SAHRA Case ID: 11828

Prospecting Right Application NC 30/5/1/1/2/11639 PR

UPDATED PALAEONTOLOGICAL ASSESSMENT

WITH REVISED FOSSIL FINDS PROCEDURE FOR THE EMP.

PROPOSED PROSPECTING ON THE REMAINING EXTENT OF PORTION 1 OF THE FARM ANNEX VIEGULANDS PUT 42, NEAR PRIESKA, SIYATHEMBA LOCAL MUNICIPALITY, PRIESKA MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

BY

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FOR

Archaeological and Heritage Services Africa (Pty) Ltd

CLIENT/APPLICANT

Mr P.S. Thukgwi

4 JANUARY 2018

DECLARATION OF INDEPENDENCE

UPDATED PALAEONTOLOGICAL ASSESSMENT

WITH REVISED FOSSIL FINDS PROCEDURE FOR THE EMPR

PROPOSED PROSPECTING ON THE REMAINING EXTENT OF PORTION 1 OF THE FARM ANNEX VIEGULANDS PUT 42, NEAR PRIESKA, SIYATHEMBA LOCAL MUNICIPALITY, PRIESKA MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

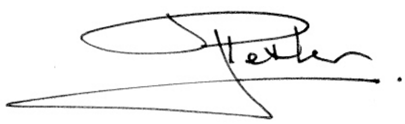
Terms of Reference

This assessment forms part of the Heritage Assessment it assesses the overall palaeontological (fossil) sensitivities of formations underlying the Project Area.

Declaration

I …**John Pether**……, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in the compilation of the above report;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed to the EAP any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management act;
- have provided the EAP with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 48 of the 2014 NEMA EIA Regulations.



Signature of the specialist

Date: 4 JANUARY 2018

CURRICULUM VITAE

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)

Independent Consultant/Researcher recognized as an authority with 35 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine).

At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~240 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Accredited member, Association of Professional Heritage Practitioners, Western Cape.

Past Clients Palaeontological Assessments

Agency for Cultural Resource Management (ACRM).	Klomp Group.
AMATHEMBA Environmental.	Megan Anderson, Landscape Architect.
Anél Blignaut Environmental Consultants.	Ninham Shand (Pty) Ltd.
Arcus Gibb (Pty) Ltd.	PD Naidoo & Associates (Pty) Ltd.
Aurecon SA (Pty) Ltd.	Perception Environmental Planning.
BKS (Pty) Ltd. Engineering and Management.	PHS Consulting.
Bridgette O'Donoghue Heritage Consultant.	Resource Management Services.
Cape Archaeology, Dr Mary Patrick.	Robin Ellis, Heritage Impact Assessor.
Cape EAPrac (Cape Environmental Assessment Practitioners).	Savannah Environmental (Pty) Ltd.
CCA Environmental (Pty) Ltd.	Sharples Environmental Services cc
Centre for Heritage & Archaeological Resource Management.	Site Plan Consulting (Pty) Ltd.
Chand Environmental Consultants.	Strategic Environmental Focus (Pty) Ltd.
CK Rumboll & Partners.	SRK Consulting (South Africa) (Pty) Ltd.
CNdV Africa	UCT Archaeology Contracts Office (ACO).
CSIR - Environmental Management Services.	UCT Environmental Evaluation Unit
Digby Wells & Associates (Pty) Ltd.	Urban Dynamics.
Enviro Logic	Van Zyl Environmental Consultants
Environmental Resources Management SA (ERM).	ENVIRO DINAMIK.
Greenmined Environmental	Wethu Investment Group Ltd.
Guillaume Nel Environmental Management Consultants.	Withers Environmental Consultants.

Stratigraphic consulting including palaeontology

Afri-Can Marine Minerals Corp	Council for Geoscience
De Beers Marine (SA) Pty Ltd.	De Beers Namaqualand Mines.
Geological Survey Namibia	IZIKO South African Museum.
Namakwa Sands (Pty) Ltd	NAMDEB

CONTENTS

1 BACKGROUND

The applicant, Mr Paul S.Thukgwi, proposes to prospect for diamonds on a portion of farm Annex Viegulands Put 42 in the Prieska District of the Northern Cape Province. Wadala Mining and Consultants (Pty) Ltd were engaged and have submitted the Environmental Impact Assessment Report (EIA) and the Environmental Management Plan (EMP) on behalf of the applicant. A Heritage Impact Assessment has been submitted to the South African Heritage Resources Agency (SAHRA) by Archaeological and Heritage Services Africa (Pty) Ltd. (AHSA), which included a desktop Palaeontological Assessment. An Interim Comment has been issued by SAHRA (Case ID 11828) in which the Fossil Finds Procedure accompanying the Palaeontological Assessment is regarded as too generic and not adequately addressing the conditions specific to the geological formations that will be affected by the development.

The purpose of this report is to address this issue and thereby also provide updated, more complete information for inclusion in updated EMP guidelines with respect to palaeontological finds and also in the HIA section of the EIA Report. As regards more specific geological information, this report benefits from the astute observations included in the Ecological Assessment Report by Betsie Milne (*Boscia* Ecological Consulting) and technical reports for neighbouring diamond operations (*e.g.* Marshall & Norton, 2015).

2 LOCATION

The Project Area is the Remaining Extent of Portion 1 of the Farm Annex Viegulands Put 42 which is situated along the R357 between Prieska and Douglas (Figure 1).

1:50 000 Topo-cadastral Sheets 2923AC KALKKRANS and 2923CA ROOISLOOT.

Farmstead: - -29.468604°S / 23.205715°E. WGS84.

3 LOCALITY PLAN

See Figure 2.

4 DESCRIPTION OF THE PROPOSED DEVELOPMENT

The earth works proposed in the prospecting programme first involves a phase of ~20 trial pits, 1X2 m in plan and up to ~5 m deep, dependent on deposit thickness, located on a widely-spaced grid. A typical section of the deposits is expected to entail ~3 m of calcrete and sand overburden underlain by ~2 m of diamondiferous gravel. Pits with positive diamond results will be followed up by bulk sampling entailing trenches 200 m long and 100 m wide. Excavation of a “slimes” dam for washed-out sand and mud will be required. A diamond plant will be constructed, along with a mobile office complex, security facilities, workshop, stores and fuel storage depot.

5 HERITAGE RESOURCES IDENTIFIED

The triangular Project Area is situated on a watershed spur at the edge of a dissected plateau surface adjacent to the steeper slopes of the incised Orange River valley (Figure 1). To the south are the slopes of the major Brakrivier tributary drainage. The highest elevation of ~1110 m asl. is in the southwest corner, from which the flat terrain slopes very gently generally north-eastwards down towards a slope-break at about 1070 m asl. which is marked by a distinct lineament feature (Figures 1 & 2). The latter defines the western edge of flatter, terrace-like terrain hosting pans which flanks the defunct palaeodrainage farther east. The elevation along the eastern boundary is ~1060 m asl. A low ridge cresting at ~1080 m asl. is present along the north-western boundary.

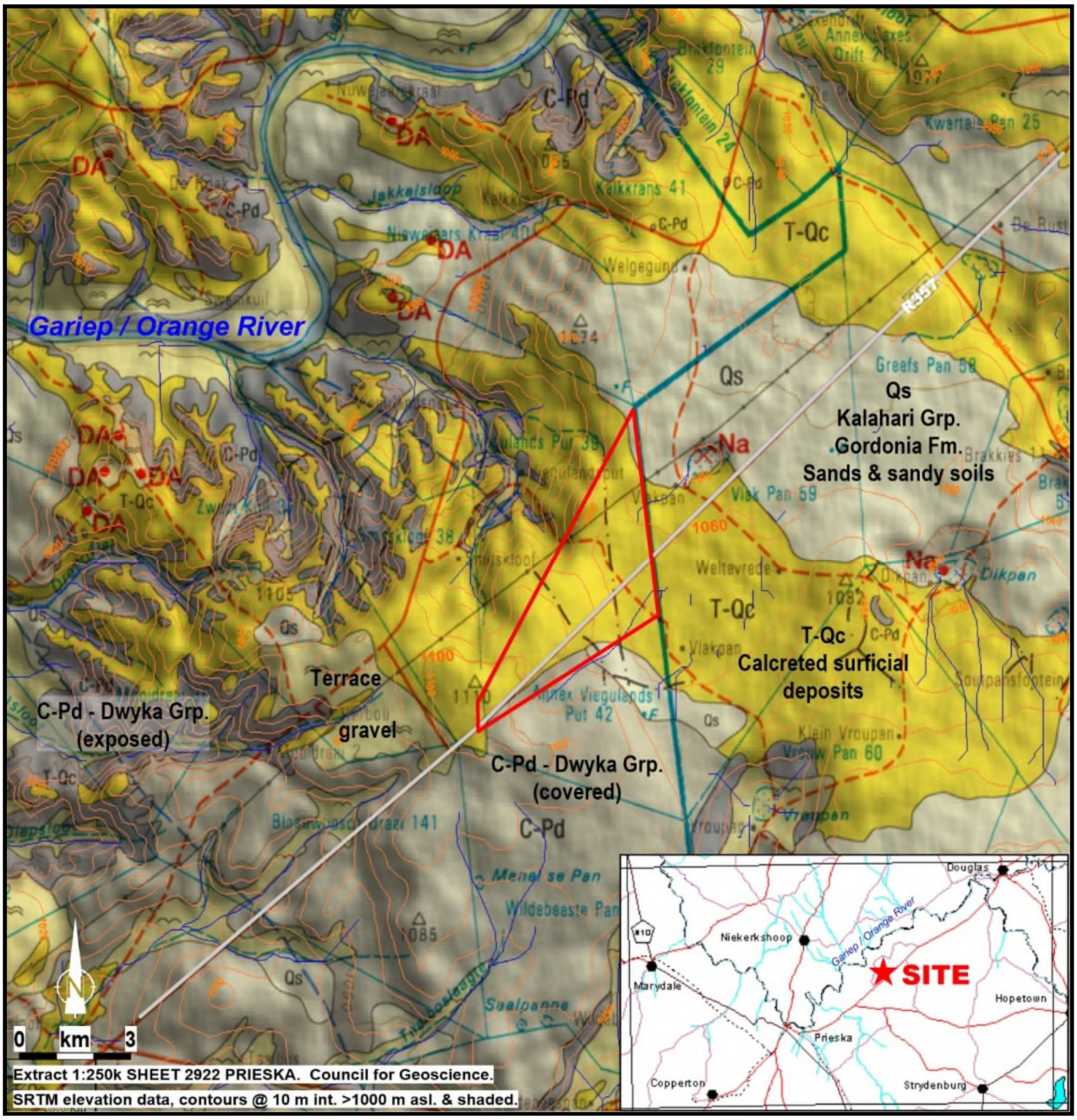


Figure 1. Geological context of the Project Area.

The bedrock of the area is comprised of the **Dwyka Group** sediments of the **Karoo Supergroup** (Figure. 1, C-Pd). Known more informally as the “Dwyka Tillites”, these sediments represent the melt-out content of glaciers and ice sheets when southern Africa, then part of the Gondwana supercontinent, was in the vicinity of the South Pole about 300 Ma (Ma = million years ago. Grinding ice carved out great valleys in the basement rocks. During subsequent climatic warming the ice sheets melted back to the northern highlands, depositing massive tillites in the valleys which were then succeeded by marine muds with melt-out dropstones from floating icebergs (the “boulder shales”). These valley and inlet deposits, named the **Mbizane Formation** (Visser *et al*., 1990), are therefore very variable, comprising tillites, conglomerates, sandstones and mudrocks which were left behind on the ice-scoured landscape by the retreating glaciers.

The landscape is mantled by calcretes (surface limestone) formed both on the Dwyka bedrock (Figure 1, C-Pd – covered) and within the overlying deposits (**T-Qc**), the latter which underlie the Project Area. Although not distinguished, the mapped unit T-Qc subsumes deposits and capping calcretes of various ages. Thick, mature calcretes distinguish the flat, older land surface and are exposed in erosional scarps flanking the younger valleys, while less-developed calcretes have formed in the diamondiferous alluvial terraces (Figure 1, DA) of Pliocene and Miocene age and in colluvial deposits within the valleys.

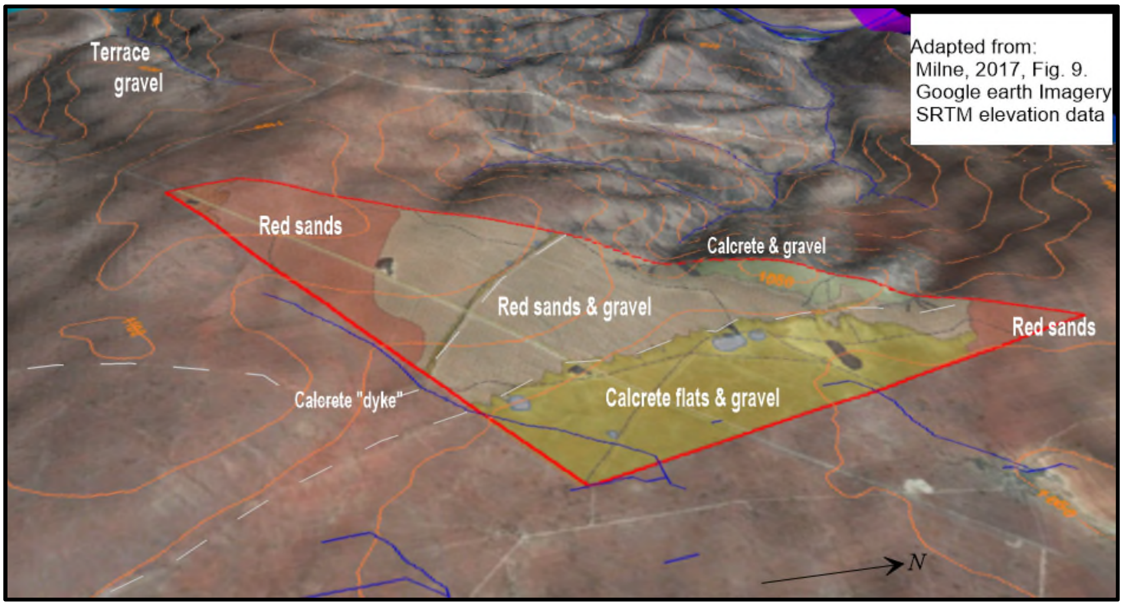


Figure 2. Surface terrains of the Project Area, after Milne (2017). Simulated aerial view looking approximately westwards.

Relative to the Orange River level (~940 m asl.) the elevation range of the Project Area is ~120 to 170 m arl. A "Terrace gravel" deposit on an adjacent property similarly occurs between ~140 to 170 m arl. (Figures 1 & 2). The age of the calcreted deposits beneath the Project Area is assumed to pre-date the alluvial terraces at lower elevations within the Orange River valley. The oldest and highest of these, at elevations of 60-90 m arl., correlates with the high sea-levels/river base levels of the Mid-Miocene Climatic Optimum ~19-15 Ma. The higher gravels at the elevations of the Project Area are considered to be older and may be residuals of earlier Eocene alluvial sediments deposited during climatic optimum intervals between ~52 to ~35 Ma. However, the extent to which these gravels are original river deposits is not clear and they would also include gravel that was produced locally by weathering out of the Dwyka. They are not correlated with the later Miocene/Pliocene fluvial Eden Formation of the Kalahari Group (Figure 3), being considered an older, relict unit within the Orange-Vaal drainage, separate from the Kalahari Basin.

The calcrete underlies the flat terrain of the eastern portion of the Project Area, with a thin cover of red soil and scattered gravel (Milne, 2017) (Figure 2). Calcrete with scattered gravel also mantles the interfluves of the dissected terrain along the north-western boundary (Matenga, 2017). The calcrete in the area is broadly correlated with the **Mokalanen Formation** of the **Kalahari Group** which is the calcrete capping of the main Kalahari Group, considered to have formed due to climatic aridification since the late Pliocene (Figure 3) (Partridge *et al*., 2006).

The calcrete cappings have been subjected to ongoing processes of dissolution, erosion/brecciation and re-formation (McCarthy, 1983). This has usually produced a high-microrelief, bumpy surface of pits (*makondos*) and ridges. Reddened gravels are found on this surface and filling the pits (Figures 4& 5). Known as the "derived" or **Rooikoppie** gravels, these are resistant clasts derived from the weathering and downwasting of the calcrete which released the included alluvial gravels and sands. This material was then subjected to reddening in an iron-oxide-rich, lateritic soil profile which itself was later washed and deflated away and the gravel was extensively redistributed by colluvial, slope-wash and creep processes. These residual gravels are broadly equivalent to the **Obobogorop Formation** which occupies a similar context in the Kalahari Group (Partridge *et al*., 2006).

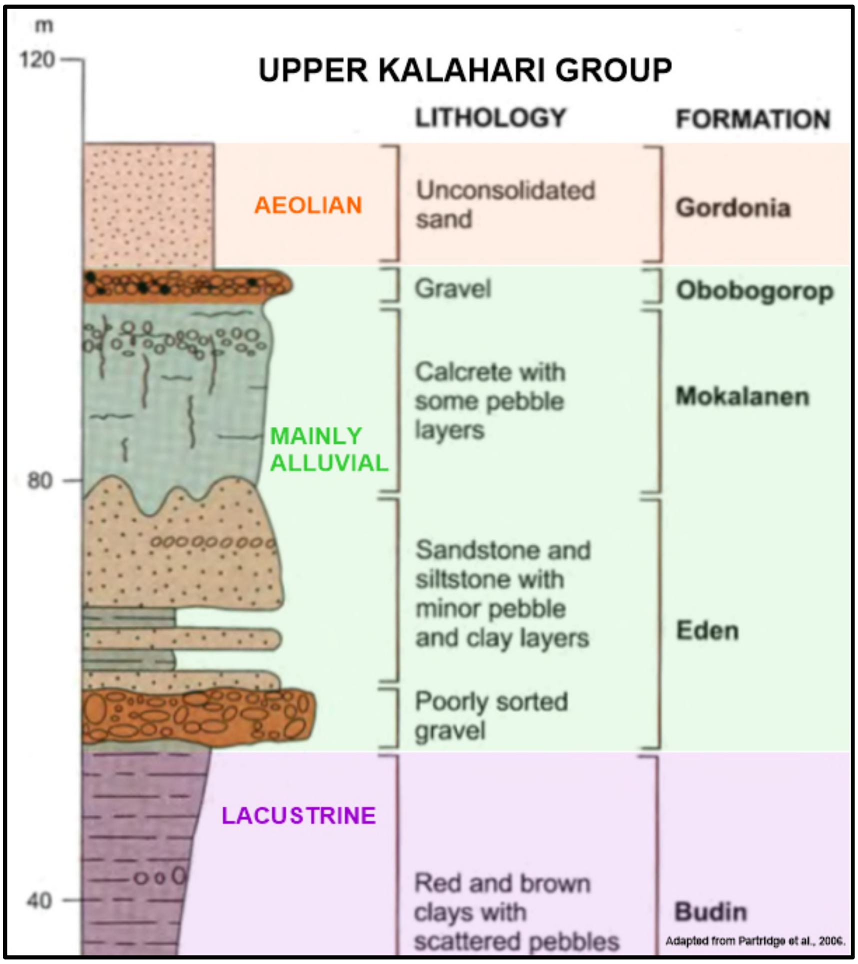


Figure 3. Generalized section of the Upper Kalahari Group. After Partridge *et al*., 2006.

The central portion of the Project Area is covered by red sandy soil with rocks, supporting thornveld in a background of shrubby grassland (Milne, 2017) (Figure 2). A curvilinear calcrete "dyke" feature traverses the central portion and ponds some small pans on its upslope side. As it is approximately on trend with an aeromagnetic anomaly (Figure 1, blue dashes) it is taken to be a dolerite dyke which has been preferentially calcretized. The streaks of similar grey hue that trend approximately downslope may speculatively reflect closely underlying ridge topography of the calcrete (*cf*. Figure 5).

Reddened Kalahari-type aeolian sands are present as a cover of variable thickness overlying the calcrete and red gravels and are thickest in the southern and northernmost portions of the Project Area, where blown in swathes out of the Orange River valley by north-westerly winds (Figure 2). The red sands are referable to the **Gordonia Formation** of the Kalahari Group and in this area are likely to be of late Quaternary age.

Figure 4. Small-scale *makondo* surface on calcrete, with infilling "Rooikoppie" gravel. From Horn, 2014.

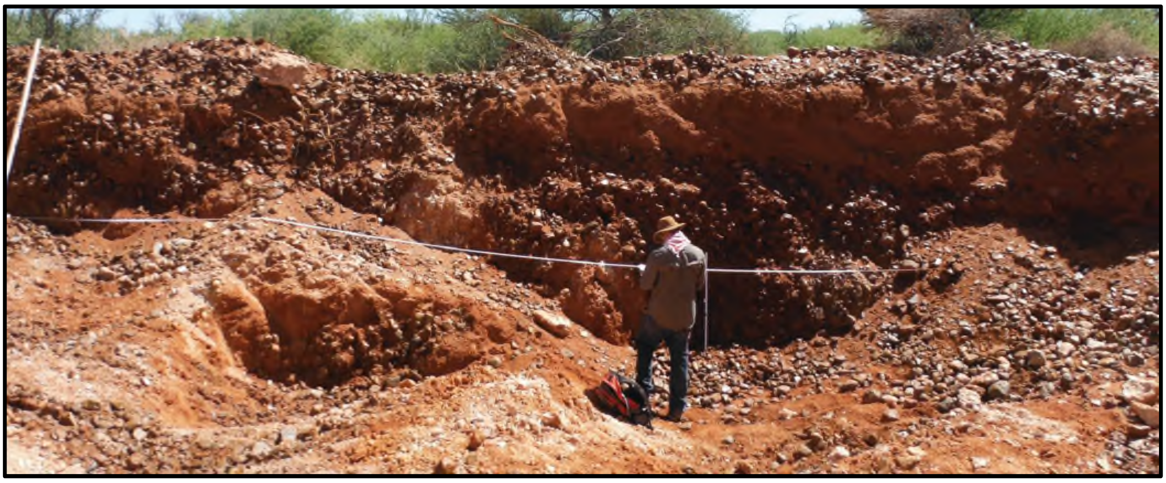


Figure 5. Larger-scale relief on calcrete surface, with infilling "Rooikoppies" gravel and overlying Kalahari red sands. From Horn, 2014.

6 ANTICIPATED IMPACTS ON PALAEONTOLOGICAL HERITAGE RESOURCES

Fossils in the **Mbizane Formation** (Dwyka Group bedrock) are sparse and mainly limited to trace fossils made by arthropods and fish, plant fragments and petrified wood. Accordingly the palaeontological sensitivity rating of the Mbizane Formation is considered to be moderate (Almond & Pether (2009). However, the weathering and calcretization of the landscape bedrock renders fossil preservation unlikely and thus the sensitivity in this context is LOW. Nevertheless, durable fossil material, such as petrified wood, may be reworked into the overlying gravels.

The overlying superficial gravels in the Project Area are older than the mid-Miocene and younger terrace deposits at lower elevations within the Orange River valley and have been subjected to a long pedogenic history involving extensive calcretization, calcrete degradation, release of the included gravels and lateritic soil development. Similar "High Level" gravels locally preserved in a few places in the Orange-Vaal drainage have evidently not yielded fossil finds. A notable exception are calcified fluvial gravels in palaeochannels in the vicinity of Mahura Muthla near Kuruman, on the high northern watershed formed by the Ghaap Plateau, where an array of fossil petrified woods occur as rounded pebbles and log pieces. The wood anatomies identified are representative of at least four periods *viz*. Upper Karoo (post-Permian), Early Cretaceous, Late Cretaceous and Tertiary (De Wit *et al*., 2009), attesting to the remarkable persistence of this remnant of an ancient land surface. These fossils are a critical datum point in the debates on the earlier denudation history of the subcontinent. The gravels in the Project Area may also contain petrified wood.

The fossil content of calcretes includes root casts, termitaria and termite burrows, land snails and sometimes tortoise carapaces, ostrich eggshell and rare bones. According to the available evidence, the (Mokalanen Fm.) calcrete formed much later than the deposition of the primary alluvial deposits, in later Miocene and Pliocene times. Given the long and complex pedogenic history of these early Tertiary (Eocene?) alluvial deposits it is unlikely that soluble fossils such as bones would have survived the humid climatic periods that occurred before aridification and calcrete formation during the later Miocene, unless circumstances were favourable for petrification soon after deposition. The probability of fossil vertebrate material being preserved in the calcrete is evidently low, with the possible exception of petrified hard parts such as teeth. Similarly, the preservation potential of fossil bones in the derived Rooikoppie gravels (Obobogorop Fm.) that mantle the karstic *makondo* calcrete surface is low, with the exception of petrified material.

The red Kalahari sands (Gordonia Fm.) may also include trace fossils such as root casts and insect burrows, particularly termite burrows and termitaria. Land snails (*Dorcasia*, *Xeroceratus*), tortoise carapaces and ostrich eggshell are typical. Larger burrows in compact sands are made by lizards, ground squirrels, meerkats, moles and aardvarks. These may contain fossil material and the large aardvark burrows may sequester hyaena bone accumulations. However, such finds of larger-mammal fossil bones are rare in the Gordonia Formation dunes and coversands and consequently the overall palaeontological sensitivity of the Gordonia Formation is Low (Almond & Pether, 2009).

The pans and their margins, as waterholes, have a high sensitivity for both palaeontological and archaeological material of mid to late Quaternary age. Pan deposits are important palaeo-environmental archives with conditions of the past recorded by the nature of the sediments and the included fossils of micro-organisms, crustaceans, molluscs, amphibians, birds, plant remains and the remains of animals that succumbed to drought and predators.

7 RECOMMENDATIONS

In summary, there is some possibility that petrified fossil material, most likely wood, could occur in the alluvial deposits, its calcreted part and the overlying residual, derived gravels. Such finds will be of considerable scientific significance. The overlying Kalahari sands may contain buried archaeological material, associated fossil bones, or bone accumulations in burrows. The highest probability of uncovering fossil bones and archaeological material is in the vicinity of pans.

It is recommended that a requirement to be alert for possible fossil materials and buried archaeological material be included in the Environmental Management Plan (EMP) for the proposed prospecting operations.

7.1 FOSSIL FINDS PROCEDURE

As part of pre-prospecting Environmental and Health & Safety awareness training, personnel must be instructed to be alert for the occurrence of fossil wood, bones, archaeological material and of unrecorded burials.

If a potential petrified fossil wood or bone pebble/cobble is noticed in the alluvial gravels, it must be retrieved from loss immediately and placed in the safekeeping of the Environmental Control Officer (ECO) who must then inform SAHRA, providing information as below.

In the event of a possible find of bones or a buried concentration of archaeological material in the Kalahari Gordonia sands or in pan deposits, work must cease at the site and the works foreman and the Environmental Control Officer (ECO) for the project must be informed immediately. Unearthed parts/fragments of the find must be retrieved and returned to the main find site which must be protected from further disturbance.

The ECO or representative must then inform SAHRA immediately and provide:

- A description of the nature of the find.
- Position of the excavation (GPS) and depth.
- Digital images of excavation showing vertical sections (sides) (with scales).
- Detailed images of the finds (with scale included).

SAHRA and an appropriate specialist palaeontologist will assess the information and liaise with the developer, the environmental consultants and the ECO and a suitable response will be established.

Should a prospecting excavation expose a sequence through pan deposits, SAHRA must be informed as it is essential that these beds are sampled for fossil pan organisms present and the beds recorded in detail by a specialist.

8 REFERENCES

Almond, J.E. & Pether, J. 2009. Palaeontological Heritage of the Northern Cape. SAHRA Palaeotechnical Report, Natura Viva cc., Cape Town. 121pp.

De Wit, M.C.J., Ward, J.D., Bamford, M.K. & Roberts, M.J. 2009. The significance of the Cretaceous diamondiferous gravel deposit at Mahura Muthla, Northern Cape Province, South Africa. South African Journal of Geology 112: 89-108.

Horn, R. 2014. Poster: A study of the variation of Rooikoppie gravels of the Middle Orange River, Hay District, Northern Cape. GSSA Kimberley Diamond Symposium, September 2014. Courtesy of Rockwell Diamonds Inc.: http://www.rockwelldiamonds.com/diamonds-2/white-papers-conference-presentations/.

Marshall, T.R. & Norton, G.A. 2015. Technical Report on the Saxendrift alluvial diamond mine (incorporating the Saxendrift, Brakfontein, Kwartelspan and Kransfontein properties), Hay District, Republic of South Africa. For Rockwell Diamonds Inc. Courtesy of Rockwell Diamonds Inc.: http://www.rockwelldiamonds.com/saxendrift-property/.

Matenga, E. 2017 Archaeological and Heritage Services Africa (Pty) Ltd. Phase I Heritage Impact Assessment (Including Palaeontological Assessment) requested in terms of Section 38 of the National Heritage Resources Act (No 25/1999) For the Proposed Mine Prospecting on the Remaining Extent of Portion 1 of the Farm Viegulands Put 42, Prieska District, Northern Cape Province. For Paul Seun Thukgwi.

McCarthy, T.S. 1983. Evidence for the former existence of a major, south flowing river in Griqualand West. Transactions of the Geological Society 86: 37-49.

Milne, E. 2017. Boscia Ecological Consulting - Ecological Assessment Report in application for Environmental Authorisation related to a Prospecting Right Application (Ref: NC 30/5/1/1/2/11639 PR). The Remaining Extent of Portion 1 of the Farm Viegulands Put 42. For Paul Seun Thukgwi.

Partridge, T.C., Botha, G.A. & Haddon, I.G. 2006. Cenozoic deposits of the Interior. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The Geology of South Africa, pp. 585-604. Geological Society of South Africa, Marshalltown.

Visser, J.N.J., Von Brunn, V. & Johnson, M.R. 1990. Dwyka Group. Catalogue of South African Lithostratigraphic Units 2: 15-17. Council for Geoscience, Pretoria.

9 APPENDIX 1. PALAEONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

HIGH: Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

MODERATE: Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

LOW: Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

MARGINAL: Formations that are composed either of volcaniclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcaniclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

NO POTENTIAL: Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.