

Palaeontological Desk Top Study for proposed
small scale mining operations for diamonds
(alluvial and Kimberlite) on the farm Dutoitspan
119, District of Boshoff, Free State

**DESKTOP STUDY
PALAEONTOLOGY**

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For:

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3 June 2018

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1. Executive Summary

The study area is situated mainly on Karoo age sedimentary rock which is overlain in the southern half by Quaternary sediments. The Karoo is represented in the study area by the Prince Albert Formation of the Ecca Group. The Quaternary deposits consist mostly of calcrete, calcified pandune and surface limestone.

Although no fossils have been reported from the study area, both the Prince Albert Formation and the Quaternary sediments are potentially fossiliferous. It is difficult to find exposures of the Prince Albert Formation in the study area - except in road cuttings, wells and drill cores because it is most often covered by wind-blown sand and the fact that it weathers easily.

The proximity of dolerite dykes and sills in the study area and immediate vicinity would suggest that thermal metamorphism could have destroyed the Karoo-age fossils to a large degree if there were any.

There is a slight probability of finding mammal, bird or reptile bones, mollusc shells and ostrich egg fragments in the alluvium, soils and gravels constituting the Quaternary to Recent deposits.

The ECO should take responsibility of monitoring the excavations. If a significant find is made the procedure stipulated under Procedure for Chance Palaeontological Finds (p.15) should be followed which includes the safeguarding of the exposed fossils and the contacting of a palaeontologist for further advice.

2. Introduction

The palaeontological heritage of South Africa is unsurpassed and can only be described in superlatives. The South African palaeontological record gives us insight in *i.a.* the origin of life, dinosaurs and humans. Fossils are also used to identify rock strata and determine the geological context of the geological formations and the chronostratigraphy of Southern Africa.

The first evidence of tectonic plate movement was discovered after studying the distribution of Karoo-age fossils in South Africa and other continents and subcontinents such as India, Antarctica, South America and Australia. Fossils are also used to study evolutionary relationships, sedimentary processes and palaeoenvironments.

The Heritage Act of South Africa stipulates that fossils and fossil sites may not be altered or destroyed. The purpose of this document is to detail the probability of finding fossils in the study area which may be impacted by the proposed development.

3. Terms of reference for the report

According to the South African Heritage Resources Act (Act 25 of 1999) (Republic of South Africa, 1999), certain clauses are relevant to palaeontological aspects for a terrain suitability assessment.

- **Subsection 35(4)** No person may, without a permit issued by the responsible heritage resources authority-
- (a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
- (b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
- (c) trade in, sell for private gain, export or attempt to export from the republic any category of archaeological or palaeontological material or object, or any meteorite; or
- (d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist with the detection or recovery of metals or archaeological material or objects, or use such equipment for the recovery of meteorites.
- **Subsection 35(5)** When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedures in terms of section 38 has been followed, it may-
- (a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
- (b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;
- (c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph (a) to apply for a permit as required in subsection (4); and
- (d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

South Africa's unique and non-renewable palaeontological heritage is protected in terms of the NHRA. According to this act, heritage resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

As areas are developed and landscapes are modified, heritage resources, including palaeontological resources, are threatened. As such, both the environmental and heritage legislation require that development activities must be preceded by an assessment of the impact undertaken by qualified professionals. Palaeontological Impact Assessments (PIAs) are specialist reports that form part of the wider heritage component of:

- Heritage Impact Assessments (HIAs) called for in terms of Section 38 of the National Heritage Resources Act, Act No. 25, 1999 by a heritage resources authority.
- Environmental Impact Assessment process as required in terms of other legislation listed in s. 38(8) of NHRA;
- Environmental Management Plans (EMPs) required by the Department of Mineral Resources.

HIAs are intended to ensure that all heritage resources are protected, and where it is not possible to preserve them in situ, appropriate mitigation measures are applied. An HIA is a comprehensive study that comprises a palaeontological, archaeological, built environment, living heritage, etc specialist studies. Palaeontologists must acknowledge this and ensure that they collaborate with other heritage practitioners. Where palaeontologists are engaged for the entire HIA, they must refer heritage components for which they do not have expertise on to appropriate specialists. Where they are engaged specifically for the palaeontology, they must draw the attention of environmental consultants and developers to the need for assessment of other aspects of heritage. In this sense, Palaeontological Impact Assessments that are part of Heritage Impact Assessments are similar to specialist reports that form part of the EIA reports. The standards and procedures discussed here are therefore meant to guide the conduct of PIAs and specialists undertaking such studies must adhere to them. The process of assessment for the palaeontological (PIA) specialist components of heritage impact assessments, involves:

Scoping stage in line with regulation 28 of the National Environmental Management Act (No. 107 of 1998) Regulations on Environmental Impact Assessment. This involves an **initial assessment** where the specialist evaluates the scope of the project (based, for example, on NID/BIDs) and advises on the form and extent of the assessment process. At this stage the palaeontologist may also decide to compile a **Letter of Recommendation for Exemption from further Palaeontological Studies**. This letter will state that there is little or no likelihood that any significant fossil resources will be impacted by the development. This letter should present a reasoned case for exemption, supported by consultation of the relevant geological maps and key literature.

A **Palaeontological Desktop Study** – the palaeontologist will investigate available resources (geological maps, scientific literature, previous impact assessment reports, institutional fossil collections, satellite images or aerial photos

, etc) to inform an assessment of fossil heritage and/or exposure of potentially fossiliferous rocks within the study area. A Desktop studies will conclude whether a further field assessment is warranted or not. Where further studies are required, the desktop study would normally be an integral part of a field assessment of relevant palaeontological resources.

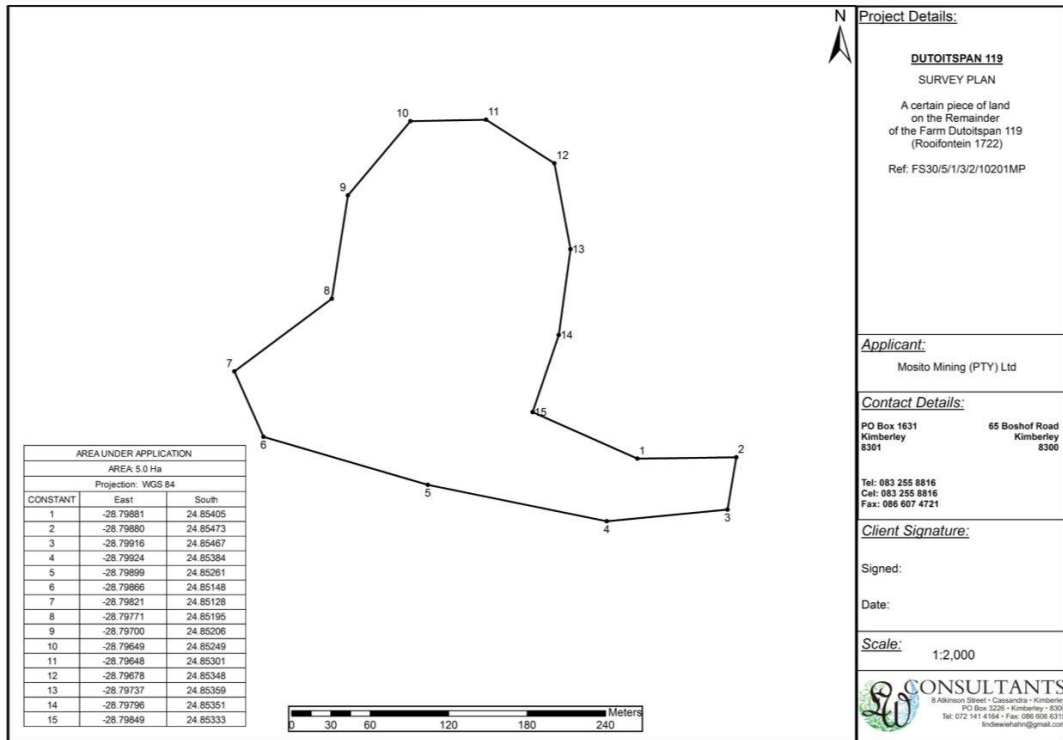
A **Phase 1 Palaeontological Impact Assessment** is generally warranted where rock units of high palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large-scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed project area is unknown. In the recommendations of Phase 1, the specialist will inform whether further monitoring and mitigation are necessary. The Phase 1 should identify the rock units and significant fossil heritage resources present, or by inference likely to be present, within the study area, assess the palaeontological significance of these rock units, fossil sites or other fossil heritage, comment on the impact of the development on palaeontological heritage resources and make recommendations for their mitigation or conservation, or for any further specialist studies that are required in order to adequately assess the nature, distribution and conservation value of palaeontological resources within the study area.

A **Phase 2 Palaeontological Mitigation** involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or the recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before Phase 2 may be implemented.

A **'Phase 3' Palaeontological Site Conservation and Management Plan** may be required in cases where the site is so important that development will not be allowed, or where development is to co-exist with the resource. Developers may be required to enhance the value of the sites retained on their properties with appropriate interpretive material or displays as a way of promoting access of such resources to the public.

The assessment reports will be assessed by the relevant heritage resources authority, and depending on which piece of legislation triggered the study, a response will be given in the form of a Review Comment or Record of Decision (ROD). In the case of PIAs that are part of EIAs or EMPs, the heritage resources authority will issue a comment or a record of decision that may be forwarded to the consultant or developer, relevant government department or heritage practitioner and where feasible to all three.

4. Details of study area and the type of assessment:



Project Details:
DUTOITSPAN 119
 SURVEY PLAN
 A certain piece of land on the Remainder of the Farm Dutoitspan 119 (Roofontein 1722)
 Ref: FS30/5/1/3/2/10201MP

Applicant:
 Mosto Mining (PTY) Ltd

Contact Details:
 PO Box 1631 Kimberley 8301
 65 Boshof Road Kimberley 8300
 Tel: 083 255 8816
 Cell: 083 255 8816
 Fax: 086 607 4721

Client Signature:
 Signed: _____
 Date: _____

Scale:
 1:2,000

SO CONSULTANTS
 8 Alkemon Street - Cassandra - Kimberley
 PO Box 5228 - Kimberley - 8300
 Tel: 072 141 4164 - Fax: 086 806 0316
 info@soconsultants@gmail.com

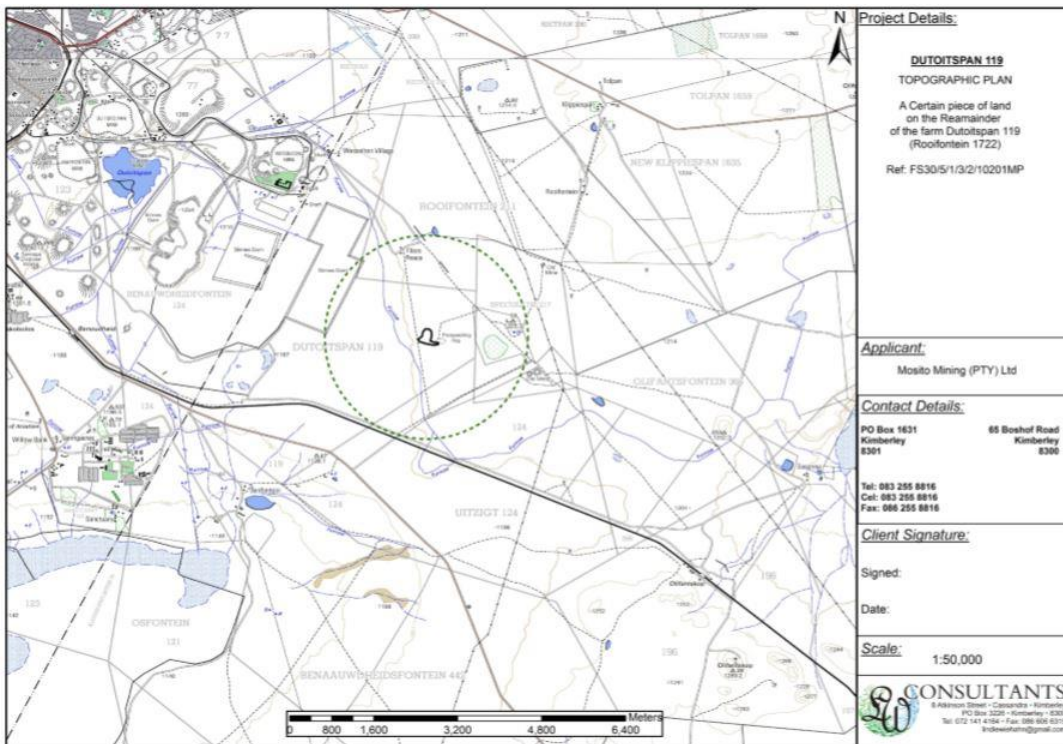


Figure 1: Topographical maps showing study area



Figure 2: Google Earth photo indicating the study area



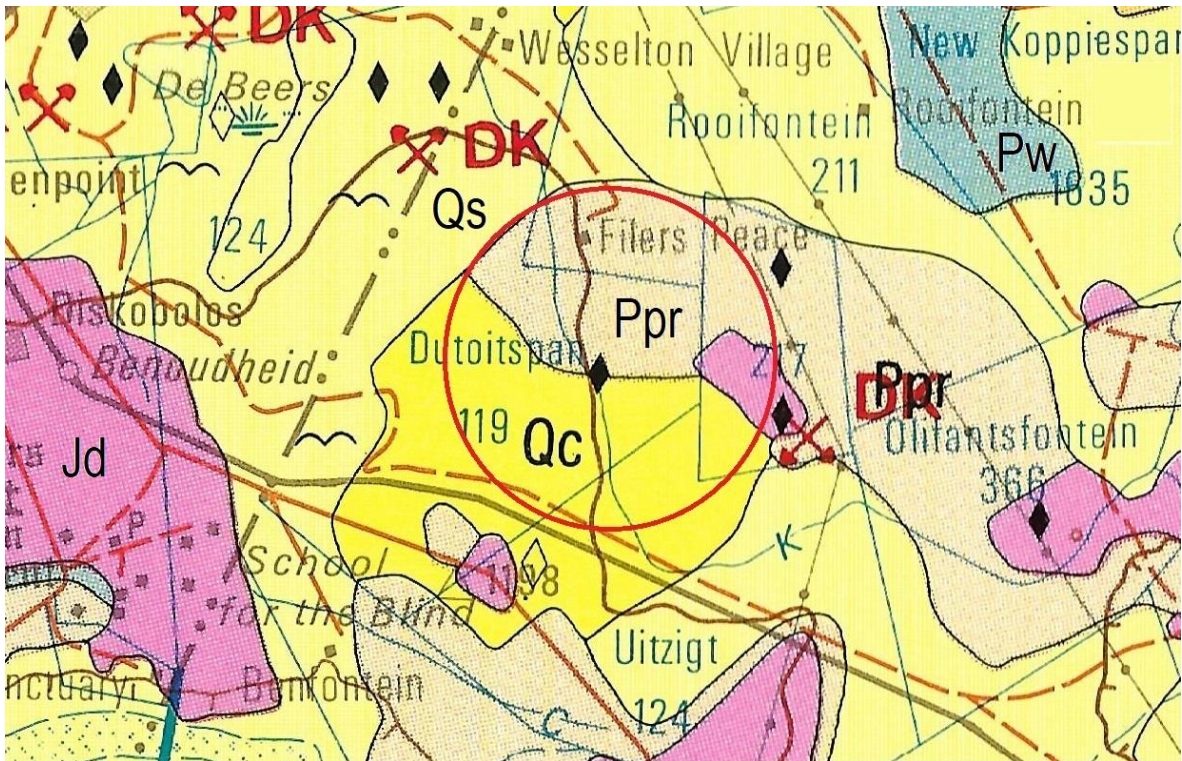
Figure 3: Palaeosensitivity map of the study area and surroundings (SAHRA, 2018)

The proposed development will take place in an area which is mostly used for farming and mining east of Kimberley (see Figs. 1, 2). The area is mostly flat and vegetation is sparse. There are diamond mines adjacent to the study area (see Figs. 2, 4).

The proposed development will take place in an area which is considered by the South African Heritage Resources Agency (SAHRA) to have a High Palaeontological Sensitivity (see Fig. 3). There is a patch on the eastern limit of the study area which consists of dolerite (see Fig. 4) which has no palaeontological significance.

The relevant literature and geological maps for the study area in which the development is proposed to take place, have been studied for a Desktop Report.

5. Geological setting of the study area



The study area is indicated by the red circle.

Figure 4: Geology of the study area and surroundings. Adapted from the 2824 KIMBERLEY 1:250 000 Geology Map (Geological Survey, 1993)

GEOLOGICAL LEGEND

	Lithology	Stratigraphy		Age
Qs	Sand: Red and grey aeolian dune sand			Quaternary
~ ~	Alluvium and scree			
Qc	Calcrete, calcified pandune and surface limestone			
Jd	Dolerite intrusions			Jurassic
Pw	White-weathering carbonaceous scale	Whitehill, Ecca	Karoo Supergroup	Permian
Ppr	Shale	Prince Albert, Ecca		Ecca

The study area is underlain by rocks of the Ecca Group which is covered in places by Quaternary to Recent deposits (see Fig. 4).

The Prince Albert Formation occurs in the south-western half of the Karoo Basin. The northern facies of this formation which is approximately 90 m thick in the Kimberley region is characterised by the predominance of greyish to olive-green micaceous shale and grey silty shale as well as a pronounced transition to the underlying glacial deposits. Dark-grey to black carbonaceous shale and fine-to medium-grained feldspathic arenite and wacke are also present. Calcareous concretions and irregular carbonate bodies are found in the sandstones and mudrocks of this formation. Few exposures of this formation are visible because of its tendency to weather and because it is largely covered with wind-blown sand (Bosch, 1993; Johnson *et al.*, 2009).

The Whitehill Formation follows concordantly on the Prince Albert Formation weather white on the surface while the subsurface facies consist of black, carbonaceous, pyrite-bearing shale (Bosch, 1993; Johnson *et al.*, 2009).

Dolerite dykes and sills occur in the study area and surroundings. It was noted in the Kimberley map area that in bore core samples that there is almost always a dolerite sill present at the upper or lower contact or both of the Whitehill Formation (Bosch, 1993).

Most of the Karoo age rocks in the region are covered by sand, alluvium and calcrete of Quaternary to Recent age (Partridge *et al.*, 2009).

6. Palaeontological potential of the study area

Prince Albert Formation of the Ecca Group

This formation has yielded marine invertebrates (bivalves, nautiloids, brachiopods), palaeoniscoid fish, sharks, fish coprolites, protozoans (foraminiferans, radiolarians), petrified wood, palynomorphs (spores, acritarchs), non-marine trace fossils (especially arthropods, fish, also structures which resemble worm burrows), possible stromatolites and oolites (McLachlan and Anderson, 1973; Bosch, 1993; Johnson *et al.*, 2009).

Whitehill Formation of the Ecca Group

Fossils of plants such as Glossopteris and lycopods, several species of palaeoniscoid fish, the marine reptile Mesosaurus, cephalochordates and arthropods such as Notocaris tapiscotti and rare remains of insects have been found in this geological formation (Oelofsen & Araujo, 1987; Cole & McLachlan, 1991; Bosch, 1993).

Quaternary deposits

Alluvium, scree, sand, gravel and soil dating from the Late Cenozoic to Recent cover the southern part of the Prince Albert Formation in the study area. Although no fossils or sub-fossils been reported from the Quaternary sediments in the study area, there is always the possibility that something may be discovered. In spite of these Quaternary fossiliferous deposits being extremely rare there are well documented cases of remains of tortoises, snail shells, ostrich eggs, termitaria, bones etc. that have been discovered elsewhere (Macrae, 1999; Partridge *et al.*, 2009).

References:

Bosch, P.J.A. (1993). Die geologie van die gebied Kimberley. Geological Survey, Pretoria, pp. 60.

Cole, D.I. & McLachlan, I.R. (1991). Oil potential of the Permian Whitehill Formation in the Main Karoo Basin, South Africa. In: Proceedings of the 7th International Gondwana Symposium, Brazil, pp.379-430.

Geological Survey (1993). 2824 KIMBERLEY 1: 250 000 Geology Map. Geological Survey, Pretoria.

McLachlan, I.R. and Anderson, A.M. (1973). Fossil insect wings from the Early Permian White Band Formation, South Africa. *Palaeontologia Africana* 20:83-86

Macrae, C. (1999). Life etched in stone. Fossils of South Africa. The Geological Society of South Africa, Johannesburg, 305 pp.

Oelofsen, B.W. & Araujo, D. (1987). *Mesosaurus tenuidens* and *Stereosternum tumidum* from the Permian Gondwana of both the Permian Gondwana of both southern Africa and South America, South African Journal of Science, 83:370-372.

Partridge, T.C., Botha, G.A. & Haddon, I.G. (2009). Cenozoic Deposits of the Interior. 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: 585-604.

7. Conclusion and recommendations:

The area is underlain by weathered Karoo aged rocks and it is unlikely that fossils will be found during prospecting. The chances of finding fossils are increased however when fresh unweathered rocks are exposed during mining. The Prince Albert Formation may have undergone thermal metamorphism in the study area due to dolerite intrusions.

In the unlikely event that fossils are found in the study area the ECO should take the following steps:

PROCEDURE FOR CHANCE PALAEOLOGICAL FINDS

Extracted and adapted from the National Heritage Resources Act, 1999 Regulations Reg No. 6820, GN: 548.

The following procedure must be considered in the event that previously unknown fossils or fossil sites are exposed or found during the life of the project:

1. Surface excavations should continuously be monitored by the ECO and any fossil material be unearthed the excavation must be halted.
2. If fossiliferous material has been disturbed during the excavation process it should be put aside to prevent it from being destroyed.
3. The ECO then has to take a GPS reading of the site and take digital pictures of the fossil material and the site from which it came.
4. The ECO then should contact a palaeontologist and supply the palaeontologist with the information (locality and pictures) so that the palaeontologist can assess the importance of the find and make recommendations.
5. If the palaeontologist is convinced that this is a major find an inspection of the site must be scheduled as soon as possible in order to minimise delays to the development.

From the photographs and/or the site visit the palaeontologist will make one of the following recommendations:

- a. The material is of no value so development can proceed, or:
- b. Fossil material is of some interest and a representative sample should be collected and put aside for further study and to be incorporated into a recognised fossil repository after a permit was obtained from SAHRA for the removal of the fossils, after which the development may proceed, or:

c. The fossils are scientifically important and the palaeontologist must obtain a SAHRA permit to excavate the fossils and take them to a recognised fossil repository, after which the development may proceed.

7. If any fossils are found then a schedule of monitoring will be set up between the developer and palaeontologist in case of further discoveries.

8. Declaration of Independence:

I, Jacobus Francois Durand declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of my performing such work.



Palaeontological specialist:

Dr JF Durand (Sci. Nat.)

BSc Botany & Zoology (RAU), BSc Zoology (WITS), Museology Dipl. (UP),
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