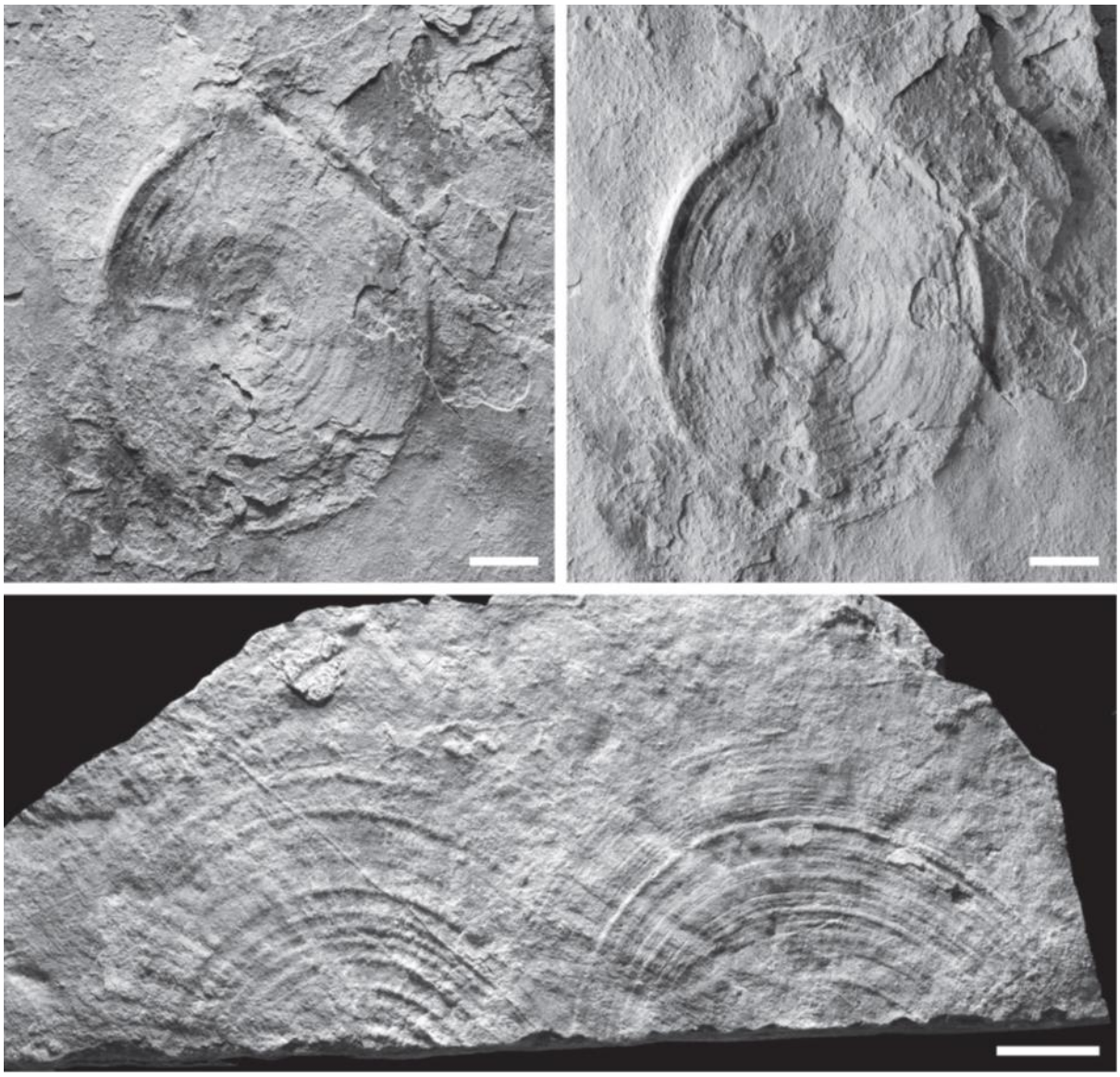

Figure 7: Scratch circles from south of Vioolsdrif, Northern Cape Province. Scales: A, B = 10mm; C= 20mm. (Fig 9 in Jensen et al., 2018). A scratch circle (Fig. 9A, B) was collected by John Almond in 2008 (Almond 2009) on a platy float block of grey-green siltstone from the lower part of the Vingerbreek Member (Nudaus Formation, Schwarzrand Subgroup, Nama Group) on the eastern face of the Neint Nababeep Plateau (28° 51′ 41.7″ S, 17° 36′ 27.2″ E), ca 10.26 km south of Vioolsdrif.

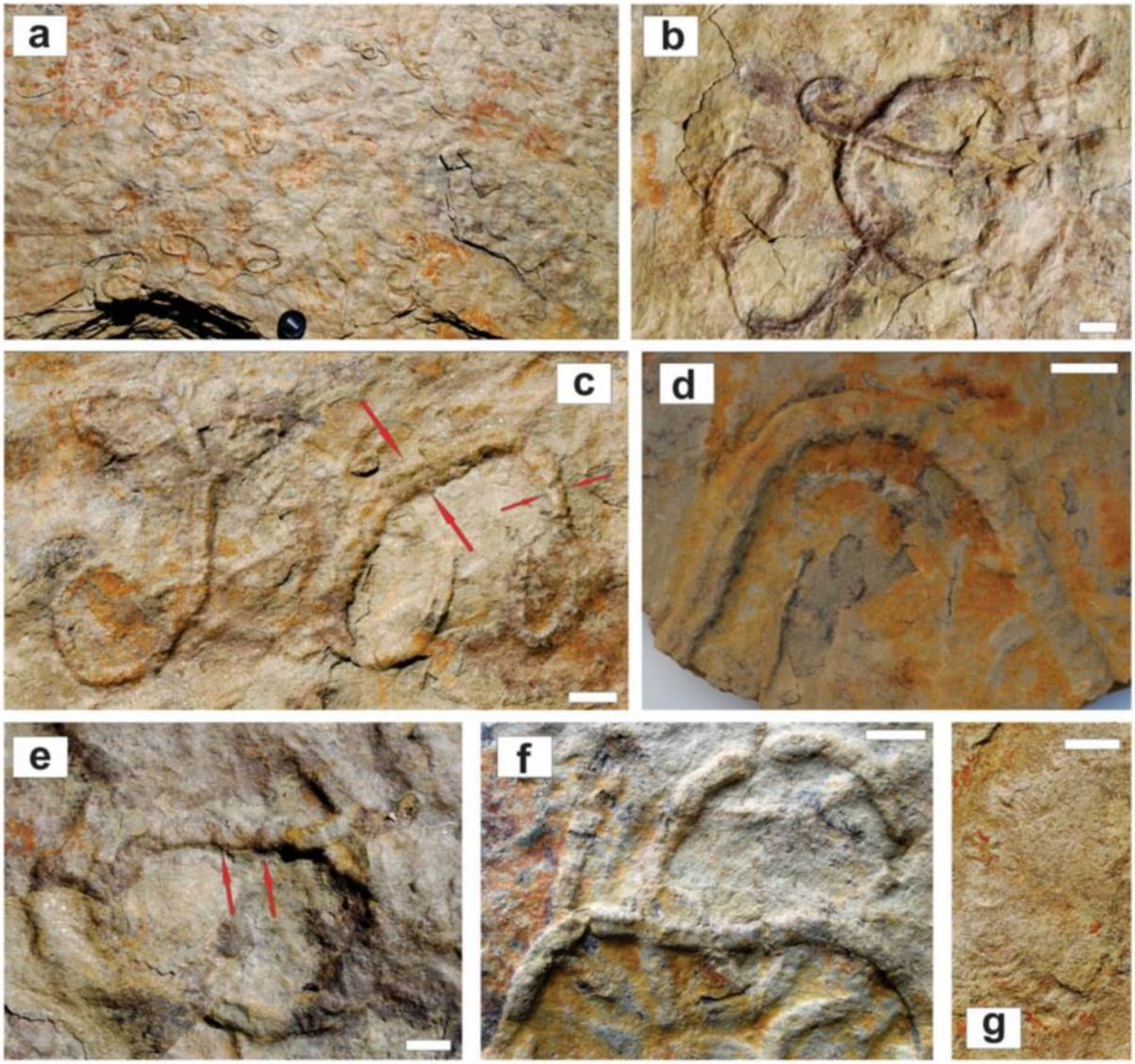

Figure 8: Figure 3. Morphological variability of Parapsammichnites pretzeliformis n. igen. and n. isp. from the Urusis Formation from Buatois et al., 2018.

(a) General view of sandstone base showing moderate density of horizontal trace fossils depicting scribbles, circles and spirals. Lens cover is 5.5 cm wide. (b) Close-up of scribbles, showing bilobate nature of the structures. (c) Trace fossil displaying self-overcrossing and pretzel shape. Long trace fossil displaying several self-overcrossings and significant width changes along the course (large and short arrows). Large arrows show expansion “envelope” of reworked sediment. (d) Unilobate trace fossil showing sediment pads and grading into a bilobate segment (left). (e) Specimens displaying inclined arcuate ridges (sediment pads), resulting locally in constricted aspect. Arrows mark arcuate sediment pads slightly offset from the axis. (f) Several specimens showing transitions between unilobate to bilobate segments. (g) Weathered specimen displaying meniscate laminae, hinting towards packing in sediment pads. All views are from sandstone bed soles. All scale bars are 2 cm long.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
July 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-
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:
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	0
Masters	10	4
PhD	11	4
Postdoctoral fellows	10	5

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
- Lieliefontein 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
- Frankfort-Windfield Eskom Powerline 2020 for 1World
- Beaufort West PV Facility 2021 for ACO Associates
- Copper Sunset MR 2021 for Digby Wells
- Sannaspos PV facility 2021 for CTS Heritage
- Smithfield-Rouxville-Zastron PL 2021 for TheroServe

xi) Research Output

Publications by M K Bamford up to July 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)