

**Palaeontological Impact Assessment for the  
proposed swimming pool and facilities at Die  
Stroom Picnic site, Bontebok National Park,  
Swellendam, Western Cape Province**

**Desktop Study (Phase 1)**

**For**

**Enviro EAP (Pty) Ltd**

**24 July 2024**

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## **Expertise of Specialist**

The Palaeontologist Consultant: Prof Marion Bamford  
Qualifications: PhD (Wits Univ, 1990); FRSSAf, mASSAf, PSSA  
Experience: 35 years research and lecturing in Palaeontology  
27 years PIA studies and over 350 projects completed

## **Declaration of Independence**

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Enviro EAP (Pty) Ltd, Agulhus, 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: *MKBamford*

## Executive Summary

A Palaeontological Impact Assessment was requested for the proposed construction of a swimming pool and associated facilities at Die Stroom Picnic site, Bontebok National Park, Swellendam. Western Cape Province, Case No.: HWC24022107SB0222.

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 Quaternary river terrace gravels of unknown palaeosensitivity. These sediments have been reworked and redeposited by the river action in the past and so their origin and context are unknown. If any fossils have been eroded, transported and deposited along the Brede River, they would be very fragmented and of limited scientific value. Nonetheless, 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 contractor, environmental officer or other designated responsible person once excavations, drilling or mining activities have commenced. Since the impact will be low, as far as the palaeontology is concerned, the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Unknown	Very Low	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

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# 1. Background

Bontebok National Park was established in 1931 with the main focus around conserving the near-extinct bontebok (*Damaliscus pygargus* spp. *pygargus*). It is the smallest of South Africa's 19 National Parks, covering an area of 27.86 km<sup>2</sup>. The park is part of the Cape Floristic Region, which is a World Heritage Site.

**The proposed swimming pool, recreational facilities and associated infrastructure at Die Stroom Picnic Site in the Bontebok National Park, Swellendam will include the following:**

- Pool Backwash tank slab = 15m<sup>2</sup> for 5000liter JoJo
- Septic tank and Pump chamber = 40m<sup>2</sup>
- Pool pump room = 40m<sup>2</sup>
- Ablutions/Shower/Change Area = 105m<sup>2</sup>
- Swimming Pool = 315m<sup>2</sup>
- Terrace less Pool = 1115m<sup>2</sup>
- Fence = 210m long and 1.5m high
- Physically Disabled Ramp = 80m<sup>2</sup>
- Parking = 240m<sup>2</sup>
- Underground electrical cable = 110m long (Area measured in sewer trench calculation)
- Sewer line /Soak-away = 260m long (Area = 390m<sup>2</sup>)
- Pool back-wash and soak-away = 260m long (Area measured in sewer trench calculation)
- Water supply line = 25m long (Area 25m<sup>2</sup>) (Balance of area measured in sewer trench calculation)
- Soak-away = 150m<sup>2</sup> (15m x 10m)
- 2 x Biofilters = 64m<sup>2</sup> (4m x 8m each)

Construction footprint = 0.44ha.

The final development footprint for the developments as described above = ± 0.28Ha?  
Proposed development will lead to the permanent clearance of ±0.2ha of indigenous vegetation.

The picnic site is on the western bank of the Brede River and some infrastructure already exists (Figures 1-3). The site is on Erf RE/5338 Swellendam.

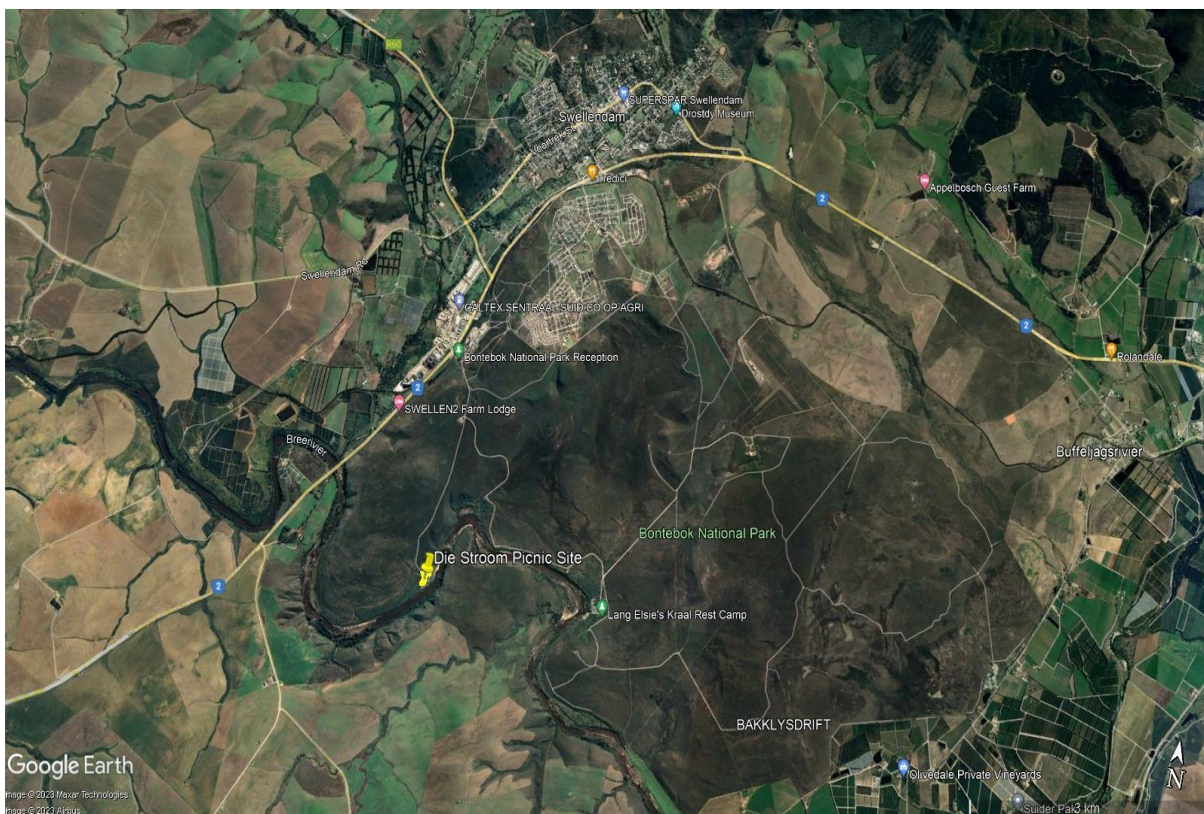
In response to the Notice to Develop (NID) Heritage Western Cape has requested a Palaeontological Impact Assessment (Case No.: HWC24022107SB0222)

In order 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.

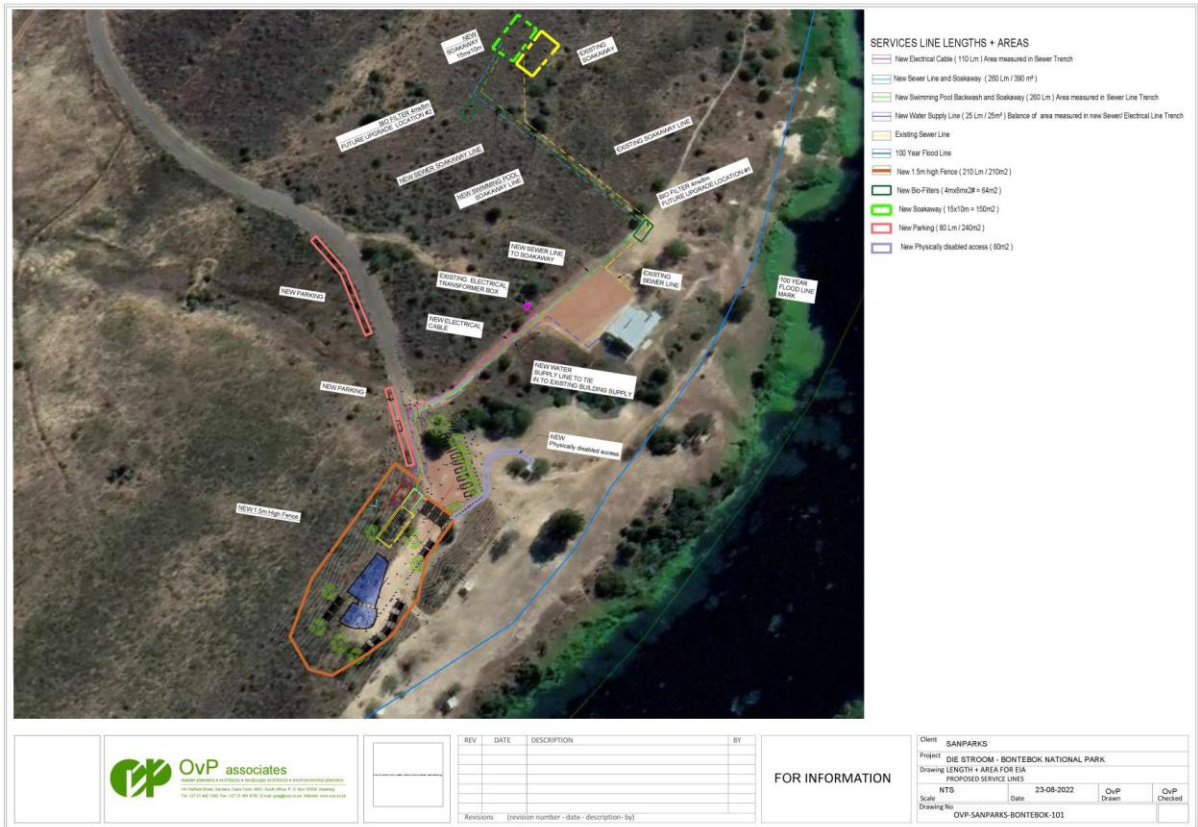
**Table 1: National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) and Environmental Impact Assessment (EIA) Regulations, 2014 (as amended) - Requirements for Specialist Reports (Appendix 6). Includes the requirements from GNR Appendix 6 of GN 326 EIA Regulation 2017.**

	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
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

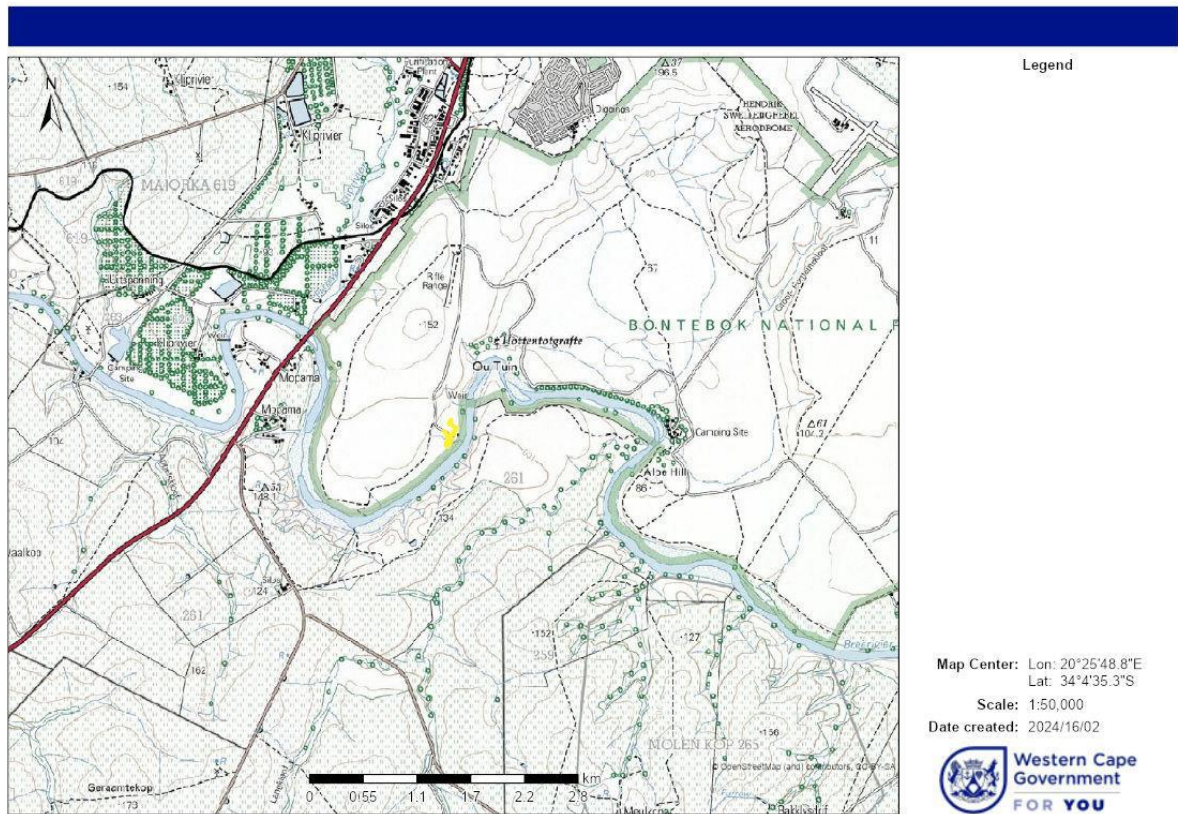
	<b>A specialist report prepared in terms of the Environmental Impact Regulations of 2017 must contain:</b>	<b>Relevant section in report</b>
nii	If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMP, 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 of any comments that were received during any consultation process	N/A
q	Any other information requested by the competent authority.	N/A
2	Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A



**Figure 1: Google Earth map of the general area to show the relative land marks. The swimming pool site at Die Stroom Picnic Site, Bontebok National Park is shown by the yellow pin.**



**Figure 2: Google Earth Map of the proposed development of a swimming pool at Die Stroom Picnic site, Bontebok National Park. Map from the NID document**



**Figure 3: 1:50 000 topographic map of the proposed development.**

## 2. Methods and Terms of Reference

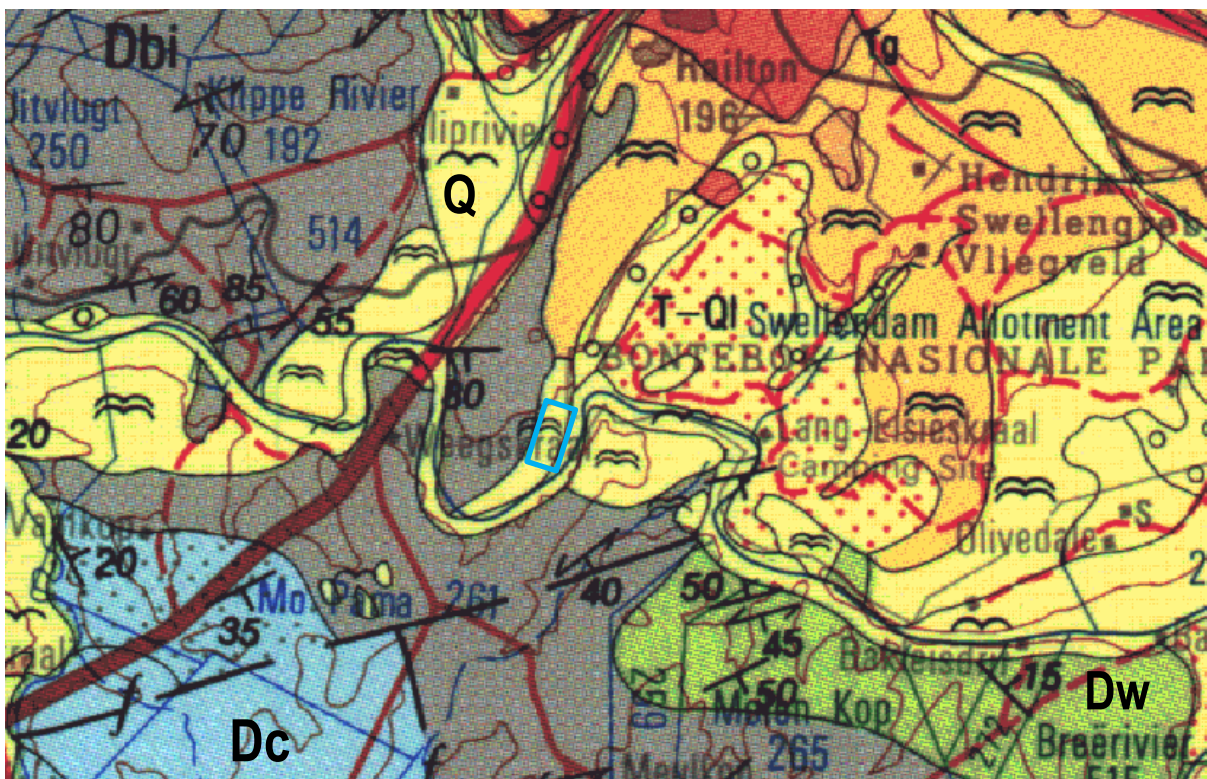
The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.

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 include records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases; eg <https://sahris.sahra.org.za/map/palaeo>
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' representativity 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 4: Geological map of the area around the Die Stroom Picnic Site. The location of the proposed project is indicated within the blue rectangle. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 250 000 map 3420 Riversdale.**

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

Symbol	Group/Formation	Lithology	Approximate Age
Q m	Quaternary	River terrace gravels; Alluvium, sand, calcrete; sand undifferentiated Bredasdorp Group	Quaternary ca 1.0 Ma to Present
T-Ql	Quaternary	Undifferentiated Bredasdorp loam and sandy loam	Quaternary ca 1.0 Ma to Present
Je	Enon Fm, Uitenhage Group	Cinglomerate, sandstone	Late Jurassic to Early Cretaceous
Dw	Wagon Drift Fm, Weltevrede Subgroup, Witteberg Group, Cape SG	Shale, siltstone, sandstone	Devonian
Dbi	Bidouw Subgroup, Bokkeveld Group, Cape SG	Sandstone, siltstone	Devonian
Dc	Ceres Subgroup, Bokkeveld Subgroup, Cape SG	Sandstone	Devonian

The project lies in the Cape Basin where the rocks of the Cape Supergroup are exposed. They are unconformably overlain by much younger sands, loam, and soils of Quaternary age (Figure 4). The main group here is the Bredasdorp Group but it is not always possible to distinguish the formations, hence the sands along the Brede River are indicated as “undifferentiated sand, loam or sandy loam.”

The Cenozoic deposits of littoral marine, estuarine, fluvial, lacustrine and aeolian origin have developed along the coastal margin of South Africa over the last 60 million years. Onshore deposits are relatively thin but offshore deposits are much thicker, especially in the extensional rift basins and as cones at major river mouths (Dingle et al., 1983; Roberts et al., 2006). Reasons for this discrepancy in thickness are that the passive coastal margins are buoyant and the continent has undergone at least two phases of epeirogenic uplift (Partridge and Maud, 1987; but see Braun et al., 2014)

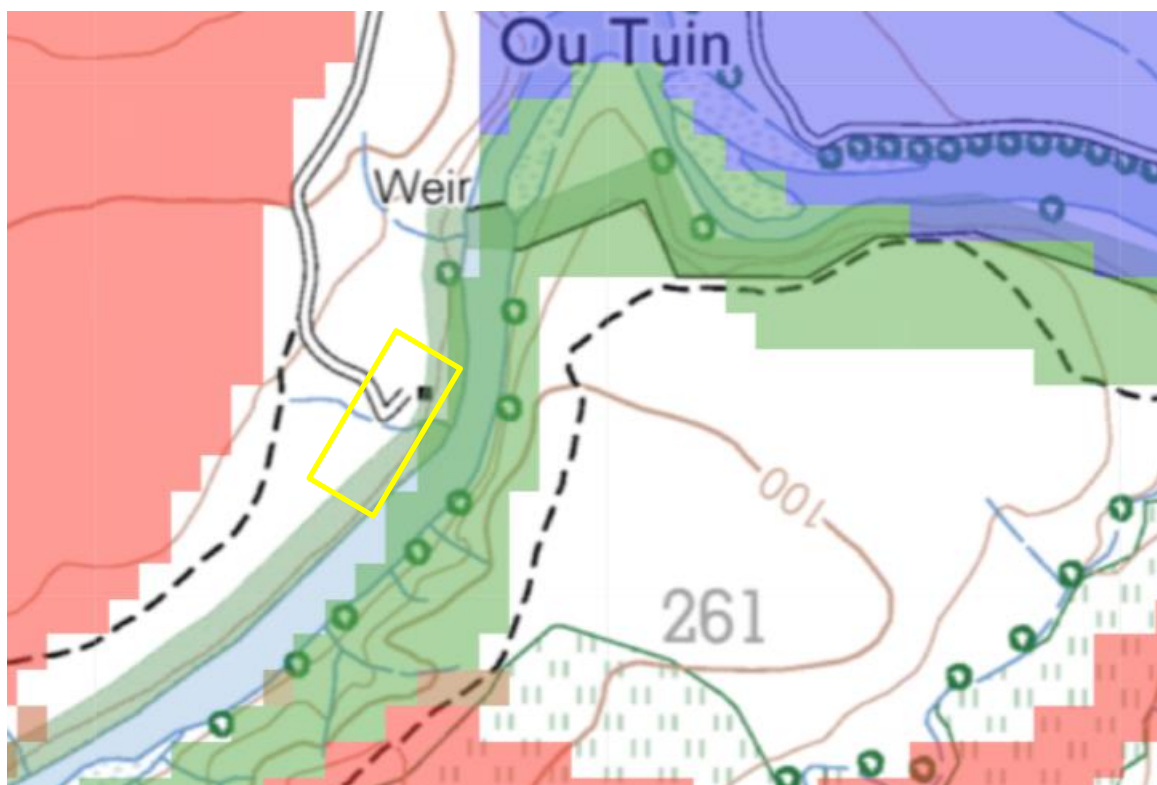
The Bredasdorp Group comprises five coastal formations with differences in the amounts and types of limestones, calcarenites, calcrudites, conglomerates, coquinites and calcareous sandstones (Roberts et al., 2006), with the basal De Hoopvlei Formation sitting unconformably on the Enon Formation or the Bokkeveld Group. The De Hoopvlei Formation has most of the lithofacies mentioned above with rare outcrops as it is mostly covered by the overlying aeolian sands of the Wankoe Formation. The Wankoe aeolianites form the most extensive package in the Bredasdorp Group. It probably represents dune cordons relating to the Early Pliocene transgression and is contemporaneous with the De Hoopvlei Formation (Roberts et al., 2006). According to Malan (1990) the Klein Brak Formation rests unconformably on the wave cut platforms incised into Mesozoic and Palaeozoic rocks along the coast at elevations less than 18m asl. This thin early Pleistocene-aged formation is overlain by the semi-consolidated

aeolianites and thin calcrete lenses of the Waenhuiskrans Formation. The latter is extensive and represents at least three dune cordons that formed in the Early Pleistocene. The uppermost and most recent deposit is the Strandveld Formation that is composed of unconsolidated calcareous sands formed from aeolian activity.

Along the rivers, however, the sediments become mixed and redeposited by occasional flooding of the Brede River and it is no longer possible to distinguish between the various formations.

## ii. Palaeontological context

Marine or terrestrial invertebrate shells of different species occur in the different formations of the Bredasdorp Group (Roberts et al., 2006) but along the naturally disturbed rivers the high energy flow and flooding mixes the sediments and fragments any fossils within. It is very unlikely that any intact fossil occurs in the river terrace gravels along the Brede River, hence the palaeosensitivity is indicated as unknown (white) in the SAHRIS palaeosensitivity map (Figure 5).



**Figure 5: SAHRIS palaeosensitivity map for the site for the proposed Die Stroom Picnic site 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.**

In contrast the DFFE palaeosensitivity screening map (Figure 6) indicates that site is moderately sensitive (yellow). It does not distinguish between the different formation and is based on a general geological map only. The SAHRIS palaeosensitivity map is based on the geology and the palaeontology record, as described in the Palaeotechnical Report for SAHRA for the Western Cape (Almond et al. 2009) so the SAHRIS map is more accurate. Nonetheless, a fossil chance find protocol has been added to this report.

MAP OF RELATIVE PALEONTOLOGY THEME SENSITIVITY

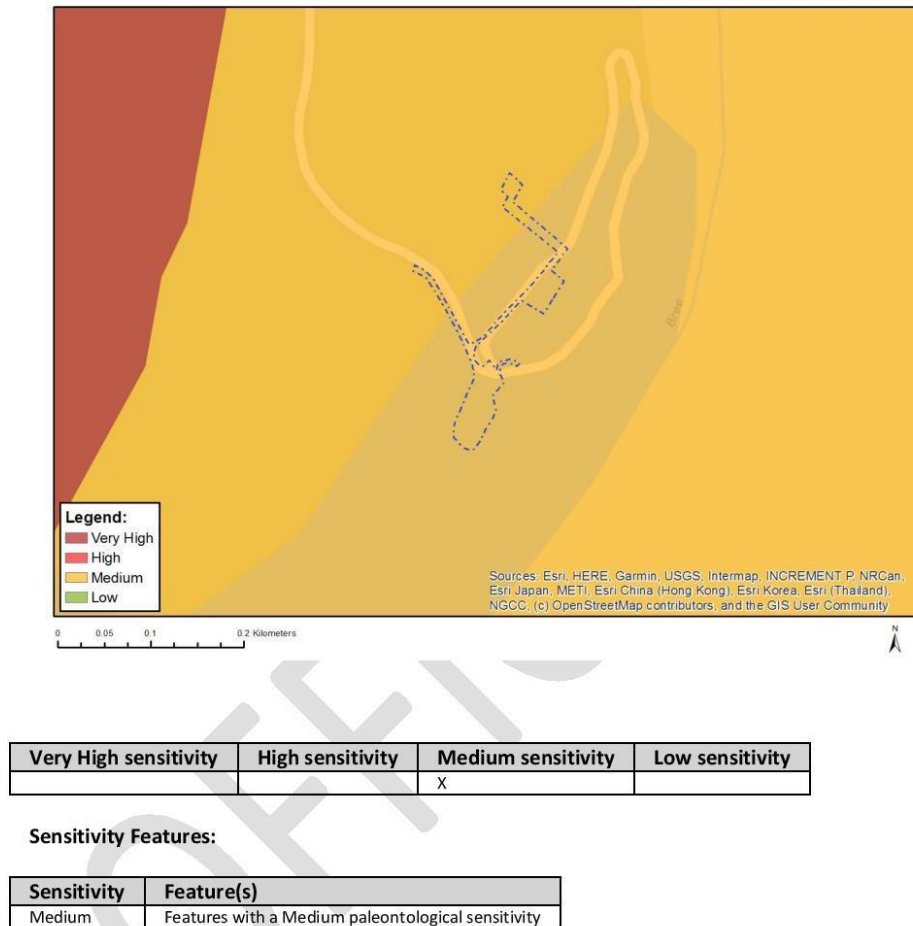


Figure 6: DFFE palaeosensitivity screening map

#### 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**

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

**Table 3b: Impact Assessment**

<b>PART B: Assessment</b>		
<b>SEVERITY/NATURE</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	Sands do not preserve fossils; so far there are no records from the Quaternary undifferentiated river terrace gravels of plant or animal fossils in this region so it is very unlikely that fossils occur on the site. The impact would be negligible
	<b>L+</b>	-
	<b>M+</b>	-
	<b>H+</b>	-
	<b>DURATION</b>	<b>L</b>
<b>M</b>		-
<b>H</b>		Where manifest, the impact will be permanent.

<b>PART B: Assessment</b>		
<b>SPATIAL SCALE</b>	<b>L</b>	Since the only possible fossils within the area would be fossil shell fragments in the sands and gravels, the spatial scale will be localised within the site boundary.
	<b>M</b>	-
	<b>H</b>	-
<b>PROBABILITY</b>	<b>H</b>	-
	<b>M</b>	-
	<b>L</b>	It is extremely unlikely that any fossils would be found in the loose soils and sands that cover the area or in the terrace gravels that will be excavated. 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 the right age but the wrong type (alluvial sands and gravels) to contain fossils. Furthermore, the material to be excavated is sand and soil and these do not preserve fossils. Since there is an extremely small chance that fossils from the inland may have washed down the river and been buried on the terraces 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 dolomites, sandstones, shales and sands are typical for the country and only some might contain fossil plant, insect, invertebrate and vertebrate material. The sands of the Quaternary period would not preserve fossils.

## 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 overlying soils and the river sands of the Quaternary. There is a very small chance that fossils from the inland might have washed down the river and been buried in the terrace sands and gravels so a Fossil Chance Find Protocol should be added to the EMPr. If fossils are found by the environmental officer, or other responsible person once excavations for foundations, the pool or amenities have commenced then they should be rescued and HWC notified to call a palaeontologist to assess and collect a representative sample. The impact on the palaeontological heritage would be low, as far as the palaeontology is concerned, so the project should be authorised.

ASPECT	SCREENING TOOL SENSITIVITY	VERIFIED SENSITIVITY	OUTCOME STATEMENT/ PLAN OF STUDY	RELEVANT SECTION MOTIVATING VERIFICATION
Palaeontology	Unknown	Very Low	Palaeontological Impact Assessment	Section 7.2. SAHRA Requirements

## 7. References

Almond, J.E., de Klerk, W.J., Gess, R., 2009. Palaeontological Heritage of the Western Cape; interim report. SAHRA Report. 23pp.

Braun, J., Guillocheau, F., Robin, C., Baby, G., Jelsma, H., 2014. Rapid erosion of the Southern African Plateau as it climbs over a mantle superswell, *Journal of Geophysical Research; Solid Earth* 119, 6093–6112. doi:10.1002/2014JB010998

Dingle, R.V., Seisser, W.V., Newton, A.R., 1983. *Mesozoic and Tertiary Geology of Southern Africa*. A.A. Balkema, Rotterdam, 375pp.

Partridge, T.C., Maud, R.R., 1987. Geomorphic evolution of southern Africa since the Mesozoic. *South African Journal of Geology* 90, 179-208.

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.

Roberts, D.L., Botha, G.A., Maud, R.R., Pether, J., 2006. Coastal Cenozoic deposits. 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 605-628.

Thamm, A.G., Johnson, M.R., 2006. The Cape 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 443 – 460.

## 8. Chance Find Protocol

### **Monitoring Programme for Palaeontology – to commence once the excavations activities 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 discard must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (shells, plants, insects, bone or coal) 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 fossil plants, vertebrates, invertebrates or trace fossils in the shales and mudstones (for example see Figure 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 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 shells, 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 HWC permit must be obtained. Annual reports must be submitted to HWC 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 HWC 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.

## 9. Appendix A – Examples of fossils from the Quaternary coastal sands



**Figure 7: Photographs of modern and fossils shells from coastal deposits to assist the on-site responsible person.**

## 10. Appendix B – Details of specialist

### **Curriculum vitae (short) - Marion Bamford PhD January 2024**

Present employment: Professor; Director of the Evolutionary Studies Institute.  
Member Management Committee of the NRF/DSI Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa

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[marionbamford12@gmail.com](mailto: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

### v) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	13	0
Masters	13	3
PhD	13	7
Postdoctoral fellows	14	4

### vi) 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 12 - 20 students per year.

### vii) 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 -

Associate Editor: *Cretaceous Research*: 2018-2020

Associate Editor: *Royal Society Open*: 2021 -

Review of manuscripts for ISI-listed journals: 30 local and international journals

### viii) Palaeontological Impact Assessments

27 years' experience in PIA site and desktop projects

Selected from recent projects only - list not complete:

- 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
- Glosam Mine 2022 for AHSA
- Wolf-Skilpad-Grassridge OHPL 2022 for Zutari
- Iziduli and Msenge WEFs 2022 for CTS Heritage
- Hendrina North and South WEFs & SEFs 2022 for Cabanga
- Dealesville-Springhaas SEFs 2022 for GIBB Environmental
- Vhuvhili and Mukondeleli SEFs 2022 for CSIR
- Chemwes & Stilfontein SEFs 2022 for CTS Heritage
- Equestria Exts housing 2022 for Beyond Heritage
- Zeerust Salene boreholes 2022 for Prescali
- Tsakane Sewer upgrade 2022 for Tsimba
- Transnet MPP inland and coastal 2022 for ENVASS
- Ruighoek PRA 2022 for SLR Consulting (Africa)
- Namli MRA Steinkopf 2022 for Beyond Heritage
- Adara 2 SEF 2023 for CTS Heritage
- Buffalo & Lyra SEFs 2023 for Nextec
- Camel Thorn Group Prospecting Rights 2023 for AHSA
- Dalmanutha SEFs 2023 for Beyond Heritage
- Elandsfontein Residential 2023 for Beyond Heritage
- Waterkloof Samancor 2023 for Elemental Sustainability
- Zonnebloem WTP 2023 for WSP
- Elders Irrigation 2023 for SRK
- Leghoya WEFS 2023 for Red Cap & SLR

#### ix) **Research Output**

Publications by M K Bamford up to January 2024 peer-reviewed journals or scholarly books: over 175 articles published; 5 submitted/in press; 14 book chapters.

Scopus h-index = 33; Google Scholar h-index = 40; -i10-index = 121 based on 7261 citations.

Conferences: numerous presentations at local and international conferences.