Palaeontological Heritage: combined desktop and field-based Compliance Statement

PROPOSED LOXTON WIND ENERGY FACILITY 1, UBUNTU LOCAL MUNICIPALITY (PIXLEY KA SEME DISTRICT MUNICIPALITY) IN THE NORTHERN CAPE PROVINCE.

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EXECUTIVE SUMMARY

It is proposed to develop three commercial Wind Energy Facilities (WEFs) - known as Loxton WEF 1, Loxton WEF 2 and Loxton WEF 3 - and associated infrastructure on a site located *c*. 20-30 km north and east of Loxton within the Ubuntu Local Municipality (Pixley Ka Seme District Municipality) in the Northern Cape Province. The Loxton WEF 1 will involve 42 wind turbines with a contracted capacity of up to 240 MW and a permanent footprint of up to 65 ha. The project site covers approximately 7 200 ha and comprises the following farm portions: Portion 12 of the Farm Rietfontein 572, Remaining Extent of Farm 582, Remaining Extent of the Farm Saaidam No. 574; and Remaining Extent of the Farm Springfontein No. 573.

Historical palaeontological site mapping for the region between Loxton and Victoria West reveals a paucity of recorded vertebrate fossil sites within the Loxton WEF Cluster project area. This is supported by recent palaeontological field surveying, both here and in neighbouring WEF project areas, which shows that:

(1) Levels of Beaufort Group bedrock exposure are very limited here due to pervasive cover by Late Caenozoic superficial sediments; (2) Intensive intrusion by dolerite sills and dykes has compromised fossil preservation over large areas; (3) The Beaufort Group bedrocks represented here span the catastrophic end-Middle Permian Extinction Event which is associated with an unusually low abundance of well-preserved fossil remains.

Over the course of eight days, only a handful of fossil sites were recorded within the entire Loxton WEF Cluster project area, the majority of which are poorly preserved and of limited scientific or conservation significance. Even occasional small areas showing excellent, fresh mudrock exposure ideal for palaeontological recording yielded hardly any fossils. Almost no fossil sites were recorded within the Late Caenozoic superficial deposits. **None of the very few (6) new fossil sites recorded within the Loxton WEF 1 project area are of significant scientific or conservation value and no mitigation is recommended here with regard to these known sites (Appendix 1).** The only site which lies very close to the proposed WEF footprint (Site 007) comprises poorly-preserved invertebrate trace fossils of little scientific interest. No known significant or unique palaeontological heritage sites are threatened by the proposed WEF development.

While additional, unrecorded fossil sites of high palaeontological and conservation value are likely to occur at and beneath the land surface within the Loxton WEF Cluster project areas, they are probably very sparse and sporadic in distribution and can be effectively handled in the Construction Phase through a Chance Fossil Finds Protocol (See Appendix 2). All the recorded sites can, if necessary, be effectively mitigated in the preconstruction phase.

It is concluded that the palaeosensitivity of the combined Loxton WEF Cluster project area is, in practice, LOW. The provisional palaeosensitivity mapping by the DFFE Screening Tool is accordingly *contested* in this report.

Despite the substantial WEF project footprints as well as the known occurrence of important vertebrate and other fossil sites elsewhere in the wider region between Loxton and Victoria West, **the impact significance of the proposed renewable energy developments on local palaeontological heritage – including the Loxton 2 WEF project considered in this report - is anticipated to be LOW.** These impacts, including cumulative impacts considering other renewable energy projects in the broader region (*e.g.* the adjoining Victoria West WEF Cluster), are expected to fall within acceptable limits. There are therefore no objections on palaeontological heritage grounds to authorisation of the Loxton WEF Cluster developments.

The potential for unrecorded palaeontological sites of scientific and conservation value cannot be completely excluded. These are best mitigated through the application of a Chance Fossil Finds Protocol by the ECO / ESO during the Construction Phase (See Appendix 1) which should be incorporated into the EMPrs for the WEF developments. The qualified palaeontologist responsible for mitigation work will need to apply for a Fossil Collection Permit for the Northern Cape from SAHRA. Minimum standards for PIA reports have been compiled by Heritage Western Cape (2021) and SAHRA (2013).

Given the inferred low overall site sensitivity and anticipated impact significance, formal palaeontological heritage impact assessment for the proposed Loxton WEF Cluster projects is not considered necessary. However, a combined desktop and field-based palaeontological heritage study outlining and mapping the recorded fossil sites, their scientific / conservation value and their geological context is provided in this report as part of the Heritage Assessment process for the proposed Loxton 1 WEF development.

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1. Project outline

The applicant Loxton Wind Facility 1 (Pty) Ltd is proposing the development of a commercial Wind Energy Facility (WEF), to be known as Loxton WEF 1, and associated infrastructure on a site located approximately 20-30 km north and east of Loxton within the Ubuntu Local Municipality and the Pixley Ka Seme District Municipality in the Northern Cape Province.

Two additional WEF's are concurrently being considered on the surrounding properties and are assessed by way of separate impact assessment processes contained in the 2014 Environmental Impact Assessment Regulations (GN No. R982, as amended) for listed activities contained in Listing Notices 1, 2 and 3 (GN R983, R984 and R985, as amended). These projects are known as Loxton WEF 2 and Loxton WEF 3.

A preferred project site with an extent of approximately 52 000 ha has been identified as a technically suitable area for the development of the three WEF projects. Loxton WEF 1 & Loxton WEF 3 comprise of 42 and 38 turbines, each with a contracted capacity of up to 240 MW and a permanent footprint of up to 65 ha each whereas Loxton WEF 2 will have up to 62 turbines, with a contracted capacity of up to 480 MW and permanent footprint of up to 110 ha.

The Loxton WEF 1 project site covers approximately 7 200 ha and comprises the following farm portions situated some 20 km NNE of Loxton (see map Figure 1):

- Portion 12 of the Farm Rietfontein 572;
- Remaining Extent of Farm 582;
- Remaining Extent of the Farm Saaidam No. 574;
- Remaining Extent of the Farm Springfontein No. 573.

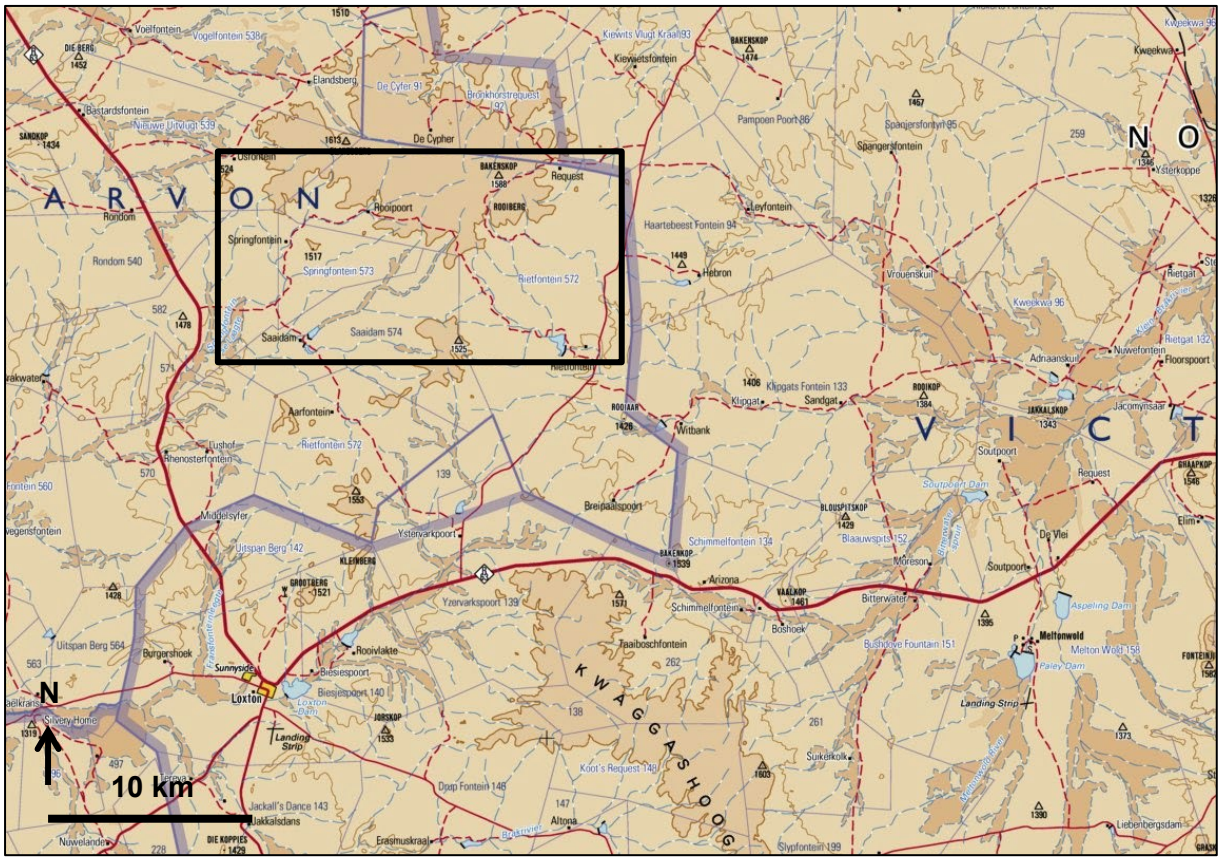

Figure 1: Extract from 1: 250 000 topographical sheet 3122 Loxton showing the *approximate* location of the Loxton WEF 1 project area (black rectangle) some 20 km to the NNE of Loxton, Ubuntu Local Municipality (Pixley ka Seme District Municipality), Northern Cape Province.

The Loxton WEF 1 project site is proposed to accommodate the following infrastructure, which will enable the wind farm to supply a contracted capacity of up to 240 MW (see Appendix 1, Figure A1.1):

- Up to 42 wind turbines with a maximum hub height of up to 160 m and a rotor diameter of up to 200 m;
- A transformer at the base of each turbine;
- Concrete turbine foundations with a permanent footprint 5.5 ha;
- Each turbine will have a crane hardstand of 70 m x 45 m. The permanent footprint for turbine hardstands will be up to 12 ha.
- Each turbine will have a temporary blade hardstand of 80 m x 45 m. The temporary footprint for blade hardstands will be up to 14 ha.
- Temporary laydown areas (with a combined footprint of up to 23 ha) which will accommodate the boom erection, storage and assembly area;
- Battery Energy Storage System (with a footprint of up to 5 ha);
- Medium voltage (33 kV) cables/powerlines running from wind turbines to the facility substations. The routing will follow existing/proposed access roads and will be buried where possible.

- One on-site substation of up to 2 ha in extent to facilitate the connection between the wind farm and the electricity grid;
- Access roads to the site and between project components inclusive of stormwater infrastructure. A 15 m road corridor may be temporarily impacted upon during construction and rehabilitated to 8 m wide after construction. The WEF will have a total road network of up to 50 km.
- A temporary site camp establishment and concrete batching plants (with a combined footprint of up to 2 ha); and
- Operation and Maintenance buildings (with a combined footprint of up to 2 ha) including a gate house, security building, control centre, offices, warehouses, parking bays, a workshop and a storage area.

The Electrical Grid Infrastructure (EGI) associated with the Loxton WEF considers a 300m wide corridor route from the Loxton Switching Station / Collector Station to the Gamma MTS near Hutchinson. The EGI will be located within the Central Strategic Powerline Corridor and therefore subject to a separate Basic Assessment process in accordance with GN 113 of 16 February 2018 listed under NEMA, 1998.

2. Data sources

The combined desktop and field-based palaeontological heritage study of the Loxton WEF Cluster project area is based on the following information resources:

1. A project outline, kmz files, screening report and maps provided by the project Applicant being Loxton Wind Facility 1 Pty Ltd.

2. A desktop review of:

(a) the relevant 1:50 000 scale topographic maps (3122AB Alarmkraal, 3122AD Loxton, 3122BC Schimmelfontein, 3122CB Slangfontein, 3122DA Slypfontein) and the 1:250 000 scale topographic map 3122 Victoria West);

(b) Google Earth© satellite imagery;

(c) published geological and palaeontological literature, including 1:250 000 geological map (3122 Victoria West) and the relevant sheet explanation (Le Roux & Keyser 1988), as well as

(d) several previous and on-going fossil heritage (PIA) assessments for renewable energy and transmission line projects in the Karoo region between Beaufort West, Loxton and Victoria West by the author (See References under Almond, especially Almond 2023 for the Victoria West Cluster WEFs which have a very similar geological setting to the present Loxton WEF Cluster projects).

3. The author's field experience with the formations concerned and their palaeontological heritage (*cf* Almond & Pether 2008 and PIA reports listed in the References); and

4. An eight-day palaeontological heritage survey of the combined Loxton WEF Cluster project area by the author and an experienced field assistant between 17 and 26 October 2022 of which approximately two days were spent within the Loxton WEF 1 project area. The season in which the site visit took place does not have a critical bearing on this palaeontological study. Extensive grass cover as well as locally impassable farm roads limited bedrock visibility and site access in some areas but these constraints do not markedly affect the conclusions reached in this report, confidence levels for which are rated as Medium.

3. Legislative context

All palaeontological heritage resources in the Republic of South Africa are protected by the National Heritage Resources Act (Act 25 of 1999). Heritage resource management in the Northern Cape: is 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).

The various categories of heritage resources recognised as part of the National Estate in Section 3 of the National Heritage Resources Act (Act 25 of 1999) include, among others:

- geological sites of scientific or cultural importance;
- palaeontological sites; and
- 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 agency.
(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 agency, or to the nearest local agency offices or museum, which must immediately notify such heritage resources Agency.
(4) No person may, without a permit issued by the responsible heritage resources agency—
(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 agency 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 agency 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 recently been published by SAHRA (2013) and Heritage Western Cape (2021).

4. Geological context of Loxton WEF Cluster project area

The Loxton WEF Cluster project area comprises semi-arid, gently hilly, rocky to sandy and gravelly terrain of the Upper Karoo, situated at elevations between *c*. 1390 and 1580m amsl. to the north and east of the small town of Loxton and the Loxton – Carnarvon road (R63) as well as straddling the R63 road sector between Loxton and Victoria West (1: 250 000 sheet 3122 Victoria West; 1: 50 000 sheets 3122AB Alarmskraal, 3122 AD Loxton, 3122BC Schimmelfontein, 3122CB Slangfontein, 3122DB Slypfontein). Much of the terrain is of fairly subdued, rolling relief, with occasional dolerite-capped *koppies* and ridges, especially in the south (*e.g.* Kleinberg 1534 m, Die Rooikoppie 1514 m, Rooiaar dyke just east of the project area). There are no major rivers; much of the area is drained by a network of small, mostly unnamed, non-perennial streams (*e.g.* Springbokfontein se Leegte), variously draining SW into the Loxton Dam and Biesjespoort Dam and the Soutpoortrivier or eastwards into the Klein-Brakrivier and the Bitterwaterspruit.

The geology of the WEF Cluster project area is outlined on 1: 250 000 geological sheet 3122 Victoria West (Council for Geoscience, Pretoria) (Figure 2) with a short accompanying explanation by Le Roux & Keyser (1988). The area is largely underlain at depth by continental (fluvial / lacustrine) sediments of the **Lower Beaufort Group** (Karoo Supergroup) of Middle to Late Permian age (*c*. 260 to 256 Ma = million years ago) (Johnson *et al.* 2006). The sedimentary succession in the north-western sector of the Main Karoo Basin represented here broadly gets younger from north to south. The beds here are assigned to the **Abrahamskraal Formation** and the lowermost, sandstone-rich part of the **Teekloof Formation** (**Poortjie Member**), while the overlying mudrock-dominated **Hoedemaker Member** only crops out within the associated Grid Connection corridor towards Victoria West (to be separately assessed).

The fine-scale lithostratigraphy of the Lower Beaufort Group succession in this sector of the Main Karoo Basin - including the correlation of the main channel sandstone packages such as the Moordenaars Member and Poortjie Member - remains unresolved (*cf* Day & Rubidge 2020a, Almond 2023). A major sandstone package within the upper part of the Abrahamskraal Formation in the Loxton WEF Cluster project area is tentatively correlated here with the **Moordenaars Member** while a higher-lying, thick mudrock package may be equivalent to the **Karelskraal Member**. The outcrop area of the **Poortjie Member** has probably been underestimated on the published 1: 250 000 map with several small, unmapped outliers of Poortjie sandstone to the north of the main outcrop area. Le Roux and Keyser (1988 p.6) note that the Moordenaars Member may pass directly up into the Poortjie Member in some parts of the Williston and Victoria West 1: 250 000 sheets, complicating mapping of the Abrahamskraal Formation – Teekloof Formation contact. However, a well-defined, thick Karelskraal Member package does appear to be present in the Loxton WEF 3 project area; it is recognisable on satellite images by its finely-striped outcrop area (numerous thin sedimentary cycles) which has been emphasized here by thermal metamorphism.

In this subregion of the Upper Karoo the Beaufort Group sediments are intruded by an extensive network of dyke and sill complexes of the Early Jurassic **Karoo Dolerite Suite**, especially in the southern sector of the combined WEF project area where a dolerite sill – referred to here as the Kwaggashoogte dolerite sill - intrudes close to the Abrahamskraal / Teekloof Formation contact, probably within a thick mudrock package of the lower Poortjie Member (*e.g.* Kleinberg 1534 m, Die Rooikoppie 1514 m, Rooiaar dyke just east of the project area) (Chevallier & Woodford 1999, Duncan & Marsh 2006). These intrusions have thermally metamorphosed and altered considerable volumes of the adjoining country rocks (*e.g.* where these overlie shallow, saucer-shaped intrusions), locally compromising fossil preservation as well as generating large volumes of tough quartzitic and doleritic colluvial and eluvial rubble (locally calcretised) that mantles the neighbouring potentially fossiliferous

bedrocks. Kimberlite pipes or other intrusions are not mapped within the project area itself but do occur shortly to the east (small black diamond symbols on the geological map).

Levels of tectonic deformation (including folding, cleavage development) within the wider region are probably low; satellite imagery suggests that the Beaufort Group sediments are fairly flat-lying while they are also cut by numerous small faults which are often picked out by dark lines of shrubs as well as by dolerite dykes. Regular sets of rectilinear joints are a prominent feature of quartzitic sandstone cappings in the region, the joints again being picked out on satellite images by dark shrubs.

The Permian and Jurassic bedrocks within the project area are extensively mantled by a range of **Late Caenozoic superficial deposits**, limiting exposure levels of fresh (unweathered), potentially fossiliferous Permian sediments. In addition to thick (up to several meters), gravelly to sandy alluvial sediments along numerous active or defunct drainage lines, these younger cover sediments include pan and spring deposits, gravelly debrite and inundite diamictites, colluvial (slope) and eluvial (downwasted) surface gravels dominated by clasts of quartzite, dolerite, hornfels and palaeocalcrete, pedocretes (*e.g.* calcrete hardpans, especially in doleritic terrain) *plus* a spectrum of mainly sandy to gravelly soils.

Illustrations of geological scenery and representative rock exposures within the Loxton WEF 1 project area are given below in Figures 3 to 32, together with explanatory figure legends.

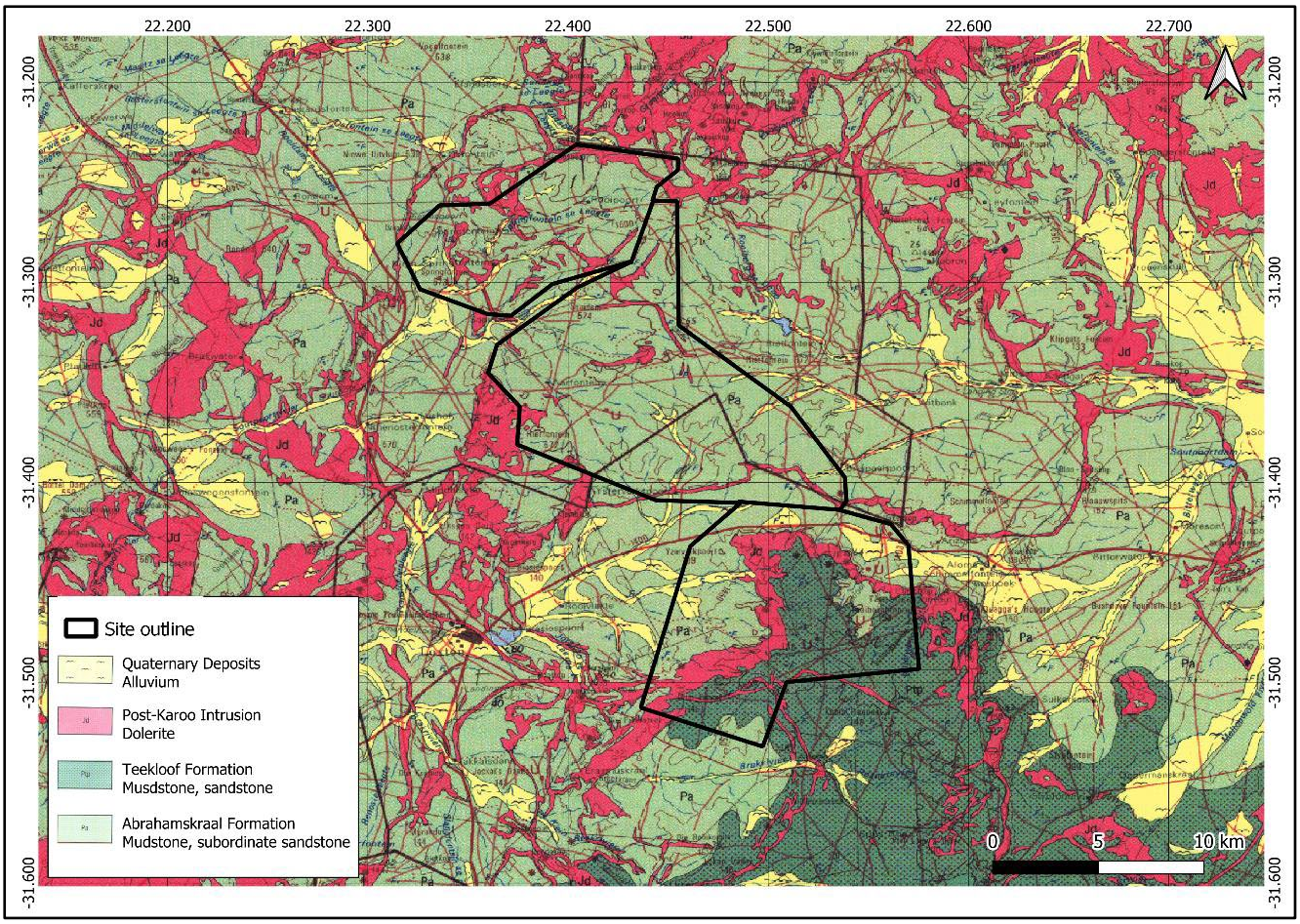

Figure 2: Extract from 1: 250 000 geology sheet 3122 Victoria West showing the location of the proposed Loxton WEF Cluster project areas between Loxton and Victoria West, Northern Cape (Base map published by the Council for Geoscience, Pretoria). The main rock units represented regionally include: Pa (pale green) = Middle to Late Permian Abrahamskraal Formation. Ptp (middle green with stipple) = Late Permian Poortjie Member, Teekloof Formation (Adelaide Subgroup). Pth (middle green without stipple) = Late Permian Hoedemaker Member, Teekloof Formation (Adelaide Subgroup). Jd (red) = dolerite sills and dykes of the Early Jurassic Karoo Dolerite Suite. Pale yellow with flying bird symbol = Late Caenozoic (Neogene / Pleistocene to Recent) alluvium. Small black diamonds – kimberlite pipes. *N.B.* The mapping of the various members within the Abrahamskraal and Teekloof Formations shown in this region is contested.

Figure 3: View south-eastwards towards the Biesiespoort dolerite ridge in the northern sector of Farm 582 RE showing the minimal level of sedimentary bedrock exposure seen in most parts of the WEF project area.

Figure 4: View northwards on Springfontein 573 RE showing low hills of baked Abrahamskraal Formation in the background and extensive sandy *vlaktes* in the foreground. The latter area is earmarked for WEF infrastructure such as the construction laydown area, O&M building, on-site substation *etc*.

Figure 5: Rugged, dolerite-capoped hillslope terrain in the central sector of Springfontein 573 RE 018 showing minimal mudrock exposure between ridges of pale brown, baked channel sandstone.

Figure 6: Dolerite-capped *koppies* of baked metasediments building a low escarpment incised by a shallow stream valley on Springfontein 573 RE. The hillslopes are mantled by doleritic and quartzitic colluvial / eluvial rubble.

Figure 7: Limited exposures of baked, greyish Abrahamskraal Formation overbank mudrocks and prominent-weathering, tabular channel sandstones (possible Moordenaars Member equivalents) on the northern margins of Springfontein 573 RE.

Figure 8: Plateau of baked Abrahamskraal Formation channel sandstones with poorly sorted eluvial sandstone rubble on the southern edge of Springfontein 573 RE. Such scenery is typical for many of the upland ridges favoured for wind turbine sites.

Figure 9: Good exposures of a thick package of brownish-weathering channel sandstones on the edge of the dam just south of Saaidam homestead (Farm 754 RE). This package might be equivalent to the Moordenaars Member within the upper part of the Abrahamskraal Formation.

Figure 10: Channel sandstone unit exposed just NW of Saaidam farmstead on Farm 574 RE – a subunit of the Moordenaaars Member package illustrated above.

Figure 11: Thin-bedded, medium-grained, yellow-brown channel sandstones of the Abrahamskraal Formation incised by a shallow cut-and-fill channel above, stream bank exposure on Farm 582 RE, *c*. 1.6 km SSE of Springfontein homestead. Hammer = 30 cm.

Figure 12: Streambed exposure of well-jointed, baked Abrahamskraal Formation sandstones on the northern sector of Farm 582 RE. Such exposures are prospected for tetrapod trackways and other trace fossils.

Figure 13: Wave-rippled crevasse splay sandstone bed top near a small farm dam on Springfontein 573 RE. Such rippled palaeosurfaces yield low diversity trace fossil assemblages (*cf* Figures 42 and 43).

Figure 14: Sandstone-capped ridge along the northern edge of Saaidam Farm 574 RE with limited gullied exposures of greyish overbank mudrocks on the underlying slopes.

Figure 15: Well-developed, lenticular, ferruginised breccio-conglomerates within a thick channel sandstone package illustrated above. Hammer = 30 cm. See following figure for more detail.

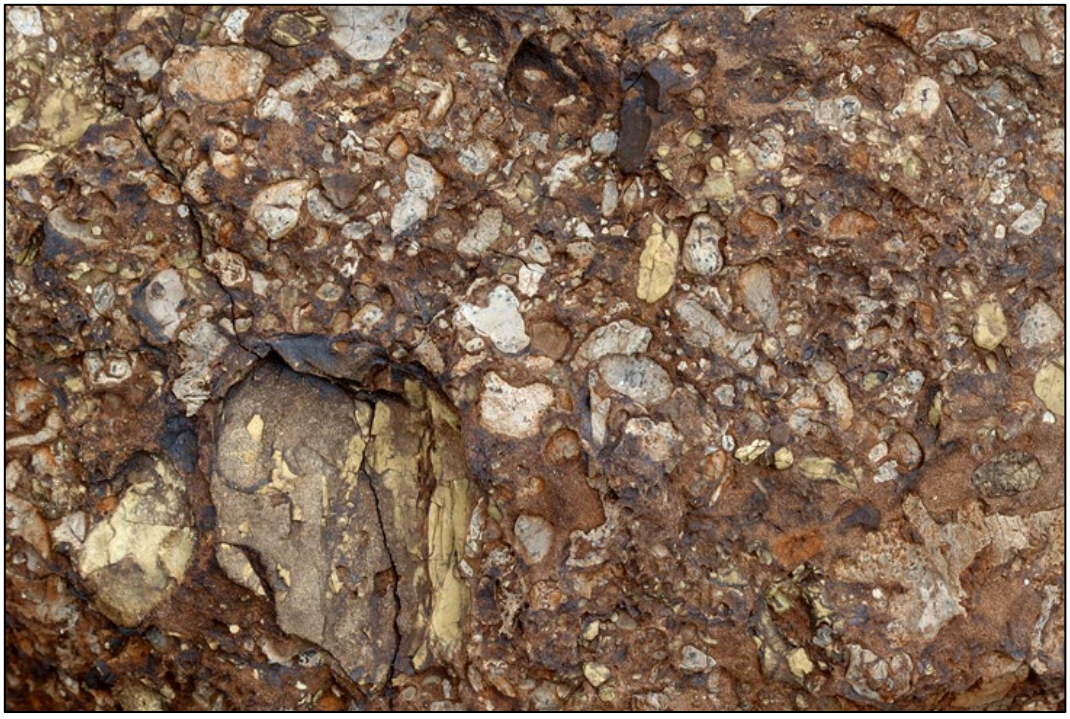

Figure 16: Close-up of the poorly-sorted, ferruginised channel breccio-conglomerates illustrated above showing predominance of pale grey clasts of reworked pedogenic calcrete as well as subordinate yellowish sandstone clasts up to 10cm in diameter. These breccias contain sparse reworked fossil bones (*cf* Figure 41).

Figure 17: Riverine cliff section through heterolithic channel margin facies of the Abrahamskraal Formation on the south-eastern portion of Farm 582 RE. Sharp-based, thin, tabular, medium-bedded sandstone packages are interbedded with massive to thin-bedded, grey-green overbank mudrock.

Figure 18: Rare extensive, gentle hillslope exposures of Abrahamskraal Formation mudrocks in the eastern sector of Springfontein 573 RE. The khaki hues and crumbly weathering of the mudrocks are typical where the bedrocks are thermally metamorphosed.

Figure 19: Lens of rusty-brown ferruginous carbonate within Abrahamskraal Formation mudrocks in the eastern sector of Springfontein 573 RE. Hammer = 30 cm. Comminuted bone breccias are recorded within comparable facies in this area.

Figure 20: Pale grey horizon of baked pedogenic limestone within the Abrahamskraal Formation on the western portion of Farm 582 RE. Such horizons are an important focus for vertebrate fossil prospecting.

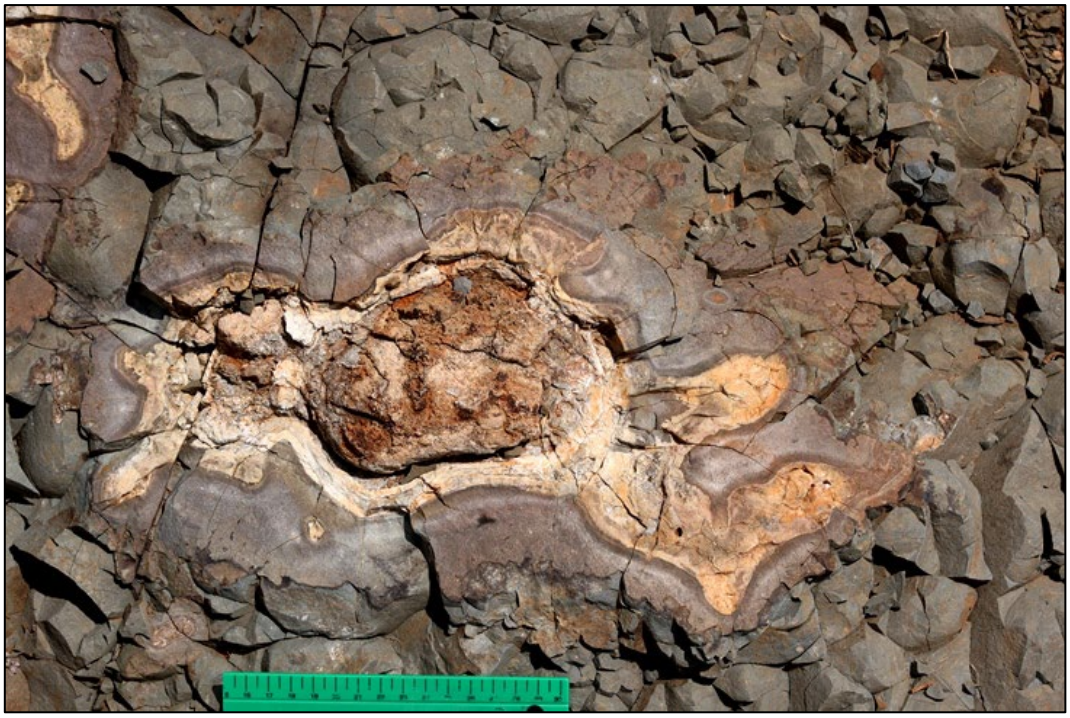

Figure 21: Pedogenic carbonate concretions within overbank mudrocks are often recrystallized and surrounded with haloes of secondary minerals in the vicinity of dolerite intrusions, as seen here on Farm Rietfontein 572 Portion 12. Scale in cm. Thermal metamorphism often destroys fossils preserved within palaeosol horizons.

Figure 22: Good streambank exposures of grey overbank mudrocks and subordinate wackes capped by a dolerite sill on the eastern margins of Rietfontein 572 Portion 12.

Figure 23: Extensive stream bed and bank exposures of jointed, grey to grey-green Abrahamskraal Formation mudrocks at the locality illustrated above.

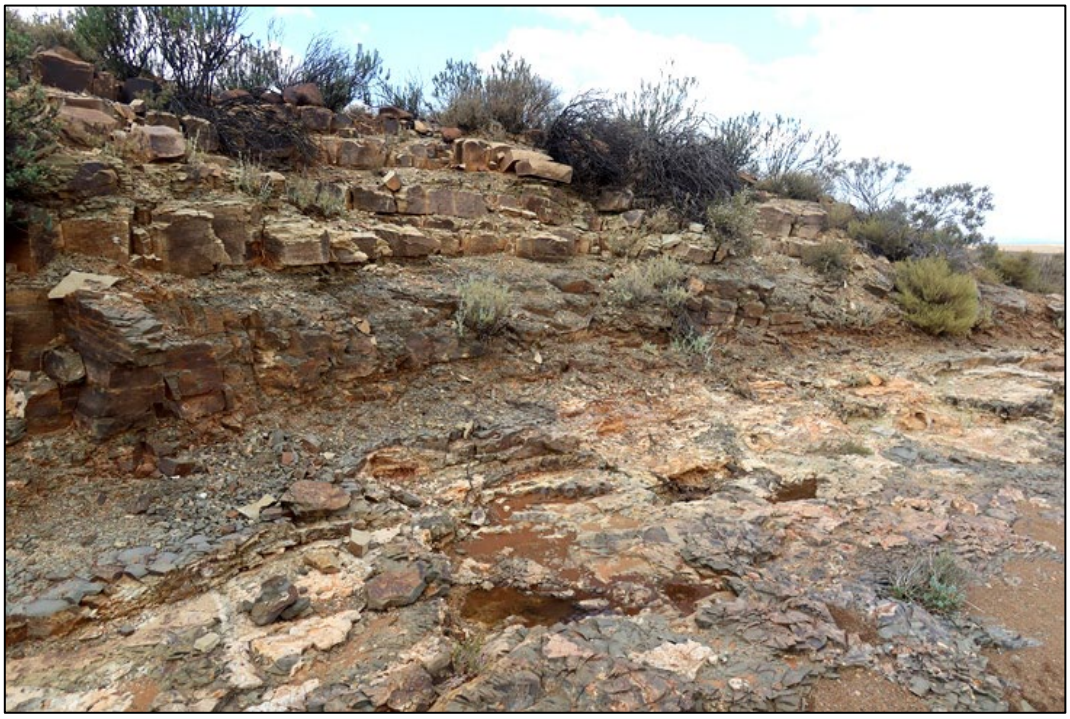

Figure 24: A close-up of the stream banks at the same locality shows that the hackly-weathering mudrocks here are baked and extensively veined with calcrete, reducing their palaeosensitivity. No fossils were recorded in this area.

Figure 25: Well-exposed thin-bedded to laminated mudrocks of the Abrahamskraal Formation deposited in a distal floodplain (and possibly lacustrine) setting, with occasional horizons of desiccation cracks and thin mudflake breccias, dam overflow just NW of Saaidam homestead on Farm 574 RE. Hammer = 30 cm.

Figure 26: Ruiniform weathering of a dolerite sill on the northern margins of Farm Rietfontein 572 Portion 12 to form a series of small castle-like *koppies* with thick, orange-brown sandy soils in lower-lying areas.

Figure 27: Rubbly "High Level Gravels" of poorly-sorted, angular to subrounded dolerite and quartzite elevated a few meters above the present-day stream bed on Springfontein 573 RE. These older alluvial deposits are probably Quaternary in age.

Figure 28: Streambank section showing several meters of orange-brown sandy alluvium mantling low-lying valley areas on Springfontein 573 RE.

Figure 29: Streambank on Springfontein 573 RE showing a section through crudely bedded, poorly-sorted, heavily calcretised alluvial deposits. Hammer = 30 cm. Calcretised rhizoliths or burrows are recorded at this locality (*cf* Figure 45).

Figure 30: Rubbly, partially calcretised older alluvial gravels overlain by younger, unconsolidated gravels and sands in a stream bank on Farm 582 RE. Hammer = 30 cm.

Figure 31: Large portions of low-lying, low relief *vlaktes* within the WEF project area are mantled at surface by various types of alluvial or eluvial gravels, as here on the south-western portion of Springfontein 573 RE.

Figure 32: Close-up of the surface gravels illustrated above, here mainly comprising subrounded, rusty-brown dolerite corestones and subangular clasts of paler quartzite with minor greyish carbonate concretion material. Hammer = 30 cm.

5. Palaeontological heritage context

The Middle to Late Permian Abrahamskraal and Teekloof Formation bedrocks in the combined Loxton Cluster study area are characterised by fossil assemblages of the ***Tapinocephalus* and *Endothiodon* Assemblage Zones** (the latter was previously termed the *Pristerognathus* and *Tropidostoma* Assemblage Zones (Kitching 1977, Keyser & Smith 1977-78, Rubidge 1995, Rubidge 2005, Van der Walt *et al.* 2010, Smith *et al.* 2012, Smith *et al.* 2020, Day & Rubidge 2020b, Day & Smith 2020) (Figures 33 and 34). They include a wide range of fossil tetrapods - especially reptiles and therapsids ("mammal-like reptiles" or protomammals"") - as well as fish, amphibians, plant remains (*e.g.* petrified wood, plant compressions), microfossils and trace fossils (*e.g.* vertebrate and invertebrate burrows, trackways). These fossil assemblages and the sedimentary bedrocks within which they occur are of special scientific interest because they span the environmentally critical boundary between the Middle and Late Permian Periods which was associated with the catastrophic end-Capitanian Mass Extinction Event of *c*. 260 Ma (million years ago) (Day *et al.* 2015).

Only a few historical vertebrate fossil sites are mapped near Loxton on the published 1: 250 000 geological map and in the key early review by Kitching (1977). The Karoo fossil vertebrate site map of Nicolas (2007) shows low density of fossil records east of Loxton with just a few sites recorded south and north of the town (Figure 35). The region between Loxton and Victoria West is the subject of ongoing palaeontological research by Professor Bruce Rubidge of the Evolutionary Studies Institute (ESI), Wits University as well as Dr Mike Day of the Natural History Museum, London. Important concentrations of fossil sites are known *c.* 20 km east of the WEF project area near Melton Wold and west of Gamma Substation as a result of a long history of palaeontological fieldwork in the Biesiespoort area (close to the eastern sector of the associated Grid Connection Corridor). Recent palaeontological fieldwork by the present author for WEF and SEF project areas in the broader Loxton – Victoria West – Beaufort West region (*e.g.* Nuweveld WEFs, Hoogland WEFs, Modderfontein WEF, Victoria West WEF Cluster, Skietkuil / iLanga project areas – see References under Almond) and earlier research by other Karoo palaeontologists (*e.g.* Smith 1993) suggest that unrecorded fossil sites of scientific and conservation value are likely to occur here. However, vertebrate fossil records are often sparse in areas intruded by dolerite. New tetrapod fossil finds within the project area should help resolve outstanding lithostratigraphic ambiguities in the region as well as contributing to on-going scientific research concerning palaeoenvironmental and evolutionary events before and during the catastrophic end-Middle Permian Extinction Event of *c*. 260 million years ago as well as during the succeeding biotic recovery (Retallack *et al.* 2006, Day *et al.* 2015).

Most of the varied Late Caenozoic superficial sediments within the project area are largely of low palaeosensitivity. However, relict and often consolidated older (Neogene / Pleistocene) alluvial deposits along drainage lines might contain sporadic fossil assemblages of mammals (bones, teeth, horn cores), freshwater invertebrates (*e.g.* unionid bivalves) and trace fossils (*e.g.* calcretised termitaria, rhizoliths / plant root casts).

6. New palaeontological heritage data (Loxton WEF 1)

New fossil sites recorded within the Loxton WEF 1 project area are tabulated with gps data, brief description, provisional Field Rating and any recommended mitigation in Appendix 1 where the sites are also mapped with reference to the provisional WEF layout (Figures A1.1 and A1.2). Selected fossil sites are illustrated below in Figures 36 to 45, together with explanatory legends.

Only six fossil occurrences were recorded during the approximately 2-day site visit to the Loxton WEF 1 project area, indicating that this area is of low palaeosensitivity overall. Fieldwork mainly focussed on the very limited exposures of Lower Beaufort Group mudrocks (here entirely mapped within the

Abrahamskraal Formation outcrop area) but representative exposures of Beaufort Group sandstones, older alluvial deposits and surface gravels were also examined for palaeontological material.

The only vertebrate fossil remains recorded comprised comminuted and disarticulated bone fragments of small to medium-sized tetrapods preserved (1) within ferruginous carbonate horizons and (2) calcrete-dominated channel breccia lenses (Figures 36 to 41). The former probably represents suncracked skeletal material which had been exposed for a considerable time on the ancient Karoo floodplain before being swept by sheetwash currents into shallow depressions and preserved there within diagenetic carbonate. The partial long bone embedded within channel breccio-conglomerate was swept into a river channel and became incorporated into a riverbed gravel lag. All this tetrapod material is probably too poorly preserved to be identifiable.

Two of the very few vertebrate fossil sites were recorded from mudrock and sandstone facies on the upper slopes of a sandstone-capped ridge on the northern margins of Saaidam Farm 574 RE (See Appendix 1, satellite map Figure A1.2). Intermittent exposures of Abrahamskraal Formation mudrocks around this ridge (greyish on satellite images) might yield further vertebrate fossils in future; these exposures are not directly threatened by the proposed WEF development and could not be fully prospected due to time constraints.

Low diversity trace fossil assemblages are seen on wave-rippled as well as planar tops of crevasse splay sandstone units (Figures 42 to 44). These burrows are ascribed to small invertebrates (*e.g.* insects, worms), are poorly preserved, widely occurring and of limited scientific interest.

The only fossils recorded from the Late Caenozoic superficial sediments are local concentrations of vertical to inclined, calcretised root structures (rhizoliths) and possible burrows that are preserved within consolidated older alluvial deposits (Figure 45). These trace fossils occur wisely within Late Caenozoic alluvium in the Karoo and are of limited conservation value.

None of the very few new fossil sites recorded within the Loxton WEF 1 project area are of significant scientific or conservation value. The only site which lies very close to the proposed WEF footprint (Site 007) comprises poorly-preserved invertebrate trace fossils of little scientific interest. No known significant or unique palaeontological heritage sites are threatened by the proposed development.

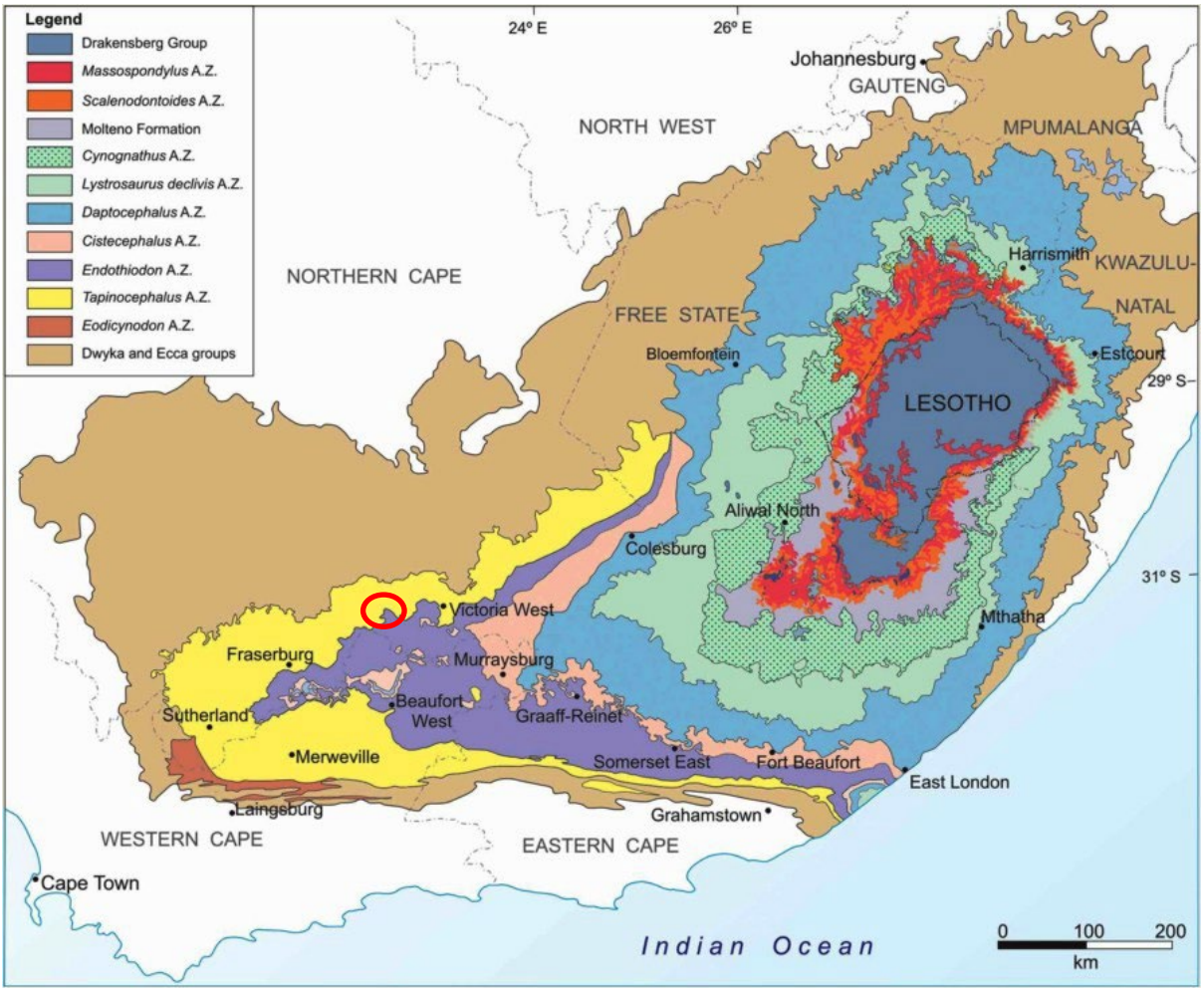

Figure 33: The latest fossil biozonation map for the Main Karoo Basin (Smith *et al.* 2020) shows the occurrence of Mid to Late Permian fossil assemblages of the *Tapinocephalus* Assemblage Zone and perhaps also the succeeding *Endothiodon* Assemblage Zone in the Loxton WEF Cluster project area (small red ellipse).

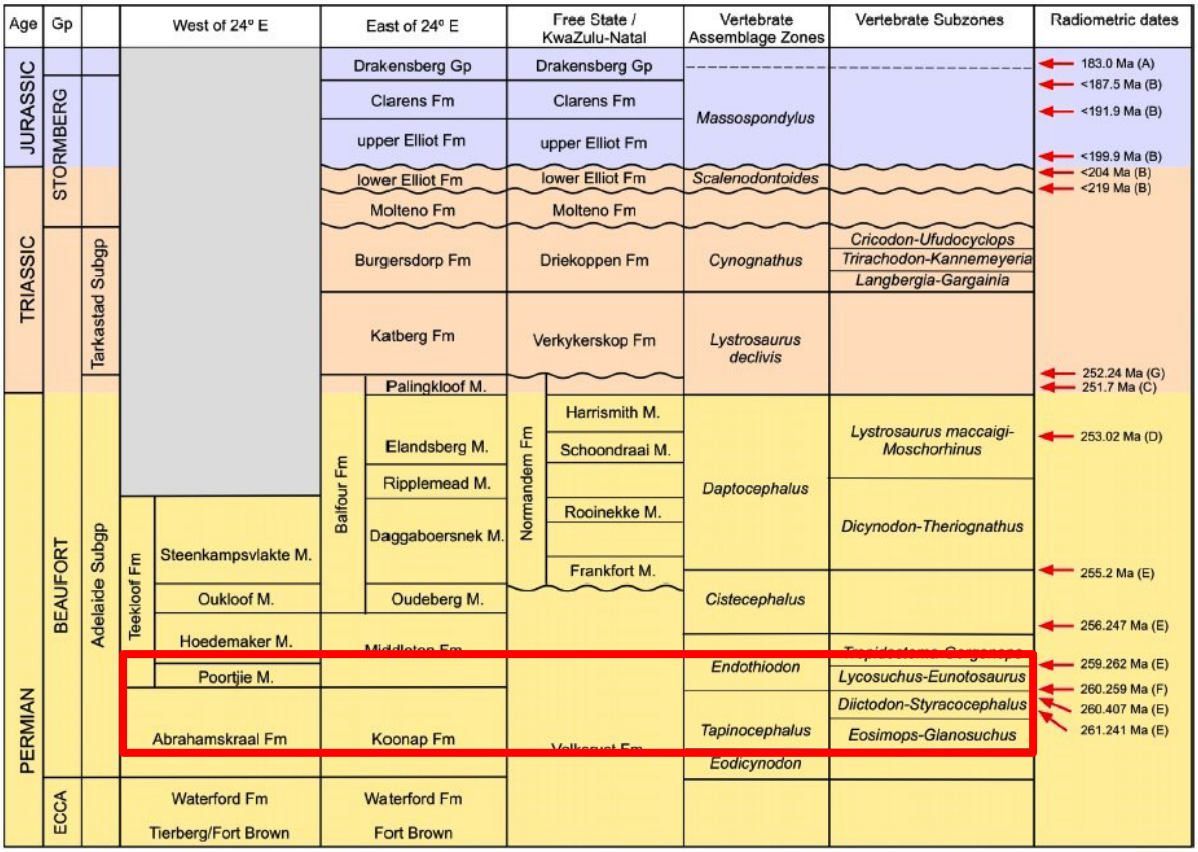

Figure 34: Chart showing the latest, revised fossil biozonation of the Lower Beaufort Group of the Main Karoo Basin (abstracted from Smith *et al.* 2020). Rock units and fossil assemblage zones mapped within the Loxton WEF Cluster project area are outlined in red respectively. The Hoedemaker Member is only present within the associated Grid Connection corridor (to be assessed separately). The detailed mapping of these lithostratigraphic and biostratigraphic units within the present project area between Loxton and Beaufort West is unresolved at present.

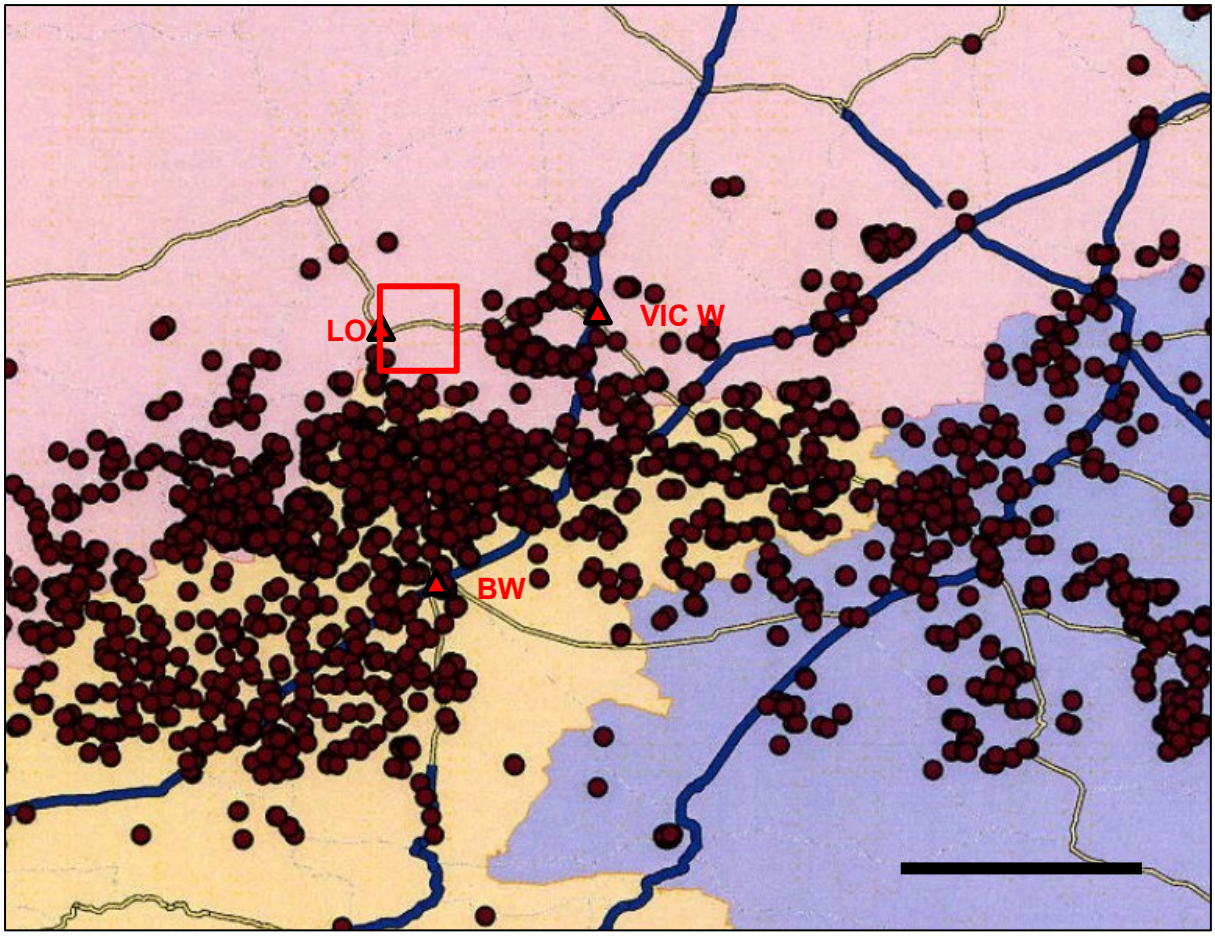

Figure 35: Distribution map of recorded vertebrate fossil sites within the Lower Beaufort Group of the Great Karoo between Loxton (LOX), Victoria West (VIC W) and Beaufort West (BW), showing the very *approximate* outline of the study area for the Loxton WEF Cluster within the red rectangle (map abstracted from Nicolas 2007). Note the scarcity of known sites in the area just to the east of Loxton, with a few sites recorded just to the north and south of the town. The abundance of known fossil sites close to the N1 to the northeast of Three Sisters and south of Victoria West reflects in part the long history (> 100 years) of fossil collection by both academics as well as knowledgeable amateurs at sites close to Biesiespoort Station. Scale bar = 10 km. N towards the top of the image.

Figure 36: Thin (*c.* 10-15cm) lens of rusty-brown, ferruginous carbonate rich in bone breccia situated at the base of a thin sandstone bed, Abrahamskraal Formation on Saaidam Farm 574 RE (Loc. 044). Scale = 15 cm. The following four figures show downwasted blocks from this breccia lens.

Figure 37: Several blocks of bone breccia within a ferruginous carbonate matrix downwasted from the lens illustrated above (Loc. 044). Scale = 15 cm.

Figure 38: Close-up of one of the breccia blocks illustrated above showing intense sun-cracking of bone exposed on the ancient Karoo floodplain (Loc. 044).

Figure 39: Additional bone breccia blocks from Loc. 044 showing dense concentration of disarticulated bones (*e.g.* ribs) of a moderate-sized tetrapod within some layers. Scale in cm and mm.

Figure 40: Close-up of breccia block from Loc. 044 (*c*. 7.5 cm thick) showing highly comminuted, dispersed bone fragments.

Figure 41: Close-up of well-developed, *in situ* ferruginised breccia within a sandstone package of the Abrahamskraal Formation containing fragmentary reworked long bone of a small-bodied tetrapod (arrowed), Saaidam Farm 574 RE (Loc. 046). Scale in cm and mm. See also Figure 15 for context.

Figure 42: Wave-rippled bed top of a crevasse splay sandstone of the Abrahamskraal Formation on Springfontein 573 RE (Loc. 007) showing a network of possible sinuous invertebrate burrows. Scale in cm and mm. See Figure 13 for context.

Figure 43: Close-up of the wave-rippled surface illustrated above. Some of the branching structures seen might be small-scale mudcrack infills rather than trace fossils.

Figure 44: Sandstone bedding plane of the Abrahamskraal Formation on Farm 582 RE showing poorly-preserved, small-scale trace fossils of burrowing invertebrates (Loc. 031). Hammer = 30 cm. See Figure 12 for context.

Figure 45: Calcretised gravelly alluvium of Late Caenozoic age containing vertical and oblique subcylindrical structures that are probably rhizoliths (root casts or moulds) but in some cases might be burrows, Farm Springfontein 573 RE (Loc. 005). Hammer = 30 cm. See also Figure 29 for context.

7. Palaeontological heritage site sensitivity verification

Provisional sensitivity mapping using the DFFE Screening Tool (Figures 46 and 47) as well as the SAHRIS palaeosensitivity map (SAHRIS Website) suggests that most of the combined Loxton WEF Cluster project area is of **Very High Palaeosensitivity**, primarily based on the presence here of potentially fossiliferous Lower Beaufort Group bedrocks. Thick alluvial deposits are assigned a **Medium Sensitivity** while dolerite intrusions are **Insensitive** (*i.e.* unfossiliferous). Based on (1) recent experience with WEF projects in the broader region (notably the Victoria West WEF Cluster immediately to the east), (2) desktop analysis of vertebrate fossil sites in the Main Karoo Basin, as well as the recent eight-day palaeontological heritage of the Loxton WEF Cluster project area, this preliminary palaeosensitivity mapping is critically re-assessed in this report.

Fossil site maps for the region between Loxton and Victoria West (*e.g.* Nicolas 2007; Figure 35 herein) show a paucity of sites within the Loxton WEF Cluster project area. This cannot be attributed simply to the lack of palaeontological fieldwork in the area, however. Recent palaeontological field surveying shows that:

(1) Levels of Beaufort Group bedrock exposure are very limited here due to pervasive cover by Late Caenozoic superficial sediments (*e.g.* colluvial and eluvial gravels, alluvial soils);

(2) Intensive intrusion by dolerite sills and dykes has altered the sedimentary country rocks through thermal metamorphism and hydrothermal activity (*viz*. circulation of hot, mineralizing ground waters) which has compromised fossil preservation over large areas;

(3) The Beaufort Group bedrocks represented here (uppermost Abrahamskraal Formation – Poortjie Member interval) span the catastrophic end-Middle Permian Extinction Event which is associated with an unusually low abundance of well-preserved fossil remains. Over the course of eight days, only a handful of fossil sites were recorded within Beaufort Group bedrocks underlying the WEF Cluster project area, the majority of which are poorly preserved and of limited scientific or conservation significance. Even occasional small areas showing excellent, fresh (*i.e.* unweathered) mudrock exposure ideal for palaeontological recording yielded hardly any fossils. Almost no fossil sites were recorded within the Late Caenozoic superficial deposits.

While additional, unrecorded fossil sites of high palaeontological and conservation value are likely to occur at and beneath the land surface within the Loxton WEF Cluster project areas, they are probably very sparse and sporadic in distribution and can be effectively handled in the Construction Phase through a Chance Fossil Finds Protocol (See Appendix 1). All the recorded sites can, if necessary, be effectively mitigated in the preconstruction phase.

It is concluded that the palaeosensitivity of the combined Loxton WEF Cluster project area is, in practice, LOW. The provisional palaeosensitivity mapping by the DFFE Screening Tool is accordingly *contested* in this report.

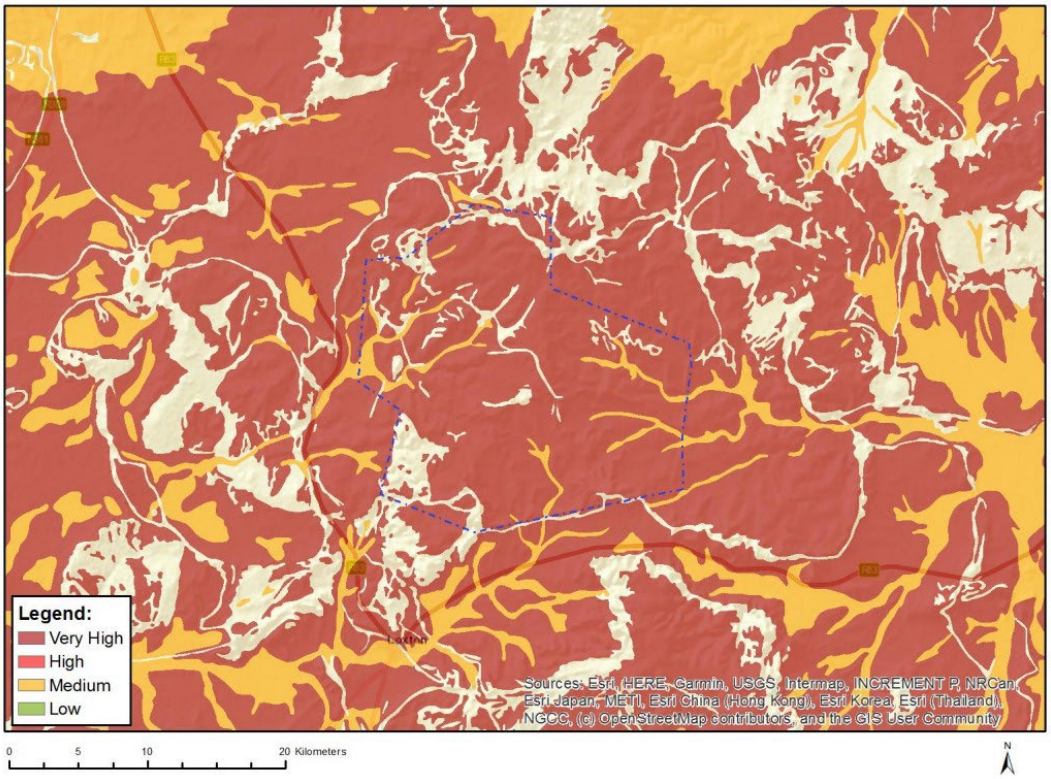

Figure 46: Provisional palaeosensitivity mapping of the northern sector of the Loxton WEF Cluster project area using the DFFE Screening Tool. The Very High sensitivity of most of the project area is *contested* in this report.

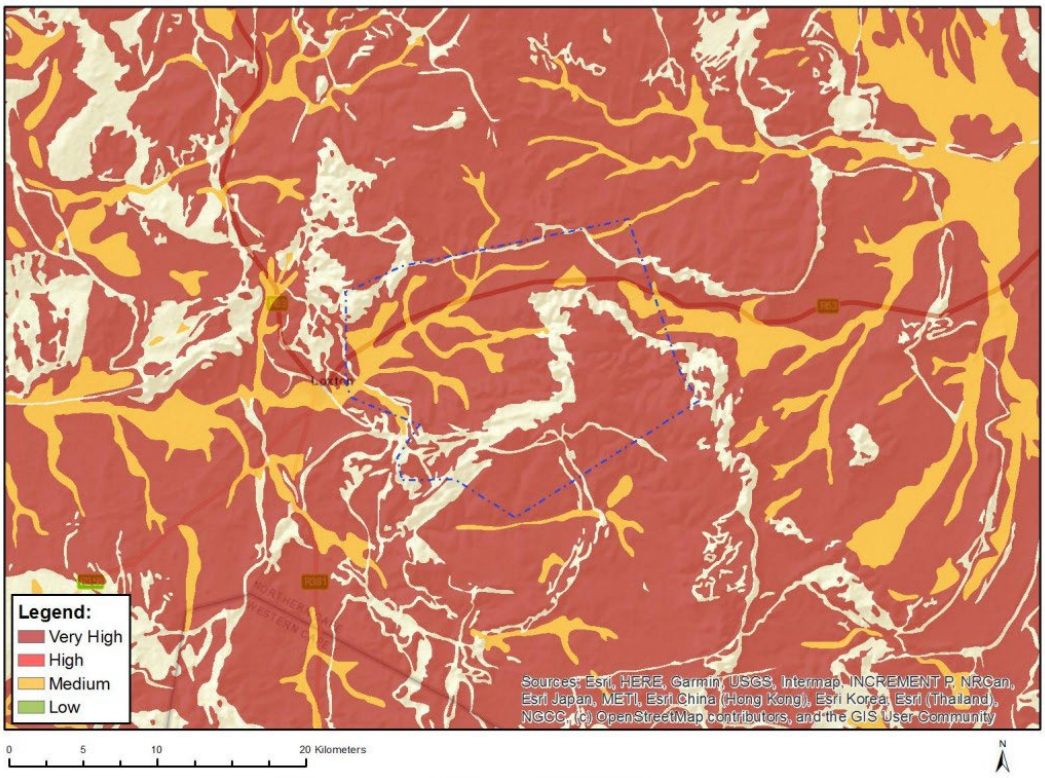

Figure 47: Provisional palaeosensitivity mapping of the southern sector of the Loxton WEF Cluster project area using the DFFE Screening Tool. The Very High sensitivity of most of the project area *contested* in this report.

8. Potential impacts on palaeontological heritage and mitigation

The proposed Loxton WEF Cluster projects will involve substantial surface clearance and bedrock excavations - for example for wind turbine foundations, access road networks, underground cables, construction laydown areas/camps, operation & maintenance buildings, on-site substations and electrical pylon footings - which may disturb, damage or destroy legally projected palaeontological heritage resources of scientific and conservation value.

None of the very few new fossil sites recorded within the Loxton WEF 1 project area are of significant scientific or conservation value. The only site which lies very close to the proposed WEF footprint (Site 007 situated very close to or within the access road footprint) comprises poorly-preserved invertebrate trace fossils of little scientific interest (see Appendix 1). No known significant or unique palaeontological heritage sites are threatened by the proposed development.

Despite the substantial project footprints as well as the known occurrence of important vertebrate and other fossil sites elsewhere in the wider region between Loxton and Victoria West, **the impact significance of the proposed renewable energy developments on local palaeontological heritage is anticipated to be LOW.** This is based on the inferred Low Palaeosensitivity of the project area overall based on desktop and field-based data, as motivated above. These impacts, including cumulative impacts considering other renewable energy projects in the broader region (*e.g.* Victoria West WEF Cluster), are expected to fall within acceptable limits.

The potential for unrecorded palaeontological sites of scientific and conservation value cannot be completely excluded, however. These are best mitigated through the application of a Chance Fossil Finds Protocol by the ECO / ESO during the Construction Phase (See Appendix 2) which should be incorporated into the EMPrs for the WEF developments. The qualified palaeontologist responsible for mitigation work will need to apply for a Fossil Collection Permit for the Northern Cape from SAHRA. Minimum standards for PIA reports have been compiled by Heritage Western Cape (2021) and SAHRA (2013).

9. Conclusions and recommendations

Historical palaeontological site mapping for the region between Loxton and Victoria West reveals a paucity of recorded vertebrate fossil sites within the Loxton WEF Cluster project area. This is supported by recent palaeontological field surveying, both here and in neighbouring WEF project areas (e.g. Victoria West WEF Cluster studied by Almond 2023), which shows that:

(1) Levels of Beaufort Group bedrock exposure – especially the potentially most fossiliferous mudrock facies - are very limited here due to pervasive cover by Late Caenozoic superficial sediments;

(2) Intensive intrusion by dolerite sills and dykes has compromised fossil preservation over large areas;

(3) The Beaufort Group bedrocks represented here span the catastrophic end-Middle Permian Extinction Event which is associated with an unusually low abundance of well-preserved fossil remains. Over the course of eight days, only a handful of fossil sites were recorded within the entire WEF Cluster project area, the majority of which are poorly preserved and of limited scientific or conservation significance. Even occasional small areas showing excellent, fresh mudrock exposure ideal for palaeontological recording yielded hardly any fossils. Almost no fossil sites were recorded within the Late Caenozoic superficial deposits.

None of the very few new fossil sites recorded within the Loxton WEF 1 project area are of significant scientific or conservation value and no mitigation is recommended here with regard

to these known sites (Appendix 1). The only site which lies very close to the proposed WEF footprint (Site 007) comprises poorly-preserved invertebrate trace fossils of little scientific interest. No known significant or unique palaeontological heritage sites are threatened by the proposed WEF development.

While additional, unrecorded fossil sites of high palaeontological and conservation value are likely to occur at and beneath the land surface within the Loxton WEF Cluster project areas, they are probably very sparse and sporadic in distribution and can be effectively handled in the Construction Phase through a Chance Fossil Finds Protocol (See Appendix 2) which should be incorporated into the Environmental Management Programmes for the Loxton Cluster WEF developments. All the recorded sites can, if necessary, be effectively mitigated in the preconstruction phase.

It is concluded that the palaeosensitivity of the combined Loxton WEF Cluster project area is, in practice, LOW. The provisional palaeosensitivity mapping by the DFFE Screening Tool is accordingly *contested* in this report.

Despite the substantial WEF project footprints as well as the known occurrence of important vertebrate and other fossil sites elsewhere in the wider region between Loxton and Victoria West, **the impact significance of the proposed renewable energy developments on local palaeontological heritage is anticipated to be LOW.** These impacts, including cumulative impacts considering other renewable energy projects in the broader region (*e.g.* the adjoining Victoria West WEF Cluster), are expected to fall within acceptable limits. **There are therefore no objections on palaeontological heritage grounds to authorisation of the Loxton WEF Cluster developments, including the Loxton WEF 1 project considered in this report.**

The potential for unrecorded palaeontological sites of scientific and conservation value cannot be completely excluded. These are best mitigated through the application of a Chance Fossil Finds Protocol by the ECO / ESO during the Construction Phase (See Appendix 2). The qualified palaeontologist responsible for mitigation work will need to apply for a Fossil Collection Permit for the Northern Cape from SAHRA. Minimum standards for PIA reports have been compiled by Heritage Western Cape (2021) and SAHRA (2013).

10. Acknowledgements

The Project Applicant, is thanked for commissioning this palaeontological heritage study and for supplying the necessary project information. I am grateful to the landowner of the Farm Saaidam for facilitating the fieldwork as well as to Ms Madelon Tusenius of *Natura Viva* cc for logistical support, palaeontological input and companionship in the field.

11. Key references

ALMOND, J.E. & PETHER, J. 2008. Palaeontological heritage of the Northern Cape. Interim SAHRA technical report, 124 pp. Natura Viva cc., Cape Town.

ALMOND, J.E. 2015. Proposed Noblesfontein 3 Wind Energy Facility near Three Sisters, Central Karoo District, Western Cape. Palaeontological specialist assessment: desktop study, 26 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020a. Proposed Redcap Nuweveld North Wind Farm, Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop and field-based palaeontological report, 113 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020b. Proposed Redcap Nuweveld East Wind Farm, Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop and field-based palaeontological report, 114 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020c. Proposed Redcap Nuweveld West Wind Farm, Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. Palaeontological heritage assessment: combined desktop and field-based palaeontological report, 115 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2020d. Grid connection for the proposed Redcap Nuweveld Wind Farms, Beaufort West Local Municipality, Central Karoo District Municipality, Western Cape. Palaeontological heritage assessment: desktop and field-based palaeontological report, 95 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2021. Proposed Modderfontein Wind Energy Facility near Victoria West, Central Karoo and Pixley Ka-Seme Districts, Western Cape & Northern Cape Provinces. Palaeontological specialist assessment: combined desktop and field-based study, 68 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2022a. Northern Cluster: Hoogland 1 Wind Farm, Hoogland 2 Wind Farm and associated Hoogland Northern Grid Connection, Western Cape Province. Combined desktop and field-based palaeontological heritage assessment, 120 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2022b. Proposed Gamma 400 kV Gridline Project. Palaeontological Heritage, 76 pp. Natura Viva cc, Cape Town.

ALMOND, J.E. 2023. Victoria West Renewable Energy Cluster, Ubuntu Local Municipality (Pixley ka Seme District Municipality), Northern Cape Province, RSA. Palaeontological Heritage: Combined Desktop and Field-based Assessment, 95 pp. Natura Viva cc, Cape Town.

CHEVALLIER, L. & WOODFORD, A. 1999. Morpho-tectonics and mechanism of emplacement of the dolerite rings and sills of the western Karoo, South Africa. South African Journal of Geology 102, 43-54.

DAY, M.O., RAMEZANI, J., BOWRING, S.A., SADLER, P.M., ERWIN, D.H., ABDALA, F. & RUBIDGE, B.S. 2015. When and how did the terrestrial mid-Permian mass extinction occur? Evidence from the tetrapod record of the Karoo Basin, South Africa. Proc. R. Soc. B 282: 20150834. http://dx.doi.org/10.1098/rspb.2015.0834

DAY, M.O. & RUBIDGE, B.S. 2020a. Biesiespoort revisted: a case study on the relationship between tetrapod assemblage zones and Beaufort lithostratigraphy south of Victoria West. Palaeontologia Africana 53, 51-65.

DAY, M.O. & RUBIDGE, B.S.. 2020b. Biostratigraphy of the *Tapinocephalus* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 149 - 164.

DAY, M.O. & SMITH, R.M.S. 2020. Biostratigraphy of the *Endothiodon* Assemblage Zone (Beaufort Group, Karoo Supergroup), South Africa. South African Journal of Geology 123, 164 - 180.

DUNCAN & MARSH 2006. The Karoo Igneous Province. In: Johnson, M.R., Anhaeusser, C.R. & Thomas, R.J. (Eds.) The geology of South Africa, pp. 501-520. Geological Society of South Africa, Marshalltown.

HERITAGE WESTERN CAPE 2021. Guide for minimum standards for archaeology and palaeontology reports submitted to Heritage Western Cape - June 2021, 6 pp.

JOHNSON, M.R., VAN VUUREN, C.J., VISSER, J.N.J., COLE, D.I., WICKENS, H. DE V., CHRISTIE, A.D.M., ROBERTS, D.L. & BRANDL, G. 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson. M.R., Anhaeusser, C.R. & Thomas, R.J. (eds.) The geology of South Africa, pp. 461-499. Geological Society of South Africa, Johannesburg & the Council for Geoscience, Pretoria.

KEYSER, A.W. & SMITH, R.M.H. 1977-78. Vertebrate biozonation of the Beaufort Group with special reference to the Western Karoo Basin. Annals of the Geological Survey of South Africa 12: 1-36.

KITCHING, J.W. 1977. The distribution of the Karroo vertebrate fauna, with special reference to certain genera and the bearing of this distribution on the zoning of the Beaufort beds. Memoirs of the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand, No. 1, 133 pp (incl. 15 pls).

LE ROUX, F.G. & KEYSER, A.W. 1988. Die geologie van die gebied Victoria-Wes. Explanation to 1: 250 000 geology Sheet 3122, 31 pp. Council for Geoscience, Pretoria.

NICOLAS, M.V. 2007. Tetrapod diversity through the Permo-Triassic Beaufort Group (Karoo Supergroup) of South Africa. Unpublished PhD thesis, University of Witwatersrand, Johannesburg.

RETALLACK, G.J., METZGER, C.A., GREAVER, T., HOPE JAHREN, A., SMITH, R.M.H. & SHELDON, N.D. 2006. Middle – Late Permian mass extinction on land. GSA Bulletin 118, 1398-1411.

ROSSOUW, L. 2019. Exemption from further Heritage Impact Assessment: Rectification in terms of Section 24G for Residential Development in Loxton, Northern Cape Province, 11pp. Palaeo Field Services, Langenhoven Park.

RUBIDGE, B.S. (Ed.) 1995. Biostratigraphy of the Beaufort Group (Karoo Supergroup). South African Committee for Biostratigraphy, Biostratigraphic Series No. 1., 46 pp. Council for Geoscience, Pretoria.

RUBIDGE, B.S. 2005. Re-uniting lost continents – fossil reptiles from the ancient Karoo and their wanderlust. 27th Du Toit Memorial Lecture. South African Journal of Geology 108, 135-172.

SAHRA 2013. Minimum standards: palaeontological component of heritage impact assessment reports, 15 pp. South African Heritage Resources Agency, Cape Town.

SMITH, R.M.H. 1993. Vertebrate taphonomy of Late Permian floodplain deposits in the southwestern Karoo Basin of South Africa. Palaios 8, 45-67.

SMITH, R., RUBIDGE, B. & VAN DER WALT, M. 2012. Therapsid biodiversity patterns and paleoenvironments of the Karoo Basin, South Africa. Chapter 2 pp. 30-62 in Chinsamy-Turan, A. (Ed.) Forerunners of mammals. Radiation, histology, biology. xv + 330 pp. Indiana University Press, Bloomington & Indianapolis.

SMITH, R. M. H., RUBIDGE, B. S., DAY, M. O., & BOTHA, J. 2020. Introduction to the tetrapod biozonation of the Karoo Supergroup. South African Journal of Geology 123(2), 131–140. doi:10.25131/sajg.123.0009

VAN DER WALT, M., DAY, M., RUBIDGE, B., COOPER, A.K. & NETTERBERG, I. 2010. A new GIS-based biozone map of the Beaufort Group (Karoo Supergroup), South Africa. Palaeontologia Africana 45, 1-5.

12. Outline of specialist's experience

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 the University of Tübingen in Germany, and has carried out palaeontological research in Europe, North America, the Middle East as well as North and South Africa and Madagascar. 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 numerous palaeontological impact assessments for developments and conservation areas in the Western, Eastern and Northern Cape, Limpopo, Northwest Province, Mpumalanga, Gauteng, KwaZulu-Natal and the Free State under the aegis of his Cape Town-based company *Natura Viva* cc. He has served as a 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**

APPENDIX 1: LOXTON WEF 1 – NEW FOSSIL SITE DATA (October 2022)

All GPS readings were taken in the field using a hand-held Garmin GPSmap 64s instrument. The datum used is WGS 84.

See Figures A1.1 and A1.2 below for satellite maps showing the distribution of new fossil localities in relation to the proposed WEF infrastructure layouts.

Please note that:

- Locality data for South African fossil sites in *not* for public release, due to conservation concerns.
- The table does *not* represent all potential fossil sites within the WEF project area but only those sites recorded during the site visits. The absence of recorded fossil sites in any area therefore does *not* mean that no fossils are present there.
- The detailed stratigraphic data for each site is provisional (based in part on the published CGS 1: 250 000 geology sheet which requires revision) and has yet to be confirmed.

Loc	GPS data	Comments
LOXTON WEF 1		
005	-31.296344° 22.363090°	Springfontein 573 RE Abrahamskraal Formation Calcretised gravelly alluvium of Late Caenozoic age containing vertical and oblique subcylindrical structures that are probably rhizoliths (root casts or moulds) but in some cases might be burrows. Proposed Field Rating IIIC. No recommended mitigation.
007	-31.291296° 22.364557°	Springfontein 573 RE Abrahamskraal Formation Wave-rippled bed top of a crevasse splay sandstone showing a network of possible sinuous invertebrate burrows (possibly also small-scale mud crack infills). Proposed Field Rating IIIC. No recommended mitigation.
020	-31.284193° 22.403343°	Springfontein 573 RE Abrahamskraal Formation Finely-comminuted bone breccia within ferruginous carbonate concretions within mudrock package. Proposed Field Rating IIIC. No recommended mitigation.
031	-31.265990° 22.349251°	Farm 582 RE Abrahamskraal Formation Sandstone bedding plane showing poorly-preserved, small-scale trace fossils of burrowing invertebrates. Proposed Field Rating IIIC. No recommended mitigation.
044	-31.297790° 22.399572°	Saaidam Farm 574 RE Abrahamskraal Formation Thin (*c.* 10-15cm) lens of rusty-brown, ferruginous carbonate rich in bone breccia situated at the base of a thin sandstone bed. Proposed Field Rating IIIB. No recommended mitigation.
046	-31.298180° 22.399874°	Saaidam Farm 574 RE Abrahamskraal Formation Well-developed, *in situ* ferruginised breccia within a sandstone package of the Abrahamskraal Formation containing fragmentary reworked long bone of a small-bodied tetrapod. Proposed Field Rating IIIB. No recommended mitigation.

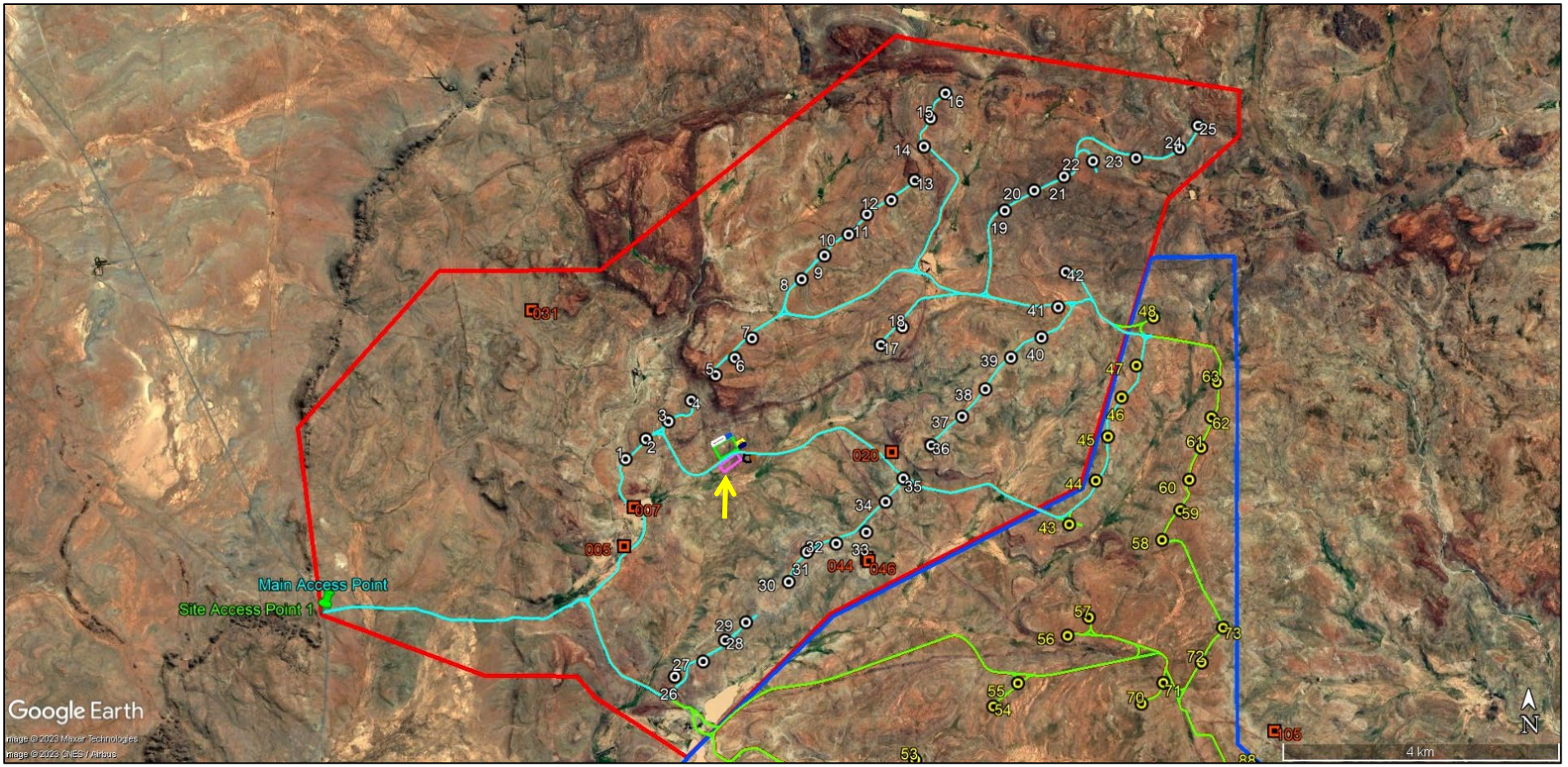

Figure A1.1: Google Earth© satellite image of the Upper Karoo region NNE of Loxton, Northern Cape showing the Loxton WEF 1 project area (red polygon) and fossil sites (numbered red squares) in relation to the provisional WEF layout (numbered white circles = wind turbine locations; pale blue lines = access road network; arrowed cluster of rectangles = laydown area, O&M building, on-site substation, BESS *etc*). None of the recorded fossil sites is of significant scientific or conservation value (see table above). Apart from the low-significance site 007, none of the known sites lies within or close to (< 20 m) the WEF project footprint and no mitigation is recommended here with regard to these sites. The sparseness of recorded fossil sites indicates that the WEF project area is of LOW palaeosensitivity overall.

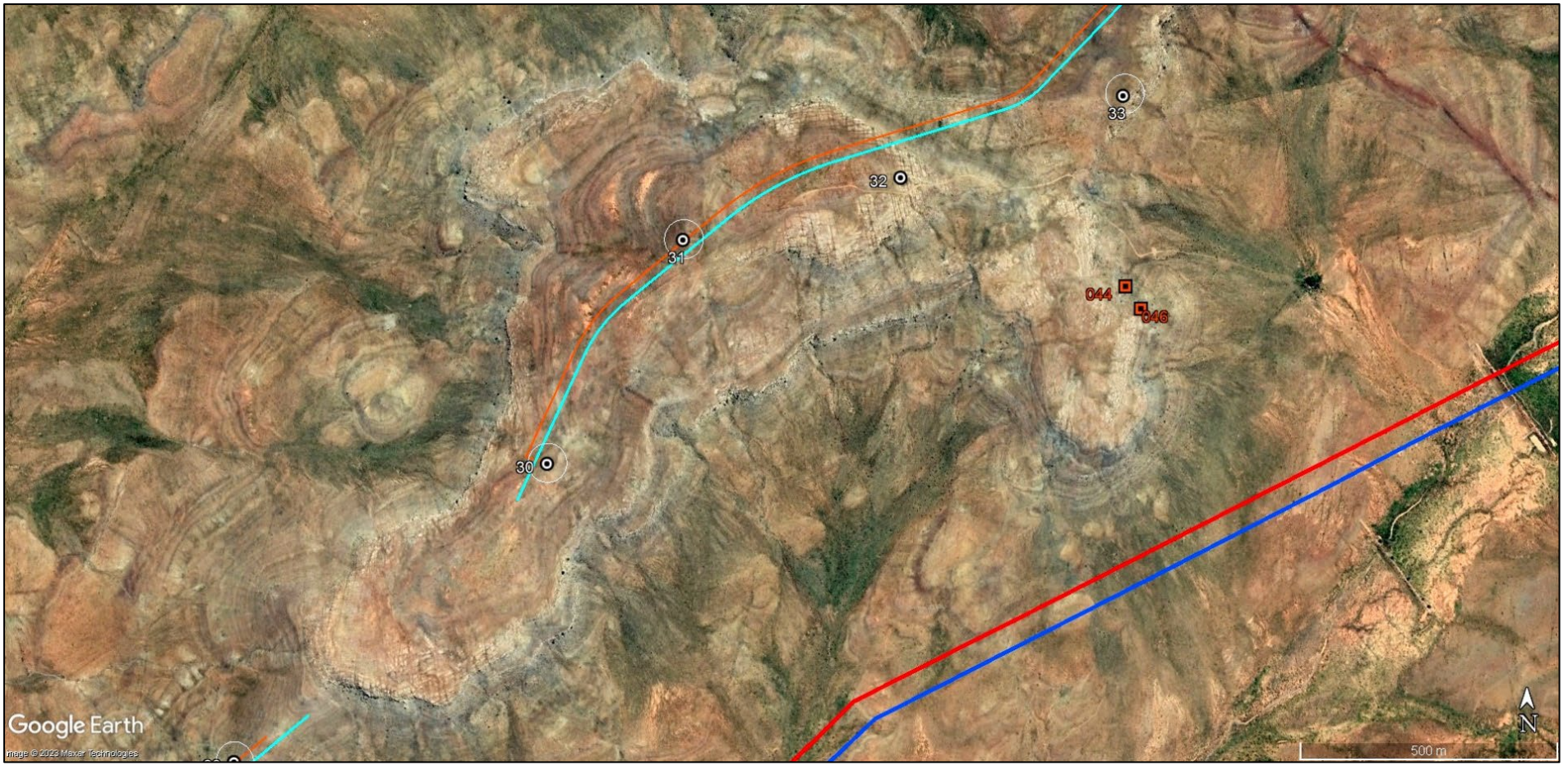

Figure A1.2: Google Earth© satellite image of an area on the northern margins of Saaidam Farm 574 RE showing vertebrate fossil sites 044 and 046. Intermittent exposures of Abrahamskraal Formation mudrocks around this ridge (greyish on satellite image) might yield further vertebrate fossils in future; these exposures are not directly threatened by the proposed WEF development, however.

<table>
<tr><th colspan="3">APPENDIX 2 - CHANCE FOSSIL FINDS PROCEDURE: Loxton WEF Cluster near Loxton, Northern Cape Province</th></tr>
<tr><td>Province & region:</td><td colspan="2">Northern Cape (Pixley Ka-Seme District, Ubuntu Local Municipality)</td></tr>
<tr><td>Responsible Heritage Management Agencies</td><td colspan="2">SAHRA for N. Cape: 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">Abrahamskraal Formation and Teekloof Formation (Lower Beaufort Group), Late Caenozoic alluvium.</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil skulls, postcrania of tetrapods, amphibians, fish as well as rare petrified wood, vertebrate and invertebrate burrows within bedrocks. Mammalian bones, teeth & horn cores, freshwater molluscs, calcretised trace fossils & rhizoliths and plant material in alluvium.</td></tr>
<tr><td rowspan="5">ECO / ESO 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">Apply for Fossil Collection Permit Record / submit Work Plan to the relevant Heritage Resources Agency. 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>

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

PROJECT TITLE

PROPOSED LOXTON CLUSTER WEF, NORTHERN CAPE PROVINCE

Kindly note the following:

1. This form must always be used for applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting where this Department is the Competent Authority.
2. This form is current as of 01 September 2018. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Project Specialist:	Dr John Edward Almond		
Trading name (if any):	Natura Viva cc		
Business reg. no./ID. no.:	5905275218183		
Contact person:	As above		
Physical address:	76 Breda Park, Breda Street, Oranjezicht, CAPE TOWN		
Postal address:	As above		
Postal code:	8001	**Cell:**	071 947 0577
Telephone:	021 462 3622	**Fax:**	n/a
E-mail:	naturaviva@universe.co.za		
Qualifications:	PhD (palaeontology) University of Cambridge, UK		
Professional affiliation (s) (if any)	Palaeontological Society of Southern Africa Association of Professional Heritage Practitioners (Western Cape)		

2. DECLARATION BY THE SPECIALIST

I, **Dr John Edward Almond**, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

John E Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

19 April 2023

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, **Dr John Edward Almond**, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

John E Almond

Signature of the Specialist

NATURA VIVA CC

Name of Company

19 April 2023

Date

Signature of the Commissioner of Oaths

SOUTH AFRICAN POLICE SERVICE
STATION COMMANDER
CAPE TOWN
19 APR 2023
CAPE TOWN
STATION COMMANDER
SOUTH AFRICAN POLICE SERVICE

Date 2023-04-19