PALAEONTOLOGICAL ASSESSMENT: DESKTOP STUDY

Proposed diamond prospecting on a Portion of Farm 21 near Pampierstad, Frances Baard District, Northern Cape Province

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March 2021

EXECUTIVE SUMMARY

Vutomi Mining (Pty) Limited is proposing a small-scale diamond prospecting programme on a 1085 ha portion of Farm 21, located approximately 30 km west of Pampierstad / Hartswater in the Frances Baard District Municipality (Dikgatlong Local Municipality) of the Northern Cape Province.

The proposed diamond prospecting activities might compromise *potential* occurrences of (1) well-preserved stromatolites at or near surface within the Precambrian carbonate bedrocks of the Reivilo Formation (Ghaap Group), (2) petrified wood or other fossils within any relict Cretaceous fluvial gravels, or (3) mammalian remains and other fossils within calcretised hardpans and karstic fissure infills. The kimberlite target rocks are generally not fossiliferous (apart from very rare sedimentary xenoliths) while fossil-rich crater lake beds are very unlikely to be preserved in this region due to landscape denudation since Cretaceous times.

The proposed invasive diamond prospecting activities – notably up to five boreholes plus short sectors of temporary access roads - are on a very small scale (footprint *c*. 200 m^2) and the significance of potential impacts on local fossil heritage resources is likely to be minimal. There are no objections on palaeontological heritage grounds to authorization of the prospecting activities.

Given the High to Very High palaeosensitivity of the project area identified on the SAHRIS palaeosensitivity map, it is recommended that - as for the adjoining diamond prospecting areas that have already been authorized by SAHRA - a specialist field-based palaeontological assessment of the project area should be undertaken as part of any subsequent application for a Mining Rights Permit.

No further specialist palaeontological studies or mitigation for the proposed diamond prospecting project are recommended here, pending the potential discovery of scientifically important fossil material before or during the invasive phase. Should substantial fossil remains - such as well-preserved stromatolites, vertebrate bones and teeth, shells or fossil wood - be encountered at surface or exposed during prospecting, the ECO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist, at the developer's expense. A tabulated Chance Fossil Finds Procedure is appended to this report.

1. Project outline and brief

The company Vutomi Mining (Pty) Limited is proposing a diamond prospecting programme on a 1085 ha portion of Farm 21, located just west of the small community of Vallboschhoek. The project area is situated approximately 30 km west of Pampierstad / Hartswater and approximately 120 km northwest of Kimberley in the Frances Baard District Municipality (Dikgatlong Local Municipality) of the Northern Cape Province on the border with Northwest Province (Figs. 1 & 2).

In addition to non-invasive activities (*i.e.* desktop studies and ground geophysical surveys) the prospecting programme will also involve drilling up to 5 boreholes up to 165 mm in diameter with an average depth of 100 m to test for the presence of kimberlite. The location of the proposed drill traverses can only be determined after completion of non-invasive investigations. Minimal surface disturbance will take place and the drilling operation will not create any overburden or fine residue dumps. The prospecting footprint will be ± 200 m² in extent. Rehabilitation will be carried out on a continuous basis under the supervision of an ECO as work progresses and will consist largely of backfilling drill holes with the drill chips and cleaning up of drill sites and tracks used for drilling. Access to the drill sites will be *via* existing farm tracks or, if no tracks are available, *via* 'twee-spoor' tracks made by driving the drilling rig under the supervision of an ECO. Any new "spoors" generated will be rehabilitated directly after drilling by raking.

Given (1) the High to Very High palaeosensitivity mapped for the prospecting project area on the SAHRIS website and (2) the current unpredictability of the borehole sites, a desktop palaeontological impact assessment (PIA) of the proposed prospecting project has been requested by the South African Heritage Resources Agency (SAHRA Case ID: 15922, Interim Comment dated January 29 2021). The present report has accordingly been commissioned on behalf of the proponent as part of an overarching Heritage Impact Assessment undertaken by ASHA (Contact details: Dr Jayson Orton. ASHA Consulting (Pty) Ltd. 40 Brassie Street, Lakeside, 7945. Tel: (021) 788 1025 | 083 272 3225. E-mail: jayson@asha-consulting.co.za).

The proposed diamond prospecting project area lies adjacent to a much larger prospecting project area on Farms Vaalboschfontein 11; Remainder and Portions 1, 2, 3, and 4 of Farm 12; Remainder and Portion 1 of Farm 13; Farm 14; Farm 21 and Remainder and Portion 1 of Kook Fontein 31 in the Dikgatlong Municipal Area in the Northern Cape where prospecting for diamonds (alluvial and kimberlite) has already been approved by SAHRA (SAHRA Case ID: 4417, Final Comment dated January 22, 2014). It appears from their comment, however, that SAHRA was under the serious misapprehension that "the area proposed for prospecting is underlain by Dwyka Group sediments of medium to low palaeontological significance". SAHRA also made their approval subject to the condition that "a new application is made to SAHRA for comment in terms of Section 38(8) of the National Heritage Resources Act (Act 25 of 1999), should a mining right be applied for. As mining activities are generally more intrusive than prospecting activities, this process may require additional heritage studies".

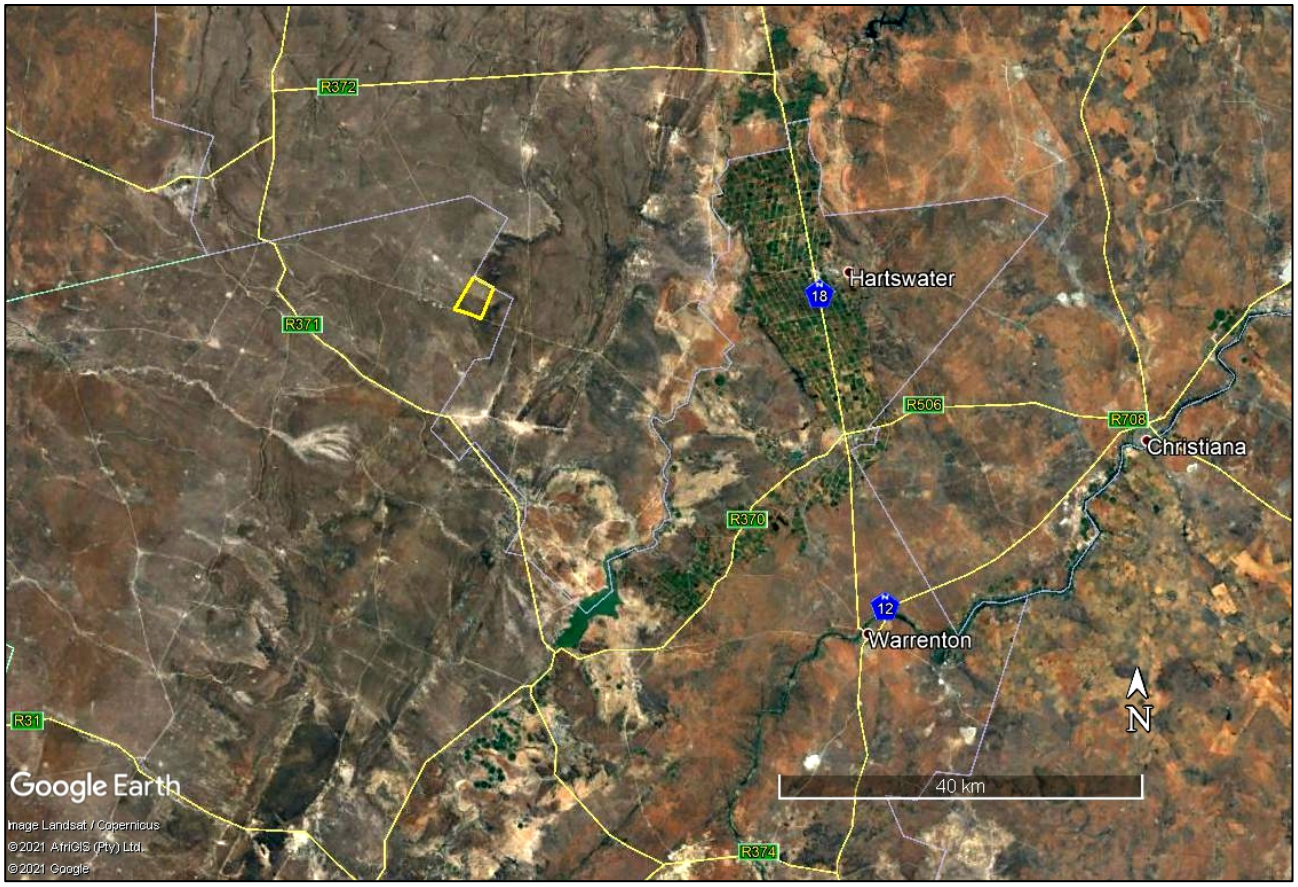

Figure 1: Google Earth© satellite image showing the location of the proposed diamond prospecting project area on a portion of Farm 21 situated approximately 30 km west of Pampierstad / Hartswater and 120 km northwest of Kimberley, Frances Baard District Municipality (Dikgatlong Local Municipality) Northern Cape Province (small yellow polygon).

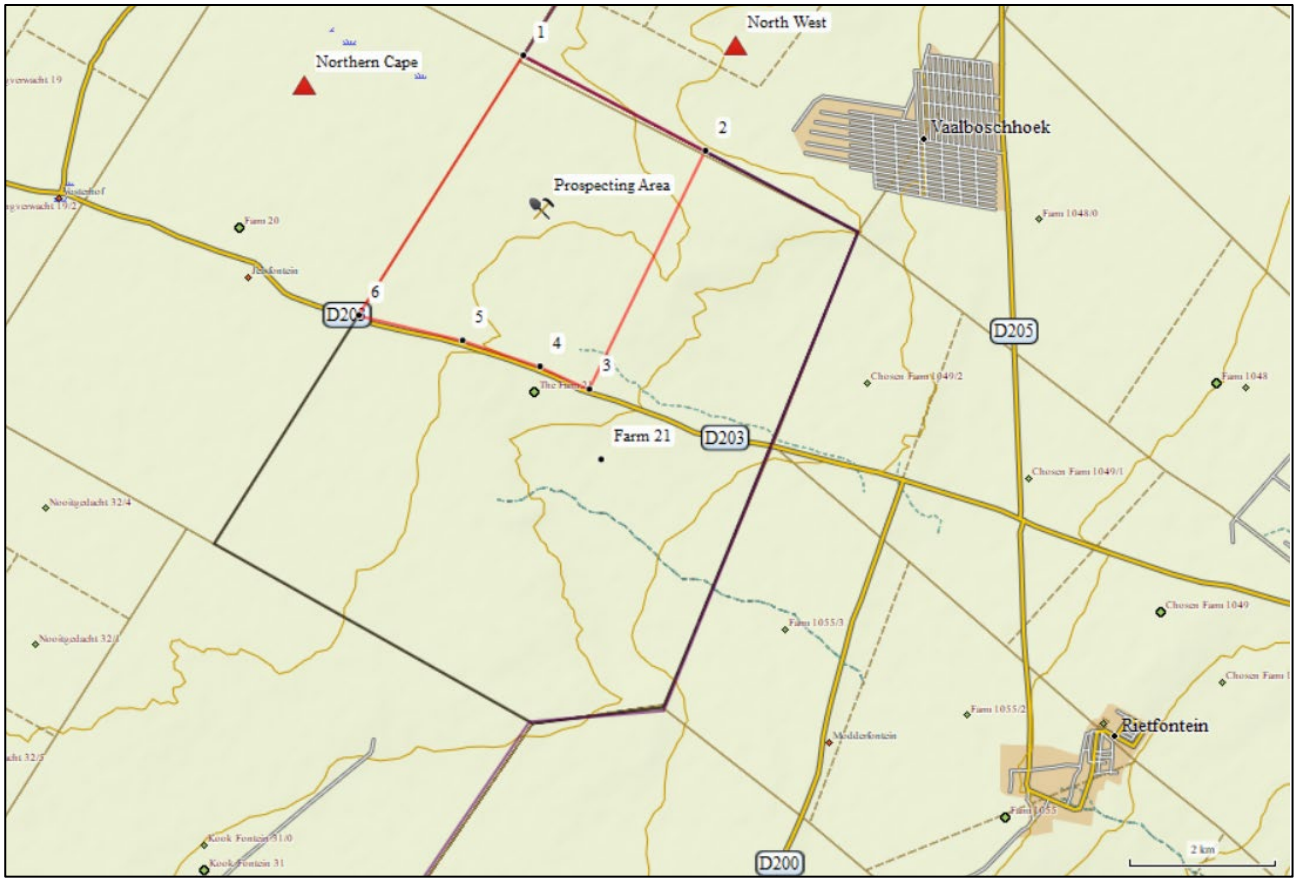

Figure 2: Map showing the location of the proposed diamond prospecting area (orange polygon) on a portion of Farm 21, situated on the northern side of the D203 near the village of Vaalboschhoek, Northern Cape (Image abstracted from the Draft Basic Assessment Report and EMPr by Private Enterprise, dated December 2020).

Figure 3: Satellite image of the prospecting area on a portion of Farm 21 near Vaalboschhoek (Image abstracted from the Draft Basic Assessment Report and EMPr by Private Enterprise, dated December 2020). The area is largely flat-lying with sparse small pans and no major drainage lines but occasional, shallowly incised streams. Narrow, dark (vegetated) linear structures towards the south are mapped as dolerite dykes but may be Cretaceous kimberlite intrusions.

1.1. Information sources

The present desktop palaeontological heritage report is primarily based on the following information sources:

1. A detailed project outline, kmz files, draft Basic Assessment Report and EMPr compiled by Private Enterprise (dated December 2020);
2. A desktop review of (a) the relevant 1:50 000 and 1:250 000 scale topographic maps, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1:250 000 geological maps (2724 Christiana) and relevant sheet explanations (Schutte 1994) as well as (d) several previous fossil heritage (PIA) assessments in the Ghaap Plateau region by the author and palaeontological colleagues (See References);
4. The author's field experience with the formations concerned and their palaeontological heritage (*cf* Almond & Pether 2008 and PIA reports listed in the References).

1.2. Legal context

The proposed prospecting activities are located in areas that are underlain by potentially fossil-rich sedimentary rocks of Precambrian, Cretaceous and younger, Tertiary or Quaternary age (Sections 2 and 3). The invasive phase of prospecting might adversely affect legally-protected, scientifically and culturally valuable palaeontological material preserved at or beneath the ground surface within the study area by damaging, destroying, disturbing fossils that are then no longer available for scientific research or other public good.

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:
(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
(2) All archaeological objects, palaeontological material and meteorites are the property of the State.
(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
(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 in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
(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 procedure 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.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been developed by SAHRA (2013).

1.3. Assumptions and limitations

The accuracy and reliability of palaeontological specialist studies as components of heritage impact assessments are generally limited by the following constraints:

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.
2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant ("mappable") bedrock units as well as major areas of superficial "drift" deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.
3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information;
4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies;
5. Absence of a comprehensive computerized database of fossil collections in major RSA institutions which can be consulted for impact studies. A Karoo fossil vertebrate database is now accessible for impact study work.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:
(a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
(b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

Since most areas of the RSA have not been studied palaeontologically, a palaeontological desktop study usually entails *inferring* the presence of buried fossil heritage within the study area from relevant fossil data collected from similar or the same rock units elsewhere, sometimes at localities far away. Where substantial exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly enhanced through field assessment by a professional palaeontologist.

In the case of the present diamond prospecting project area a major limitation for fossil heritage studies is the often poor exposure of potentially fossiliferous carbonate bedrocks of the Ghaap Group, as well as the paucity of previous field-based specialist palaeontological studies in the Ghaap Plateau region of the Northern Cape.

2. Geological context

The diamond prospecting area on Farm 21 near Vaalboschhoek is situated in semi-arid, flat-lying terrain between 1330-1350 m amsl on the eastern margins of the extensive Ghaap Plateau region of the Northern Cape and Northwest Provinces (Figs. 1 & 3). On satellite images the area shows sparse small pans but no major drainage lines.

The geology of 1: 250 000 sheet area 2724 (Christiana) is briefly covered in the relevant sheet explanation by Schutte (1994) (Fig. 4). A very useful geological review of the proposed diamond prospecting area, abstracted below, is provided in the Draft Basic Assessment report by Private Enterprise (2020):

The area lies on the Kaapvaal craton, on the Eastern edge of the Griqualand West basin, and consists of dolomite, limestone and chert of the Reivilo formation (2567 Ma). These shallow water carbonate deposits form the lower section of the Campbell Rand Subgroup of the Ghaap Group, and are overlain by recent cover of calcrete and sand. Ghaap Group sediments are known to be underlain by lithologies of the Ventersdorp Supergroup. These are known to occur at a depth of approximately 400m from Sedibeng Diamond mine 30 km to the south-east.

Kimberlite intrusions, some of which are diamondiferous, represent the final phase of igneous activity in the region. These were emplaced during the Cretaceous age in several parallel north-northeast and east-west trending structures. Historically, several kimberlite occurrences are known in the area, and number of these have been exploited for diamonds in the past (e.g. the Bobbejaan and Bellsbank fissures on the edge of the Ghaap Plateau 30km to the SW). There have also been various alluvial diamond operations within the vicinity of the exploration area (e.g. Mahura Muthla 40km to the north); however, the calcretised nature of the deposits has made them relatively difficult to mine. The GCS 1:250 000 geological maps report two kimberlites to the east of the exploration area.

The detailed geology and economic potential of the area under application is currently unknown, though the area is perceived to have good potential for hosting economically viable kimberlites due to the proximity of current, or historically producing, hard-rock diamond mines. The regional geology is also conducive to the possibility of alluvial diamonds in paleochannels.

The Bellsbank and Bobbejaan kimberlite deposit occurrences in the vicinity of the prospecting area being applied for are Group II 'fissures' (kimberlite dykes with an average width of 0.5m to 1m) and occasional blows (irregular shaped enlargements on the fissures, often with large amounts of wall rock included with the kimberlite to form a breccia). Fissures are not continuous intrusions, but systems of discrete, disc-like lenses of kimberlite that pinch and swell along the strike (typical lenses are 70-80m in diameter). Where one lens pinches out and disappears, the next is usually located to the side of the first, offset by several meters. The same offset, or en-echelon, pattern between lenses is evident vertically as well as horizontally. This system is often repeated at a larger scale with fissure 'segments' (made up of groups of individual lenses) of hundreds of meters in length being separated by offsets of more than 100m in places. These larger offsets often coincide with major geological features, e.g., discontinuities in host rock lithologies such as faults and unconformities.

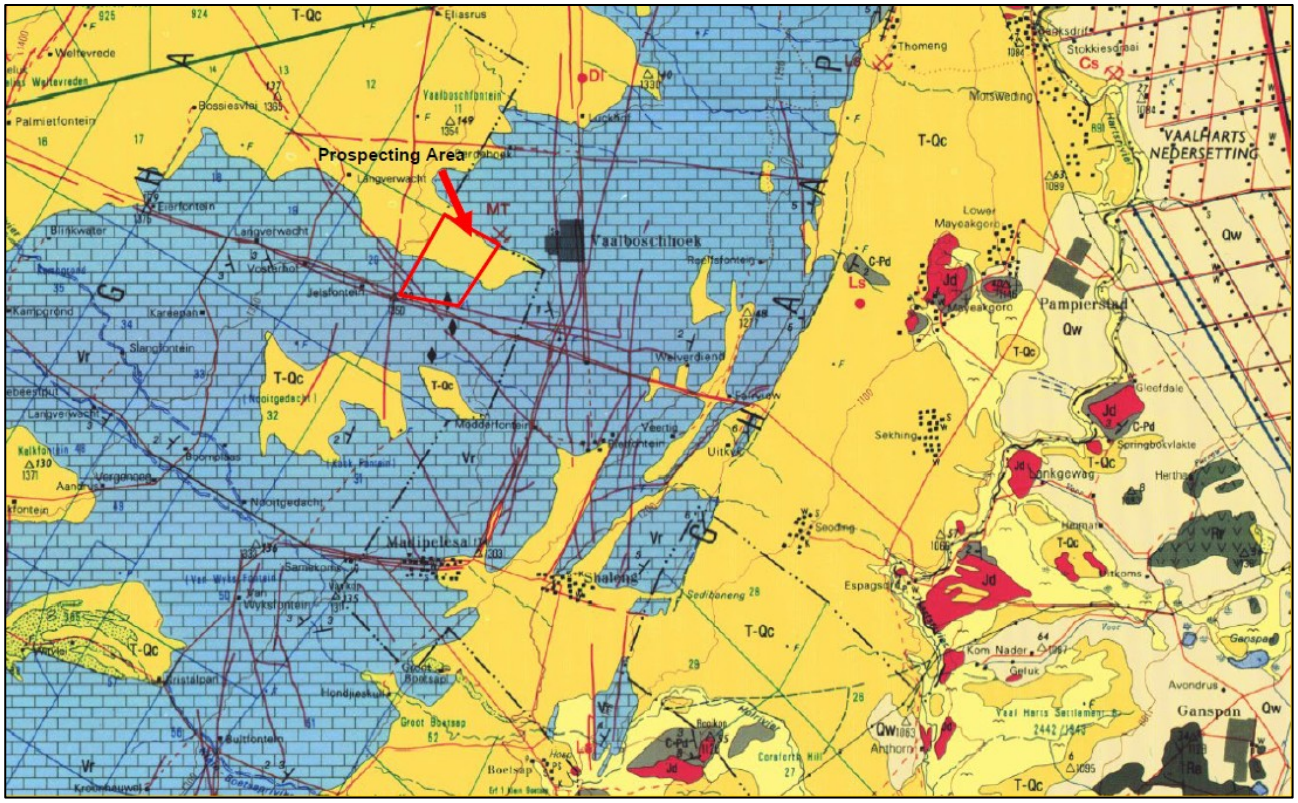

Figure 4: Extract from 1: 250 000 geological map 2724 Christiana (Council for Geoscience. Pretoria) showing the geology of the diamond prospecting area on a portion of Farm 21 (red polygon). The bedrocks here are mapped as Precambrian platform carbonates of the Reivilo Formation (Campbell Rand Subgroup, Ghaap Group, Transvaal Supergroup) (Vr, pale blue) stratigraphically below the BIF-like Kanguru Member. The Precambrian carbonate bedrocks are extensively overlain in the northern sector of the area by Caenozoic calcrete hardpans (T-Qc, yellow). Other unmapped superficial deposits here are likely to include downwasted cherty and calcrete gravels as well as various soils. Potentially diamondiferous, consolidated relict alluvial deposits of Cretaceous age, such as those recorded at Mahura Mutla some 50 km NW of the project area, might also occur here. Small diamond symbols refer to known kimberlite-hosted diamond occurrences of Cretaceous age. Thin red lines with a N-S, NW-SE and NNW-SSE trend are mapped as Jurassic-age dolerite dykes but may be kimberlitic, at least in part.

The **Campbell Rand Subgroup** of the Ghaap Group - previously included within the Ghaapplato Formation in older literature - is a very thick (1.6 - 2.5 km) carbonate platform succession of dolostones, dolomitic limestones and cherts with minor tuffs and siliciclastic rocks. It was deposited on the shallow submerged shelf of the Kaapvaal Craton roughly 2.6 to 2.5 Ga (billion years ago) (See the readable general account by McCarthy & Rubidge 2005). A range of shallow water facies, often forming depositional cycles reflecting sea level changes, are represented here, including stromatolitic limestones and dolostones, oolites, oncolites, laminated calcilutites, cherts and marls, with subordinate siliclastics (shales, siltstones) and minor tuffs (Beukes 1980, Beukes 1986, Sumner 2002, Eriksson *et al.* 2006, Sumner & Beukes 2006). The dolomitic **Reivilo Formation** that is mapped within the present prospecting project area (Vr, pale blue in Fig. 4) is up to 900 m thick and crops out over a large portion of the Ghaap Plateau. In addition to cherty, stromatolitic, oolitic and fenestral facies, a deep water BIF-like package towards the top of tbe Reilvilo succession is recognised as the **Kanguru Member** (Eriksson *et al.* 2006) but this crops out west of the present project area (Fig. 5).

Diamondiferous consolidated **fluvial channel sediments of Cretaceous age** and up to 30 m thick that were incised into the Precambrian carbonate bedrocks have been reported on the Ghaap Plateau near Reivilo by Schutte (1994) and, in more detail, by De Wit *et al.* (2009) – most notably in the Mahura-Mutla palaeochannel situated about 50 km NW of the present study area (Fig. 5). These relict sediments contain clasts of BIF (from the Kanguru Member), agates and petrified wood as well as diamonds from kimberlite pipes in the provenance area. They fine broadly northwards and are thought to have formed within a NW-flowing tributary of the ancient Kalahari River. The ancient river gravels were calcretised in Paleogene (Early Tertiary) times.

Mappable exposures of **calcrete** or **surface limestone** (T-Qc, yellow in Fig. 4) are shown in the northern sector of the project area.. These pedogenic limestone deposits reflect seasonally arid climates in the region over the last five or so million years and are briefly described by Truter *et al.* (1938) as well as Visser (1958), Bosch (1993) and Schutte (1994). The surface limestones may reach thicknesses of over 20 m, but are often much thinner, and are locally conglomeratic with clasts of reworked calcrete as well as exotic pebbles. The limestones may be secondarily silicified and incorporate blocks of the underlying Precambrian carbonate rocks. The older, Pliocene - Pleistocene calcretes in the broader Kalahari region, including sandy limestones and calcretised conglomerates, have been assigned to the **Mokalanen Formation** of the **Kalahari Group** and are possibly related to a globally arid time period between 2.8 and 2.6 million years ago, *i.e.* late Pliocene (Partridge *et al.* 2006). Thick deposits of Pleistocene and older calc-tufa ("*kranskalk*") occur along the margins of the Ghaap Plateau, as at Ulco and Taung, where lime-rich groundwaters reach the ground surface (Bosch 1993).

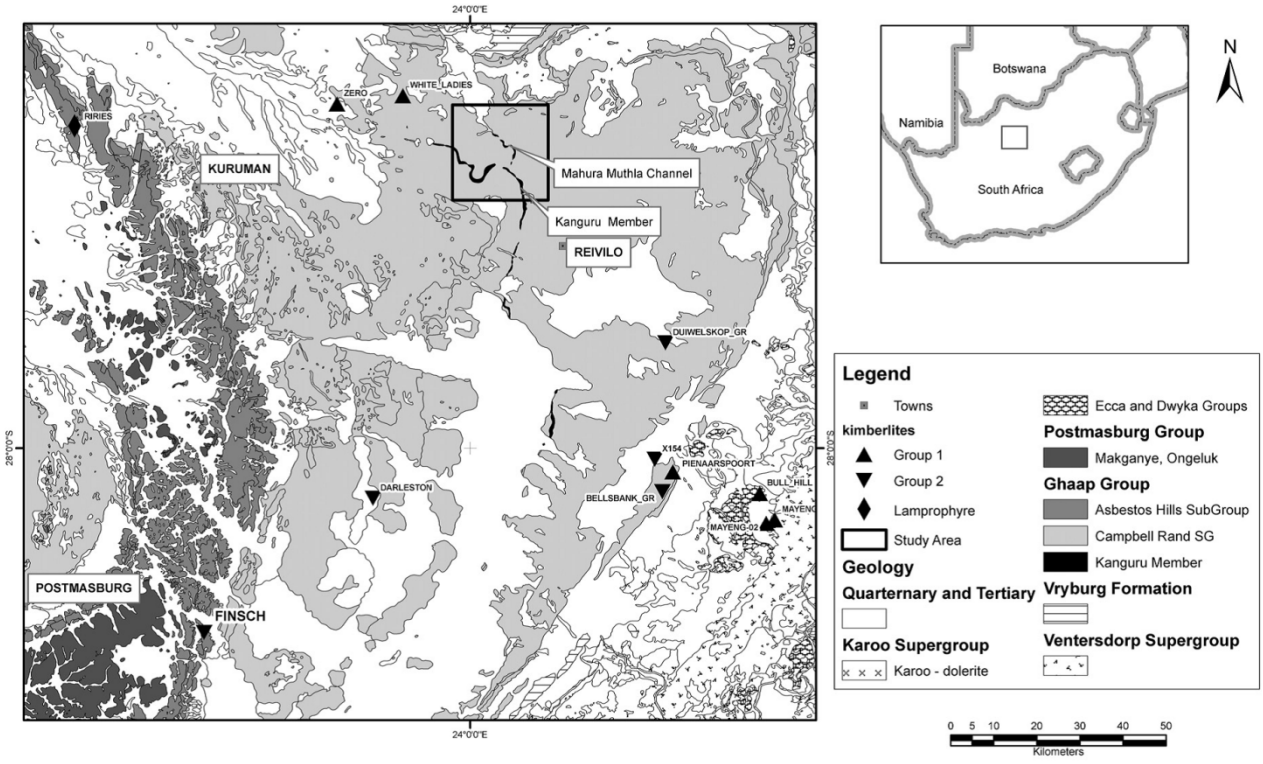

Figure 5: Geological map of the Ghaap Plateau region showing the location of the Cretaceous diamoniferous fluvial gravels near Mahura Mutla, some 50 km NW of the present project area (From De Wit *et al.* 2009). Comparable ancient river gravels might be preserved within the project area as well and would form a important target for diamond prospecting, in addition to intrusive kimberlite bodies.

3. Potential palaeontological issues

Potential palaeontological heritage issues within the diamond prospecting area include stromatolites (fossil microbial bio-sedimentary structures) within the Precambrian carbonate bedrocks, petrified wood within any potentially diamondiferous relict Cretaceous fluvial gravels as well as various fossil groups within older Tertiary – Quaternary calcrete hardpans and karstic fissure infills.

The shallow shelf and intertidal sediments of the carbonate-dominated lower part of the **Ghaap Group** (*i.e.* **Schmidtsdrif** and **Campbell Rand Subgroups**) are well known for their rich fossil biota of *stromatolites* or microbially-generated, finely-laminated sheets, mounds and branching structures. Some stromatolite occurrences on the Ghaap Plateau of the Northern Cape are spectacularly well-preserved (*e.g.* Boetsap locality northeast of Daniëlskuil figured by McCarthy & Rubidge 2005, Eriksson *et al.* 2006). Detailed studies of these 2.6-2.5 Ga carbonate sediments and their stromatolitic biotas have been presented by Young (1932), Beukes (1980, 1986), Eriksson & Truswell (1974), Eriksson & Altermann (1998), Eriksson *et al* (2006), Altermann and Herbig (1991), and Altermann and Wotherspoon (1995). Some of the oldest known (2.6 Ga) fossil microbial assemblages with filaments and coccoids have been recorded from stromatolitic cherty limestones of the Lime Acres Member, Kogelbeen Formation at Lime Acres (Altermann & Schopf 1995). The oldest, Archaean stromatolite occurrences from the Ghaap Group have been reviewed by Schopf (2006, with full references therein). The Tsineng Formation at the top of the Campbell Rand carbonate succession has yielded both stromatolites (previously assigned to the Tsineng Member of the Gamohaan Formation) as well as filamentous microfossils named *Siphonophycus* (Klein *et al.*1987, Altermann & Schopf 1995).

The **Reivilo Formation** is characterised by chocolate-brown, manganese-rich “giant stromatolites” as well as horizons of columnar stromatolites and fenestral fabrics (some possibly evaporitic in origin) (Beukes 1980, Schutte 1994, Eriksson *et al.* 2006). Large-scale elongate stromatolites (2-10 m wide x 5 m to > 45 m long) are well-seen at the famous Boetsap locality on the eastern edge of the Ghaap Plateau, *c*. 23 km SE of the present project area, and interpreted as being shallow subtidal in origin (Sumner 2002).

The Cretaceous **kimberlite** target rocks are not fossiliferous in themselves – apart from very rare fossil-bearing sedimentary xenoliths - since they are of intrusive igneous origin. Fossiliferous crater lake sediments originally associated with Cretaceous kimberlite volcanoes in the subcontinental interior (*cf* Orapa in Botswana) have not been preserved on the Ghaap Plateau due to subsequent landscape denudation. However, the somewhat later **Cretaceous fluvial gravel deposits** preserved in bedrock-incised channels at Mahura Mutla, and possibly elsewhere, have yielded an important palaeoflora, including a surprising range of petrified (silicified) woods of Post-Permian (Upper Karoo), Early Cretaceous, Late Cretaceous and Tertiary age, as described in detail by Bamford in De Wit *et al.* (2009) (*cf* Fig. 5).

Late Caenozoic superficial deposits overlying the Precambrian carbonates within the study area are likely to be largely or entirely unfossiliferous. Thick calcretes might contain trace fossils such as rhizoliths, termite and other insect burrows, ostrich egg shells or even mammalian trackways. Mammalian bones, teeth and horn cores (also tortoise remains, and fish, amphibian or even crocodiles in wetter depositional settings such as pans) may be occasionally expected within Kalahari Group sediments and calcretes, notably those associated with ancient, Plio-Pleistocene alluvial gravels. Calcretised sedimentary fissure infills within karstified dolomite and limestone bedrocks may contain rich assemblages of microvertebrate remains (*e.g.* micromammal bones,

teeth) while Plio-Pleistocene calc-tufa and karstic cave deposits occasionally host important mammalian remains, such as those recorded along the edge of the Ghaap Plateau at Taung (*cf* McKee 1994, MacRae 1999).

4. Conclusions and recommendations

The proposed diamond prospecting activities on a portion of Farm 21 near Pampierstad in the Frances Baard District of the Northern Cape might compromise *potential* occurrences of (1) well-preserved stromatolites at or near surface within the Precambrian carbonate bedrocks of the Reivilo Formation (Ghaap Group), (2) petrified wood or other fossils within any relict Cretaceous fluvial gravels, or (3) mammalian remains and other fossils within calcretised hardpans and karstic fissure infills. The kimberlite target rocks are generally not fossiliferous (apart from very rare sedimentary xenoliths) while fossil-rich crater lake beds are very unlikely to be preserved in this region due to landscape denudation since Cretaceous times.

The proposed invasive diamond prospecting activities – notably up to five boreholes plus short sectors of temporary access roads - are on a very small scale (footprint *c*. 200 m^2) and the significance of potential impacts on local fossil heritage resources is likely to be minimal. There are no objections on palaeontological heritage grounds to authorization of the prospecting activities.

Given the High to Very High palaeosensitivity of the project area identified on the SAHRIS palaeosensitivity map, it is recommended that - as for the adjoining diamond prospecting areas that have already been authorized by SAHRA - a specialist field-based palaeontological assessment of the project area should be undertaken as part of any subsequent application for a Mining Rights Permit here.

No further specialist palaeontological studies or mitigation for the proposed diamond prospecting project are recommended here, pending the potential discovery of scientifically important fossil material before or during the invasive phase. Should substantial fossil remains - such as well-preserved stromatolites, vertebrate bones and teeth, shells or fossil wood - be encountered at surface or exposed during prospecting, the ECO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency (Contact details: Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). This is to ensure that appropriate action (*i.e.* recording, sampling or collection of fossils, recording of relevant geological data) can be taken by a professional palaeontologist, at the developer's expense. A tabulated Chance Fossil Finds Procedure is appended to this report.

5. Key references

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6. Acknowledgements

Dr Jayson Orton of ASHA, Lakeside, Cape Town is thanked for commissioning this study and for providing the necessary background information.

7. Qualifications & experience of the author

Dr John Almond has an Honours Degree in Natural Sciences (Zoology) as well as a PhD in Palaeontology from the University of Cambridge, UK. He has been awarded post-doctoral research fellowships at Cambridge University and in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa. For eight years he was a scientific officer (palaeontologist) for the Geological Survey / Council for Geoscience in the RSA. His current palaeontological research focuses on fossil record of the Precambrian - Cambrian boundary and the Cape Supergroup of South Africa. He has recently written palaeontological reviews for several 1: 250 000 geological maps published by the Council for Geoscience and has contributed educational material on fossils and evolution for new school textbooks in the RSA.

Since 2002 Dr Almond has also carried out palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mupumalanga, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a long-standing member of the Archaeology, Palaeontology and Meteorites Committee for Heritage Western Cape (HWC) and an advisor on palaeontological conservation and management issues for the Palaeontological Society of South

Africa (PSSA), HWC and SAHRA. He is currently compiling technical reports on the provincial palaeontological heritage of Western, Northern and Eastern Cape for SAHRA and HWC. Dr Almond is an accredited member of PSSA and APHP (Association of Professional Heritage Practitioners – Western Cape).

Declaration of Independence

I, John E. Almond, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, 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.

Dr John E. Almond
Palaeontologist
(*Natura Viva* cc)

<table>
<tr><th colspan="3">APPENDIX: CHANCE FOSSIL FINDS PROCEDURE: Diamond prospecting on Farm 21 near Pampierstad, Northern Cape</th></tr>
<tr><td>Province & region:</td><td colspan="2">NORTHERN CAPE: Frances Baard District Municipality (Dikgatlong Local Municipality)</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Phone: +27 (0)21 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za).</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Campbell Rand Subgroup (Ghaap Group) carbonate bedrocks, possible Cretaceous fluvial gravels, Cretaceous kimberlite intrusions, Late Caenozoic calcretes, other superficial sediments.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Well-preserved stromatolites within Precambrian carbonate bedrocks. Petrified wood and other fossil remains within Cretaceous fluvial gravels. Mammalian remains (bones, teeth, horncores), calcretised trace fossils etc within calcrete hardpans and karstic fissure infills.</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>