

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 60 MW generated by c. 12 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 (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, Millstead 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).

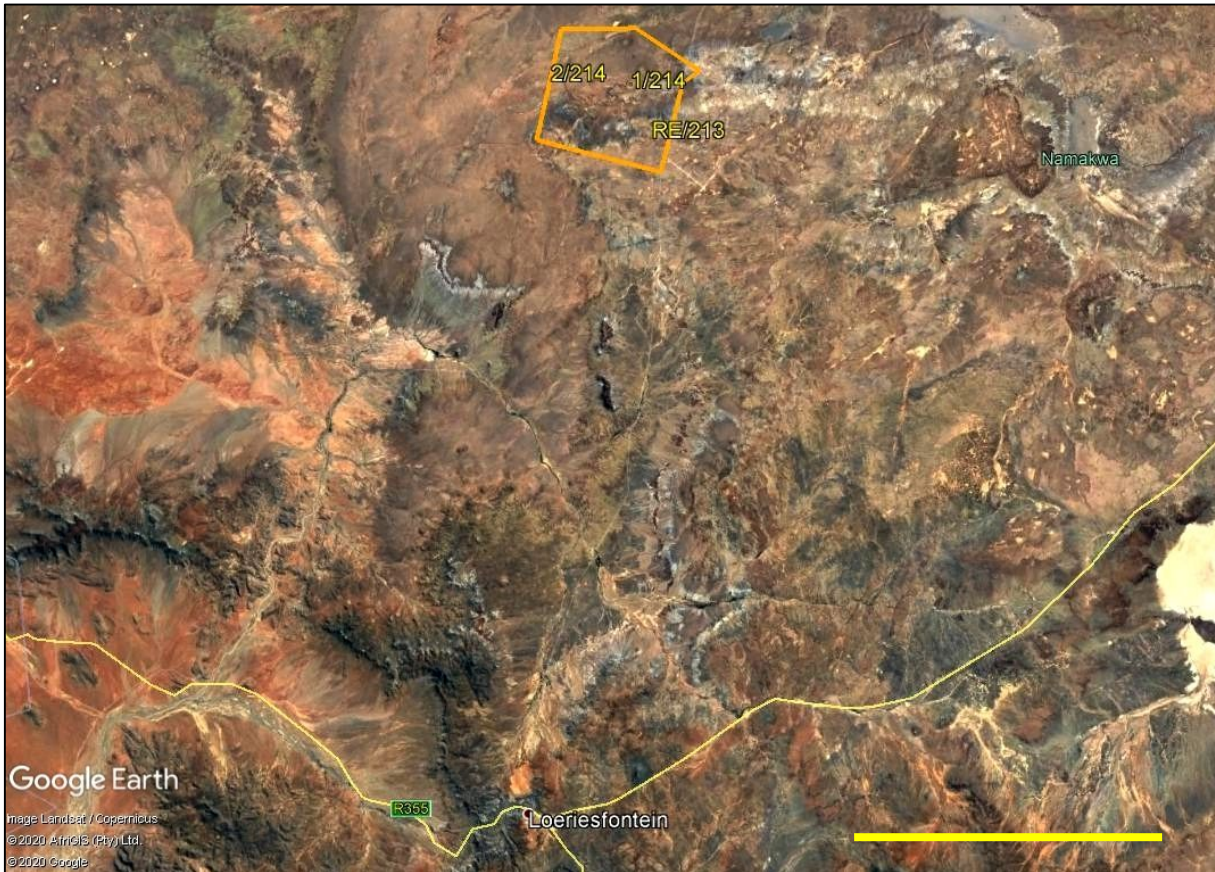


Figure 1: Google Earth© satellite image showing the location of combined project area (orange polygon) for the Kokerboom 3 WEF and Kokerboom 4 WEF situated some 60 km to the north of Loeriesfontein, Namakwa District Municipality and Hantam Local Municipality, Northern Cape. Scale bar = 30 km. N towards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

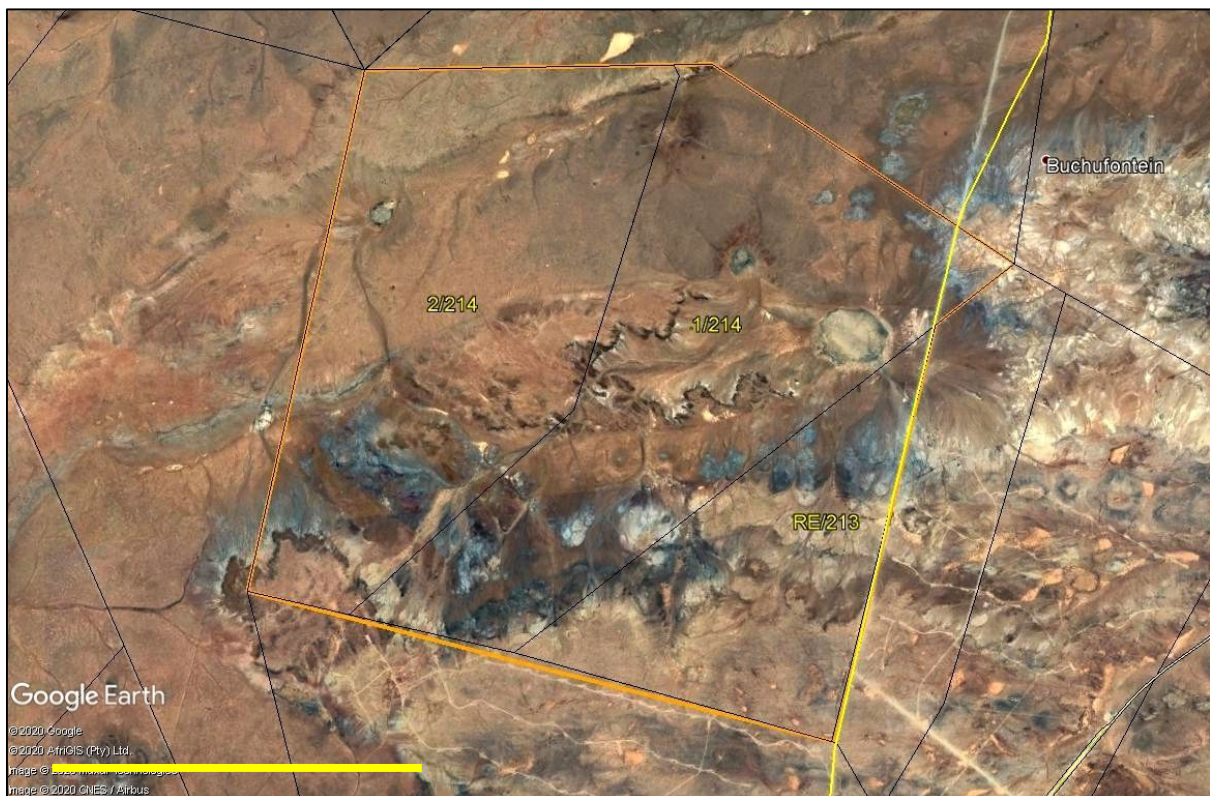


Figure 2: Google Earth© satellite image showing the three land parcels concerned with the project area for the Kokerboom 3 and Kokerboom 4 WEFs. Scale bar = 7 km. N towards the top of the image.

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.

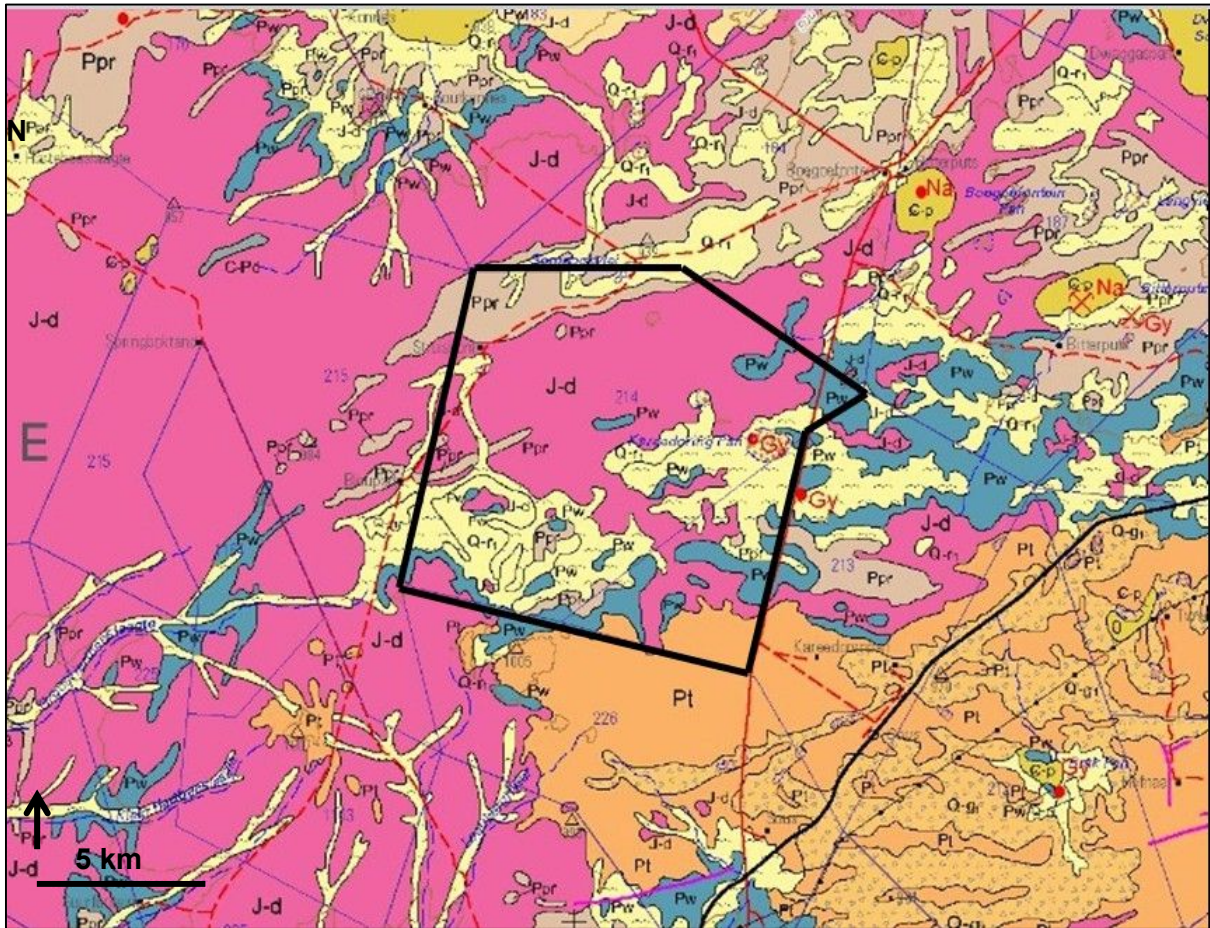


Figure 3: Extract from 1: 250 000 geology sheet 3018 Loeriesfontein (Council for Geoscience, Pretoria) showing the rock units underlying the land parcels forming the combined project area for the Kokerboom 3 Wind Farm and Kokerboom 4 Wind Farm (black polygon), situated c. 60 km north of Loeriesfontein,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

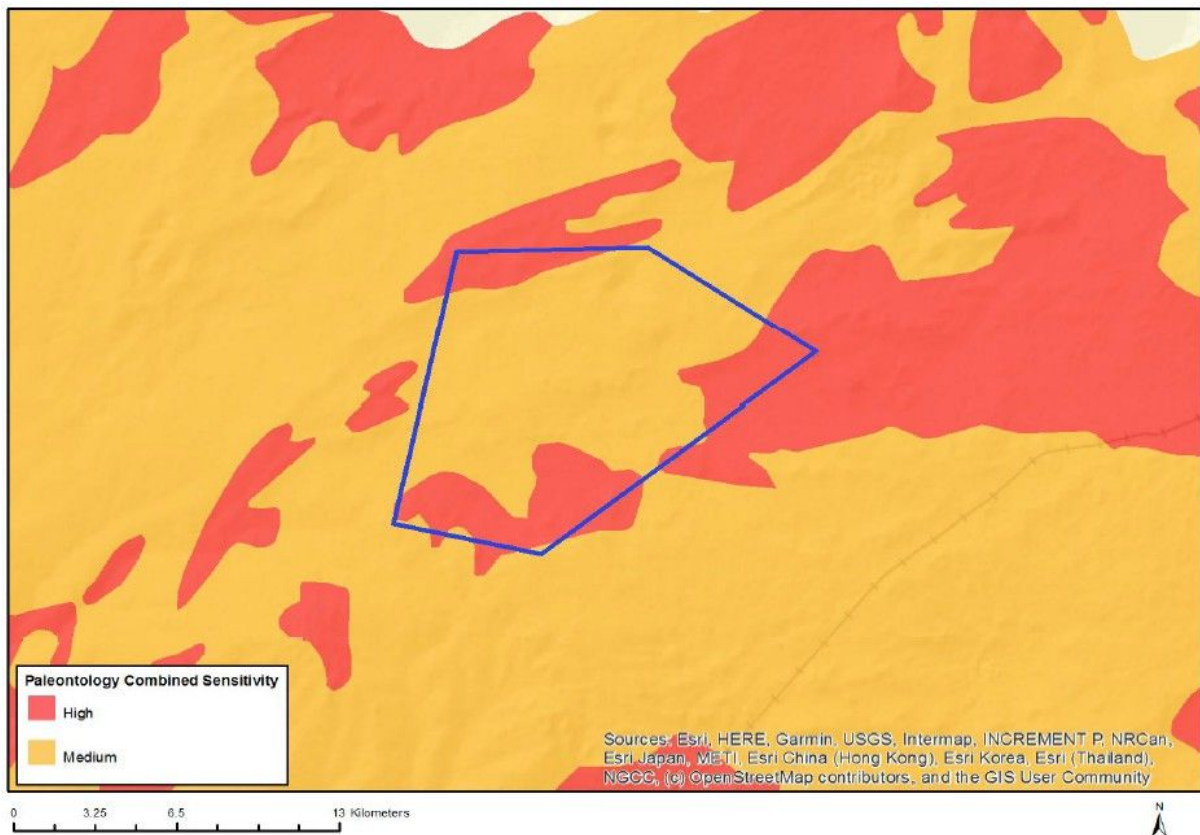


Figure 4: Provisional palaeosensitivity of the Kokerboom 3 Wind Farm project area based on the DEA screening tool (Map supplied by Zutari).

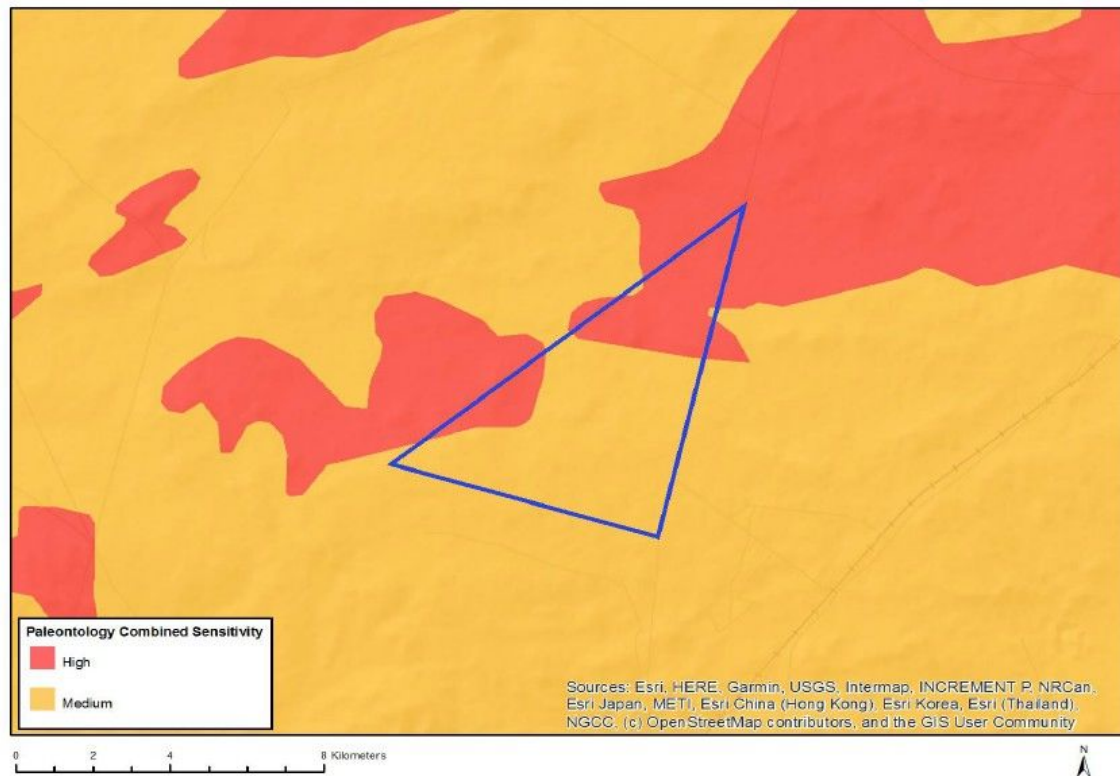


Figure 5: Provisional palaeosensitivity of the Kokerboom 4 Wind Farm project area based on the DEA screening tool (Map supplied by Zutari).

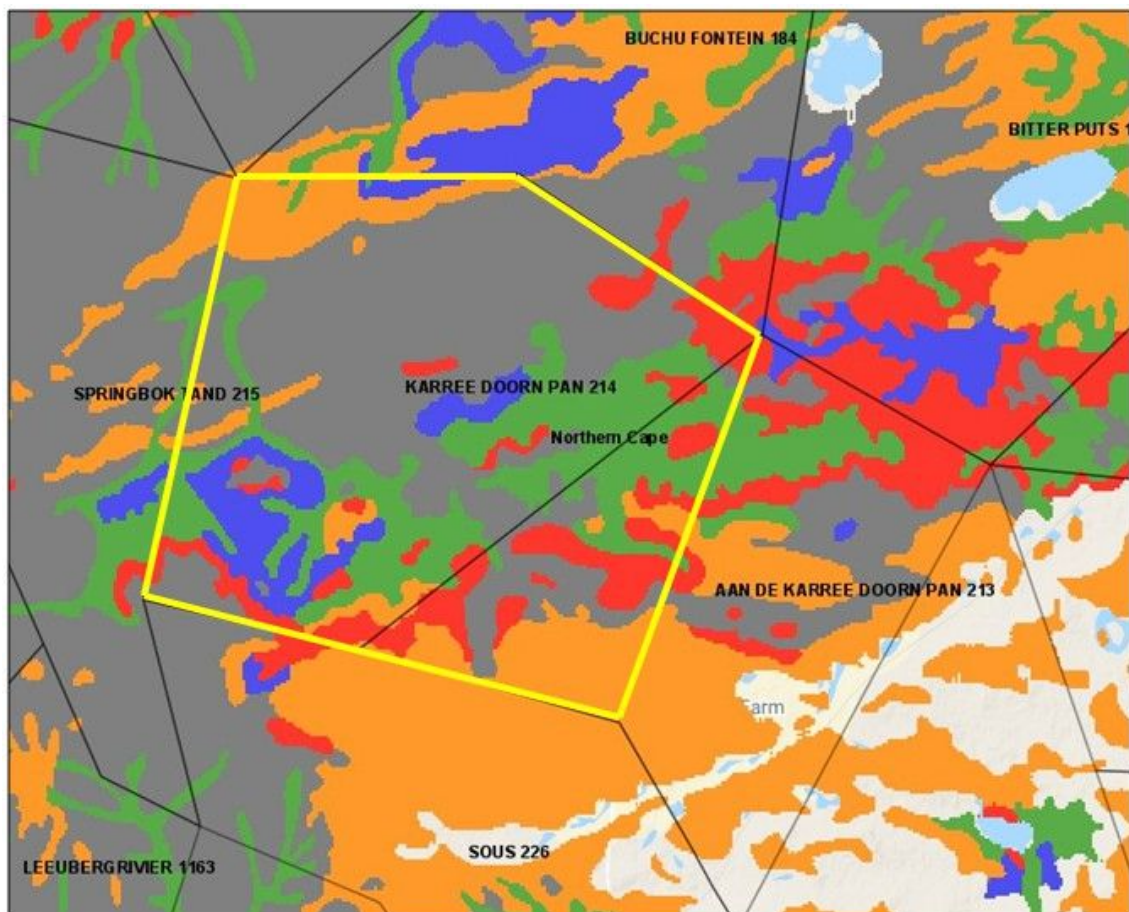


Figure 6: Palaeosensitivity map of the combined Kokerboom 3 and Kokerboom 4 Wind Farm project areas (yellow polygon) as shown on the SAHRIS website (based on 1: 250 000 geological maps). The key to the colour coding is provided below. Ecca Group bedrocks are assigned a High (orange) to Very High (red) 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), Millsted (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, sparse vascular plants (leaves, petrified wood), moderate diversity trace fossil assemblages (as below <i>plus</i> variety of additional taxa such as large ribbed pellet burrows, arthropod scratch burrows, <i>Siphonichnus</i> etc)	<p>Ecce Sea traces are among most diverse and best preserved non-marine ichnofaunas from Gondwana.</p> <p>Doubtful stromatolites also recorded.</p>
	Collingham Fm (Pc)	Offshore non-marine mudrocks with numerous volcanic ashes, subordinate turbidites	Low diversity 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 (<i>Glossopteris</i> leaves, lycopods etc)	<p>High carbon content of mudrocks probably derived from phytoplankton blooms.</p> <p>Anoxic quiet-water bottom conditions promoted frequent preservation of intact skeletons of animal life.</p> <p>Distinctive Ecce Sea fauna also found in S. America – early historical evidence for Gondwana supercontinent.</p> <p>Coeval with Ecce Coal Measures of Gauteng, KZN (Vryheid Fm).</p>
	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	<p>Transition from marine to brackish salinities early in history of epicontinental Ecce Sea.</p> <p>Marine body fossils rare (e.g. Douglas area)</p> <p>Biogenic origin of “stromatolites” within carbonate rocks needs confirmation.</p>

Table 1: Tabulated summary of the fossil record of the Ecce 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, Millstead 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**

CHANCE FOSSIL FINDS PROCEDURE: Kokerboom 3 Wind Farm & Kokerboom 4 Wind Farm near Loeriesfontein	
Province & region:	NORTHERN CAPE, Namaqua District Municipality (Hantam Local Municipality)
Responsible Heritage Resources Authority	SAHRA (Contact details: P.O. Box 4637, Cape Town 8000. Tel: 021 462 4502)
Rock unit(s)	Ecce Group (Prince Albert, Whitehill and Tierberg Formations) Late Cenozoic alluvium, aeolian sands
Potential fossils	Trace fossils, plant remains, fish, aquatic reptile, shelly fossils and crustacean remains within Ecce Group bedrocks. Mammalian bones and teeth, freshwater molluscs, calcretised root casts, termitaria, ostrich egg shells, land snail shells Late Cenozoic superficial sediments.
ECO protocol	1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (<i>N.B.</i> safety first!), safeguard site with security tape / fence / sand bags if necessary.
	2. Record key data while fossil remains are still <i>in situ</i> : <ul style="list-style-type: none"> • 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) <i>in situ</i> with scale, from different angles, including images showing context (<i>e.g.</i> rock layering)
	3. If feasible to leave fossils <i>in situ</i> : <ul style="list-style-type: none"> • Alert Heritage Resources Authority 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 Authority for work to resume
	3. If <i>not</i> feasible to leave fossils <i>in situ</i> (emergency procedure only): <ul style="list-style-type: none"> • <i>Carefully</i> remove fossils, as far as possible still enclosed within the original sedimentary matrix (<i>e.g.</i> 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 Authority and project palaeontologist (if any) who will advise on any necessary mitigation
	4. If required by Heritage Resources Authority, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.
	5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Authority
Specialist palaeontologist	Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (<i>e.g.</i> 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.

PALAEONTOLOGICAL HERITAGE ASSESSMENT: ADDENDUM TO 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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July 2021

The proposed adjoining Kokerboom 3 and Kokerboom 4 Wind Farms will be situated some 60 km north of Loeriesfontein in the Namaqua District Municipality (Hantam Local Municipality) of the Northern Cape Province. A Site Sensitivity Report and Letter of Exemption from Further Specialist Studies for these two projects by Almond (2020) was based on a 5-day field assessment on the combined wind farm project area as well as desktop analysis. It concluded that **the project area is generally of LOW to VERY LOW PALAEONTOLOGICAL SENSITIVITY. The construction phase of the two proposed wind farms is therefore 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). Similar conclusions have since been drawn concerning the grid connections associated with the two wind farms (Almond 2021a-c).

A review of the final project descriptions for the two wind farms (Table 1 and Table 2) - including all infrastructure listed here - as well as their proposed layouts (Figures 1 & 2) fully supports the conclusions reached in these earlier reports.

Cumulative impacts on palaeontological heritage resources posed by the two proposed wind farms in the context of comparable renewable energy developments in the region, as listed in Table 3, have been assessed on the basis of the available PIA reports (*cf* Almond 2011a, 2011b, 2014, 2016a, 2016b, 2017, 2020, Pether 2012, Groenewald 2014, Millstead 2014, Butler 2016). Given (1) the low palaeontological sensitivity of the broader Bushmanland region north of Loeriesfontein, (2) the large outcrop areas of the sedimentary rock units concerned and (3) the low impact significance determined for the various renewable energy projects in the region (including the Kokerboom 1-4 Wind Farms), it is concluded that **the cumulative impact on palaeontological heritage resources of all the proposed renewable energy project infrastructure, is LOW**. The anticipated cumulative impacts therefore fall within acceptable limits.

There are therefore no objections on palaeontological heritage grounds to authorization of the proposed Kokerboom 3 and Kokerboom 4 Wind Farms, including their connections to the national grid.

Given the general low palaeosensitivity of the wind farm project areas 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 Chance Fossil Finds protocol appended to the palaeontological heritage report for the Kokerboom 3 and Kokerboom Wind Farms by Almond (2020) must be included in the EMP_r for these developments.

Table 1: Summary of proposed project description for the Kokerboom 3 Wind Farm

Project Components Description	Specifications & Footprint areas	Estimated Combined Footprint (ha)
Location and Total site size	The proposed site is located approximately 60 km north of Loeriesfontein, 85 km west of Brandvlei and 160 km south east of Springbok in the Namakwa District Municipality and the Hantam Local Municipality. Land use of the site and surrounding properties comprise of low-density livestock farming (grazing).	-
Wind Turbines	<ul style="list-style-type: none"> • Up to a maximum of 60 wind turbines. • Turbine envelope: <ul style="list-style-type: none"> ○ Rotor diameter: up to 180 m (90 m blade) ○ Hub height: up to 150 m ○ Rotor top tip height: up to 240 m ○ Steel or concrete towers • Kokerboom 3 has a targeted nameplate capacity of up to a maximum of 300 MW. 	-
Turbine Foundations and Hardstands	<p>At each turbine position there will be</p> <ul style="list-style-type: none"> • A hardstand area of up to 150 m x 100 m • A laydown/assembly area of ~150 m x 15 m <p>The turbine hardstands and laydown areas will be located within a 100 m radius of the turbine base. Turbine foundations will be reinforced concrete spread footings and/ or piled foundations with an approx. 26m diameter and will have a construction footprint of 32m X 32m (including the foundation). The exact position and orientation of the hardstands and laydowns will be determined during the detailed design stage.</p>	<p>3,2ha foundations (permanent) 3ha foundations construction footprint (temporary, in addition to permanent footprint) 90ha hardstand (permanent) 13,5ha laydown (temporary)</p>
Cabling	Turbines to be connected to an on-site substation via 33 kV cables. Cables would be laid underground in trenches parallel to the roads within the road reserve. No overhead MV lines would run from the turbines to the on-site substation.	Cabling included within road reserve
Site roads	<p>Existing farm tracks would be utilized and upgraded where possible, however new roads would also be developed. A total road length of approximately 95km will be required.</p> <p>A 20 m wide road reserve is required; this accounts for a 6 m road surface width, 1 m for side drains either side, and a further 6 m either side of the road surface for MV cable trenches and associated disturbance.</p> <p>After construction the road would be rehabilitated down to 8 m wide (6 m wide road surface + 1 m drain either side) (ie. 8m road width is permanent with an additional 12 m temporary during construction making up the 20 m road reserve.)</p> <p>Roads would be provided with a gravel wearing course. The wind farm terrain is relatively flat therefore cut to fill activities are expected to be limited.</p>	<p>±76ha (8m width) (permanent) 114ha (12m width) (temporary)</p>
Facility Substation and O&M Complex	<p>A 5 ha area has been identified for the substation and Operational and Management (O&M) complex. The following infrastructure would be located within 5 ha area:</p> <ul style="list-style-type: none"> • Facility substation (approx. 1ha) • O&M building (approx. 0.5 ha) • Oil storage area (less than 30m³) (approx. 0.1 ha) • Battery Energy Storage Facility (approx. 2 ha) • Associated facilities including the parking area 	5ha (permanent)
Battery Energy Storage System (BESS)	The approximate area of 2 ha has been designated for battery storage within the substation and O&M Complex. The BESS would have a capacity of up to 150 MWh and would utilise either lithium-ion or redox flow technology.	Within O&M complex
Construction Laydown Areas	<p>Three construction laydown areas of up to 15 ha each are proposed - two near the entrances of the site and the other near the substation. One or all of the laydown areas may be utilized.</p> <p>The laydown areas would include temporary site offices, stores, workshops, turbine storage areas, fuel storage, worker mess and ablution facilities etc. These areas would be rehabilitated after</p>	up to 45ha (temporary)

Project Components Description	Specifications & Footprint areas	Estimated Combined Footprint (ha)
	construction.	
Concrete Batch Plant	A centralised concrete batch plant would be erected for the concrete works required during construction. An area of approximately 100 m x 100 m is required for the batch plant. The batch plant area would include aggregate stockpile areas, cement silos, truck parking areas and the batch plant itself. The batch plant will be located within one of the indicated laydown areas.	Included within Construction Laydown Area
Total disturbance footprint		175.6 ha temporary and 168.2ha permanent

Table 2: Summary of proposed project description for the Kokerboom 4 Wind Farm

Project Components Description	Specifications & Footprint areas	Estimated Combined Footprint (ha)
Location and Total site size	The proposed site is located approximately 60 km north of Loeriesfontein, 85 km west of Brandvlei and 160 km south east of Springbok in the Namakwa District Municipality. Land use of the site and surrounding properties comprise of low-density livestock farming (grazing).	-
Wind Turbines	<ul style="list-style-type: none"> • Up to a maximum of 12 wind turbines. • Turbine envelope: <ul style="list-style-type: none"> ○ Rotor diameter: 180 m (90 m blade) ○ Hub height: 150 m ○ Rotor top tip height: up to 240 m ○ Steel or concrete towers • Kokerboom 4 has a targeted nameplate capacity of up to a maximum of 60MW. 	-
Turbine Foundations and Hardstands	<p>At each turbine position there will be</p> <ul style="list-style-type: none"> • A hardstand area of up to 150 m x 100 m • A laydown/assembly area of up to 150 m x 15 m <p>The turbine hardstands and laydown areas will be located within a 100 m radius of the turbine base. Turbine foundations will be reinforced concrete spread footings and/ or piled foundations with an approx. 26m diameter and will have a construction footprint of 32m X 32m (including the foundation). The exact position and orientation of the hardstands and laydowns will be determined during the detailed design stage.</p>	0.7 ha foundations (permanent) 0.5 ha foundations construction footprint (temporary) 18 ha hardstand (permanent) 2.7 ha laydown (temporary)
Cabling	Turbines to be connected to on-site substation via 33kV cables. Cables to be laid underground in trenches parallel to	Cabling included within road reserve

	the roads within the road reserve. No overhead MV lines will run from the turbines to the on site substation.	
Site roads	<p>Existing farm tracks would be utilized and upgraded where possible, however new roads would also be developed. A total road length of approximately 16 km will be required.</p> <p>A 20 m wide road reserve is required; this accounts for a 6 m road surface width, 1 m for side drains either side, and a further 6 m either side of the road surface for MV cable trenches and associated disturbance.</p> <p>After construction the road would be rehabilitated down to 8 m wide (6 m wide road surface + 1 m drain either side). (ie. 8m road width is permanent with an additional 12 m temporary during construction making up the 20 m road reserve.)</p>	±12.8ha (8m width) (permanent) ±19.2ha (12m width) (temporary)
Facility Substation and O&M Complex	<p>A 5 ha area has been identified for the substation and Operational and Management (O&M) complex. The following infrastructure would be located within 5 ha area:</p> <ul style="list-style-type: none"> • Facility substation (approx. 1ha) • O&M building (approx. 0.5 ha) • Oil storage area (less than 30m³) (approx. 0.1 ha) • Battery Energy Storage Facility (approx. 2 ha) • Associated facilities including the parking area 	5 ha (permanent)
Battery Energy Storage System (BESS)	The approximate area of 2 ha has been designated for battery storage within the substation and O&M Complex. The BESS will have a capacity of up to 70 MWh and will utilise either lithium-ion or redox flow technology.	Within Substation and O&M complex
Construction Laydown Areas	Two laydown areas of up to 15ha are proposed, one near the site entrance and the other near the facility substation. One or both will be required during the construction period. The laydown areas will include temporary site offices, stores, workshops, turbine storage areas, fuel storage, worker mess and ablution facilities etc. These areas will be rehabilitated after construction.	30 ha (temporary)
Concrete Batch Plant	A centralised concrete batch plant will be erected for the concrete works required during construction. An area of approximately 100 m x 100 m is required for the batch plant. The batch plant area will include aggregate stockpile areas, cement silos, truck parking areas and the batch plant itself. The batch plant will be located within one of the indicated	Within laydown area

	laydown areas.	
Total disturbance footprint		<ul style="list-style-type: none"> o 36.5ha (permanent) o 52.4ha (temporary)

Table 3: Proposed or authorized renewable energy facilities in the vicinity (c. 40 km radius) of the Kokerboom 3 and Kokerboom 3 wind farms

Development	Current status of EIA/development	Proponent	Technology	Capacity	Farm details
Dwarsrug Wind Farm	EA issued	Mainstream Renewable Power	Wind	140MW	Remainder of the Farm Brak Pan No 212
Khobab Wind Farm	Operational	Mainstream Renewable Power	Wind	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Operational	Mainstream Renewable Power	Wind	140MW	Portions 1 & 2 of the Farm Aan de Karree Doorn Pan No 213
Graskoppies Wind Farm	EA Issued	Mainstream Renewable Power	Wind	235MW	<ul style="list-style-type: none"> • Portion 2 of the Farm Graskoppies No. 176; and • Portion 1 of the Farm Hartebeest Leegte No. 216.
Hartebeest Leegte Wind Farm	EA issued	Mainstream	Wind	235MW	<ul style="list-style-type: none"> • Entire part of the Remainder of the Farm Hartebeest Leegte No. 216.
Xha! Boom Wind Farm	EA issued	Mainstream Renewable Power	Wind	235MW	<ul style="list-style-type: none"> • Entire part of Portion 2 of the Farm Georg's Vley No. 217.
Ithemba Wind Farm	EA issued	Mainstream Renewable Power	Wind	235MW	<ul style="list-style-type: none"> • Western portion of Portion 2 of the Farm Graskoppies No. 176; and • Western portion of Portion 1 of the Farm Hartebeest Leegte No. 216.
Loeriesfontein PV3 Solar Energy Facility	EA issued	Mainstream Renewable Power	Solar	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	EA issued	Solar Capital (Pty) Ltd	Solar	Up to 525MW	Remainder of the Farm Narosies No 228
PV Solar Power Plant	EA issued	BioTherm Energy	Solar	70MW	Portion 5 of the Farm Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	EA issued	Business Venture Investments No. 1788	Wind	240MW	<ul style="list-style-type: none"> • Remainder of the Farm Leeuwergrivier No. 1163; and • Remainder of the Farm

Development	Current status of EIA/development	Proponent	Technology	Capacity	Farm details
		(Pty) Ltd (BVI)			Kleine Rooiberg No. 227.
Kokerboom Wind Farm 2	EA issued	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	Wind	240MW	<ul style="list-style-type: none"> Remainder of the Farm Springbokpan No. 1164; and Remainder of the Farm Springbok Tand No. 2157.
Kokerboom Wind Farm 3	EA issued	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	Wind	240MW	<ul style="list-style-type: none"> Remainder of the Farm Aan De Karree Doorn Pan No. 213; Portion 1 of the Farm Karree Doorn Pan No. 214; and Portion 2 of the Farm Karree Doorn Pan No. 214.

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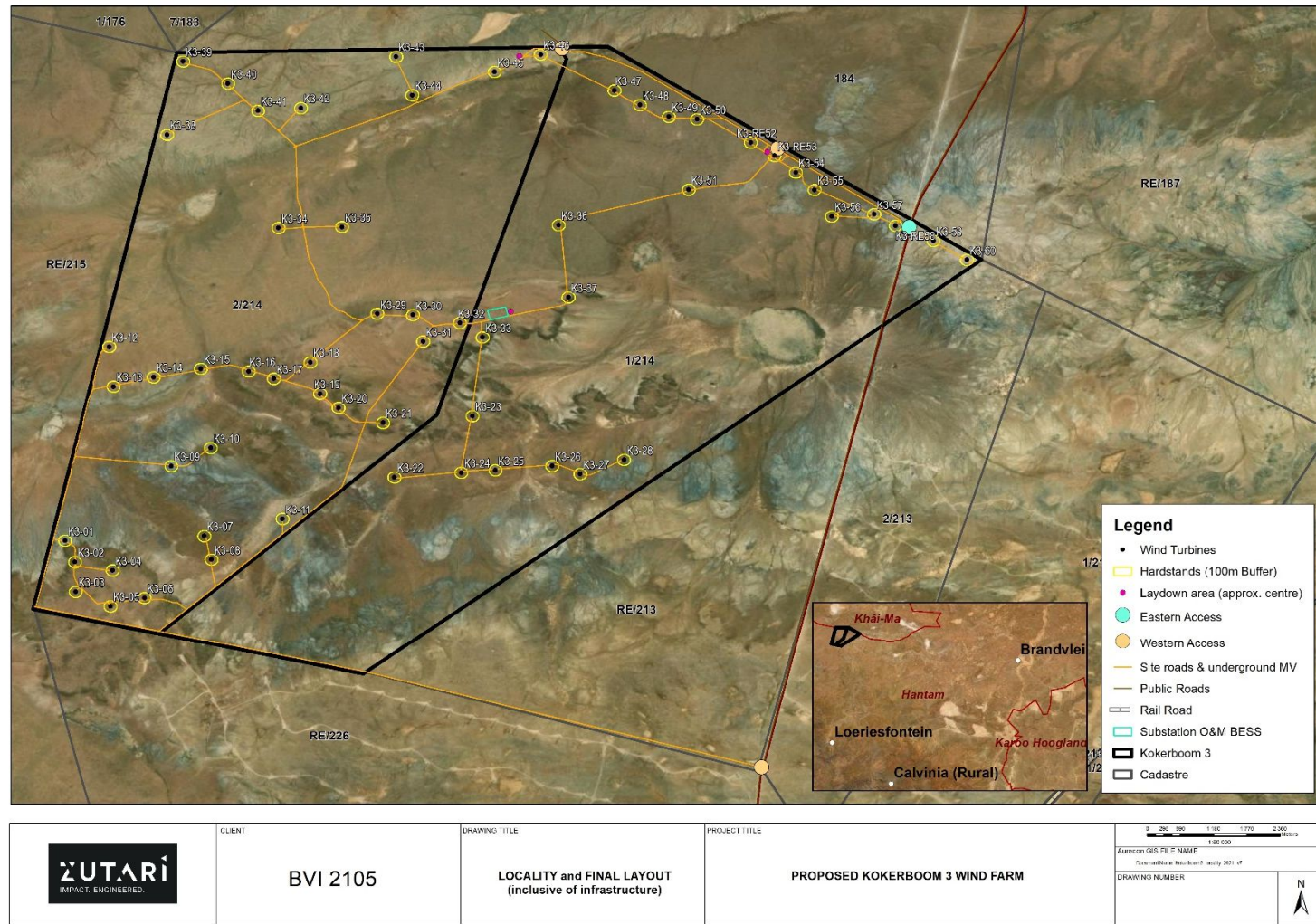


Figure 1: Proposed final layout of the Kokerboom 3 Wind Farm

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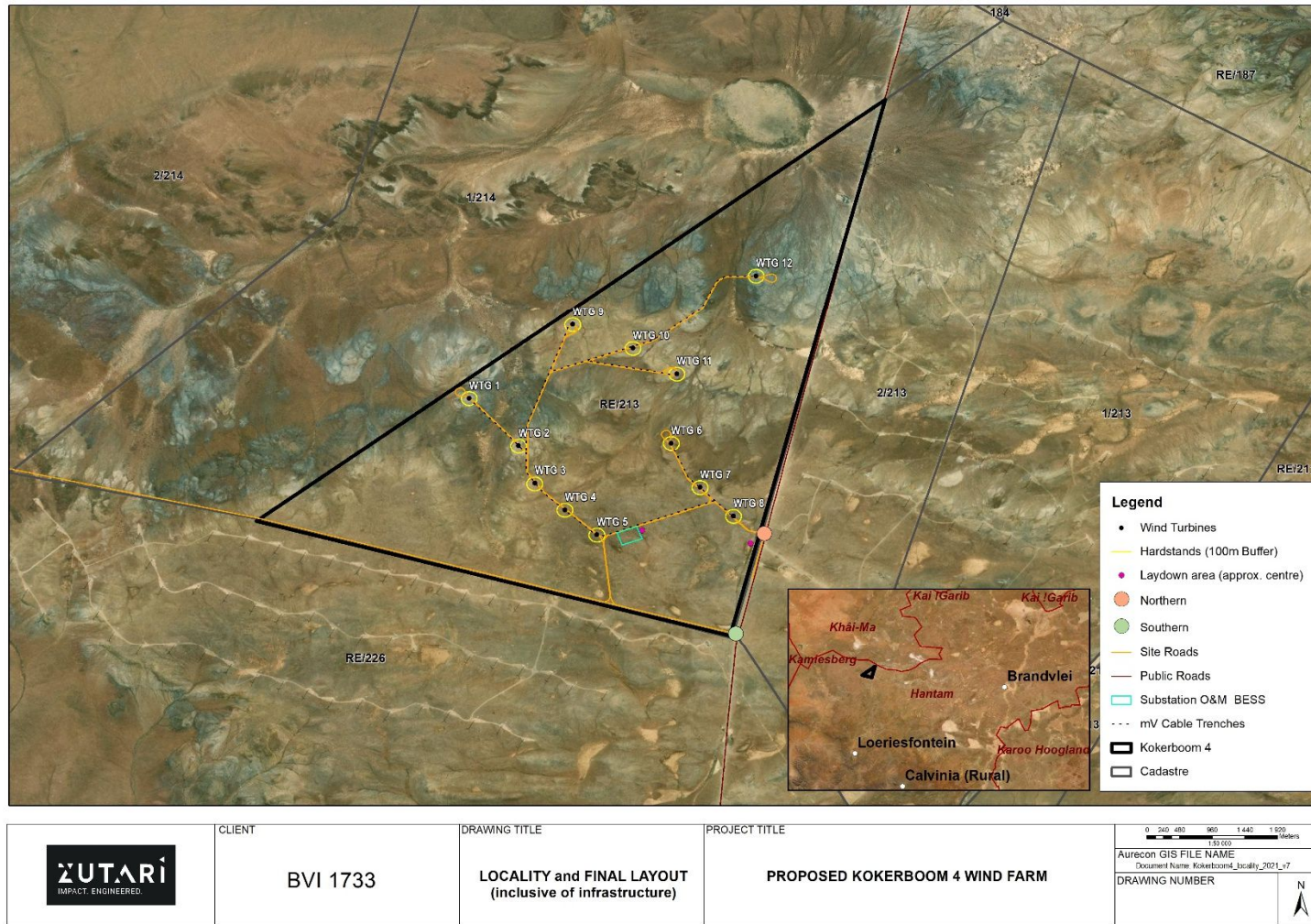


Figure 2: Proposed final layout of the Kokerboom 4 Wind Farm

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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 AHP (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.



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