Palaeontological Impact Assessment for the proposed three dam project on Portions 6 and 8, Elandsbosch 122 KR, Naboomspruit for Imvubu Berries, Limpopo Province

Desktop Study (Phase 1)

For

Setala Environmental (Pty) Ltd

20 February 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 Setala Environmental (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: 

Executive Summary

Imvubu Berries (Pty) Ltd is proposing to upgrade existing dams on Portion 6 and 8 of the farm Elandsbosch 122 KR, Naboomspruit, Limpopo Province. Dams 6 and 7 are existing and will be reconstructed; Dam 8 will be a new dam on old agricultural land.

In order 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 the dams, and requested by SAHRA (Case ID: 14643). The area is of moderate palaeontological significance according to the SAHRIS palaeomap, and as per the policy, a desktop assessment of palaeontological resources is required.

The site for the three dams lies on the arenites, sandstones and rudites of the Mogalakwena Formation (Kransberg Subgroup, Waterberg Group) that are about 2 000 million years old. According to the geology and sedimentology these coarse-grained sediments are indicative of high energy rivers and streams and not suitable for the preservation of fossils. Only microbes were present at that time and only in the older low energy and fine-grained sediments is there any indication of microbial mat structures (Makgabeng Formation). The Palaeotechnical Report for Limpopo confirms that the Waterberg Group is of low palaeosensitivity. Nonetheless, as a desktop study was requested, it has been completed and is presented here. Based on the information compiled here, it is recommended that no palaeontological impact is required, and as far as the palaeontology is concerned, the project may proceed.

Table of Contents

1. Background

Imvubu Berries (Pty) Ltd (the applicant) appointed Setala Environmental (Pty) Ltd as the independent environmental assessment practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the proposed project. The project involves the upgrade of existing in-channel farm dams and the construction of a new off-channel farm dam for the existing lawful water use(s): Surface water abstraction and storage; and for the abstraction of groundwater at Elandsbosch 122-KR for domestic purposes. The scope of the project includes application for environmental authorisation and a water use licence for the use of water for irrigation purposes.

Setala Environmental (Pty) Ltd has undertaken an environmental assessment as part of a Basic Assessment application process in support of an Environmental Authorisation (EA) in terms of the National Environment Management Act, Act 107 of 1998 (NEMA) for activities that trigger the NEMA EIA 2014 Regulations.

The property description of the site is: Portion 6 & 8 of Farm Elandsbosch KR122, Naboomspruit, Limpopo Province (Figures 1, 2). These portions were recently acquired so only the activity here is being considered, namely the existing dams 6 and 7 which will be rebuilt, and the new dam 8, that will be constructed on old agricultural lands adjacent to the stream. Refer to the Final Bar by Setala (Dec 2020; LEDET Ref: 1138782) for more details.

SAHRA requested a desktop Palaeontological Impact Assessment (CaseID: 15643) in order 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). Therefore a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development and is presented 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 A
aii	The expertise of that person to compile a specialist report including a curriculum vitae	Appendix A
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 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

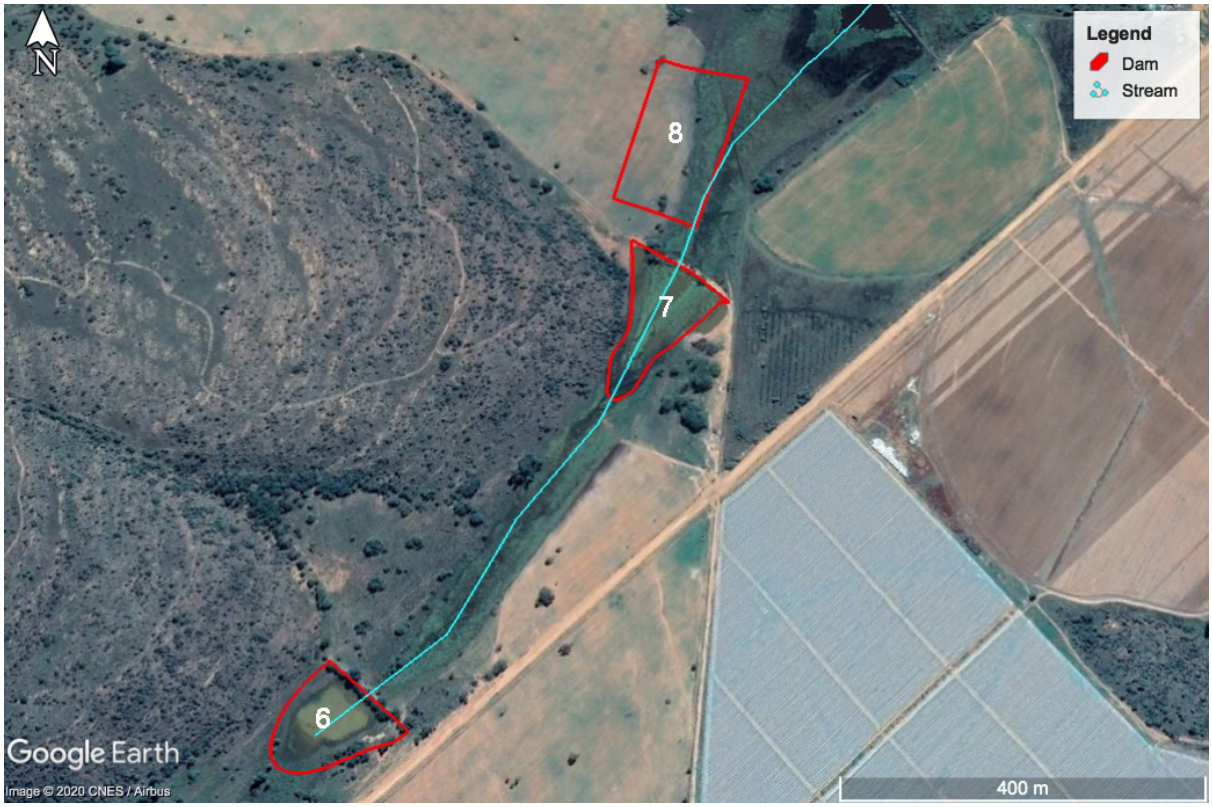

Figure 1: Google Earth map of part of portions 6 and 8 on Farm Elandsbosch 122 KR for the proposed reconstruction of two existing dams (6 and 7) the construction of a new dam, 8, with the sections shown by the red outline. Map supplied by Setala Environmental (Pty) Ltd.

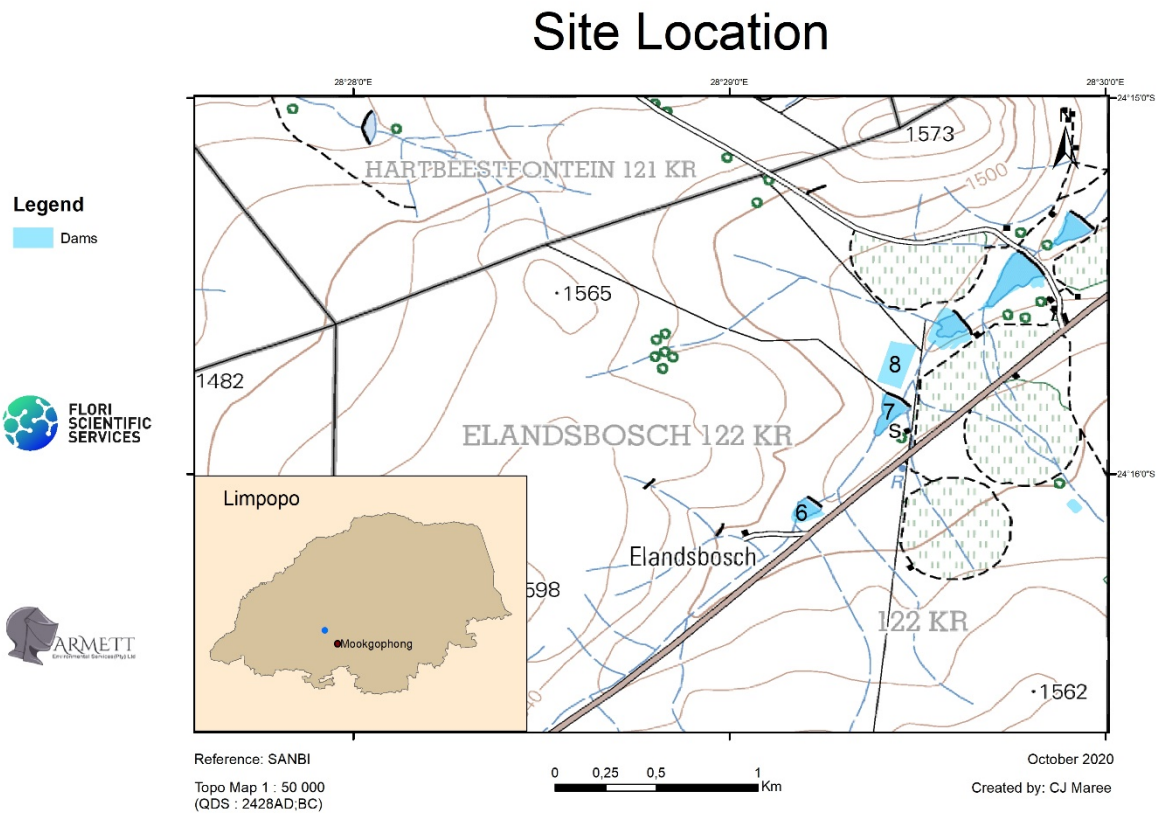

Figure 2: Topographical map of the Farm Elandsbosch 122 KR with dams 6, 7, and 8 indicated. Map supplied by Setala.

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 only rocks in this region are those of the Waterberg Group.

The Palaeoproterozoic rocks of southern Africa occur in Limpopo, Mpumalanga and Gauteng Provinces and extend westwards into Botswana, and occur in three basins. Three main strata are recognised, the Soutspansberg Group, the Waterberg Group and the Blouberg Formation. A number of attempts have been made to correlate the strata in the different basins, the Waterberg Basin, the Soutpansberg Basin and the Middelburg Basin.

The Waterberg Group occurs in the Waterberg and Nylstroom Basins (Barker et al., 2006) and rests unconformably on rocks of the Transvaal Supergroup and the Bushveld Complex. It is overlain by Karoo Supergroup rocks. Three subgroups are recognised throughout the main Waterberg Basin but only the oldest subgroup occurs in the Nylstroom Basin. Different formations are noted in the south, southwest and central areas compared to the North, northeast and central areas according to SACS, 1980.

This site occurs in the northern Waterberg Basin:
In the south, southwest and central part of the Waterberg Basin the basal Nylstroom Subgroups is divided into the lower Swaershoek formation and the Alma Formation. Above these lie the Matlabas Subgroup which comprises the Skilpadkop and Aasvoëlkop Formations. Three formations makeup the upper Kransberg Subgroup and they are from the base, the Sandriviersberg, the Cleremont and the Vaalwater Formations.

In the north, northeast and central area the basal Nystroom Subgroup is represented by the Sterk River Formation (Simpson et al., 2013). Overlying this is the Matlabas Subgroup with the Setloale and Makgabeng Formations (Barker et al., 2006), while the upper Kransberg Subgroup is composed of the Mogalakwena, Cleremont and Vaalwater Formations. While the upper two formations have the same name in both parts of the basin, the basal formations are different.

The Mogalakwena Formation is composed of granule-rich lithic arenites and granule rudites with pebble washes and interbedded pebble to cobble rudites (Bumby, 2000; Barker et al., 2006). Palaeocurrents are towards the west-southwest from large braided rivers from highlands in the north-northeast (ibid). The equivalent aged Sandriviersberg Formation represents the more distal facies of the large rivers and the Mogalakwena the more proximal facies.

In a recent publication on the Waterberg Group, Corcoran et al (2013) described the underlying Makgabeng Formation (Matlabas Subgroup) as representing mainly aeolian sedimentation with the strongest evidence for arid conditions in the horizontally bedded and rippled mudstone and sandstone lithofacies. Heavy precipitation occurred with subsequent drying up based on desiccation cracks, evaporite casts and roll-up structures. Increasingly wetter conditions over time are evidenced by the massive sandstone lithofacies that become more predominant toward the top of the Makgabeng stratigraphy. Such playa

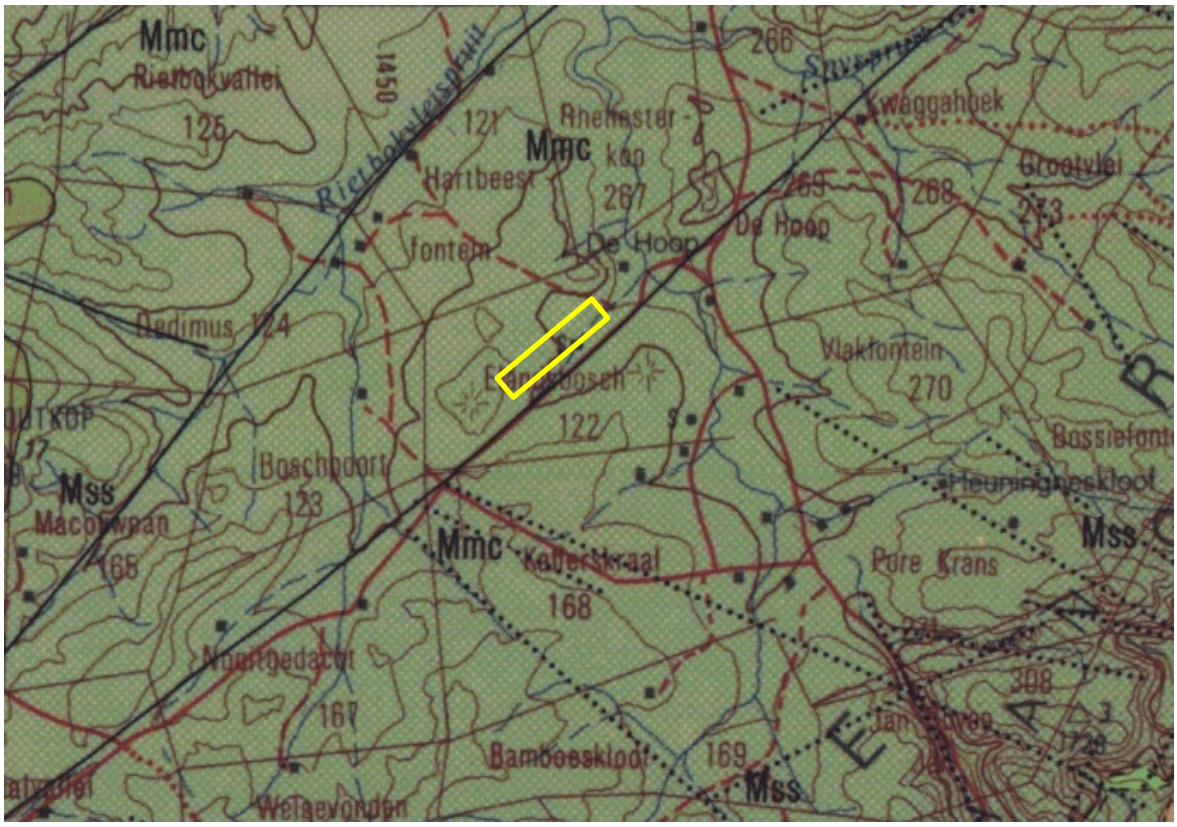

Figure 2: Geological map of the area around the Farm Elandsbosch 122 KR with the location of the proposed project is indicated within the yellow rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2428 Nylstroom.

Table 2: Explanation of symbols for the geological map and approximate ages (Anderson et al., 2019; Barker et al., 2006. Simpson et al., 2013). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Mss	Sandrivierberg Fm, Kransberg Subgroup, Waterberg Group	Coarse-grained yellow cross-bedded sandstone	Palaeoproterozoic <2 000 Ma
Mmc	Mogalakwena Fm, Kransberg Subgroup, Waterberg Group	Sandstone, grit, conglomerate and boulder conglomerate	Palaeoproterozoic <2 000 Ma

lakes in the palaeo-desert preserved microbial mat features (Simpson et al., 2013). In contrast, the overlying Mogalakwena Formation, is primarily composed of conglomerate and interbedded trough cross-bedded sandstone. The lower deposits represent coarse-grained sandstone sheets and local conglomerate-filled channels, indicating migration of braided fluvial channels (Corcoran et al., 2013). The upper part of the Mogalakwena Formation, which is well preserved in the northern part of the basin, is composed of distinct

cycles of fining-upward coarse to fine-grained sediments that are considered to have formed in a braided stream environment in which conglomerate and lower sandstone are considered in-channel deposits, and the upper sandstone and siltstone represent bar-top deposits of river channels. This more dynamic and higher energy setting is not conducive to the formation of microbial mat features (Noffke, 2010).

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 4 The site for development is in the Mogalakwena Formation and is indicated as moderately sensitive (green). The rocks are around 2000 million year old which predates the evolution of body fossils, however microbes were present. Photosynthesis by the microbes, in particular cyanobacteria and green algae, is a process that released oxygen which then oxidised the sediments and formed the extensive redbeds of the Soutpansberg and Waterberg Group rocks. Indirect evidence of the microbes has been recorded from the underlying Makgabeng Formation (Simpson et al., 2013) in the form of six different kinds of microbial mat structures. No such structures have been recorded from the much coarser-grained Mogkalakwena Formation yet the whole of the Waterberg Group is assumed to be potentially fossiliferous on the SAHRIS palaeosensitivity with a moderate rating (green).

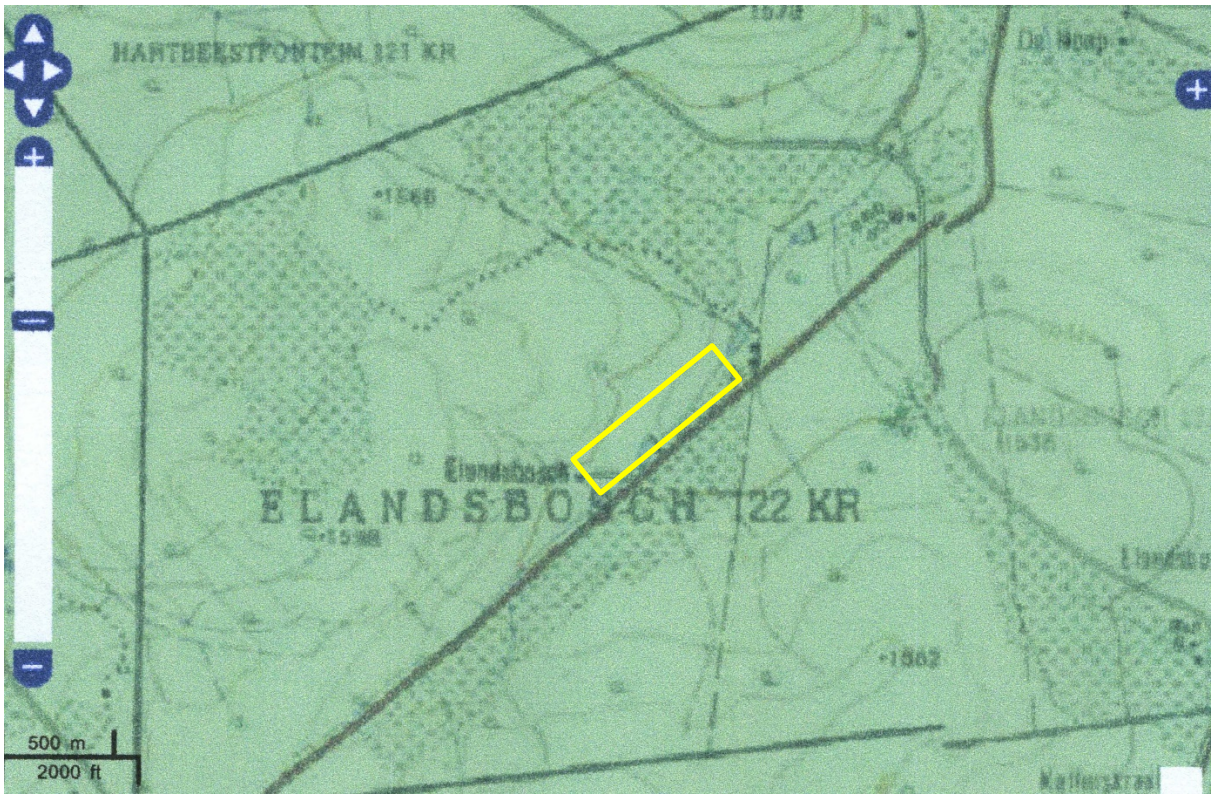

Figure 4: SAHRIS palaeosensitivity map for the site for the proposed three dams project on Farms Elandsbosch 122 KR shown within the yellow rectangle. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

The Palaeotechnical Report for Limpopo (Groenewald et al., 2014) shows the Waterberg Group to be of low sensitivity. From the geological studies it is suggested here that the Makgabeng Formation be assigned a moderate sensitivity and the Mogalakwena Formation be assigned an insignificant or Zero rating.

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	Ancient coarse-grained sediments do not preserve plant fossils; so far there are no records from the Mogalakwena of even microbial traces 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 there are no possible fossils within the area the spatial scale will be localised within the site boundary.

PART B: ASSESSMENT		
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is extremely unlikely that any fossils would be found in the ancient coarse-grained Mogalakwena Fm arenites and conglomerates.

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 much too old to contain body fossils, and much too coarse-grained and high energy to preserve delicate microbial mat structures. Since there is no chance that there are any fossils in the Mogalakwena Formation there will be no impact on the fossil heritage.

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 arenites, sandstones and conglomerates are typical for the country and do not contain any trace fossils or body fossils. The SAHRIS palaeosensitivity is incorrect in assigning a moderate sensitivity to the formation.

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 coarse-grained, high energy arenites, sandstones and conglomerates of the Mogalakwena Formation (Kransberg Subgroup, Waterberg Group). It is recommended that, as far as the palaeontology is concerned, the project to reconstruct two dams and construct one new dam on Portions 6 and 8 of Farm Elandsbosch 122 KR, Naboomspruit, may proceed. No further palaeontological impact assessment is required. Although this report is focused on Dams 6, 7, 8, the conclusion is the same for the whole farm because the geology is the same.

7. References

Andersen, T., Elburg, M, A., Van Niekerk, H.S., 2019. Detrital zircon in sandstones from the Palaeoproterozoic Waterberg and Nylstroom basins, South Africa: Provenance and recycling. South African Journal of Geology 122, 79-96.

Barker, O B., Brandl, G., Callaghan, C.C., Erikssen, P.G., van der Neut, M., 2006. The Soutspanberg and Waterberg Groups and the Blouberg Formation. 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 301-318.

Bumby, A.J., 2000. The geology of the Blouberg Formation, Waterberg and Soutpansberg groups in the area of Blouberg Mountain, Northern Province, South Africa. Ph.D. Thesis, University of Pretoria, Pretoria, South Africa., 325pp.

Bumby, A.J., Eriksson, P.G., Van Der Merwe, R. and Brümmer, J.J., 2001. Shear-zone controlled basins in the Blouberg Area, Northern Province, South Africa: syn- and post-tectonic sedimentation relating to ca. 2.0 Ga reactivation of the Limpopo Belt. Journal of African Earth Sciences, 33, 445-461.

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Simpson, E.L., Heness, E., Bumby, A., Eriksson, P.G., Eriksson, K.A, Hilbert-Wolf, H.L., Linnevelt, S., Malenda, H.F., Modungwa, T., Okaforba, O.J., 2013. Evidence for 2.0 Ga continental microbial mats in a paleodesert setting. Precambrian Research 327, 36-50.

South African Committee for Stratigraphy (SACS), 1980. Stratigraphy of South Africa. Part 1 (Comp. L.E. Kent). Lithostratigraphy of the Republic of South Africa, South West Africa/Namibia, and the republics of Bophuthatswana, Transkei and Venda. Handbook Geological Survey of South Africa, 8, 689pp.

Appendix A – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
January 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

xi) Research Output

Publications by M K Bamford up to December 2019 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)