Palaeontological Impact Assessment for the proposed Chansbury Poultry Houses, near Winterton, KwaZulu Natal Province

Desktop Study

For

Sivest SA

20 July 2019

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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 Mr Mark Summers, Sivest SA, 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 desktop Palaeontological Impact Assessment was requested for the development of poultry houses on two tracts of land adjacent to the Tugela River, Farm Vaalkrans 2180, near Winterton, KwaZulu Natal. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development.

The proposed sites lie on shales of the Normandien Formation, (Adelaide Subgroup, Beaufort Group, Karoo Supergroup) and could preserve fossil plants of the Glossopteris flora. The area has been disturbed by previous agricultural activities on the soils. Soils do not preserve fossils as they are the breakdown product of weathering. There is a very small chance that fossils could occur below the soils so a Fossil Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that proposed project can proceed and that no palaeontological site visit is required unless the geologist or responsible person finds fossils that are deemed to be scientifically important by the palaeontologist who studies the photographs.

Table of Contents

Expertise of Specialist 1

Declaration of Independence 1

1. Background 4
2. Methods and Terms of Reference 5
3. Geology and Palaeontology 6
   i. Project location and geological context 6
   ii. Palaeontological Context 6
4. Impact assessment 8
5. Assumptions and uncertainties 9
6. Recommendation 10
7. References 11
8. Chance Find Protocol 11

1. Background

A desktop Palaeontological Impact Assessment was requested for the proposed construction of poultry houses and associated infrastructure on two tracts of land adjacent to the Tugela River (Figure 1). The farm is Vaalkrans 2180 and the proposed poultry houses will be positioned on 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 and is reported here.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (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 0
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
l	Any conditions for inclusion in the environmental authorisation	N/A

m	Any monitoring requirements for inclusion in the EMPr or environmental authorisation	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 the proposed development of poultry houses on two sections of the farm Vaalkrans 2180, shown in white, and near the Tugela River.

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 sites for the poultry houses lie on the shales, siltstones and sandstones of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. In this eastern part of the main Karoo Basin the Upper Permian Adelaide Subgroup comprises the Normandien Formation.

The Karoo Supergroup is composed of the lower Dwyka Group that was deposited as Gondwana moved northwards and the ice sheets melted. The Ecca Group represents the deepwater muds and the marginal swamps where plants of the Glossopteris flora flourished in a warming environment, and peats were formed. Over time the peats were heated and compressed to form the coal seams. Overlying sediments of the Beaufort Group show the shift to a more braided river environment and vertebrate fossils of the plains animals, burrowing animals and huge diversification of plants and animals. The Stormberg Group (Molteno, Elliot and Clarens Formations) show shifting climates, origins of dinosaurs and mammals and then the Karoo deposition and fossil record were terminated – and preserved – by the Jurassic basalts and dykes of the Drakensberg Group.

ii. Palaeontological Context

The Normandien Formation (Adelaide Subgroup, Beaufort Group) preserves typical *Glossopteris* flora plants, namely *Glossopteris* leaves and reproductive structures, ferns, sphenophytes, lycopods, cordaitaleans, early gymnosperms and plants with unknown affinities (Plumstead, 1969; Anderson and Anderson, 1985; Prevec et al., 2009; see Appendix A). Plants are more likely to be preserved in acidic conditions and bones in alkaline conditions so they are rarely preserved together in the same site. The Normandien Formation tends to favour the preservation of plants. Prevec et al. (2009) surveyed for fossils in the Colenso, Clouston and Estcourt area, about 25km to the east of this project site, and found very sporadic outcrops of fossil plants, mostly along road, river or railway cuttings where the fresh and unweathered shales were exposed. Vertebrates were found but not with the plants and they were very rare and rather poorly preserved.

The Jurassic dykes are intrusive volcanic rocks so they do not preserve fossils. Furthermore, the dykes tend to destroy fossils in their immediate vicinity.

The Quaternary Kalahari Group sands are alluvial and aeolian so do not preserve any fossils in situ, except in the rare occurrences of pans where fossil plants or bones become trapped in the calcareous or siliceous sediments associated with the ephemeral water bodies.

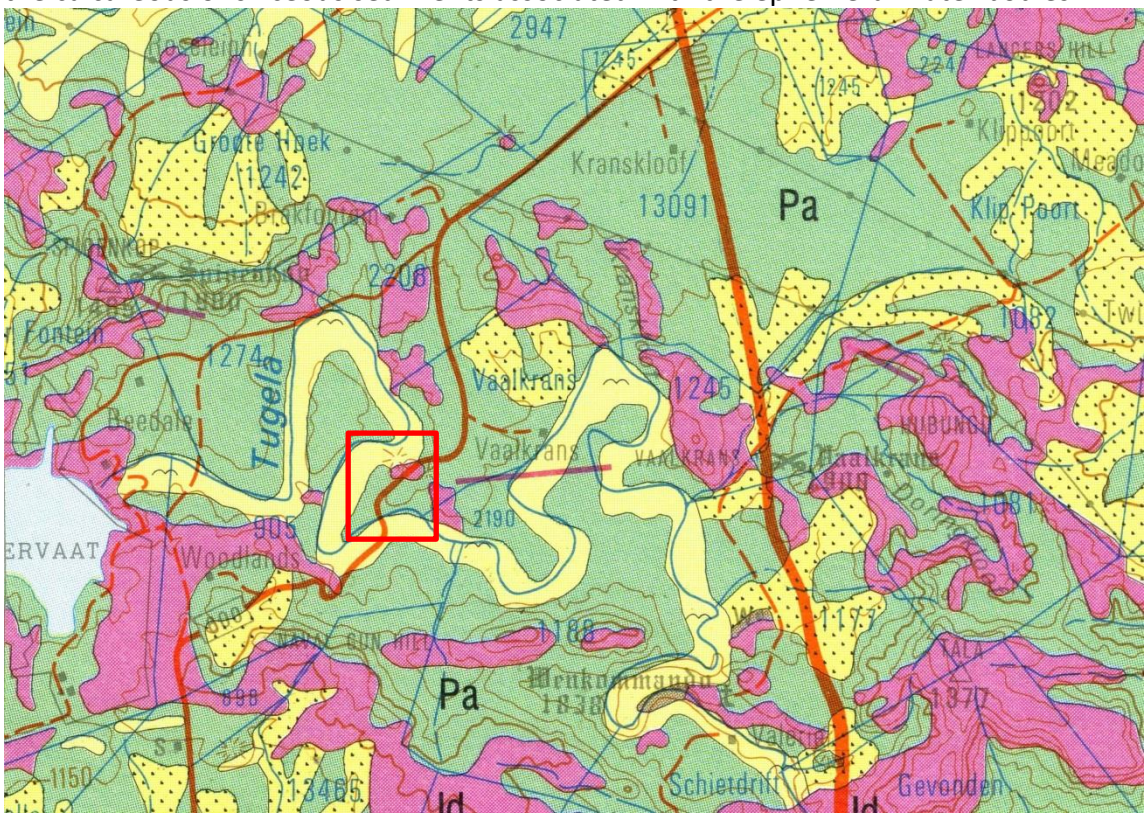

Figure 2: Geological map of the area around the proposed Chansbury poultry houses. The location of the proposed project is indicated with the red rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 2828 Harrismith, 1998.

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Johnson et al., 2006). SG = Supergroup; Fm = Formation; Ma = million years; grey shading = formations impacted by the project.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Kalahari sands, Quaternary	Alluvial and aeolian sands	Last ca 2.5 Ma
T-Qk	Sands overlying Tertiary rocks	Alluvial and aeolian sands	Last 65 Ma
Jd	Jurassic dykes	Dolerite	Ca 183 Ma
Pa	Normandien Fm, Adelaide Subgroup, Beaufort Group, Karoo SG	Grey mudstones, dark grey shales, siltstones, sandstones	255 – 253,5 Ma Upper Permian (Lopingian: Wuchiapingian to Changhsingian)

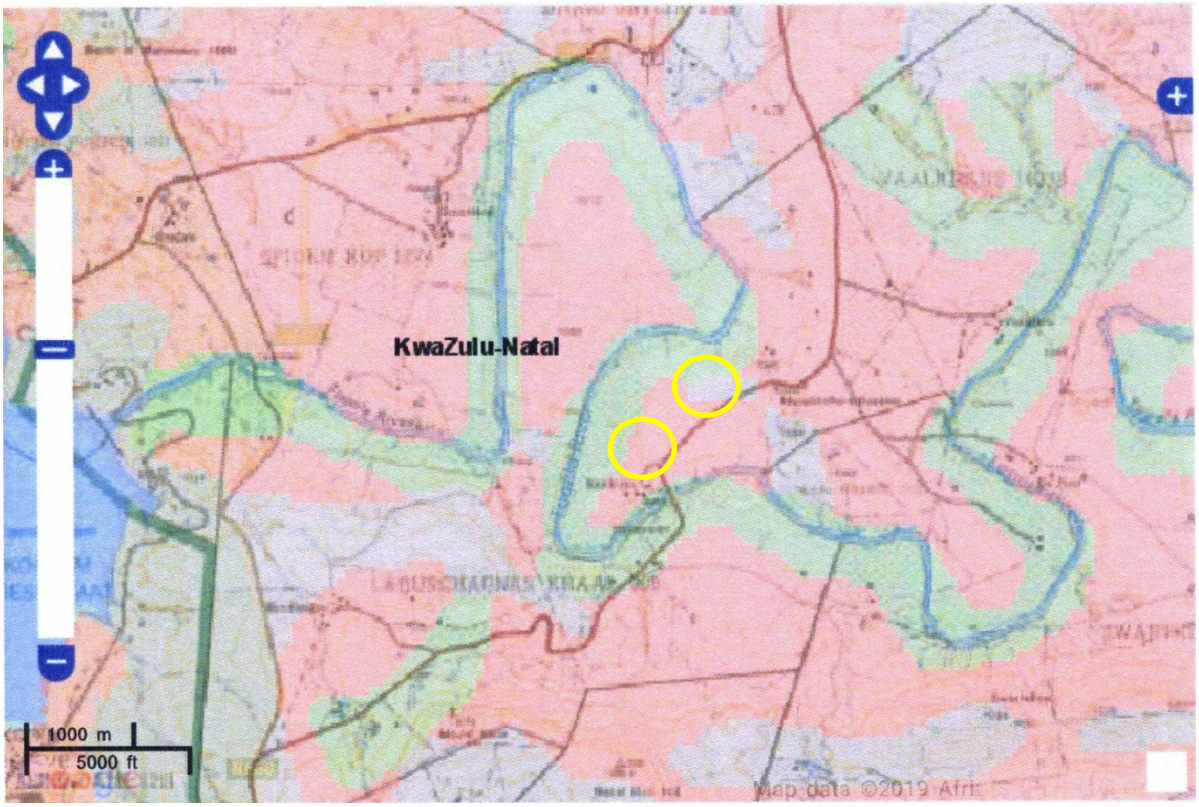

Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed Chansbury Poultry Houses on Farm Vaalkrans 2180, about 18km north of Winterton. The proposed project is shown within the yellow circles. Background colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as very highly sensitive (red) or moderately sensitive (green) along the river, so a desktop study is presented here.

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	There is a chance that fossil plants of the Glossopteris flora occur in the shales of the Normandien Fm.
	L	-
	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 of the Glossopteris flora, Normandien Fm, the spatial scale will be localised within the site boundary.
	M	-
	H	-
PROBABILITY	**H**	**-**
	M	**-**
	L	It is very unlikely that the soils would preserve fossil plants because they are a product of severe weathering plus agricultural activity. Fossil plants might occur below the soil or along rocky outcrops. Nonetheless a chance find protocol should be added to the eventual EMPr.

Based on the nature of the project, surface activities are unlikely to impact upon the fossil heritage, if preserved below the soils. The soils themselves will not preserve any fossils because they are weathered, and have been ploughed for agriculture, in the development footprint. Foundations for the poultry houses, services and infrastructure are unlikely to penetrate below a few metres. Since there is an extremely small chance that fossil plants may occur in the sediments below the surface/soils, although not recorded from here, 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 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 mudstones, sandstones, shales and sands are

typical for the country and could contain fossil plant, insect, invertebrate and vertebrate material. Unweathered and undisturbed shales, i.e. not soils, might preserve fossil plants. Dolerites do not preserve fossils. The sands of the Quaternary period would not preserve fossils and no pans are evident from the Google Earth imagery.

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 soils that would be excavated for foundations. There might be fossil plant impression of the Glossopteris flora below the ground. Fossils are not preserved in Kalahari Group sands. Nonetheless, a Fossil Chance Find Protocol should be added to the EMPr: if fossils are found once excavations have commenced then they should be rescued, photographed and a palaeontologist called to assess and collect a representative sample, with a permit from AMAFA.

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.

Barbolini, N., Bamford, M.K., Rubidge, B., 2016. Radiometric dating demonstrates that Permian spore-pollen zones of Australia and South Africa are diachronous. Gondwana Research 37, 241-251.

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.

Prevec, R, Labandeira, C.C., Neveling, J., Gastaldo, R.A., Looy, C., Bamford, M., 2009. Portrait of a Gondwanan ecosystem: A new Late Permian locality from KwaZulu-Natal, South Africa. Review of Palaeobotany and Palynology 156, 454-493.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the 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 (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 (see Figure 5-7). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary.
8. If no fossils are found and the excavations have finished then no further monitoring is required.

Appendix A – Examples of fossils

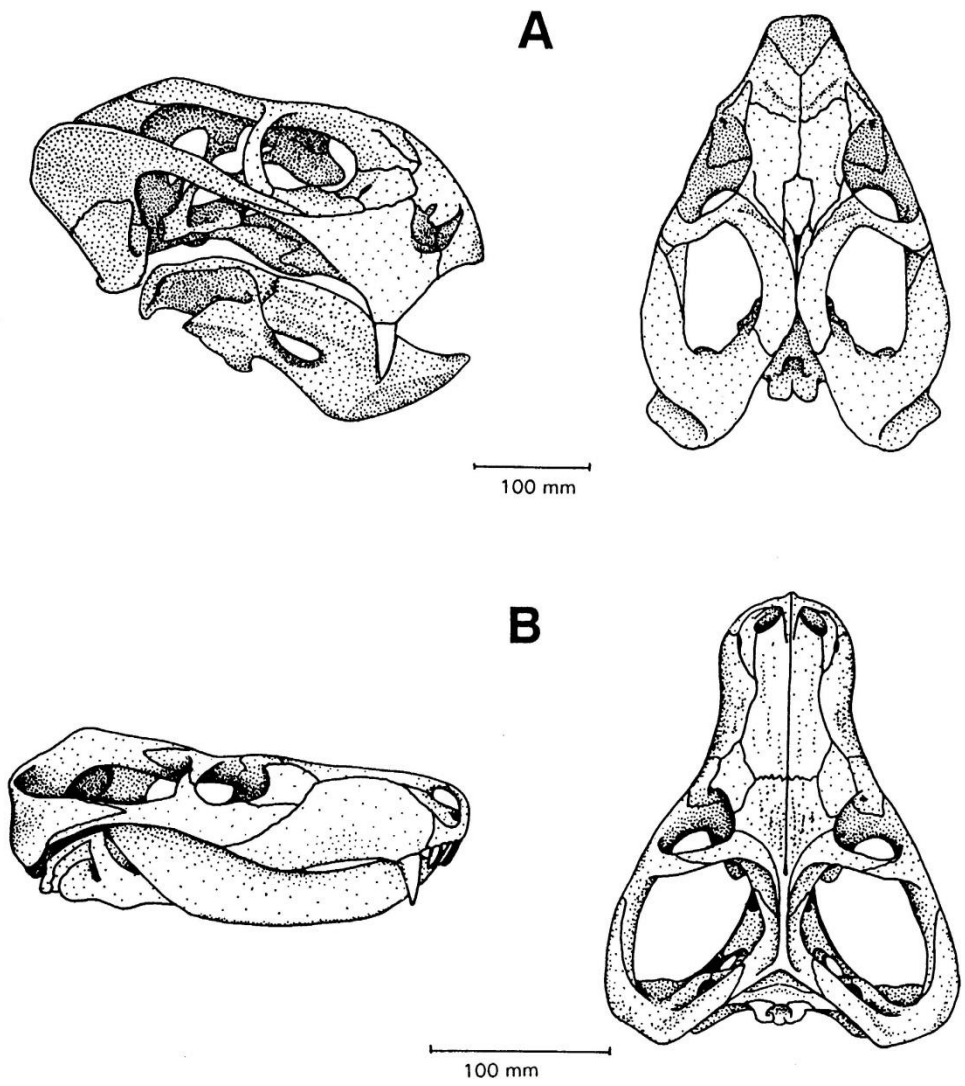

Figure 5: Diagram of Dicynodon Assemblage zone fossil vertebrate skulls. From Rubidge et al., 1995.

Figure 6: Example of what fossil bones look like when still embedded in the mudstone.

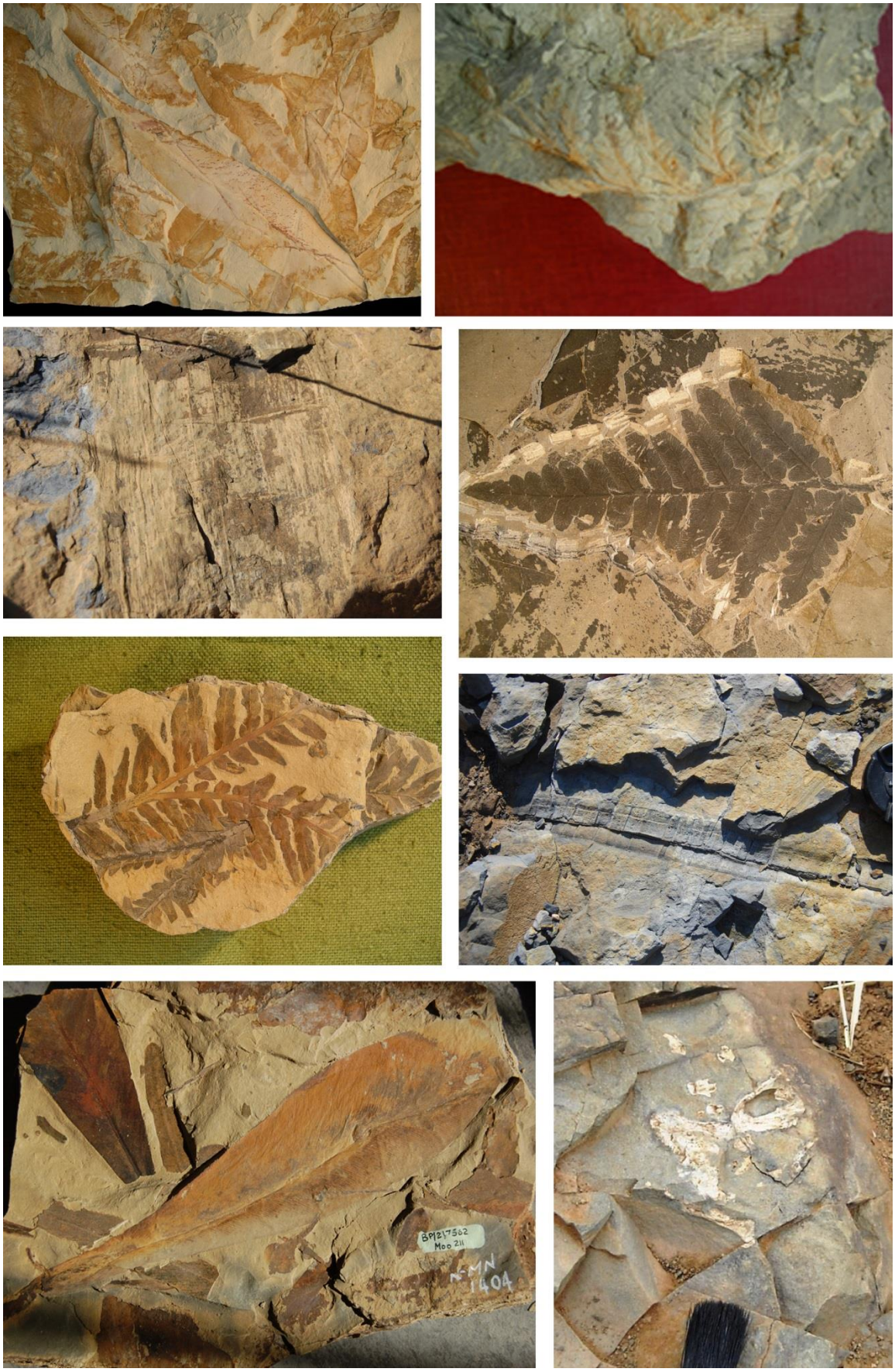

Figure 7: Examples of fossil plant impressions as seen when the rocks are split open.

Table 4: List of fossil plant taxa from the Normandien (was Estcourt) Formation. List compiled from Anderson and Anderson, 1985; Prevec et al., 2009).

Plant group – Normandien and Estcourt Fms	**Genus and Species**
Mosses	*Buthelezia mooiensis*
Sphenophytes (horsetails)	*Sphenophyllum speciosum*
	Raniganjia kilburnensis
	Phyllotheca australis
	Phyllotheca lawleyensis
	Phyllotheca wetensis
	Schizoneura gondwanensis
Ferns	*Sphenopteris lobifolia*
Glossopterids	*Plumsteadia natalensis*
	Plumsteadia gibbosa
	Estcourtia vandijksii
	Estcourtia bergvillensis
	Rigbya arberioides
	Lidgettonia africana
	Lidgettonia mooiriverensis
	Lidgettonia inhluzanensis
	Lidgettonia lidgettonioides
	Lidgettonia elegans
	Glossopteris symmetrifolia
	Glossopteris loskopensis
	Ottokariaceae
	Lidgettoniaceae
Incertae sedis	*Noeggerathiopsis spathulata*
	Pagiophyllum vandijkii
	Taeniopteris estcourtiana
	Benlightfootia mooiensis
Coniferales	*Sewardistrobus laxus*

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2019

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	6	1
Masters	8	1
PhD	10	3
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 2019 peer-reviewed journals or scholarly books: over 130 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 30;
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)