**PALAEONTOLOGICAL HERITAGE ASSESSMENT: SITE SENSITIVITY REPORT & LETTER OF EXEMPTION FROM FURTHER SPECIALIST STUDIES**

# Proposed Kokerboom 3 and Kokerboom 4 Wind Farms near Loeriesfontein, Namaqua District Municipality, Northern Cape

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## EXECUTIVE SUMMARY

It is proposed to develop two separate wind energy facilities (WEFs) in an area of Bushmanland situated some 60 km north of Loeriesfontein in the Namaqua District Municipality (Hantam Local Municipality) of the Northern Cape Province. An amended version of the authorised Kokerboom 3 Wind Farm, with maximum output of 300 MW generated by *c*. 60 turbines, will be located on Farms 2/214 and 1/214. The adjoining new Kokerboom 4 Wind Farm, with a maximum output of 40 MW generated by *c*. 8 turbines, will be located on Farm RE/213. The present palaeontological heritage comment (Site Sensitivity Report and Letter of Exemption from Further Specialist Studies) is based on a 5-day field assessment on the combined WEF project area as well as desktop analysis, including several previous palaeontological assessment studies in the vicinity by the author and others.

The combined Kokerboom 3 and Kokerboom 4 Wind Farm project area is underlain by several formations of potentially fossiliferous Late Palaeozoic sediments of the Ecca Group (Karoo Supergroup) that are extensively intruded by unfossiliferous igneous rocks of the Early Jurassic Karoo Dolerite Suite. The Ecca Group rocks (Prince Albert, Whitehill and Tierberg Formations) are very poorly-exposed and deeply-weathered near-surface. They have also been locally baked (thermally metamorphosed) by nearby dolerite intrusions and occasionally secondarily mineralised. The only fossils recorded within these rocks comprise low-diversity trace fossil assemblages that occur widely within the Loeriesfontein region and are therefore not of unique scientific interest. No fossil vertebrate or plant remains were recorded during the field assessments.

The Karoo dolerites that crop out over portions of the Kokerboom 3 Wind Farm study area are also poorly-exposed, deeply-weathered for the most part and, in addition, do not contain fossils. Several unmapped, small-scale occurrences of Karoo-age or post-Karoo breccia pipes and igneous intrusions were encountered during fieldwork. Some of the associated sandy sediments contain simple invertebrate trace fossils of uncertain age and stratigraphic position (but probably within the Prince Albert Formation). Similar traces have previously been recorded from similar settings elsewhere within the Loeriesfontein region; they are not considered to be of great scientific significance.

None of the wide range of Late Caenozoic superficial deposits examined during fieldwork (*e.g.* alluvium, colluvium, surface gravels, calcretes, stream and pan sediments, sandy soils) appear to be highly fossiliferous. Important mammalian remains are known from pan and river sediments elsewhere in Bushmanland, but they are rare and their occurrence is unpredictable.

Outcrop areas of Ecca bedrocks within the combined WEF project area have been provisionally assigned a High to Very High sensitivity on the DEA screening tool maps as well as the SAHRIS palaeosensitivity map. However, on the basis of the considerable quantity of site-specific desktop and field-based palaeontological heritage data available, it is concluded that the bedrocks as well as the superficial sediments underlying the Kokerboom 3 and Kokerboom 4 Wind Farm study areas are generally of **LOW to VERY LOW palaeontological sensitivity**, mainly due to high

levels of near-surface weathering in the region. The slight possibility remains that small, localized areas of High to Very High palaeosensitivity (*e.g.* Quaternary mammal fossils within older alluvial deposits) occur within the area but these are inherently unpredictable.

The construction phase of the two proposed wind farms is likely to have a **Very Low to Low impact significance** in terms of local palaeontological heritage resources (No significant further impacts are anticipated in the operational and decommissioning phases). No high-sensitivity **No-Go areas** have been identified within the combined project area of the wind farms.

Anticipated **cumulative impacts** of all the two WEF developments in the context of other renewable energy projects in the region are inferred to be LOW.

**There is no objection on palaeontological heritage grounds to authorization of the proposed (revised) Kokerboom 3 and (new) Kokerboom 4 Wind Farms.**

- **Recommendations for monitoring and mitigation**

Given the general low palaeosensitivity of the project area as well as the anticipated low to very low impact significance of the proposed wind farm developments, **no further specialist palaeontological studies, monitoring or mitigation are recommended for these two projects**, *pending* the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, horn cores, petrified wood) before or during the construction phase. A Chance Fossil Finds protocol has been appended to this report which must be included in the EMPr.

Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the ECO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency, SAHRA, as soon as possible (Contact details: Dr Ragna Redelstorff. Heritage Officer Archaeology, Palaeontology & Meteorites Unit, SAHRA. 111 Harrington Street, Cape Town, 8001. Tel: +27 (0)21 202 8651. Fax: +27 (0)21 202 4509 E-mail:rredelstorff@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 proponent's expense.

**These monitoring and mitigation recommendations are summarized in the Appendix to this report should be incorporated into the Environmental Management Programme (EMPr) for the Kokerboom 3 and Kokerboom 4 Wind Farms**.

## 1. PROJECT OUTLINE

It is proposed to construct two wind energy facilities (WEFs), the Kokerboom 3 Wind Farm and the Kokerboom 4 Wind Farm, on a site situated some 60 km to the north of Loeriesfontein in the Namakwa District Municipality and Hantam Local Municipality, Northern Cape (Figs. 1 & 2). The following land parcels are involved in combined Kokerboom 3 and Kokerboom 4 Wind Farm project areas (Figs. 1 & 2):

- Aan De Karree Doorn Pan Remainder of Farm 213 (Kokerboom 4)
- Karree Doorn Pan Portion 1 of Farm 214 (Kokerboom 3)
- Karree Doorn Pan Portion 2 of Farm 214 (Kokerboom 3)

The Kokerboom 3 Wind Farm is currently authorized as a 240 MW wind farm with 60 turbines (150 m hub height, 150 m rotor diameter) distributed over three land parcels (2/214, 1/214 and RE/213) It has subsequently been proposed that the authorized Kokerboom 3 Wind Farm be split into two separate projects, namely an amended Kokerboom 3 Wind Farm and a new Kokerboom 4 Wind Farm, to be located on the same three land parcels.

A combined desktop and field-based palaeontological heritage assessment of the authorized Kokerboom 3 Wind Farm has been presented by Almond (2017a). Fieldwork focused primarily on the southern portion of the land parcels where the majority of the WEF infrastructure was to be sited. The northern portions of these land parcels were subsequently surveyed by the author *plus* an experienced field assistant on 21-22 February 2020 so as to cover the entire potential project area for the combined revised Kokerboom 3 Wind Farm as well as the new Kokerboom 4 Wind Farm (Orange polygon in Figure 2).

The present palaeontological heritage report will contribute to the consolidated Heritage Impact Assessment for the revised Kokerboom 3 Wind Farm and for the new Kokerboom 4 Wind Farm. It forms part of the Environmental Impact Assessment (EIA) processes for these wind farms that are being conducted by Zutari (previously Aurecon South Africa (Pty) Ltd) (Contact details: Ms Corlie Steyn. Address: Zutari, Aurecon Centre, 1 Century City Drive, Waterford Precinct, Century City, South Africa 7441. Mobile: +27 82 5757415. E-mail:corlie.steyn@zutari.com).

- **Information sources**

This report is based on (1) a review of the relevant scientific literature, including previous palaeontological impact assessments in the Loeriesfontein area (*e.g.* Almond 2008c, 2011a, 2011b, 2014b, 2014c, 2017a, 2017b, Pether 2012, Millsteed 2014, Groenewald 2014 and Butler 2016), (2) published geological maps and accompanying sheet explanations, (3) a combined five-day field study by the author and a field assistant in the broader Kokerboom WEF study area north of Loeriesfontein (23-25 June 2016, 21-22 February 2020) as well as (4) the author's extensive field experience with the formations concerned and their palaeontological heritage (*e.g.* Almond *in* Macey *et al.* 2011).

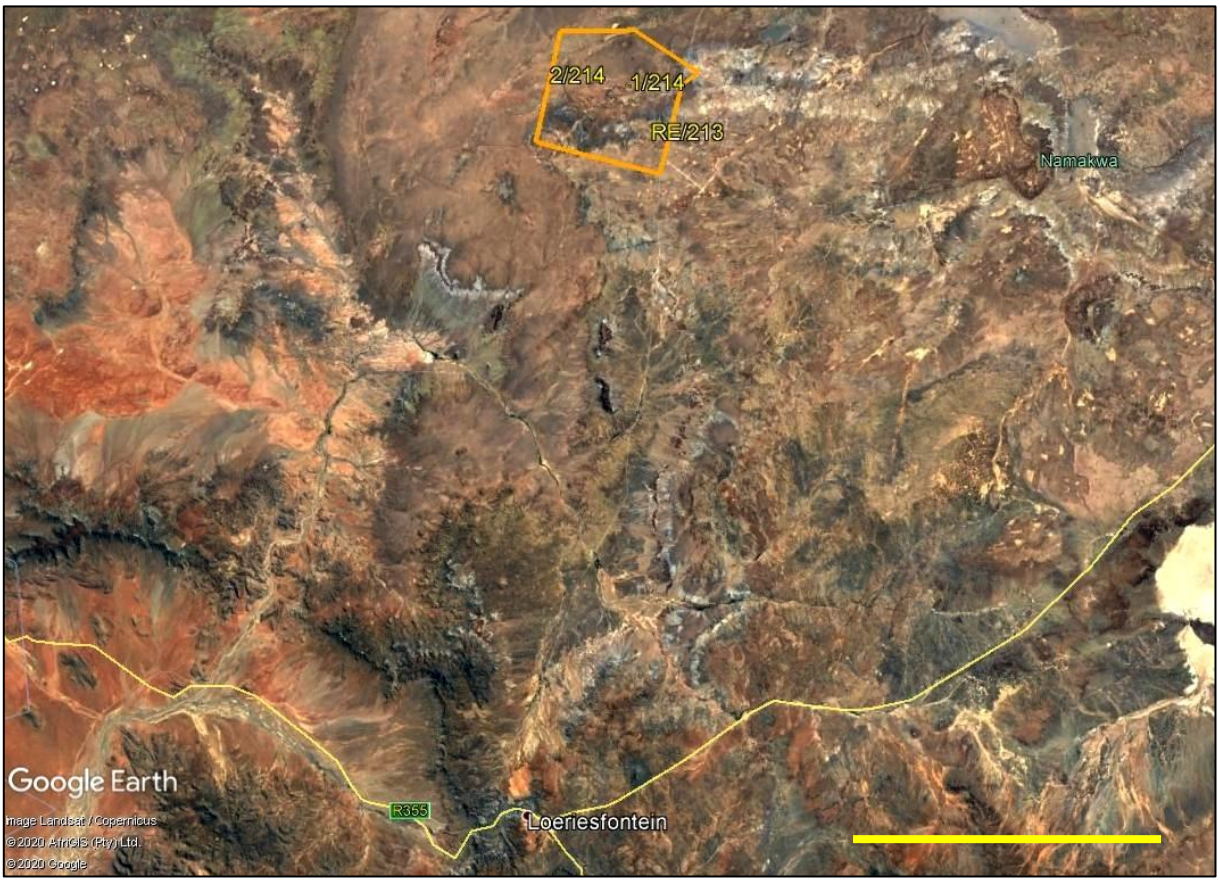


**Figure 1: Google Earth© satellite image showing the location of combined project area (orange polygon) for the Kokerboom 3 WEF and Kokerboom 4 WEF situated some 60 km to the north of Loeriesfontein, Namakwa District Municipality and Hantam Local Municipality, Northern Cape. Scale bar = 30 km. N towards the top of the image.**


**Figure 2: Google Earth© satellite image showing the three land parcels concerned with the project area for the Kokerboom 3 and Kokerboom 4 WEFs. Scale bar = 7 km. N towards the top of the image.**

## 2. GEOLOGICAL CONTEXT

The broader study area for the Kokerboom 3 and Kokerboom 4 Wind farms, situated *c*. 60 km north of Loeriesfontein, lies within semi-arid, gently undulating terrain at elevations between *c*. 900 and 1000 m amsl on the southern borders of the Bushmanland region (Figs. 1 & 2). The prominent, dolerite-capped hills of Groot Rooiberg, Klein Rooiberg and Leeuberg to the south reach elevations of *c*. 880-1000 m amsl. The Sishen-Saldanha railway runs to the southeast and the Loeriesfontein – Granaatboskolk - Pofadder dust road traverses the eastern margins of the area. The northern portion of the combined Kokerboom 3 & Kokerboom 4 project area is drained by several ephemeral streams that flow into small pans within or outside its margins (*e.g.* Kareedoringpan).

The Kokerboom WEF study area is characterised by gently-undulating terrain with low hills, few rocky *kranzes* (ridges or scarps), shallow, usually dry water courses and extensive gravelly *vlaktes* (plains) (Almond 2017a). The landscape is mantled in low karroid *bossieveld* with few, small trees along water courses and in rocky areas. In general levels of bedrock exposure are very low indeed due to the pervasive cover by superficial sediments (alluvium, colluvium, surface gravels, pedocretes *etc*); it is mainly limited to sporadic small dolerite *koppies*, stream beds, low scarps, erosion gullies as well as the margins of pans and dams. Several borrow pits, mainly situated along the Loeriesfontein – Pofadder dust road, provide important additional windows into the subsurface geology.

The Loeriesfontein region lies towards the north-western edge of the Main Karoo Basin of South Africa (Johnson *et al.* 2006). The geology of the Kokerboom WEF study area is shown on 1: 250 000 geology sheet 3018 Loeriesfontein (Macey *et al.* 2011) (Fig. 3) and has been described and illustrated by Almond (2017a; see references therein). The sedimentary bedrock successions involved are predominantly basinal mudrocks assigned to the Early to Middle Permian **Ecca Group** (**Karoo Supergroup**). They become broadly younger towards the east, although this pattern is largely obscured by much later, extensive dolerite intrusions. The three Ecca Group subunits represented in the study area include (1) dark mudrocks and fine-grained sandstones of the **Prince Albert Formation** (Ppr); (2) white-weathering carbonaceous mudrocks of the **Whitehill Formation** (Pw) followed by grey-green mudrocks and wackes (impure sandstones) of the **Tierberg Formation** (Pt). Early Jurassic sills of the **Karoo Dolerite Suite** (Jd) intrude the Ecca Group country rocks over large areas, especially in the centre of the project area. In addition, several **breccia pipes** associated with Karoo dolerite intrusion occur within the area, but are unmapped. Swarms of such intrusive pipes are well known from the Karoo region north of Loeriesfontein where they are especially abundant in the Prince Albert Formation outcrop area but also pierce through the overlying Whitehill rocks (*cf.* Macey *et al.* 2011, Almond 2014c). A range of Late Caenozoic superficial sediments - mostly unconsolidated and probably of Quaternary to Recent age – represented within the study area include alluvial and pan deposits, pedocretes (*e.g.* calcrete), surface gravels (including doleritic rubble) and various sandy to gravelly soils.

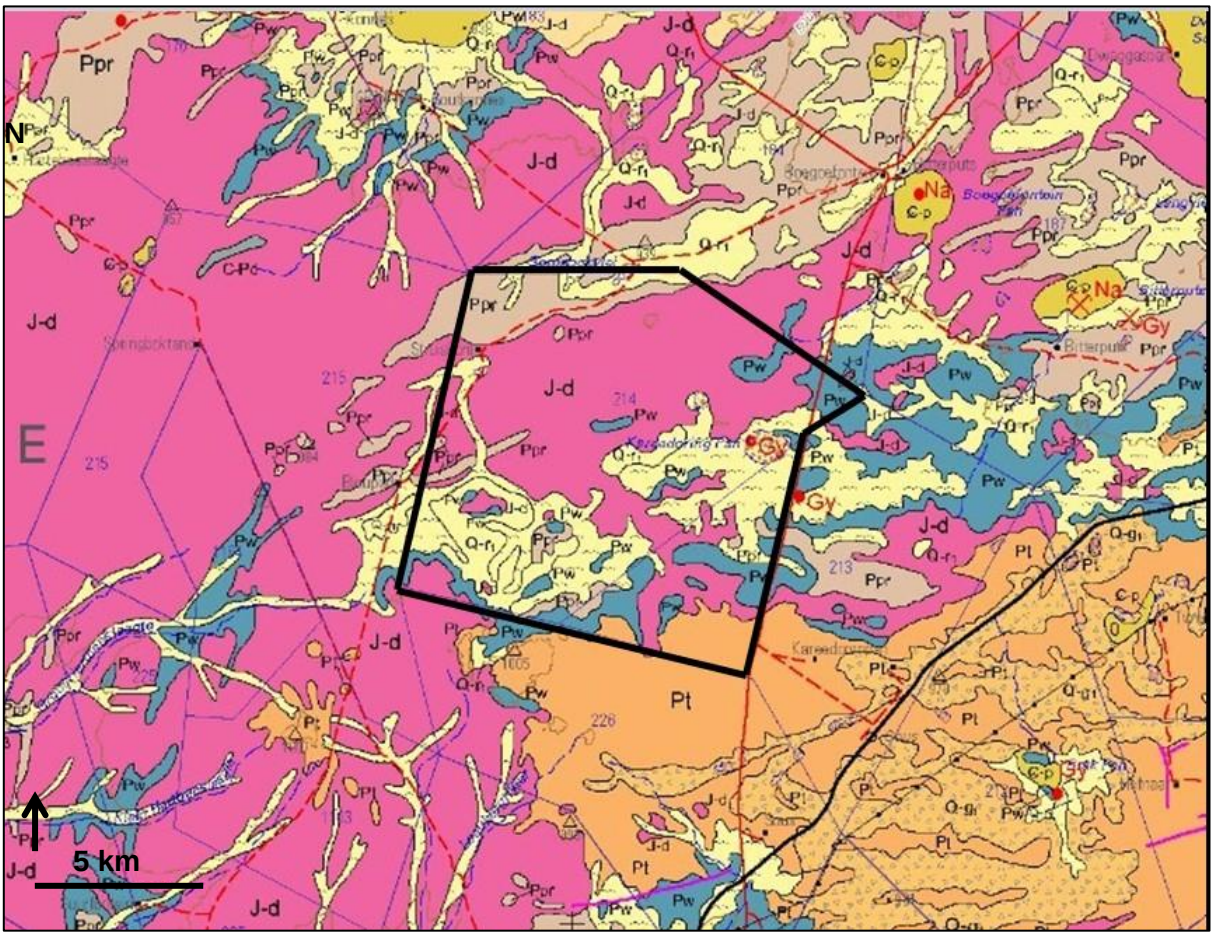


**Figure 3: Extract from 1: 250 000 geology sheet 3018 Loeriesfontein (Council for Geoscience, Pretoria) showing the rock units underlying the land parcels forming the combined project area for the Kokerboom 3 Wind Farm and Kokerboom 4 Wind Farm (black polygon), situated *c*. 60 km north of Loeriesfontein, Northern Cape. The main rock units represented within the project area are:**

**1. KAROO SUPERGROUP (ECCA GROUP)**
**Prince Albert Formation (Ppr, buff)**
**Whitehill Formation (Pw, blue)**
**Tierberg Formation (Pt, orange)**

**2. KAROO DOLERITE SUITE**
**Dolerite sills and dykes (J-d, pink)**

**3. LATE CAENOZOIC SUPERFICIAL SEDIMENTS**
**Stream and river alluvium (pale yellow with flying bird symbol), sandy soils (Q-r1, pale yellow), dolerite rubble (Q-g1, pale orange with triangle symbols), unmapped scree deposits, various surface gravels, pan sediments (red dotted areas; Gy = gypsum deposits).**

## 3. PALAEONTOLOGICAL HERITAGE & SITE SENSITIVITY

The palaeontological heritage that has been recorded elsewhere within the sedimentary rock units mapped within the combined Kokerboom 3 and Kokerboom 4 Wind Farm project area has been outlined, with extensive references, by Almond (2017a; see also Almond 2014c). A summary of the fossil record of the Ecca Group bedrock formations represented here is given in Table 1 below (data abstracted from Almond & Pether 2008).

Palaeosensitivity maps for the Kokerboom 3 Wind Farm and Kokerboom 4 Wind Farm project areas, using the DEA screening tool, have been provided by Zutari (Figs. 4 and 5). These maps, which are probably based on the 1: 1 000 000 geological maps, indicate a High Sensitivity for areas underlain by Ecca Group bedrocks and a Medium Sensitivity for the remainder (including unfossiliferous dolerite).

A more sophisticated mapping of local palaeosensitivity in the project area is provided by the SAHRIS palaeosensitivity map which is based on 1: 250 000 scale geological maps (Fig. 6). This highlights the Ecca Group sedimentary bedrocks as High to Very High Sensitivity while Late Caenozoic superficial deposits are assigned a Low to Medium Sensitivity and Karoo dolerite a Zero Sensitivity.

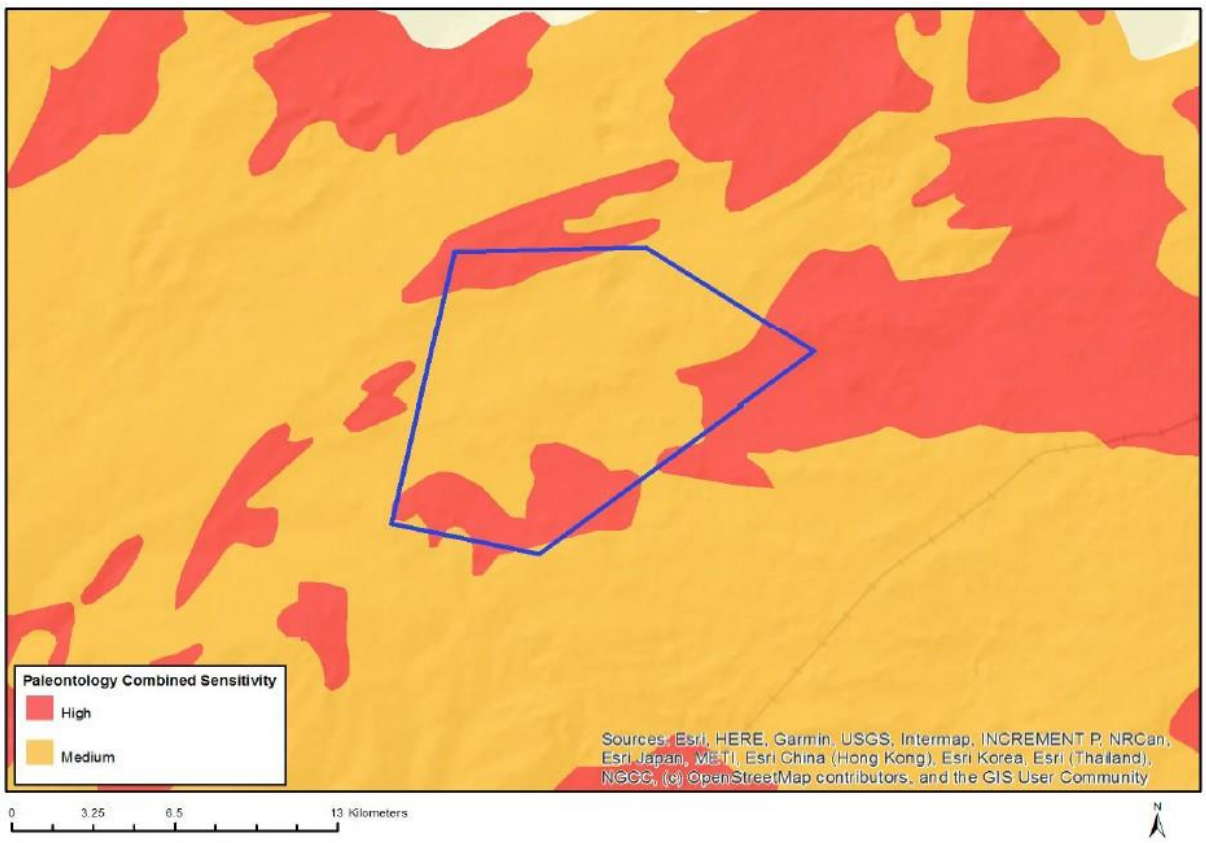


**Figure 4: Provisional palaeosensitivity of the Kokerboom 3 Wind Farm project area based on the DEA screening tool (Map supplied by Zutari).**

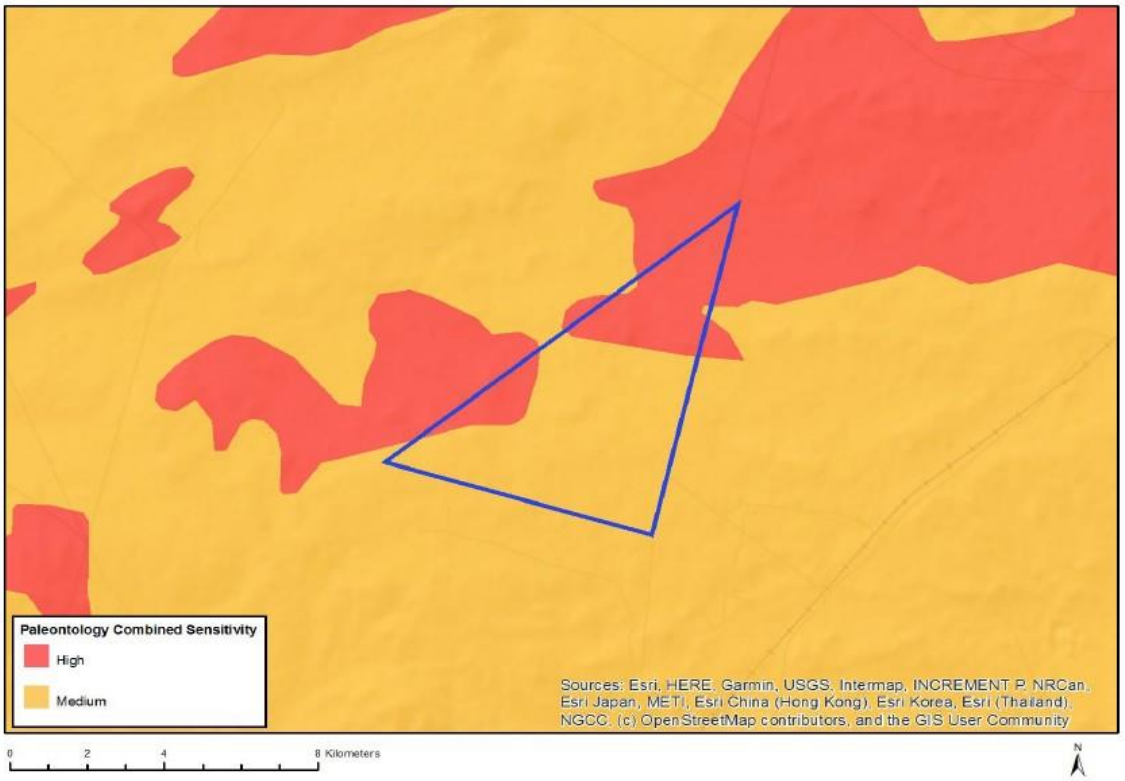


**Figure 5: Provisional palaeosensitivity of the Kokerboom 4 Wind Farm project area based on the DEA screening tool (Map supplied by Zutari).**

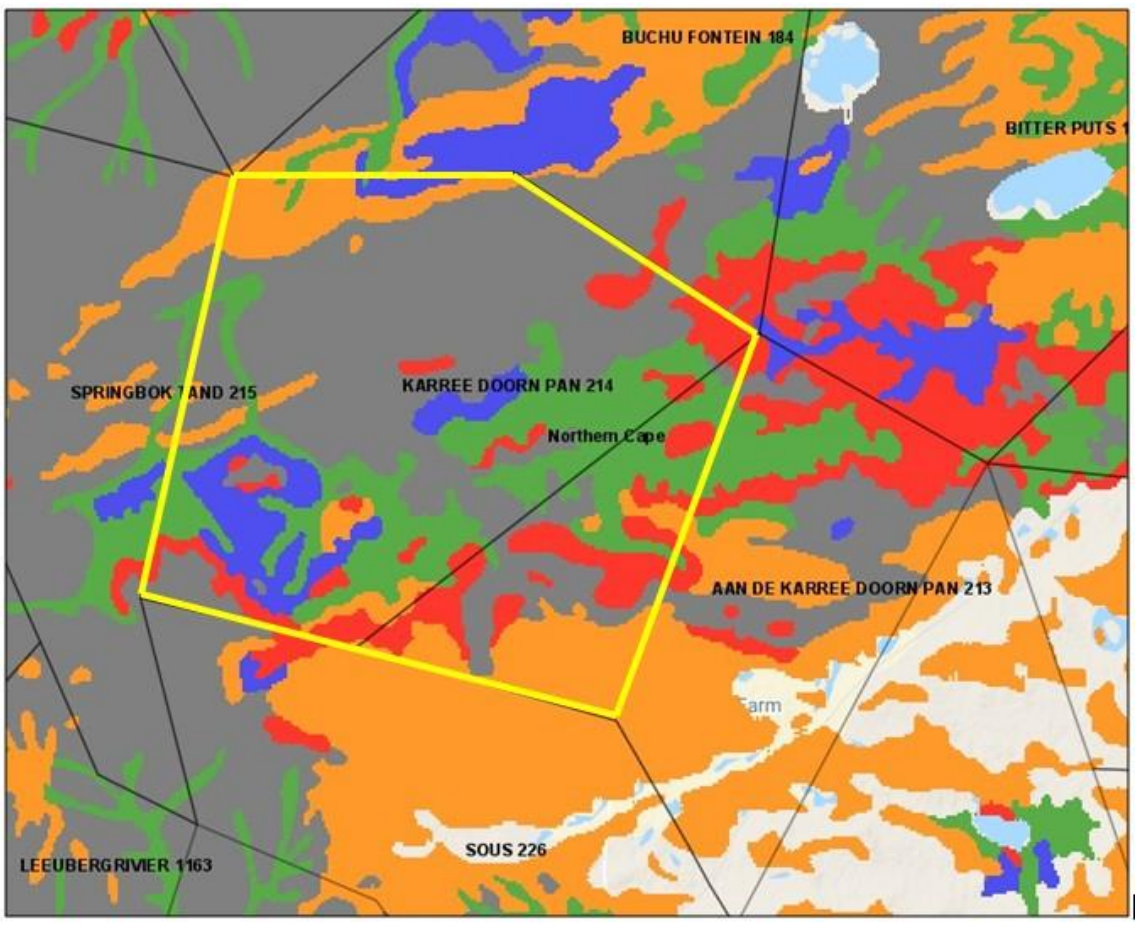


**Figure 6: Palaeosensitivity map of the combined Kokerboom 3 and Kokerboom 4 Wind Farm project areas (yellow polygon) as shown on the SAHRIS website (based on 1: 250 000 geological maps). The key to the colour coding is provided below. Ecca Group bedrocks are assigned a High (orange) to Very High (red) palaeosensitivity here.**

| Colour | Sensitivity | Required Action |
|---|---|---|
| RED | VERY HIGH | field assessment and protocol for finds is required |
| ORANGE/YELLOW | HIGH | desktop study is required and based on the outcome of the desktop study, a field assessment is likely |
| GREEN | MODERATE | desktop study is required |
| BLUE | LOW | no palaeontological studies are required however a protocol for finds is required |
| GREY | INSIGNIFICANT/ZERO | no palaeontological studies are required |
| WHITE/CLEAR | UNKNOWN | these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map. |

On the basis of desktop studies (*e.g.* Almond & Pether 2008) as well as several previous palaeontological surveys within the broader study region by the author (See References, especially Almond 2014c, 2017a) and other palaeontologists such as Pether (2012), Millsteed (2014), Groenewald (2014) and Butler (2016), including the recent 2-day survey of the combined Kokerboom 3 and Kokerboom 4 Wind Farm project area by the author, the following conclusions have been drawn:

- The Ecca Group rocks (**Prince Albert, Whitehill** and **Tierberg Formations**) are generally very poorly-exposed and deeply-weathered near-surface. They have also been locally baked (thermally metamorphosed) by dolerite intrusions and occasionally secondarily mineralised. The only fossils recorded here within these rocks comprise low-diversity trace fossil assemblages that occur widely within the Loeriesfontein region and therefore not of unique scientific importance. No scientifically important vertebrate or plant remains were recorded during the field assessment.

- The **Karoo dolerites** that crop out over the majority of the Kokerboom Wind Farm study area are also poorly-exposed, deeply-weathered for the most part and, in addition, do not contain fossils.

- Several unmapped, small-scale occurrences of Karoo and / or post-Karoo **breccia pipes** and **igneous intrusions** were encountered during fieldwork. Some of the associated sandy sediments contain simple invertebrate trace fossils of uncertain age and stratigraphic position (*N.B.* possibly within deformed Prince Albert Formation country rocks). Similar traces have previously been recorded from similar settings elsewhere within the Loeriesfontein region; they are not considered to be of great scientific significance.

- None of the wide range of **Late Caenozoic superficial deposits** examined during fieldwork (*e.g.* alluvium, colluvium, surface gravels, calcretes, stream and pan sediments, sandy soils) appears to be highly fossiliferous. Important mammalian remains are known from pan and river sediments elsewhere in Bushmanland, but they are rare and their occurrence is highly unpredictable.

**It is concluded that the bedrocks as well as the superficial sediments underlying the Kokerboom 3 and Kokerboom 4 Wind Farm study area generally are of LOW to VERY LOW palaeontological sensitivity**. However, the slight possibility remains that small, local areas of High to Very High palaeosensitivity (*e.g.* Quaternary mammal fossils within older alluvial deposits) occur within the region but these are inherently unpredictable.

| GEOLOGICAL UNIT | | ROCK TYPES & AGE | FOSSIL HERITAGE | COMMENTS |
|---|---|---|---|---|
| **ECCA GROUP** Early – Mid Permian (290 – 266 Ma) | **Tierberg Fm (Pt)** | Offshore non-marine mudrocks with distal turbidite beds, prodeltaic sediments | Disarticulated microvertebrate remains (*e.g.* fish teeth, scales), sponge spicules, spare vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below *plus* variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, *Siphonichnus etc*) | Ecca Sea traces are among most diverse and best preserved non-marine ichnofaunas from Gondwana.<br><br>Doubtful stromatolites also recorded. |
| | **Collingham Fm (Pc)** | Offshore non-marine mudrocks with numerous volcanic ashes, subordinate turbidites | Low diversiy but locally abundant ichnofaunas (horizontal "worm" burrows, arthropod trackways), vascular plant remains (petrified and compressed wood, twigs, leaves *etc*). | Trackways of giant water scorpions over 2m long recorded from W. Cape. |
| | **Whitehill Fm (Pw)** | Carbonaceous offshore non-marine mudrocks within minor volcanic ashes, dolomite nodules | Mesosaurid reptiles, rare cephalochordates, variety of palaeoniscoid fish, small eocarid crustaceans, insects, low diversity of trace fossils (*e.g.* king crab trackways, possible shark coprolites), palynomorphs, petrified wood and other sparse vascular plant remains (*Glossopteris* leaves, lycopods *etc*) | High carbon content of mudrocks probably derived from phytoplankton blooms.<br>Anoxic quiet-water bottom conditions promoted frequent preservation of intact skeletons of animal life.<br>Distinctive Ecca Sea fauna also found in S. America – early historical evidence for Gondwana supercontinent.<br>Coeval with Ecca Coal Measures of Gauteng, KZN (Vryheid Fm). |
| | **Prince Albert Fm (Ppr)** | Marine to hyposaline basin plain mudrocks, minor volcanic ashes, phosphates and ironstones, post-glacial mudrocks at base | Low diversity 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 various "worm" burrows), possible stromatolites, oolites | Transition from marine to brackish salinities early in history of epicontinental Ecca Sea.<br>Marine body fossils rare (*e.g.* Douglas area)<br>Biogenic origin of "stromatolites" within carbonate rocks needs confirmation. |

**Table 1: Tabulated summary of the fossil record of the Ecca Group bedrock units mapped within the Kokerboom 3 Wind Farm and Kokerboom 4 Wind Farm project areas (Abstracted from Almond & Pether 2008). Red = High palaeosensitivity. Green = Medium palaeosensitivity.**

## 4. CONCLUSIONS & RECOMMENDATIONS

Based on several desktop and field-based palaeontological heritage surveys in the combined Kokerboom 3 and Kokerboom 4 Wind Farm project area as well as in the broader Bushmanland region north of Loeriesfontein, it is concluded that the sedimentary bedrocks as well as the superficial sediments underlying the Kokerboom 3 and Kokerboom 4 Wind Farm study area generally are of **LOW to VERY LOW palaeontological sensitivity**. However, the slight possibility remains that small, local areas of High to Very High palaeosensitivity (*e.g.* Quaternary mammal remains within older alluvial deposits) occur within the region.

The construction phase of the two proposed wind farms is likely to have a **Very Low to Low impact significance** in terms of local palaeontological heritage resources (No significant further impacts are anticipated in the operational and decommissioning phases). No high-sensitivity **No-Go areas** have been identified within the combined project area of the two proposed wind farms.

**There is no objection on palaeontological heritage grounds to authorization of the proposed (revised) Kokerboom 3 and (new) Kokerboom 4 Wind Farms.**

- **Cumulative impacts**

Given the (1) low palaeontological sensitivity of the combined Kokerboom 3 and Kokerboom 4 Wind Farm project area, and (2) the low impact significance determined for these two WEFs and other renewable energy projects in the broader Bushmanland region north of Loeriesfontein (*cf* Almond 2011a, 2011b, 2014c, 2017a, Pether 2012, Groenewald 2014, Millsteed 2014, Butler 2016) it is concluded that the cumulative impact of all the two WEF developments is LOW.

- **Recommendations for monitoring and mitigation**

Given the general low palaeosensitivity of the project area as well as the anticipated low to very low impact significance of the proposed wind farm developments, **no further specialist palaeontological studies, monitoring or mitigation are recommended for these two projects**, *pending* the potential discovery of significant new fossil remains (*e.g.* vertebrate bones and teeth, horn cores, petrified wood) before or during the construction phase.

The Environmental Control Officer (ECO) responsible for the WEF developments should be made aware of the potential occurrence of scientifically-important fossil remains within the development footprint. During the construction phase all major clearance operations (*e.g.* for new access roads, turbine placements) and deeper (> 1 m) excavations should be monitored for fossil remains on an on-going basis by the ECO and on-site Environmental Officer (EO). Should substantial fossil remains - such as vertebrate bones and teeth, or petrified logs of fossil wood - be encountered at surface or exposed during construction, the ECO or EO should safeguard these, preferably *in situ*. They should then alert the South African Heritage Resources Agency, SAHRA, as soon as possible (Contact details: Dr Ragna Redelstorff, Heritage Officer Archaeology, Palaeontology & Meteorites Unit, SAHRA. 111 Harrington Street, Cape Town, 8001. Tel: +27 (0)21 202 8651. Fax: +27 (0)21 202 4509 E-mail:rredelstorff@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 proponent's expense.

The palaeontologist concerned with any mitigation work will need a valid fossil collection permit from SAHRA and any material collected would have to be curated in an approved depository (*e.g.* museum or university collection). All palaeontological specialist work would have to conform to international best practice for palaeontological fieldwork and the study (*e.g.* data recording fossil collection and curation, final report) should adhere as far as

possible to the minimum standards for Phase 2 palaeontological studies developed by SAHRA (2013).

**These monitoring and mitigation recommendations are summarized in the Appendix to this report should be incorporated into the Environmental Management Programmes (EMPrs) for the Kokerboom 3 and Kokerboom 4 Wind Farms**.

It should be noted that, should fossils be discovered before or during construction and reported by the responsible ECO to the responsible heritage management authority (SAHRA) for professional recording and collection, as recommended here, the overall impact significance of the project would remain low to very low (negative). However, any residual negative impacts from inevitable loss of fossil heritage would be partially offset by an improved palaeontological database as a direct result of appropriate mitigation. This is a *positive* outcome because any new, well-recorded and suitably curated fossil material from this palaeontologically under-recorded region of Bushmanland would constitute a useful addition to our scientific understanding of the fossil heritage here.

## 5. ACKNOWLEDGEMENTS

Ms Franci Gresse of Zutari, Cape Town, is thanked for commissioning this study and for providing the necessary background information. I am also very grateful, as always, to Ms Madelon Tusenius for field assistance, logistical support and companionship in the field.

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*N.B.* Full references for this project area are provided by Almond (2017a).

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## 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, Mpumalanga, KwaZulu-Natal, Gauteng 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 development 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><td colspan="3">CHANCE FOSSIL FINDS PROCEDURE: Kokerboom 3 Wind Farm & Kokerboom 4 Wind Farm near Loeriesfontein</td></tr>
<tr><td>Province & region:</td><td colspan="2">NORTHERN CAPE, Namaqua District Municipality (Hantam Local Municipality)</td></tr>
<tr><td>Responsible Heritage Resources Authority</td><td colspan="2">SAHRA (Contact details: P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Ecca Group (Prince Albert, Whitehill and Tierberg Formations)<br>Late Caenozoic alluvium, aeolian sands</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Trace fossils, plant remains, fish, aquatic reptile, shelly fossils and crustacean remains within Ecca Group bedrocks.<br>Mammalian bones and teeth, freshwater molluscs, calcretised root casts, termitaria, ostrich egg shells, land snail shells I Late Caenozoic superficial sediments.</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:<br>• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo<br>• Context – describe position of fossils within stratigraphy (rock layering), depth below surface<br>• 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:<br>• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation<br>• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Authority for work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):<br>• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)<br>• Photograph fossils against a plain, level background, with scale<br>• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags<br>• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist<br>• Alert Heritage Resources Authority and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Authority, 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 Authority</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 Authority. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Authority minimum standards.</td></tr>
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