SiVEST SA (PTY) LTD

PROPOSED CONSTRUCTION OF THE KOUP 1 WIND ENERGY FACILITY AND ASSOCIATED GRID INFRASTRUCTURE, NEAR BEAUFORT WEST, WESTERN CAPE PROVINCE, SOUTH AFRICA

Palaeontological Heritage Report

DEFF Reference: 14/12/16/3/3/2/2120

Report Prepared by: **Dr John E. Almond**
***Natura Viva* cc**
PO Box 12410 Mill Street
CAPE TOWN 8010, RSA

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PALAEONTOLOGICAL HERITAGE REPORT

EXECUTIVE SUMMARY

Genesis Enertrag Koup 1 Wind (Pty) Ltd is proposing to construct the Koup 1 WEF, comprising twenty-eight wind turbines with a maximum total energy generation capacity of up to 140MW, with a 132kV overhead power line connection to the national grid. A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The WEF and grid project areas are located in the Great Karoo region some 60 km south of Beaufort West, falling within the Beaufort West and Prince Albert Local Municipalities (Central Karoo District Municipality) of the Western Cape Province.

The Koup 1 WEF and grid connection project area is underlain by continental (fluvial / lacustrine) sediments of the Abrahamskraal and Teekloof Formations (Lower Beaufort Group, Karoo Supergroup) which are of Middle to Late Permian age and are provisionally assigned a Very High sensitivity on the SAHRIS palaeosensitivity map as well as the DFFE screening map. These bedrocks contain sparse, unpredictable to locally concentrated vertebrate fossils as well as rare trace fossils (*e.g.* tetrapod burrows) and plant material that are of scientific and conservation value. A significant number of new fossil vertebrate sites (cranial and post-cranial material of large-bodied dinocephalians, small dicynodonts, rare tetrapod burrow casts) have been recorded within the combined Koup WEF / grid connection project areas during a 5-day site visit, while several fossil sites have previously been mapped shortly outside its margins. These palaeontological sites, together with their sedimentological context, provide important data for on-going research into the pattern and causes of the Middle Permian Mass Extinction Event on land aroiund 260 million years ago.

Scientifically-valuable and legally-protected fossil heritage resources preserved at or beneath the ground surface within the project footprint are potentially threated by surface clearance and bedrock excavations during the construction phase of the WEF and grid connection (*e.g.* for access roads, wind turbine foundations). The majority of the recorded fossil sites lie outside the project footprint but most of the WEF and grid connection footprint has yet to be palaeontologically surveyed on foot. A significant number of unrecorded sites are likely to exist within or very close to the project footprint.

No Very High Sensitivity or No-Go palaeontological sites or areas have been identified within the WEF and grid connection project areas. Since all known fossil sites can be readily mitigated through professional recording and collection of fossil material in the pre-construction phase, no recommendations for micro-siting of infrastructure such as wind turbine, pylon positions or access roads are therefore made here. There are no preferences on palaeontological heritage grounds for

specific site options for the Koup 1 WEF on-site substation and construction laydown area. Of the grid conection options initially considered, Grid Option 1 (either alternative) is preferred for the grid connection since, being much shorter than Options 2 and 3, it is least likely to impact potential fossil sites. However, there are no objections on palaeontological heritage grounds to authorization of the chosen Option 2.

The proposed Koup 1 WEF and associated grid connection developments are assigned a similar overall impact significance rating (Construction Phase) of NEGATIVE MEDIUM without mitigation and NEGATIVE LOW following mitigation. No significant further impacts on fossil heritage resources are anticipated in the planning, operational and decommissioning phases. The No-Go Option may have a NEGATIVE LOW impact significance; fossils will continue to be exposed and destroyed by natural weathering processes while the positive benefits of professional mitigation (*viz*. improved palaeontological database) will be lost. Anticipated cumulative impacts in the context of several planned or authorized renewable energy projects in the region are assessed as NEGATIVE MEDIUM before mitigation and NEGATIVE LOW after mitigation.

Recommended mitigation comprises:
(1) A specialist palaeontological walk-down of the final WEF and grid connection project area in the pre-construction phase,
(2) Implementation of a Chance Fossil Finds Protocol (See Appendix 4) by the ECO / ESO during the construction phase. The specialist palaeontologist responsible will need to submit a Work Plan for approval by Heritage Western Cape.

Conclusion
No fatal flaws were identified and anticipated impacts can be substantially reduced through mitigation during the pre-construction and construction phases. On condition that the recommended mitigation measures are included within the relevant EMPrs and implemented in full, there are no objections on palaeontological heritage grounds to the authorization of the proposed Koup 1 WEF and the associated grid connection.

NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	**1.2 & Appendix 1**
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**7.7 & Addendum**
c) an indication of the scope of, and the purpose for which, the report was prepared;	**1.1 & Appendix 4**
(cA) an indication of the quality and age of base data used for the specialist report;	**1.3.1.**
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	**5**
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**1.3.1.**
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	**1.3.1.**
f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	**3.2 & 6**
g) an identification of any areas to be avoided, including buffers;	**6.2.**
h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	**Figure *65* & Figure 66**
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**2**
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified	**5,6, & 7**

alternatives on the environment) or activities;	
k) any mitigation measures for inclusion in the EMPr;	**8 & Appendix 4**
l) any conditions for inclusion in the environmental authorisation;	**8**
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	**8 & Appendix 4**
n) a reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	**9**
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	**n/a**
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**n/a**
q) any other information requested by the competent authority.	
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	

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PALAEONTOLOGICAL HERITAGE REPORT

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List of Abbreviations

amsl	above mean sea level
DFFE	Department of Forestry, Fisheries and the Environment
ECO	Environmental Control Officer
EMPr	Environmental Management Programme
ESO	Environmental Site Officer
HWC	Heritage Western Cape
Ma	millions of years ago
PIA	palaeontological heritage impact assessment
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System

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PALAEONTOLOGICAL HERITAGE REPORT

1. INTRODUCTION

Genesis Enertrag Koup 1 Wind (Pty) Ltd (hereafter referred to as “Genesis”), has appointed SiVEST Environmental (hereafter referred to as “SiVEST”) to undertake the required EIA / BA Processes for the proposed construction of the Koup 1 Wind Energy Facility (WEF) and associated grid connection infrastructure near Beaufort West in the Western Cape Province of South Africa.

The overall objective of the development is to generate electricity by means of renewable energy technology capturing wind energy to feed into the National Grid.

It is anticipated that the proposed Koup 1 WEF will comprise twenty-eight (28) wind turbines with a maximum total energy generation capacity of up to approximately 140MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line. A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The storage capacity and type of technology would be determined at a later stage during the development phase, but most likely will comprise an array of containers, outdoor cabinets and/or storage tanks.

In terms of the Environmental Impact Assessment (EIA) Regulations, which were published on 04 December 2014 [GNR 982, 983, 984 and 985) and amended on 07 April 2017 [promulgated in Government Gazette 40772 and Government Notice (GN) R326, R327, R325 and R324 on 7 April 2017], various aspects of the proposed development are considered listed activities under GNR 327 and GNR 324 which may have an impact on the environment and therefore require authorisation from the National Competent Authority (CA), namely the Department of Environment, Forestry and Fisheries (DEFF), prior to the commencement of such activities. Specialist studies have been commissioned to assess and verify the project under the new Gazetted specialist protocols.

1.1 Terms of Reference

The present combined desktop and field-based PIA report assesses potential impacts to palaeontological heritage resources that may result from the proposed Koup 1 WEF and its associated grid connection. It will

contribute to the over-arching Heritage Impact Assessments, co-ordinated by PGS Heritage and SiVEST Environmental Division, as part of the Basic Assessment / Environmental Impact Assessment processes for these developments as well as to the relevant EMPrs.

Please see Appendix 4 for the SiVEST Terms of Reference applicable to this report.

1.2 Specialist Credentials

The author, Dr John Almond, is a specialist palaeontologist who has over 40 years of experience in palaeontological research and teaching in Europe, South Africa and elsewhere. He also has more than 20 years of experience in the palaeontological heritage impact assessment world in the RSA and has been involved with numerous PIAs in the Karoo region and elsewhere (Please see Appendix 1 for a short Specialist CV).

1.3 Assessment Methodology

1.3.1 Information sources

The desktop and field-based palaeontological heritage study of the Koup 1 WEF and grid connection project areas was based on the following information resources:

1. A detailed project outline, kmz files, screening report and maps provided by SiVEST Environmental Division and PGS Heritage;

2. A desktop review of:
(a) the relevant 1:50 000 scale topographic mapS (3222DC Amandelhoogte and 3222 CD Daskop) and the 1:250 000 scale topographic map 3222 Beaufort West,
(b) Google Earth© satellite imagery,
(c) published geological and palaeontological literature, including 1:250 000 geological maps (3222 Beaufort West) and relevant sheet explanations (Johnson & Keyser 1979) as well as
(d) several previous and on-going fossil heritage (PIA) assessments in the Great Karoo region to the south of Beaufort West by the author (*e.g.* Almond 2018, 2020a, 2020b, 2021a, 2021b & 2021c *plus* various earlier studies on renewable energy projects in the region listed in the References as well as on-going field-based palaeontological heritage studies for the proposed Kwagga 1, Kwagga 2 & Kwagga 3 WEFs and the proposed Heuweltjies and Kraaltjies WEFs, all of which are situated in the southern Great Karoo shortly to the east and southeast of the present project area);

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. A five-day field assessment of the combined Koup 1 and Koup 2 WEF project area, including portions of all land parcels involved, by the author and an experienced field assistant (Ms Madelon Tusenius, *Natura*

Viva cc), during the period 14 to 19 November 2020. A local farm lessee, Ms Marietjie Mostert (Farm Bloemendal), kindly shared her knowledge of local fossil occurrences. Accessible sectors of the Grid Connection project area within the combined WEF project areas were surveyed in part, but *not* those sectors lying *outside* the WEF project area itself.

The season in which the site visit took place has no critical bearing on the palaeontological study, although palaeontological fieldwork in the Karoo winter was somewhat hampered by shorter days, occasional rain and low-angle light, making fossils more difficult to discern and to photograph effectively.

1.3.2 Study approach

In preparing a palaeontological desktop study the potentially fossiliferous rock units (groups, formations, members *etc.*) represented within the study area are determined from geological maps and satellite images. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region, and the author's field experience (consultation with professional colleagues as well as examination of institutional fossil collections may play a role here, or later following scoping during the compilation of the final report). This data is then used to assess the palaeontological sensitivity of each rock unit to development (provisional tabulations of palaeontological sensitivity of all formations in the Western Cape have already been compiled by J. Almond and colleagues; *e.g.* Almond & Pether 2008) and are shown on the palaeosensitivity map on the SAHRIS (South African Heritage Resources Information System) website. The likely impact of the development on local fossil heritage is then determined on the basis of (1) the palaeontological sensitivity of the rock units concerned and (2) the nature and scale of the development itself, most notably the extent of fresh bedrock excavation and ground clearance envisaged. When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field assessment study by a professional palaeontologist is usually warranted.

The focus of palaeontological field assessment is *not* simply to survey the development footprint or even the development area as a whole (*e.g.* farms or other parcels of land concerned in the development). Rather, the palaeontologist seeks to assess or predict the diversity, density and distribution of fossils within and beneath the study area, as well as their heritage or scientific interest. This is primarily achieved through a careful field examination of one or more *representative* exposures of all the sedimentary rock units present (*N.B.* Metamorphic and igneous rocks rarely contain fossils). The best rock exposures are generally those that are easily accessible, extensive, fresh (*i.e.* unweathered) and include a large fraction of the stratigraphic unit concerned (*e.g.* formation). These exposures may be natural or artificial and include, for example, rocky outcrops in stream or river banks, cliffs, quarries, dams, dongas, open building excavations or road and railway cuttings. Consolidated as well as uncemented superficial deposits, such as alluvium, scree or wind-blown sands, may occasionally contain fossils and should also be included in the field study where they are well-represented in the study area. It is occasional practice for impact palaeontologists to collect representative, well-localised (*e.g.* GPS and stratigraphic data) samples of fossil material during field assessment studies. In order to do so, a fossil collection permit from Heritage Western Cape (HWC) is required and all fossil material collected must be properly curated within an approved repository (usually a museum or university collection).

Note that while fossil localities recorded during field work within the study area itself are obviously highly relevant, most fossil heritage here is embedded within rocks beneath the land surface or obscured by surface deposits (soil, alluvium, *etc.*) and by vegetation cover. In many cases where levels of fresh (*i.e.* unweathered) bedrock exposure are low, the hidden fossil resources have to be *inferred* from palaeontological observations made from better exposures of the same formations elsewhere in the region but outside the immediate study area. Therefore a palaeontologist might reasonably spend far *more* time examining road cuts and borrow pits close to, but outside, the study area / project footprint than within the study area / project footprint itself. Field data from localities even further afield (*e.g.* an adjacent province) may also be adduced to build up a realistic picture of the likely fossil heritage within the study area.

Given 1) the large project areas concerned with the Koup 1 WEF project (approx. 4279.398 ha) and (2) the extensive bedrock exposure in this region of the Great Karoo, the palaeontological heritage field study largely entailed the examination of selected potentially fossiliferous sites with good Beaufort Group mudrock exposure – especially along drainage lines as well as gentler hillslopes and erosion gullies. Since previous field experience shows that in the lower part of the Beaufort Group outcrop area important fossil sites may also occur in association with crevasse splay and channel sandstones, a representative selection of such sites as well as good sections through Late Caenozoic alluvial deposits were also examined. It is emphasised that it is simply *not* practicable to record all, or even a major portion, of fossil sites within such a large area within the course of a few days' fieldwork, and that the occurrence of fossils at surface in the Great Karoo has a large element of unpredictability. Several fossil sites were discovered simply by chance. It is therefore inevitable that the recent site visit can only hope to locate a *representative subsample* of surface fossil sites present within the WEF project areas. The absence of recorded sites within an area does *not* therefore mean that palaeontologically significant material is not present there, either on or beneath the ground surface.

1.3.3 Legislative context

The present combined desktop and field-based palaeontological heritage report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project.

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

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

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

resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(a) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(b) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(c) trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

(d) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(a) serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;

(b) carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary;

(c) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and

(d) recover the costs of such investigation from the owner or occupier of the land on which it is believed an archaeological or palaeontological site is located or from the person proposing to undertake the development if no application for a permit is received within two weeks of the order being served.

Minimum standards for the palaeontological component of heritage impact assessment reports (PIAs) have been published by SAHRA (2013) and by Heritage Western Cape (2021).

2. ASSUMPTIONS AND LIMITATIONS

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

1. Inadequate database for fossil heritage for much of the RSA, given the large size of the country and the small number of professional palaeontologists carrying out fieldwork here. Most development study areas have never been surveyed by a palaeontologist.

2. Variable accuracy of geological maps which underpin these desktop studies. For large areas of terrain these maps are largely based on aerial photographs alone, without ground-truthing. The maps generally depict only significant (“mappable”) bedrock units as well as major areas of superficial “drift” deposits (alluvium, colluvium) but for most regions give little or no idea of the level of bedrock outcrop, depth of superficial cover (soil *etc*), degree of bedrock weathering or

levels of small-scale tectonic deformation, such as cleavage. All of these factors may have a major influence on the impact significance of a given development on fossil heritage and can only be reliably assessed in the field.

3. Inadequate sheet explanations for geological maps, with little or no attention paid to palaeontological issues in many cases, including poor locality information.

4. The extensive relevant palaeontological "grey literature" - in the form of unpublished university theses, impact studies and other reports (*e.g*. of commercial mining companies) - that is not readily available for desktop studies.

5. Absence of a comprehensive computerised database of fossil collections in major RSA institutions which can be consulted for impact studies.

In the case of palaeontological desktop studies without supporting Phase 1 field assessments these limitations may variously lead to either:

a) *underestimation* of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or

b) *overestimation* of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by tectonism or weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium *etc*).

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

In the case of the combined Koup 1 WEF and Koup 2 WEF project area bedrock exposure is often remarkably good in highly-dissected, hilly regions but is highly constrained by extensive superficial deposits in areas of low relief (*e.g.* NE sector of Koup 1 WEF project area), as well as, to a lesser extent, by shrubby vegetation. The project area is very extensive (> 4000 ha) and with remarkably few access roads, probably because much of the area is not currently being farmed at present. Unavoidably, only a small fraction of the entire project area could be surveyed on foot within the time available (5 days). Short days, low angle light and occasional rainy weather in winter further constrained the field survey.

Nevertheless, sufficient (*c*. 150-200) bedrock exposures – including many of excellent quality - were examined during the course of the five-day field study to assess the palaeontological heritage sensitivity of the main rock units represented within the combined Koup 1 and Koup 2 WEF and grid connection study area (See satellite image Fig. A2.1 as well as palaeontological data table in Appendix 2). Since access permission for sectors of the grid connection project area lying outside the combined WEF project area was

not available at the time of the palaeontological field survey, these sectors are only treated at a desktop level in the present report.

Comparatively few academic palaeontological studies or palaeontological impact assessments have been carried-out hitherto in this region of the Great Karoo, so any new data from impact studies here are of scientific interest. Confidence levels for this impact assessment are rated as *medium*, despite the unavoidable constraints of limited time and access in the project area.

3. TECHNICAL DESCRIPTION

3.1 Project Location

The proposed WEF and associated grid connection infrastructure is located approximately 55km south of Beaufort West in the Western Cape Province and is within the Beaufort West and Prince Albert Local Municipalities, in the Central Karoo District Municipality (**Figure 1**).

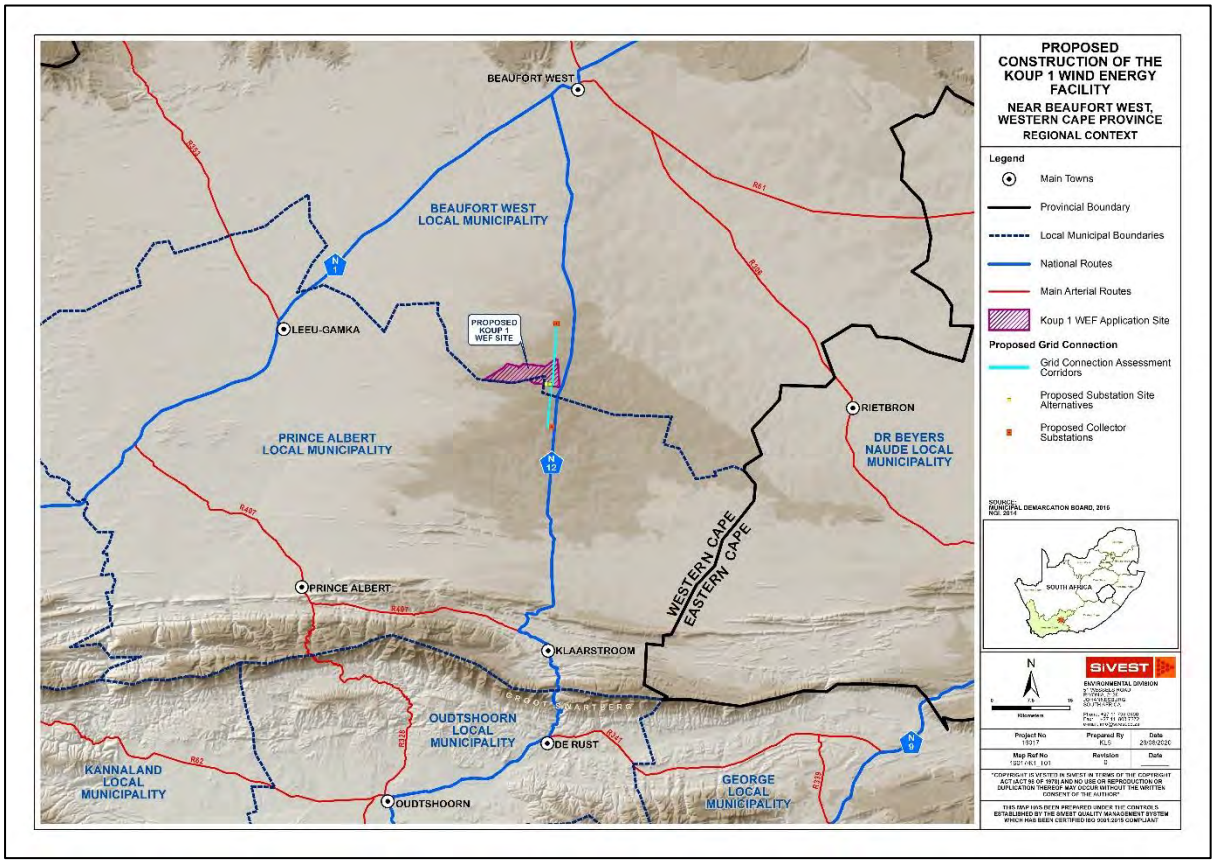

Figure 1: Regional Context Map for the proposed Koup 1 WEF south of Beaufort West.

3.1.1 WEF

The Koup 1 WEF application site as shown on the locality map below (**Figure 2**) is approximately 4279.398 hectares (ha) in extent and incorporates the following farm portions:

- The Farm Riet Poort No 231
- Portion 11 Of the Farm Brits Eigendom No 374
- Portion 15 Of the Farm Brits Eigendom No 374
- Portion 5 Of Farm 380
- Portion 10 Of Farm 380
- Portion 11 Of Farm 380

A smaller buildable area (2445.667 ha) has however been identified as a result of a preliminary suitability assessment undertaken by Genesis and this area has since been further refined with the exclusion of sensitive areas determined through various specialist studies being conducted as part of the EIA process.

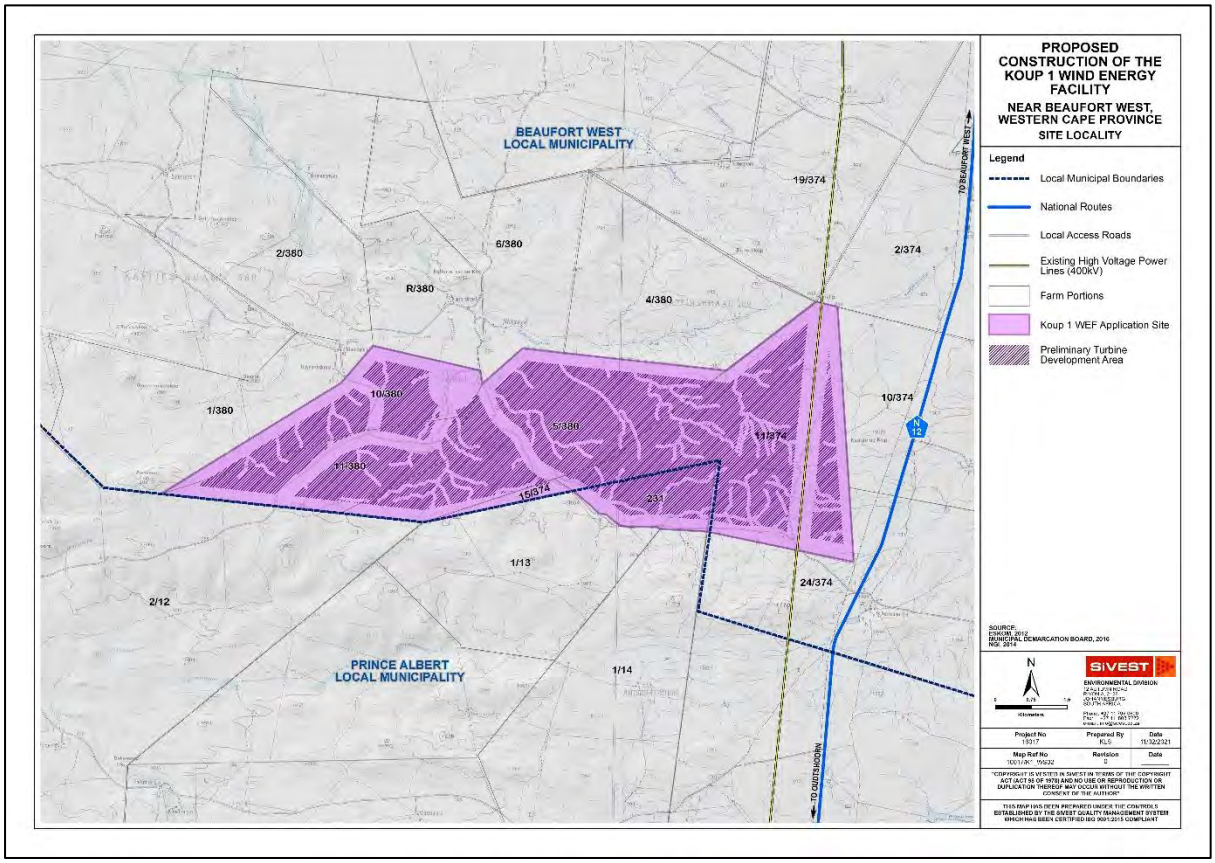

Figure 2: Koup 1 WEF Site Locality

3.1.2 Grid Connection

Three route options(Grid Options 1 to 3) have been assessed for a 132kV overhead power line connecting the Koup 1 WEF on-site switching substation / collector to the national grid either by way of an off-site collector substation, or via a direct tie-in to existing 400kV transmission lines that traverse the Koup 1 WEF project site (

Figure 3a). Of these, Grid Option 1 was not feasible as Eskom won't allow two collectors within a small radius while Grid Option 3 has been eliminated as a result of the bird nests. The route of the chosen Grid Option 2 is shown in **Figure 3b**.

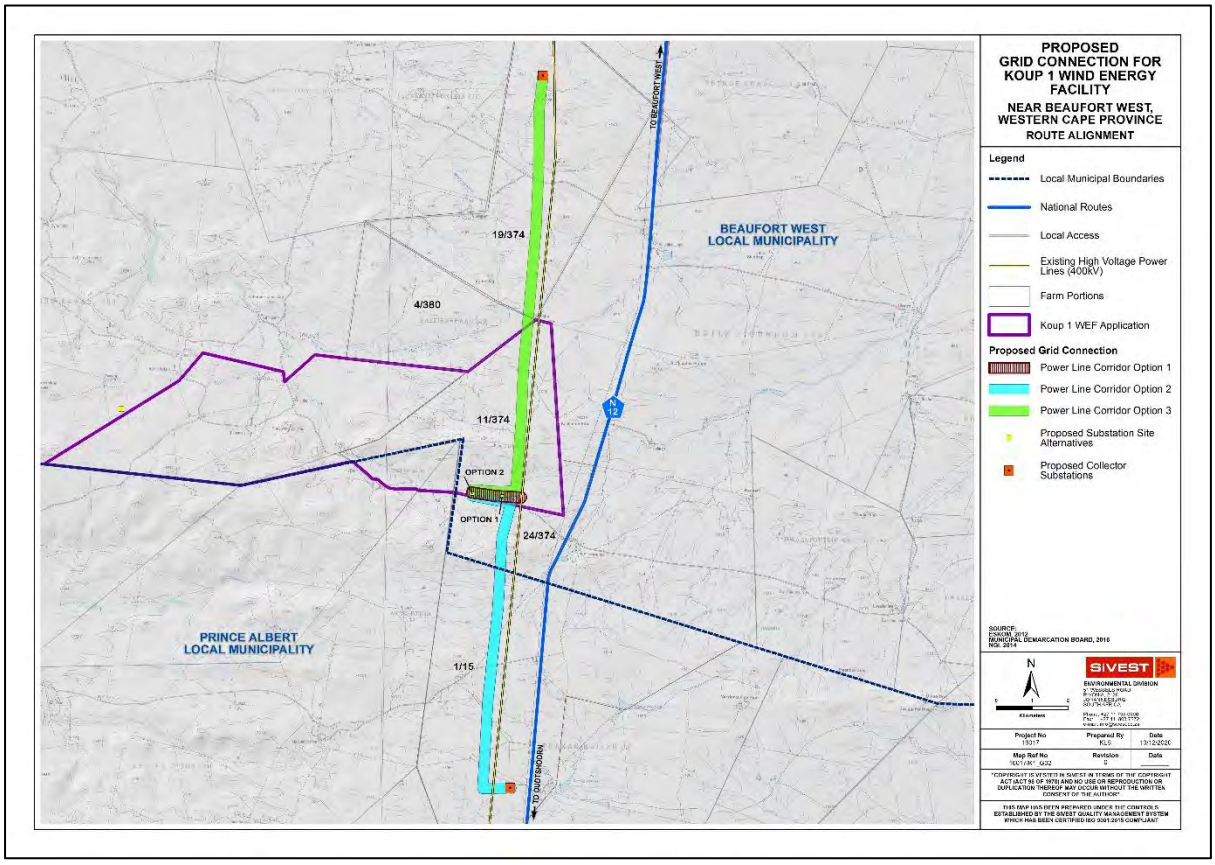

Figure 3a: 132kV Power Line Route Alignments originally considered as part of the assessment process.

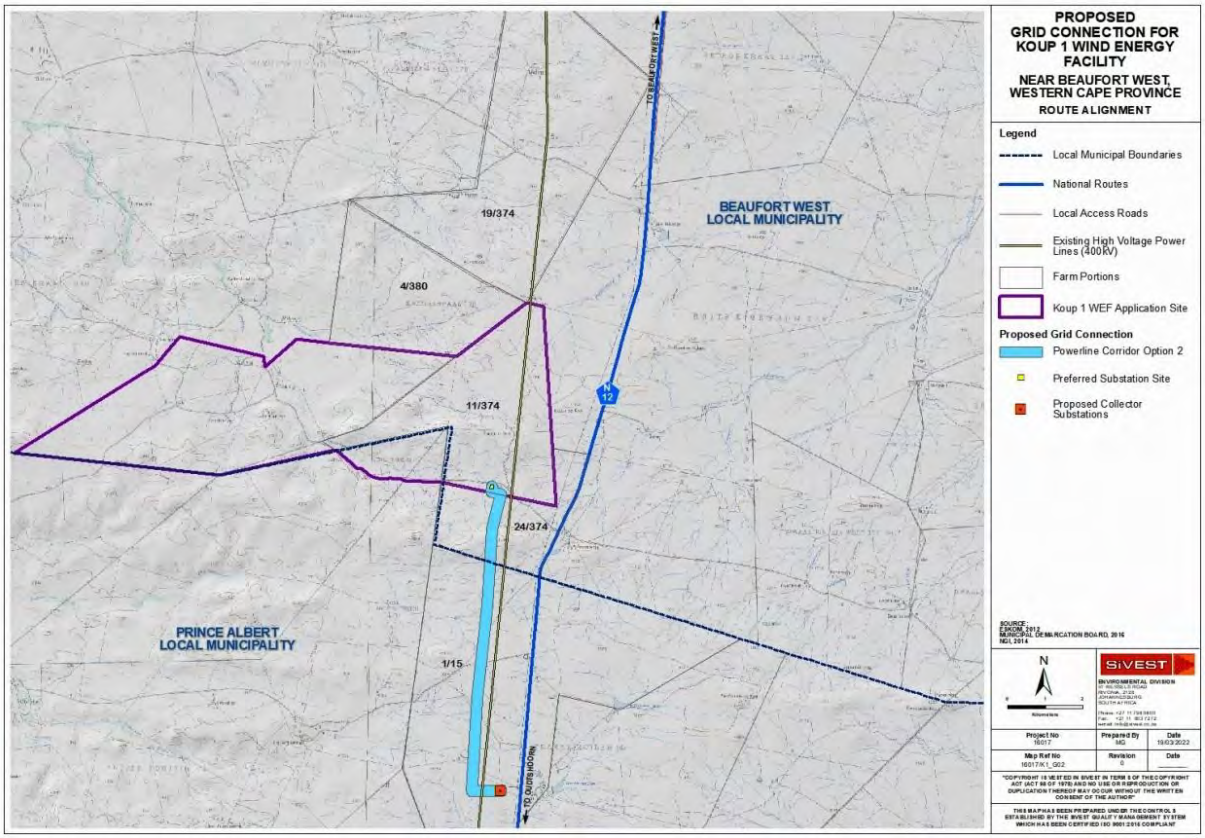

Figure 4b: Final proposed 132kV Power Line Route Alignment (Option 2, pale blue corridor).

3.2 Project Description

It is anticipated that the proposed Koup 1 WEF will comprise twenty-eight (28) wind turbines with a maximum total energy generation capacity of up to approximately 140MW. The electricity generated by the proposed WEF development will be fed into the national grid via a 132kV overhead power line. A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The storage capacity and type of technology would be determined at a later stage during the development phase, but most likely will comprise an array of containers, outdoor cabinets and/or storage tanks.

3.2.1 Wind Farm Components

- Up to 28 wind turbines, each between 5.6MW and 6.6MW, with a maximum export capacity of approximately 140MW. This will be subject to allowable limits in terms of the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). The final number of turbines and layout of the WEF will, however, be dependent on the outcome of the Specialist Studies conducted during the EIA process;
- Each wind turbine will have a hub height and rotor diameter of up to approximately 200m;

- Permanent compacted hardstanding areas / platforms (also known as crane pads) of approximately 90m x 50m (total footprint of approx. 4 500m2) per turbine during construction and for on-going maintenance purposes for the lifetime of the proposed development;
- Each wind turbine will consist of a foundation of up to approximately 15m x 15m in diameter. In addition, the foundations will be up to approximately 3m in depth;
- Electrical transformers adjacent to each wind turbine (typical footprint of up to approximately 2m x 2m) to step up the voltage to 33kV;
- One (1) new 33/132kV on-site substation and/or combined collector substation, occupying an area of approximately 1.5 ha. The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has been included in the WEF EIA and in the grid infrastructure BA (substation and 132kV overhead power line) to allow for handover to Eskom. Following construction, the substation will be owned and managed by Eskom. The current applicant will retain control of the low voltage components (i.e. 33kV components) of the substation, while the high voltage components (i.e. 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction ;
- The wind turbines will be connected to the proposed substation *via* medium voltage (33kV) cables. Cables will be buried along access roads wherever technically feasible.
- A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The storage capacity and type of technology would be determined at a later stage during the development phase, but most likely will comprise an array of containers, outdoor cabinets and/or storage tanks;
- Internal roads with a width of between 8m and 10m will provide access to each wind turbine. Existing site roads will be used wherever possible, although new site roads will be constructed where necessary. Turns will have a radius of up to 50m for abnormal loads (especially turbine blades) to access the various wind turbine positions. It should be noted that the proposed application site will be accessed via an existing gravel road from the N12 National Route;
- One (1) construction laydown / staging area of up to approximately 2.25ha. It should be noted that no construction camps will be required in order to house workers overnight as all workers will be accommodated in the nearby town;
- One (1) permanent Operation and Maintenance (O&M) building, including an on-site spares storage building, a workshop and an operations building to be located on the site identified for the construction laydown area.
- A wind measuring lattice (approximately 120m in height) mast has already been strategically placed within the wind farm application site in order to collect data on wind conditions;
- No new fencing is envisaged at this stage. Current fencing is standard farm fence approximately 1-1.5m in height. Fencing might be upgraded (if required) to be up to approximately 2m in height; and
- Water will either be sourced from existing boreholes located within the application site or will be trucked in, should the boreholes located within the application site be limited.

3.2.2 Grid Components

The proposed grid connection infrastructure to serve the Koup 1 WEF will include the following components:

- One (1) new 33/132kV on-site substation and/or collector substation, occupying an area of up to approximately 1.5 ha. The proposed substation will be a step-up substation and will include an Eskom portion and an IPP portion, hence the substation has been included in both the EIA for the WEF and in

the BA for the grid infrastructure to allow for handover to Eskom. The applicant will remain in control of the low voltage components (*i.e.* 33kV components) of the substation, while the high voltage components (*i.e.* 132kV components) of this substation will likely be ceded to Eskom shortly after the completion of construction; and

- One (1) new 132kV overhead power line connecting the on-site and/or collector substation either to an off-site collector substation, or *via* a direct tie-in to the existing 400kV overhead power lines and thereby feeding the electricity into the national grid. Power line towers being considered for this development include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the route alignment bends to a significant degree. Maximum tower height is expected to be approximately 25m.

3.3 Layout alternatives

3.3.1 Wind Energy Facility

Design and layout alternatives have been considered and assessed as part of the EIA. These include alternatives for the Substation locations and also for the construction / laydown area. The site alternatives considered are shown in **Figure 5a** below and the final proposed layout is shown in **Figure 4b**.

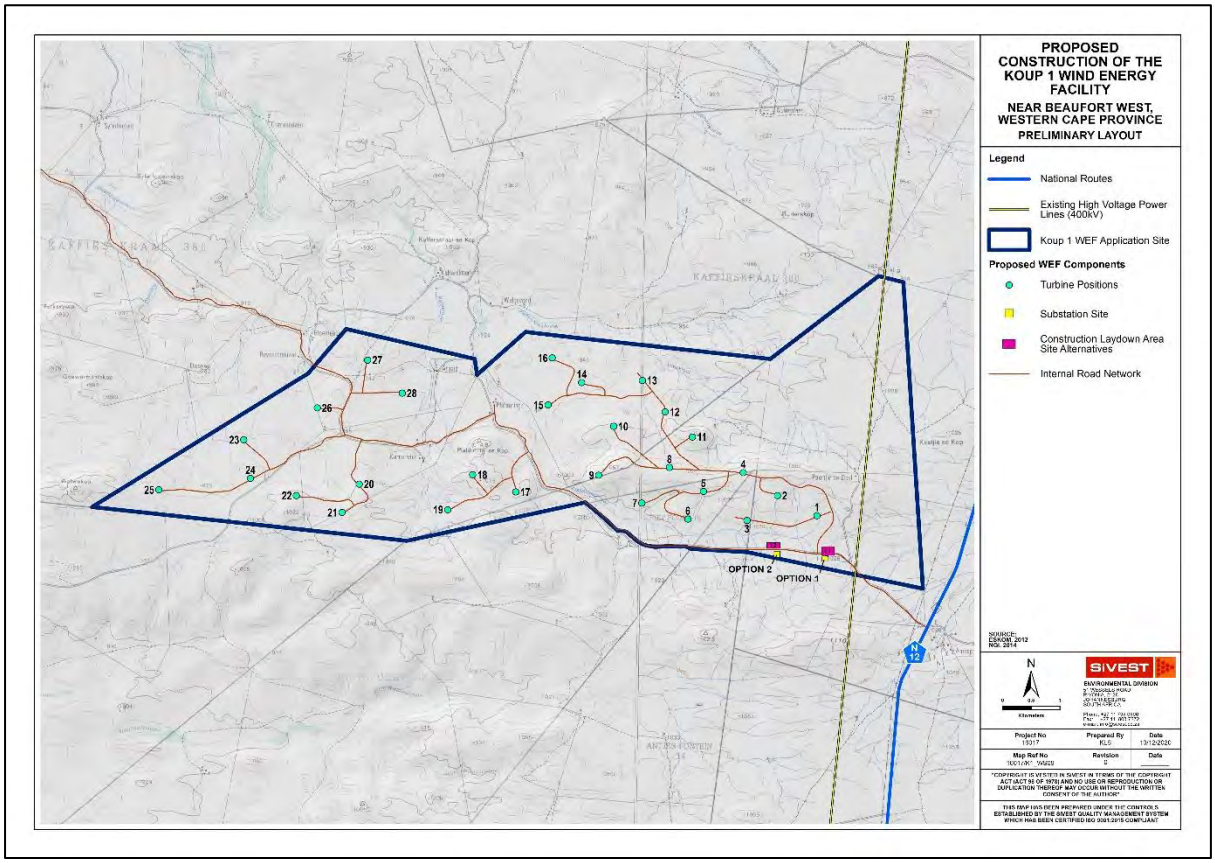

Figure 5a: Alternatives proposed and considered as part of the Koup 1 WEF assessment process

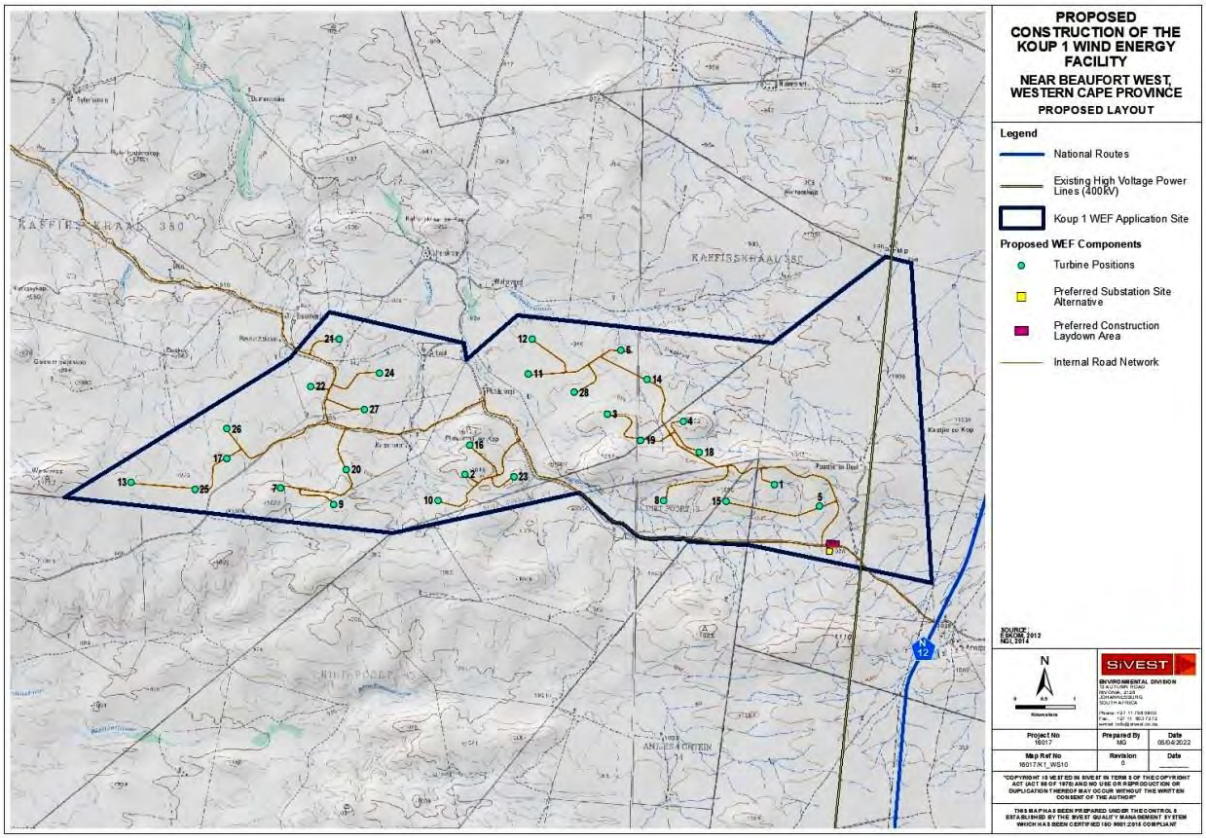

Figure 6b: Final proposed layout for the Koup 1 WEF showing turbine positions (green circles), on-site substation (yellow square) and construction laydown area (red rectangle).

3.3.2 Grid Components

The grid connection infrastructure proposals include two (2) switching and collector substation site alternatives and three (3) power line route alignment alternatives (Figure 3a). These alternatives have been considered and assessed as part of the BA process and will be amended or refined to avoid identified environmental sensitivities.

All three (3) power line route alignments have been assessed within a 300m wide assessment corridor (150m on either side of power line). These alternatives are described below:

- Power Line Corridor Option 1 is approximately 1.3km in length, linking either substation / collector Option 1 or Option 2 to the existing 400kV transmission lines.
- Power Line Corridor Option 2 is approximately 9.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the south, adjacent to the existing 400kV transmission lines.
- Power Line Corridor Option 3 is approximately 12.9km in length, linking either substation / collector Option 1 or Option 2 to a proposed Collector Substation to the north, adjacent to the existing 400kV transmission lines.

As shown in Figure 3b, the chosen grid connection is Option 2.

3.3.3 *No*-go Alternative

The ‘no-go’ alternative is the option of not undertaking the proposed WEF and / or grid connection infrastructure projects. Hence, if the ‘no-go’ option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or surrounding local area. It provides the baseline against which other alternatives are compared and will be considered throughout the report.

4. LEGAL REQUIREMENT AND GUIDELINES

4.1 Legislative context

The present combined desktop and field-based palaeontological heritage report falls under Sections 35 and 38 (Heritage Resources Management) of the South African Heritage Resources Act (Act No. 25 of 1999), and it will also inform the EMPr for this project.

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

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

According to Section 35 of the National Heritage Resources Act, dealing with archaeology, palaeontology and meteorites:

(1) The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.

(2) All archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

(4) No person may, without a permit issued by the responsible heritage resources authority—

(e) destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;

(f) destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;

(g) 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

(h) bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.

(5) When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way,

and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—

(e) 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;
(f) 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;
(g) if mitigation is deemed by the heritage resources authority to be necessary, assist the person on whom the order has been served under paragraph *(a)* to apply for a permit as required in subsection (4); and
(h) 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.

Where Preconstruction of Construction Phase mitigation, comprising palaeontological recording and collection of fossil material and associated geological data, is required as a condition of Environmental Authorization (as here), this must be carried out by a suitably qualified professional palaeontologist under a Fossil Collection Permit issued by the relevant Heritage Resources Management Agency (in the present case, Heritage Western Cape, Cape Town). The fossil material collected must be curated in an approved repository (museum / university collection). Standards for palaeontological reporting and mitigation in the RSA have been established by Heritage Western Cape (2016, 2021) and SAHRA (2013). A tabulated Chance Fossil Finds Protocol which must be implemented throughout the Construction Phase of the WEF projects is provided in Appendix 4 to this report.

5. DESCRIPTION OF THE RECEIVING ENVIRONMENT

This section of the PIA report presents a short, illustrated overview of the geology and palaeontological heritage encountered within the Koup 1 WEF project area, including the associated grid connection project area. It also draws on geological and palaeontological observations from the adjoining Koup 2 WEF project area

5.1 Geological context

A short outline of the geology of the Koup 1 WEF project area (including the associated grid connection project areas) is provided in this section of the report as context for the palaeontological heritage data discussed in the following subsection.

The Koup 1 WEF project area lies within Beaufort West District of the Western Cape while the southern grid connection corridor extends into the Prince Albert District (Fig. 1). The project area is situated on the western side of the N12 trunk road between Beaufort West and Oudtshoorn within semi-arid, low-relief to highly-dissected hilly terrain towards the southern margins of the Great Karoo region *sensu stricto*. The eastern margins of the project area (eastern sector of Koup 1 WEF project area *plus* much of grid line project area) lie on the margins of the Aberdeen *Vlaktes*, an ancient peneplanated land surface of possible Miocene age (Partridge & Maud 1987). Relief here is generally low, with gentle hillslopes largely mantled with colluvium (scree, hillwash). Elevations are around 1000 to 1100 m amsl. in this region which forms a

watershed between west- and east-flowing drainage systems. Bedrock exposure here is localized and often very poor due to the pervasive mantle of Late Caenozic superficial deposits such as alluvium, eluvium, sheetwash deposits and skeletal soils (**Figure *10*** & **Figure *11***).

Further towards the west (central and eastern Koup 1 WEF) the terrain is more dissected, hillslopes are steeper and bedrock exposure levels are much higher, occasionally superb by southern Karoo standards (See Frontispiece, **Figure *9***). This applies even to the more readily weathered and eroded Beaufort Group mudrock facies. Several of the ridges and peaks here are named and, given their concordance, most of them are probably erosional outliers of the Aberdeen *Vlakes* surface which is more extensively preserved further east. The highest elevation is Wolwekop (1022 m amsl) on southern edge of the combined WEF project area with isolated lower peaks to the north such as Turksvykop (950 m), Gouwermentskop (984), Daskop (962), Platkop (908 m), and Syfeerfonteinkop (910 m). Drainage is largely *via* intermittent-flowing (non-perennial) water courses. It flows mainly to the N and NW into the major, ancient Gamka River drainage system *via* small tributaries of the Veldmansrivier such as the Kareerivier, Platdoringrivier, Pieterskraalrivier, Diepkloof and Houtbosrivier but there are also minor streams running to the west into the Gatsrivier.

As is clear from both satellite images (e.g.

Figure *65* & **Figure *66***) as well as the geological map (**Figure *7***), the WEF project area is characterized by broadly W-E trending ridges and intervening narrow rocky *vlaktes*. The topography here strongly reflects the pronounced folding of the Beaufort Group bedrocks along E-W fold axes within the northern margins of the Permo-Triassic Cape Fold Belt (CFB). Bedding dips are nevertheless moderate to low for the most part, reaching up to 45º on some fold limbs (dips up to 20º are marked on the geological map). Numerous small-scale faults cut the Beaufort Group bedrocks in this region, as best seen in road cuttings along the N12. Low-angle reverse / thrust faults as well as some steeper normal faults are marked by well-developed quartz mineral lineation, thick, laterally-persistent quartz veins, milky quartz rubble and slickensides (**Figure *22***). A well-developed, almost pervasive axial-planar cleavage affects most of the Beaufort Group bedrocks, expressed as a spaced cleavage in sandstone facies and many siltstones as well as fine slaty or pencil cleavage in the darker, finest-grain mudrocks (**Figure *20*** & **Figure *21***). The CFB folds in this sector of the southern Karoo appear to be narrower and more tightly spaced compared with regions immediately to the N and S; hence the higher levels of tectonic deformation encountered here.

The geology of the combined Koup 1 and Koup 2 WEF project areas is covered by 1: 250 000 geology sheet 3222 Beaufort West (Council for Geoscience, Pretoria; Johnson & Keyser 1979) (**Figure *7***). The greater part of the lower-lying terrain here is underlain by Middle Permian continental sediments of the **Abrahamskraal Formation** (Lower Beaufort Group / Adelaide Subgroup, Karoo Supergroup) (Pa, pale green in **Figure *7***) (Johnson & Keyser 1979, Johnson *et al.* 2006). It is likely the majority of the bedrocks here can be largely or entirely assigned to the mudrock-dominated **Karelskraal Member** situated at the top of the very thick Abrahamskraal Formation succession but this requires confirmation from detailed field mapping that is beyond the scope of the present PIA study. The broadly west-east trending ridges and associated *koppies* located within the WEF project area, especially towards its southern and northern margins, are built of the conformably overlying, sandstone-rich **Poortjie Member** which lies at the base of the **Teekloof Formation** (Adelaide Subgroup) (Pt, dark green in **Figure *7***). The sedimentology of the Abrahamskraal – Teekloof transition has been addressed recently by Paiva (2015). Early Jurassic intrusions of the **Karoo Dolerite Suite** are not mapped within the project area but do occur closer to the Great Escarpment at Beaufort West.

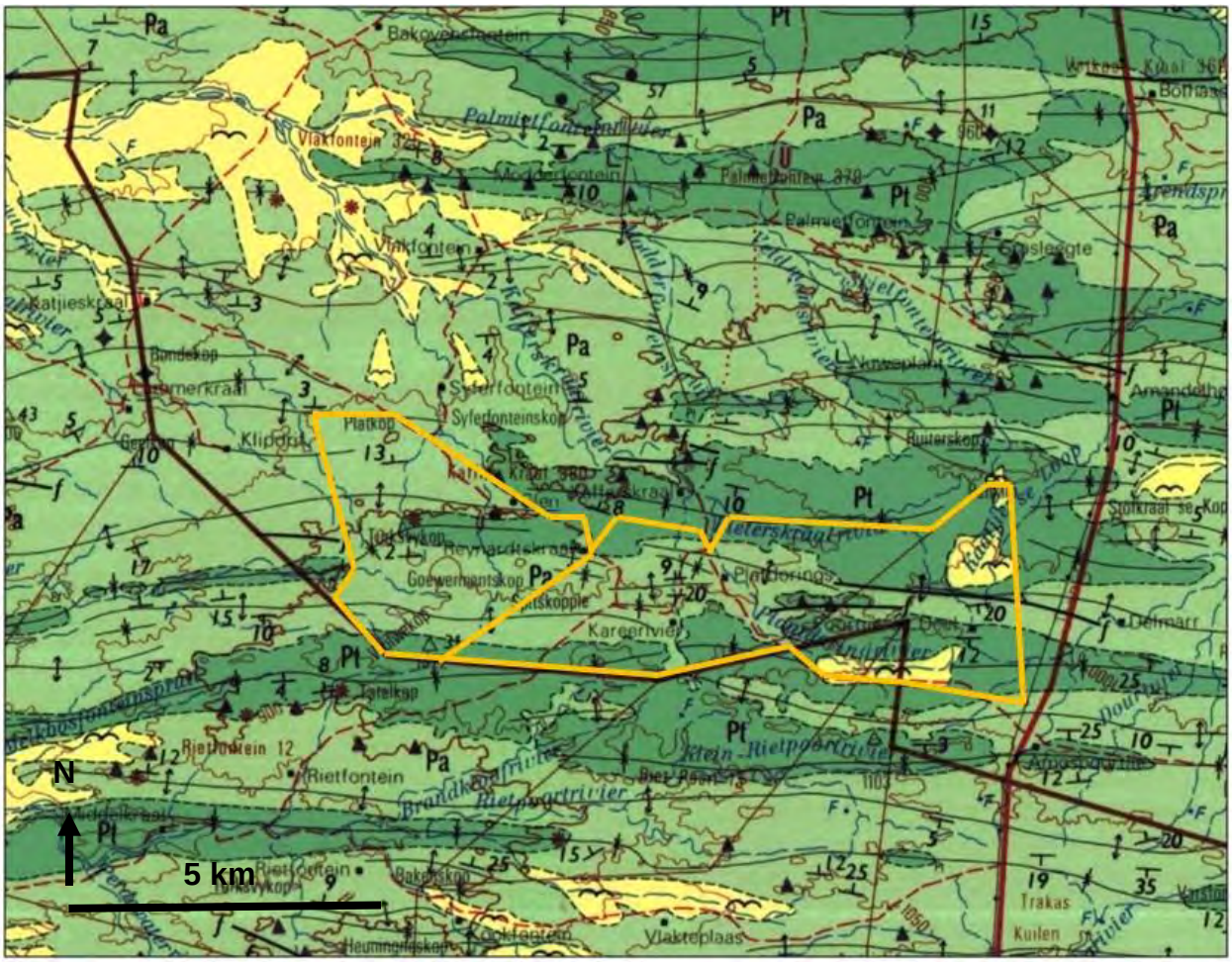

Figure 7: Extract from 1: 250 000 geology sheet 3222 Beaufort West showing the boundaries of the combined Koup 1 and Koup 2 WEF project area to the south of Beaufort West (yellow polygons). Note numerous W-E trending fold axes in the region which falls within the northern margins of the Cape Fold Belt. Pa (pale green) = Abrahamskraal Formation (Adelaide Subgroup, Lower Beaufort Group). Pt (dark green) = Teekloof Formation (Adelaide Subgroup, Lower Beaufort Group). Yellow = Late Caenozoic / Quaternary superficial sediments, including alluvium, sheet wash, colluvium, soils, locally cemented by pedocretes such as calcrete. To the west of the N12 and largely outside the WEF project area triangular symbols indicate fossil localities within the *Pristerognathus* Assemblage Zone (*N.B.* This fossil biozone data is now outdated – see updated stratigraphic chart presented below). A single fossil site for the underlying *Tapinocephalus* Assemblage zone (star symbol) is indicated c. 4 km to the NW of the combined WEF project area.

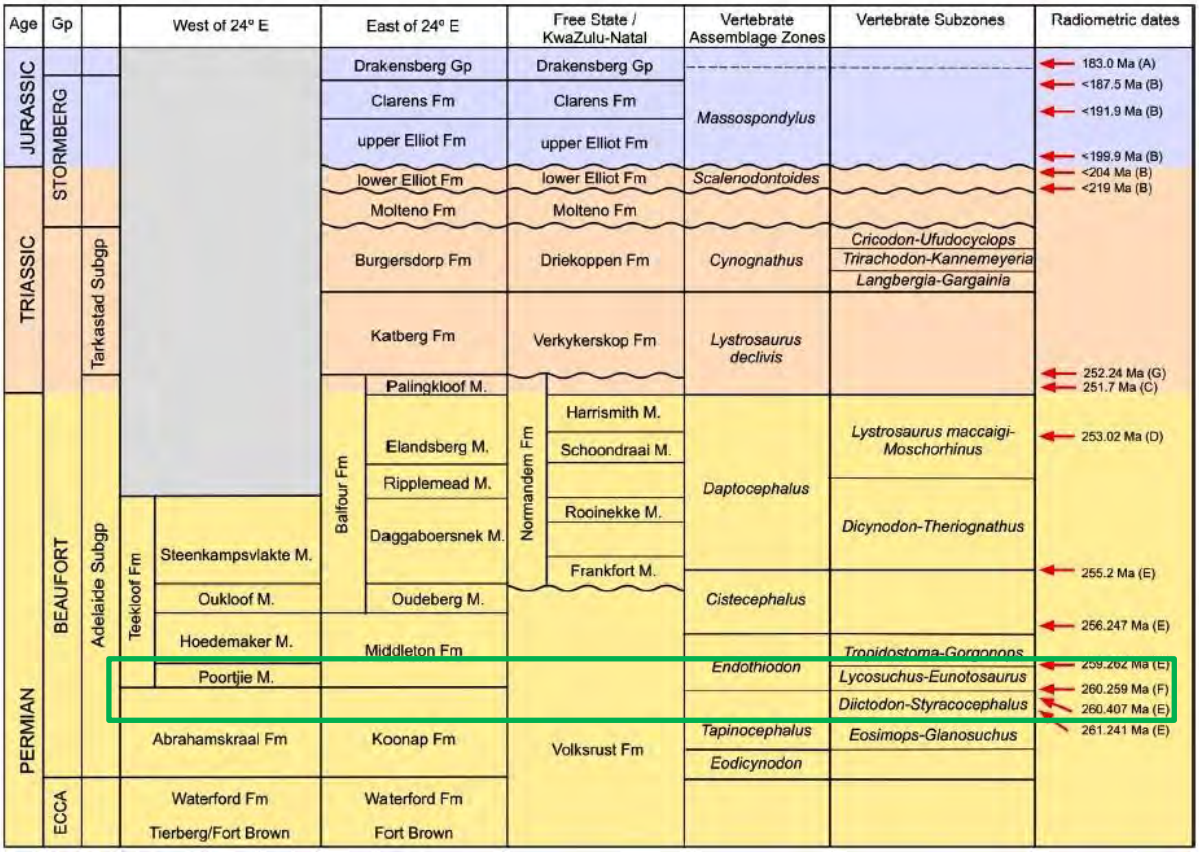

Figure 8: Stratigraphic subdivision of the Karoo Supergroup with the rock units and fossil biozones most relevant to the present PIA study outlined in green (Modified from Smith *et al.* 2020). In the combined Koup WEF project area fossil assemblages within the uppermost Abrahamskraal Formation (Karelskraal Member) and lower part of the Poortjie Member of the Teekloof Formation are now assigned to the *Diictodon-Styracocephalus* Assemblage Zone.

The **Abrahamskraal Formation** (Pa in **Figure 7**) is a very thick (*c*. 2.4 km) succession of fluvial deposits laid down in the Main Karoo Basin by meandering rivers on an extensive, low-relief floodplain during the Middle Permian Period, some 268-261 million years ago (Rossouw & De Villiers 1952, Johnson & Keyser 1979, Turner 1981, Theron 1983, Smith 1979, 1980, 1990, 1993a, 1993b, Smith & Keyser 1995a, Loock *et al*., 1994, McCarthy & Rubidge 2005, Johnson *et al*., 2006, Wilson *et al.* 2014, Cole *et al.* 2016). These sediments include (a) lenticular to sheet-like channel sandstones, often associated with thin, impersistent intraformational breccio-conglomerates (larger clasts mainly of reworked mudflakes, calcrete nodules, *plus* sparse rolled bones, teeth, petrified wood), (b) well-bedded to laminated, grey-green to purple-brown floodplain mudrocks with common pedocrete horizons (calcrete nodules formed in ancient soils), (c) thin, sheet-like crevasse-splay sandstones, as well as more (d) localized playa lake deposits (*e.g.* wave-rippled sandstones, laminated mudrocks, limestones, evaporites) (**Figure *12***, **Figure *13*** & **Figure *14***). A number of yellowish-green to reddish-weathering, silica-rich “chert” horizons are also found. Some of these appear to be secondarily silicified mudrocks or limestones of possible lacustrine origin but at least some contain high levels of reworked volcanic ash (tuffs and tuffites). A wide range of sedimentological and palaeontological observations point to deposition under seasonally arid climates. These include, for example, the abundance of calcretes and evaporites (silicified gypsum pseudomorphs or “desert roses” *cf* Keyser 1968), reddened mudrocks, sun-cracked muds, “flashy” river systems, sun-cracked fossil bones, well-developed seasonal growth rings in fossil wood, rarity of fauna, and little evidence for substantial bioturbation or vegetation cover (*e.g.* root casts) on floodplains away from the river banks.

The Karelskraal Member is generally well-exposed in many sectors of the Koup WEF project area. This applies especially to the mudrock facies which elsewhere are usually poorly-exposed due to sandstone colluvium from the overlying Poortjie Member. Lower down the Karelskraal succession includes several thin channel sandstone / wacke packages of variable lithofacies. They tend to be thin, tabular, thin-bedded, fine-grained, well-sorted, and greyish to grey-green or speckled but occasional friable "golden yellow" sandstones more typical of the Poortjie member are found, especially within the upper part of the Karelskraal succession. Breccio-conglomerates are generally not well developed but locally thin mudflake intraclast breccias do occur along erosional basal contacts. Intervening mudrock packages vary from thick and massive to thick- bedded or thin-bedded. The majority are grey to grey-green but subordinate purple-brown or mottled mudrocks occur as well. They are intercalated with thin crevasse-splay sandstones with current ripple cross-laminated tops and flat to locally loaded bases.

Well-developed calcrete palaeosol (pedocrete) horizons are common, especially lower down in the Karelskraal succession. They are often a few dm thick, pale brown, cobbly to lenticular, and blocky-weathering. The more fossiliferous palaesol horizons tend to be thinner, laterally persistent with greyish-green to rusty-brown, sphaeroidal to irregular-shaped concretions and are pale grey (micritic) to brownish internally. Prominent-weathering, laterally-extensive rusty-brown, ferruginous carbonate lenses or cobble- to boulder-sized sphaeroidal concretions occur at intervals, perhaps reflecting intervals of high water tables. Well-developed lenses and horizons of dark brown *koffieklip* up to several dm thick are also encountered, in at least one case directly overlying a tuffite bed.

Mudrock-dominated distal floodplain to lacustrine packages appear to predominate within the uppermost Karelskraal Member succession. The mudrocks are usually dark grey to purple-grey or blue-grey, massive to thin bedded or occasionally laminated and locally pencil cleaved. Sedimentological features suggesting periods of high water tables alternating with intermittent aridification within this interval include horizons with large ferruginous carbonate concretions, loading and boudinage of thin crevasse-splay sandstones, locally abundant (and often large large) stellate gypsum pseudomorphs as well as thin, blocky-weathering, greenish tuffites, occasionally showing ripple cross-lamination and wave rippled bed tops. Rectilinear, cross-cutting networks of desiccation cracks infilled with gypsiferous sandstone admixed with mudflakes are common within darker, fine-grained mudrocks (Possible neptunean dykes or dewatering features should also be considered here). However, these beds are typically fossil-poor (See following subsection).

Compared with the underlying rocks, the **Teekloof Formation** (Pt in **Figure *7***) has a generally higher proportion of sandstones and reddish mudrocks are generally more abundant here (**Figure *15*** to **Figure *18***). Multi-storied sandstones are common in the basal arenaceous **Poortjie Member**, as are thin, impersistent lenses or persistent layers of pinkish "cherts" that are probably altered volcanic ashes or lacustrine limestones (Johnson & Keyser 1979, Smith & Keyser 1995b). Several economically interesting uranium ore deposits occur within the Poortjie Member in association with brown-weathering, ferruginous channel sandstones (*koffieklip*) and transported plant material. Interesting accounts of the sedimentology and palaeontology of the Poortjie Member at the farm Putfontein, some 25 km to the north of the present WEF study area, are given by Stear (1978) as well as by Cole and Smith (2008). The base of the Poortjie Member has recently been dated to 260 Ma on the basis of a white tuff unit 3.5 m above the basal sandstone (Day *et al.* 2015). Several laterally-persistent tuff or tuffitic units are represented within the upper Abrahamskraal – Poortjie Member interval, as well seen in satellite images of the region as well as in the field, in the Koup 1 and 2 WEF project area. They may be of use in future in constraining the end-Guadalupian mass extinction event (*cf* Day *et al.* 2015, McKay *et al.* 2015, Almond 2018, Day & Rubidge 2021) (See palaeontological discussion below).

Within the combined Koup 1 & 2 WEF project area a succession of several (3-4 at least), closely-spaced, moderately thick (*c*. 5-10 m) packages of channel sandstone build the higher ground along the crests of E-W trending ridges and cap several isolated *koppies*. The Poortjie sandstones are typically "golden-yellow" weathering, flat- to cross-bedded and medium-grained with a high feldspathic component, giving them a

friable of biscuit-like texture. However, some well-sorted, tabular bedded, fine-grained packages occur here too. Thin basal breccias with reworked calcrete glaebules occur locally but the lower contacts of the sandstone packages are usually mantled by scree. Thin packages of grey to grey-green, massive to well-bedded silty mudrocks (often highly cleaved) are interleaved between the channel sandstones. They contain horizons of small to large pedogenic calcrete concretions (often ferruginised) and small to large radial gypsum pseudomorphs.

In areas of low topographic relief, such as gentler hillslopes, extensive gravelly to sandy *vlaktes* (*i.e.* plains) as well as in the vicinity of larger water courses, the Beaufort Group bedrocks are mantled by various **Late Caenozoic superficial sediments** (**Figure *23*** to **Figure *25***). For the most part these comprise downwasted or eluvial surface gravels, rubbly sandstone colluvium, silty, sandy and gravelly alluvium (pale yellow areas mapped in **Figure *7***) as well as skeletal soils, with local development along drainage lines of spring deposits such as calcrete. Most of these superficial deposits are unconsolidated and probably of Late Pleistocene to Holocene age (*i.e.* last 2.5 million years) but some alluvium is well-calcretised and might be somewhat older. High Level gravel terraces are not well-developed in the region, implying low levels of stream incision.

The greyish to pale brown, predominantly sandy to fine-gravelly alluvial deposits may reach thicknesses of several meters with finer-grained, massive to well-bedded or locally cross-bedded alluvium overlying basal gravels dominated by angular wacke clasts. Some of these deposits are probably catastrophic flood inundites. Alluvial patches are mapped in the eastern sector of the combined WEF project area in association with the Platdoringrivier and Kaatjies se Loop (**Figure *7***). In the extensive alluvial *vlaktes* in the E and S portions of the project area (N of Kareerivier and E of Platdoorns as well as on Oskloof) shallow streams expose rubbly, cobbly to pebbly alluvial gravels of wacke, tuff, vein quartz and pedogenic calcrete concretions. Finer, often subrounded, downwasted eluvial surface gravels of the same lithologies and modified by sheetwash processes occur at surface. Yellow-hued, blocky sandstone colluvium forms aprons below low *kranzes* of Poortjie sandstone while the crests of higher-lying ridges and crests are usually mantled with rubbly, weathered relictual sandstone deposits and sandy soils. The finer-grained, better-cemented wackes within the Abrahamskraal Formation show well-developed corestone weathering, generating distinctive rounded, orange-patinated wacke cobbles that are often anthropogenically flaked. Sheets of yellow-green to bright orange weathering, blocky gravels of tuffite are also characteristic of the Karelskraal – Poortjie stratigraphic interval and, like the milky vein quartz gravels associated with faults lines, can often be picked out on satellite imagery.

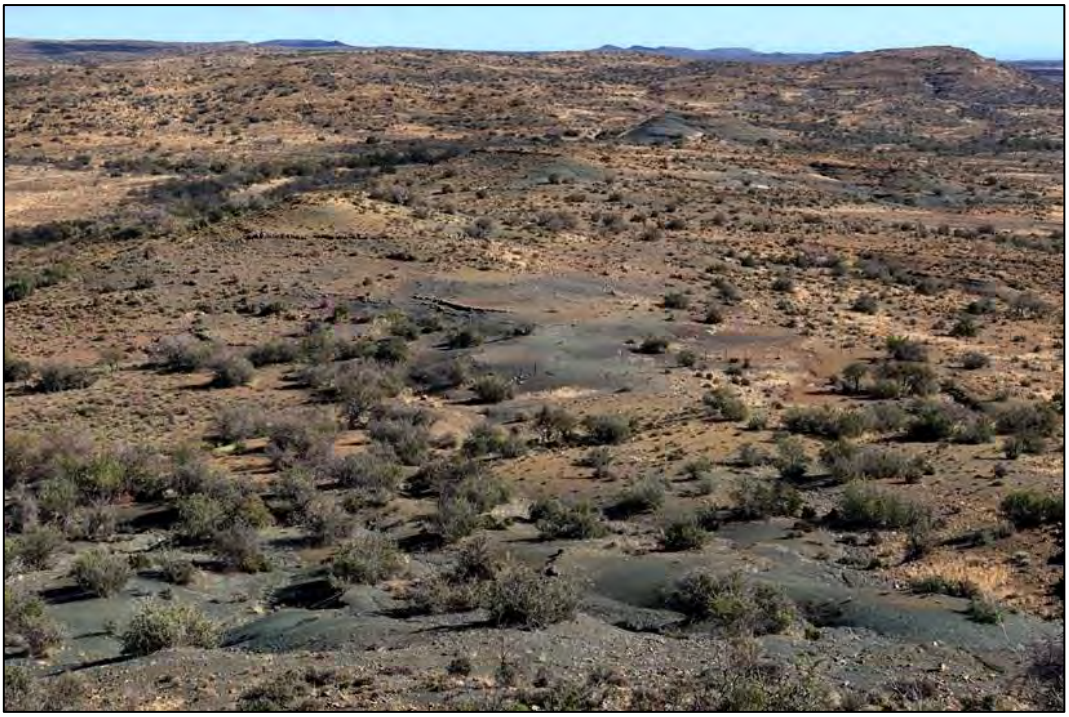

Figure 9: View westwards towards Platdoring se Kop in the central sector of the Koup 1 WEF project area (Farm 5/380). High exposure levels of dark grey to purple-brown mudrocks of the upper Karelskraal Member are evident here.

Figure 10: View northwards towards the low, E-W trending range of hills in the southern sector of the Koup 1 WEF (Farm 11/374). Away from incised stream gullies, low levels of bedrock exposure are typical of the gentle hillslopes and foot slopes here.

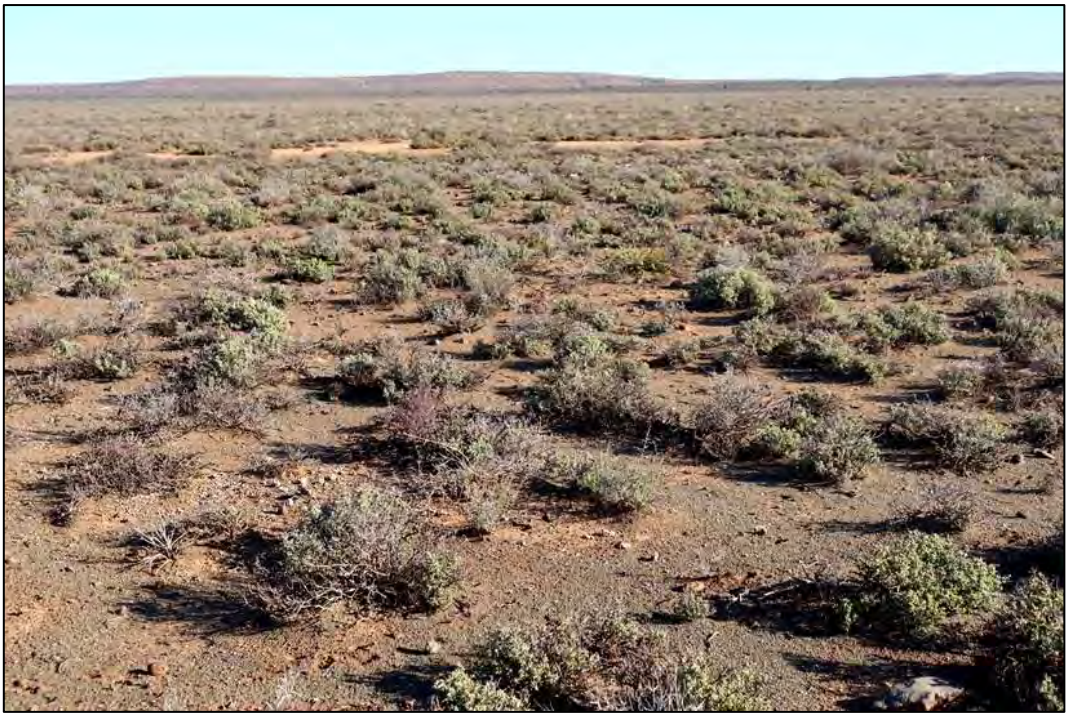

Figure 11: View southwards across the alluvial flats characterizing the NE sector of the Koup 1 WEF project area (Farm 11/374), in the vicinity of the existing grid line.

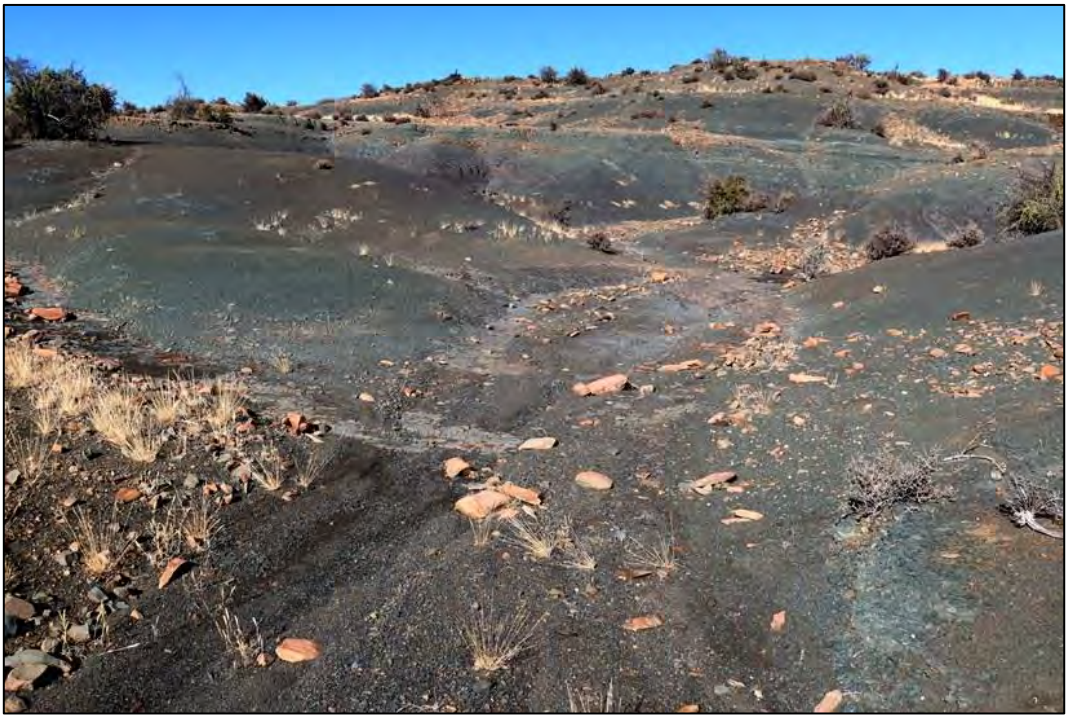

Figure 12: Excellent, gentle, gullied hillslope exposures of Karelskraal Member blue-grey to purple-brown mudrocks in the Koup 1 WEF project area (5/380). Such areas are ideal for fossil recording, but - interestingly - often prove almost completely unfossiliferous.

Figure 13: Small, rounded "desert roses" (quartz pseudomorphs after gypsum) marking intervals of high evaporation on the ancient Karoo floodplain, Karelskraal Member, Koup 1 WEF project area (Farm 5/380) (Scale in cm).

Figure 14: Polygonal networks of large-scale desiccation crack infills characterize many dark, fine-grained mudrock intervals of possible lacustrine origin, upper Karelskraal Member, Koup 1 WEF project area (Farm 11/380).

Figure 15: View eastwards along stepped, N-facing ridge slopes in the Koup 1 WEF project area (Farm 11/374) showing intercalation of yellowish-brown Poortjie Member channel sandstones and greyish packages of overbank mudrocks (a prime focus for fossil recording).

Figure 16: Typical yellowish-brown, tabular to cross-bedded sandstone package within the lower part of the Poortjie Member succession, Koup 1 WEF project area (Farm 11/380) (Hammer = 30 cm).

Figure 17: Typical Poortjie Member sandstone scenery along a ridge crest on the southern margin of the Koup 1 WEF project area (Farm 11/380). A high proportion of the WEF turbine infrastructure will be placed in this sort of terrain.

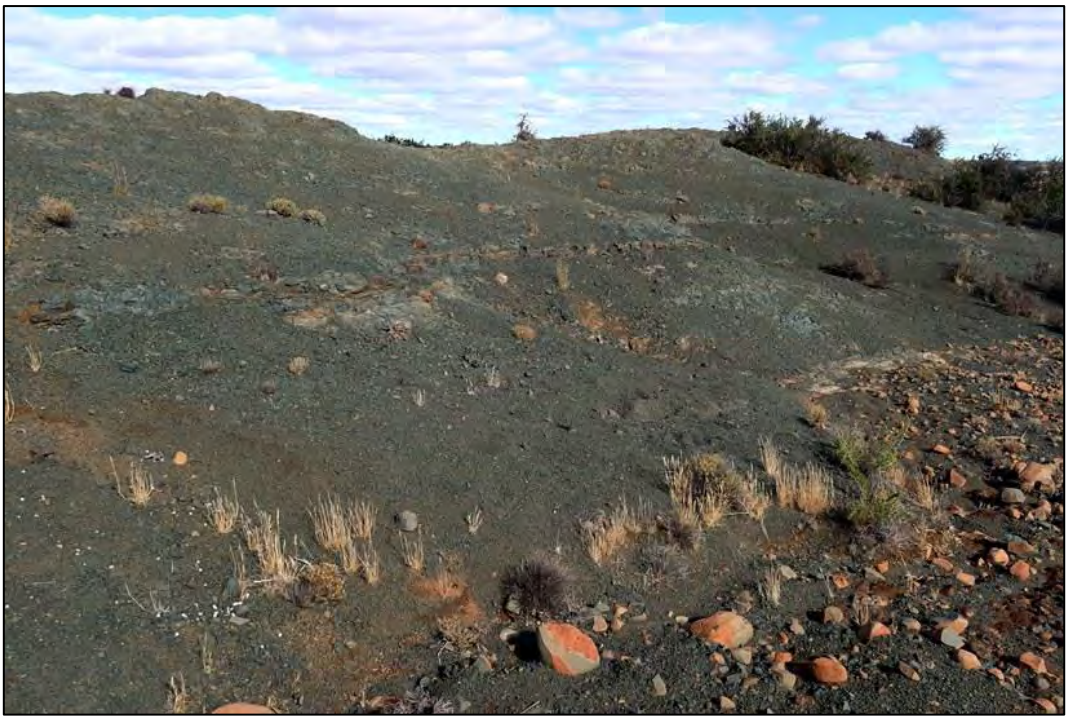

Figure 18: Good exposure of massive, cleaved, dark grey overbank mudrocks of the Poortjie Member in an upland ridge area of the Koup 1 WEF project area (Farm 5/380).

Figure 19: Steep dips along the southern flank of a major E-W anticline, displayed here by a package of dark Poortjie Member mudrocks in the Koup 1 WEF project area (Farm 231).

Figure 20: Core area of an E-W trending anticlinal ridge in the Koup 1 WEF project area (Farm 11/380) showing the pronounced, subvertical cleavage developed within both sandstone and mudrock facies. The paler central band may indicate small-scale thrusting and quartz veining here.

Figure 21: Pervasive steep tectonic cleavage of Poortjie Member siltstones along a ridge crest in the Koup 1 WEF project area (Farm 11/374). Well-preserved fossil vertebrates, protected within resistant calcrete concretions, may be found even in such unpromising-looking exposures.

Figure 22: Subhorizontal thrust zone within Beaufort Group beds marked by thick veining with milky quartz and N-S orientated quartz mineral lineation, Koup 1 WEF project area (Farm 11/380).

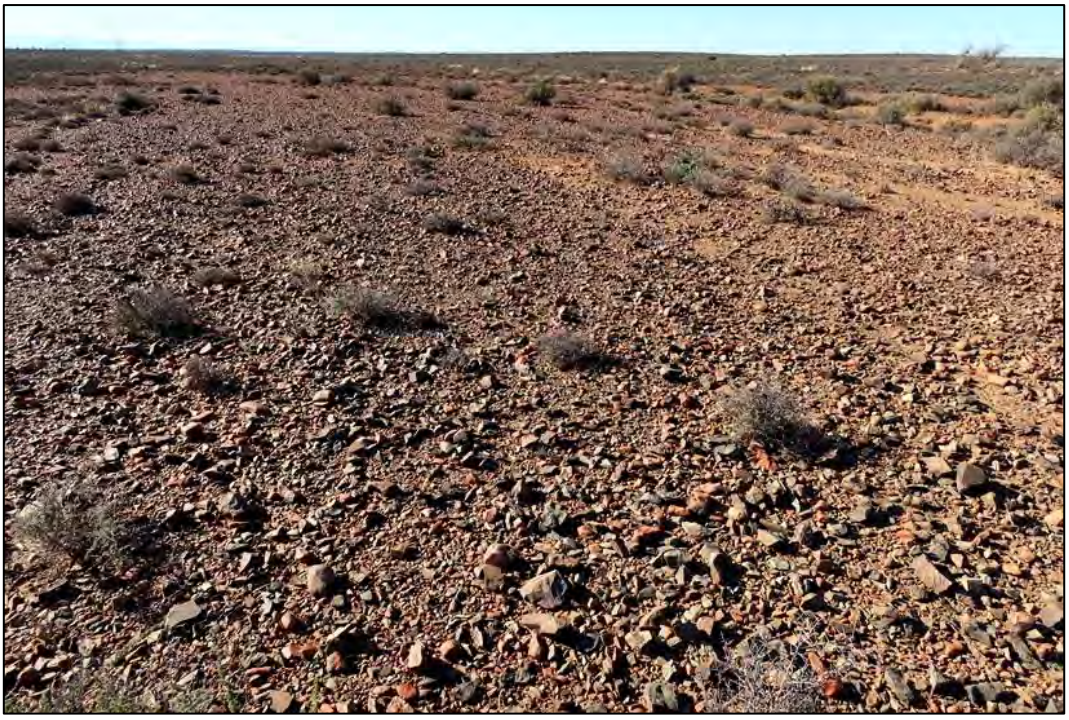

Figure 23: Dark patinated surface gravels of wacke, vein quartz, tuffite and calcrete overlying portions of the alluvial *vlaktes* in the NE portion of the Koup 1 WEF project area (Farm 11/374).

Figure 24: Rubbly, poorly-sorted, unconsolidated fluvial gravels (mainly of wacke) observed along shallow incised water courses in the NE portion of the Koup 1 WEF (Farm 11/374), close to the existing power line.

Figure 25: Alluvial flats mantled by sheet-washed fine alluvial gravels and sands associated with the Platdoringsrivier, Koup 1 WEF project area (Farm 5/380).

5.2 Palaeontological heritage

Continental (terrestrial / lacustrine / fluvial) fossil biotas within the upper part of the Abrahamskraal Formation (Moordenaars and Karelskraal Members) as well as within the lowermost portion of the Poortjie Member of the Teekloof Formation are now assigned to the ***Diictodon – Styracocephalus*** **Subzone** of the revised ***Tapinocephalus*** **Assemblage Zone** (AZ) that is of Middle Permian age (Late Capitanian, *c*. 262-260 Ma) (Day & Rubidge 2020) (See stratigraphic column in **Figure *8***). These biotas are of special palaeobiological interest in that they reflect the major Late Capitanian or Guadalupian (Late Middle Permian) Mass Extinction Event on land (See biostratigraphic chart in **Figure *28***). The highly impoverished, post-extinction vertebrate fauna represented in the uppermost part of the *Diictodon – Styracocephalus* Subzone (upper Karelskraal Member - lowermost Poortjie Member) includes – or is inferred to include – only a few representatives of several tetrapod subgroups including temnospondyl amphibians, parareptiles (pareiasaurs, *Eunotosaurus*), dinocephalians (*e.g. Criocephalosaurus,* perhaps also *Anteosaurus, Titanosuchus*), dicynodonts (*e.g. Diictodon*), therocephalians (*e.g. Pristerognathus*) and gorgonopsians (Retallack *et al* 2006, Smith *et al.* 2012, Day *et al.* 2015a, 2015b, Day & Rubidge 2020, Day & Rubidge 2021, Marchetti *et al.* 2020) (**Figure *28*** to **Figure *31***).

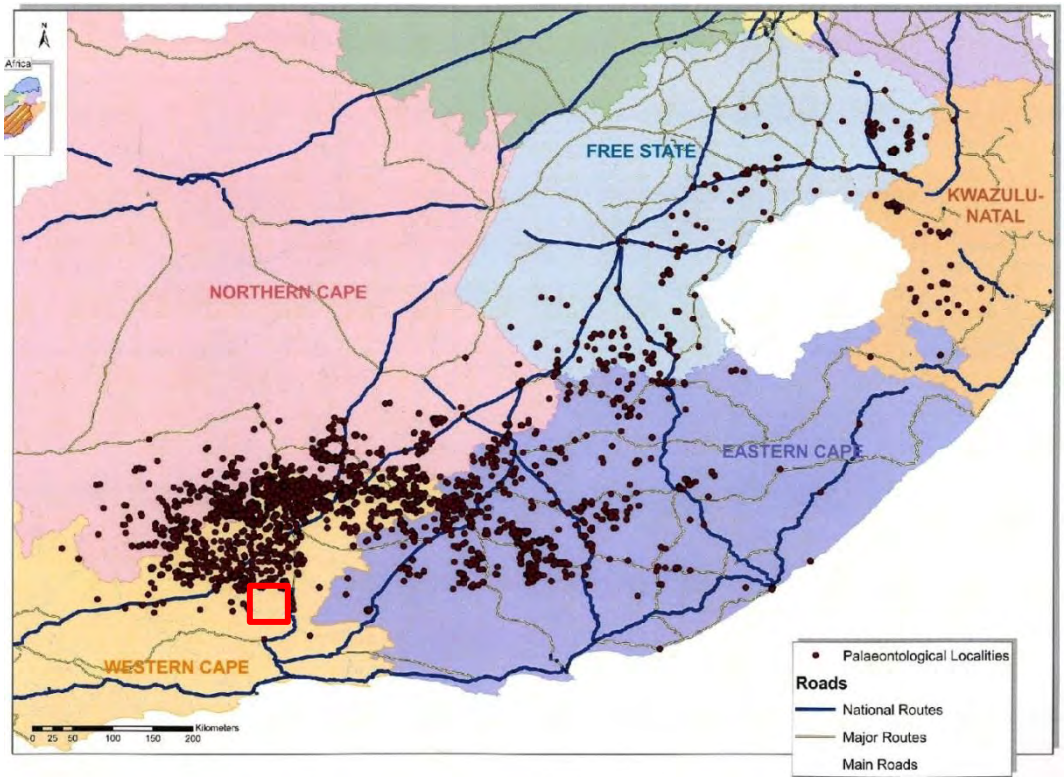

Figure 26: Distribution of recorded vertebrate fossil sites within the southern portion of the Main Karoo Basin (modified from Nicolas 2007). The approximate location of the combined Koup WEF project area to the south of Beaufort West (BW) is indicated by the red rectangle. The high density of recorded fossil sites along the N12 here as well as further to the north is notable.

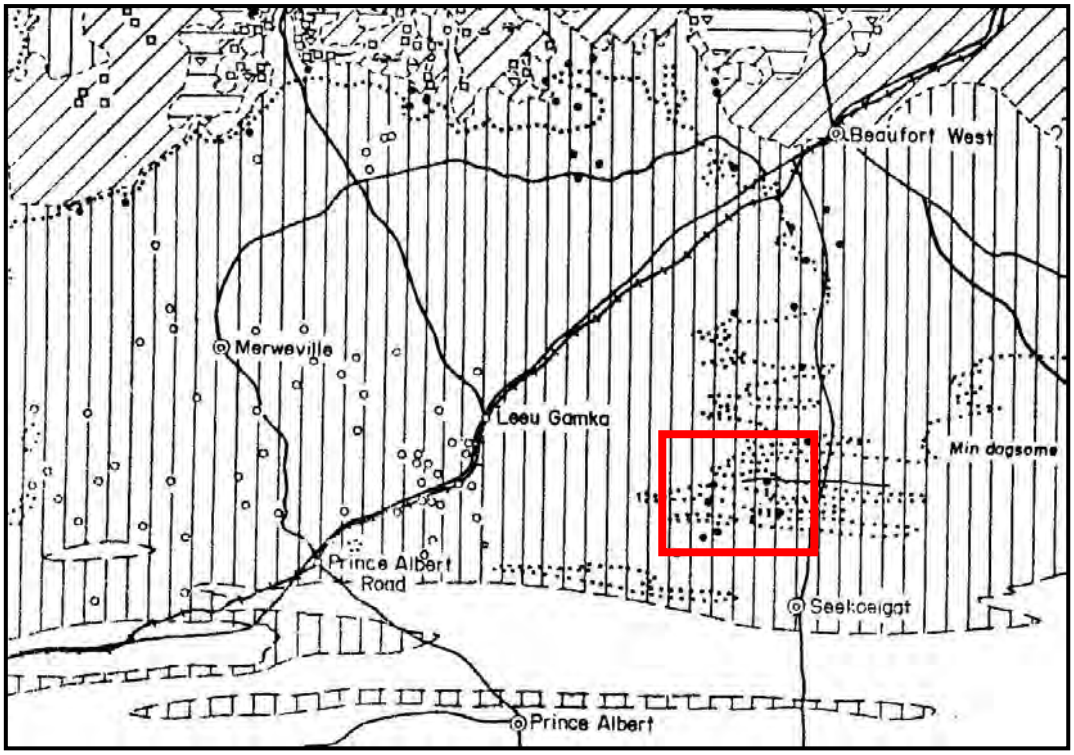

Figure 27: Vertebrate fossil localities within the Lower Beaufort Group in the region south of Beaufort West where the boundary between the Abrahamskraal and Teekloof Formations is highly folded (dotted line). *Tapinocephalus* Assemblage Zone specimens are found in the far south (small open circles) while *Pristerognathus* Assemblage Zone fossils (black dots) are associated with outcrops of the Poortjie Member (lowermost Teekloof Formation) (Map abstracted from Keyser & Smith 1977-78). The paucity of fossil records east of the N12 tar road reflects the generally poor bedrock exposure in the area compared with more dissected terrain to the west of the road.

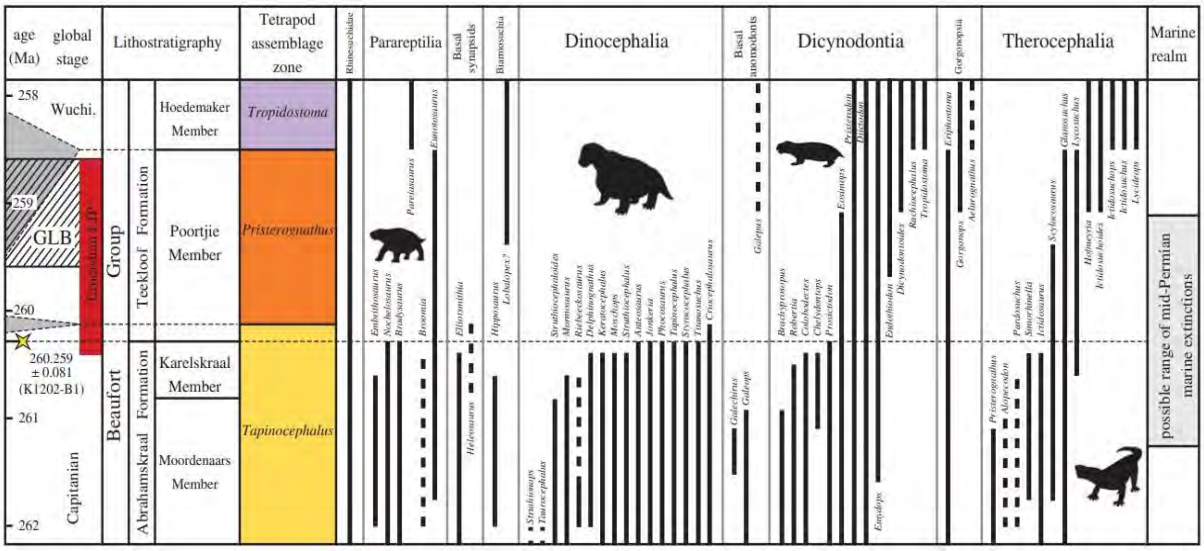

Figure 28: Chart showing the ranges of known terrestrial tetrapod genera from the Middle to Late Permian of the Main Karoo Basin (From Day *et al.* 2015b). The boundary between the Abrahamskraal and Teekloof Formations is associated with a catastrophic extinction event at the end of the Capitanian Stage (*c.* 260 Ma) that has been dated here on the basis of a tuff horizon close to the contact of the Karelskraal and Poortjie Members (yellow star). Key victims of the extinction event were almost all the large-bodied dinocephalians and pareiasaur parareptiles as well as many (but not all) dicynodonts and therocephalians.

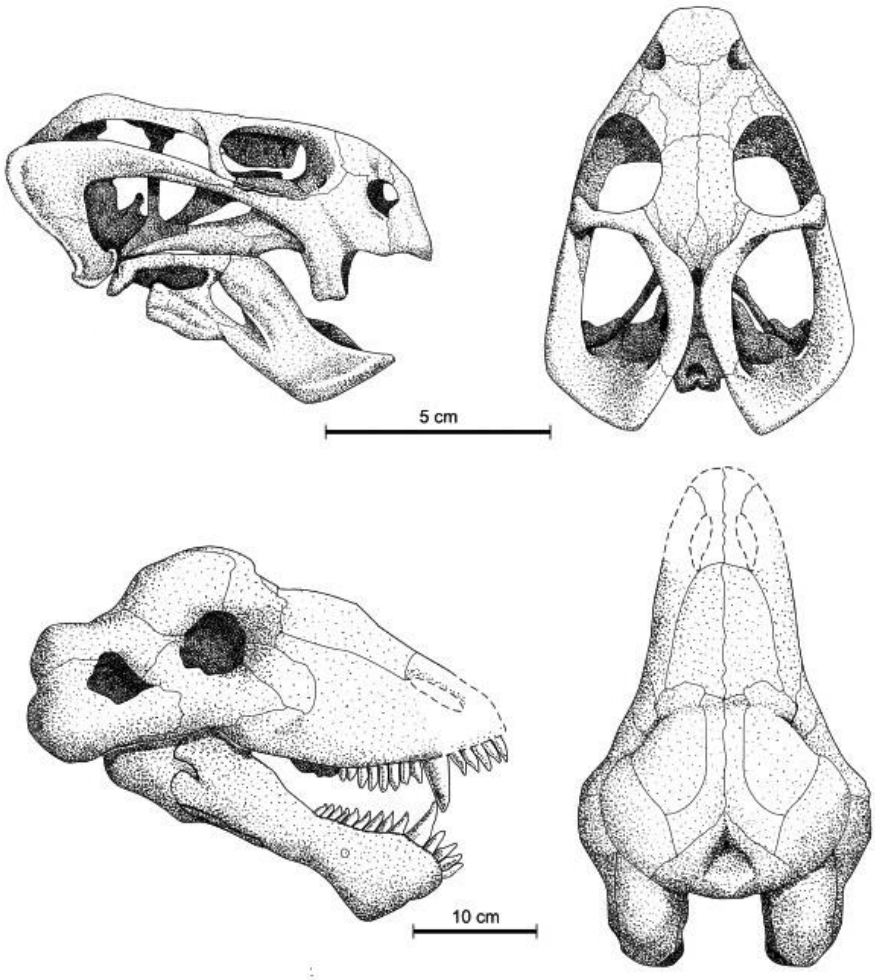

Figure 29: Skulls of two key fossil therapsid tetrapods from the upper part of the *Tapinocephalus* Assemblage Zone – the small-bodied dicynodont Diictodon (top) and the large-bodied dinocephalian *Styracocephalus*. Note the very thick cranial roof in the latter, a possible adaptation for head-butting shown by many tapinocephalid dinocephalians.

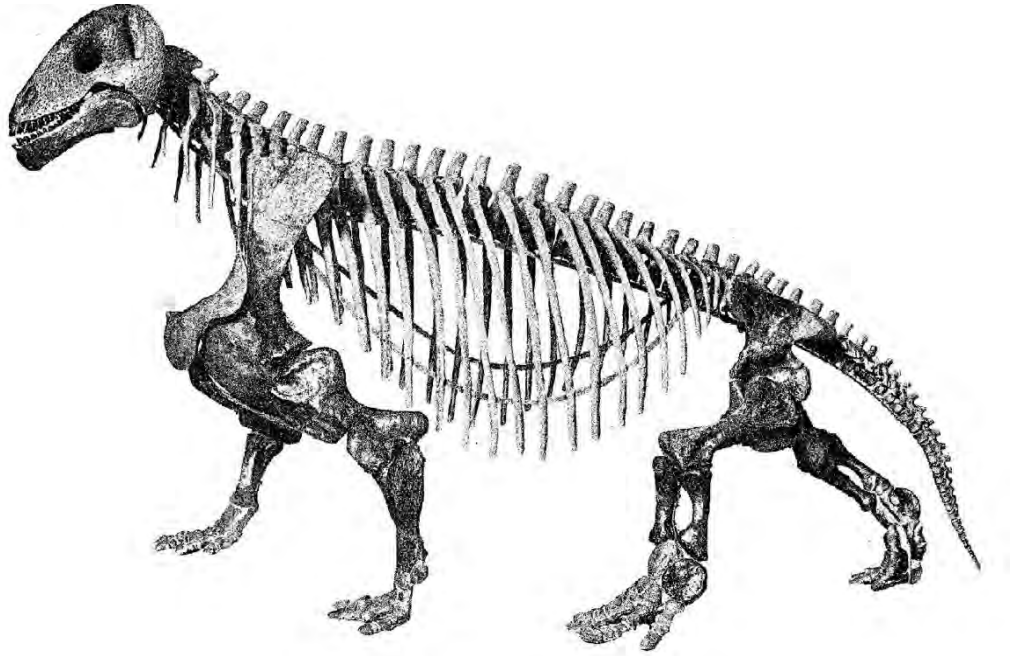

Figure 30: Skeleton of the tapinocephalid (thick-skulled) dinocephalian *Moschops*, a rhino-sized herbivorous therapsid that reached lengths of 2.5 to 3 m and may have lived in small herds. Postcranial remains (and much rarer fossil skull material) of several dinocephalians have been recorded within and just outside the Koup WEF project area.

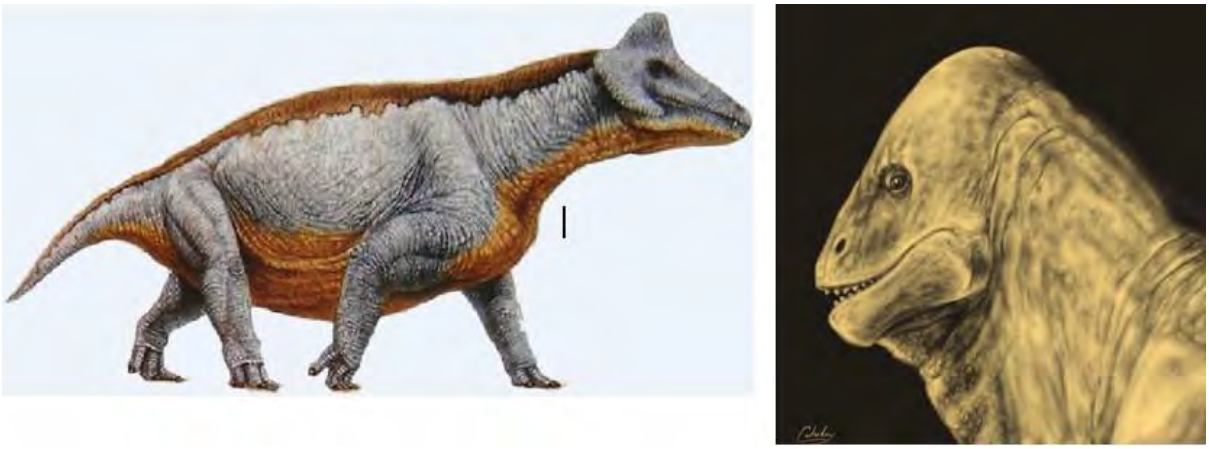

Figure 31: Artist's reconstructions of the indescribably ugly late Middle Permian dinocephalians *Styracocephalus* (left) and *Criocephalosaurus* (right). One or both these taxa may occur within or close to the WEF project area.

A number of vertebrate fossil sites of the (now outdated) *Pristerognathus* Assemblage Zone have been within the Poortjie Member both within and (mainly) ouside the Koup WEF project area by Keyser and Smith (1977-1978) (**Figure *27***). Many of these are indicated on the published 1: 250 000 scale geological map (triangular symbols on map **Figure *7***) while only a few sites for the underlying *Tapinocephalus* Assemblage Zone are recorded here (star-shaped symbols in map **Figure *7***). The more recent map of Karoo fossil vertebrates published by Nicolas (2007) (**Figure *26***) shows several fossil sites along the N12 but none just

to the west where the Koup 1 & 2 WEF project area is located. A number of dinocephalian, dicynodont and therocephalian fossil sites have been found on Farm 380 Bloemendal, situated just north of the WEF project area (Ms Marietjie Mostert, pers. comm., June 2021) One of these sites features substantial cranial fragments of several thick-skulled tapinocephalid dinocephalians (**Figure *34*** & **Figure *35***). These fossils are of particular interest in that they are mapped within the lower part of the Poortjie Member. If correct (this requires confirmation), they would then represent very rare survivors of end Middle Permian Mass Extinction Event during which almost all members of the Dinocephalia went extinct (Day *et al.* 2015a, 2015b, 2020, Day & Rubidge 2021). A wide range of vertebrate and other fossil remains have been recorded from the critical upper Abrahamskraal – lower Poortjie Member stratigraphic interval during several recent PIA field studies to the east of the N12 adjacent or close to the present project area (Almond 2018, Almond in prep. 2021).

The extensive (> 6750 ha) combined Koup 1 & 2 WEF project area contains large areas of dissected hilly terrain with good to excellent exposure of both mudrock and sandstone facies of the potentially fossiliferous Lower Beaufort Group (Section 5.1). Sizeable portions of the Koup 1 WEF project area, especially in the NE, show low relief and here the bedrocks are mantled by Late Caenozoic superficial sediments (e.g. alluvium, soils, surface gravels) of low palaeontological sensitivity. During the 5-day palaeontological field survey by the author and an experienced assistant, numerous (over 50) new vertebrate fossil sites were recorded within the more accessible portions of the combined WEF and grid connection study area (See satellite map Figs.

Figure *65*, **Figure *66*** and A2.2). GPS locality data together with a short description of each site as well as recommended mitigation (if any) is tabulated in Appendix 2 of this report while selected fossil specimens from the combinwed WEF project area are illustrated in **Figure *32*** to **Figure *63*** below with explanatory figure legends.

The main categories of fossils found here, associated with both sandstone and mudrock facies as well as downwasted surface gravels, include:

- Surface scatters and rare concentrations of disarticulated to semi-articulated skull and post-cranial skeletal elements of large-bodied tetrapods within the lower parts of the Karelskraal Member and apparently also within the lowermost part of the Poortjie Member. Most or all of these specimens are probably referrable to one or (possibly) more members of **tapinocephalid Dinocephalia** ("horrible heads") but diagnostic cranial or dental material is very rare (Alternatively, some of the material might be **pareisaur reptile** in origin but the presence of this group remains unconfirmed). Much of the bony material is fragmentary, secondarily mineralised (*e.g.* by pyrite), weathered (*e.g.* suncracked) and probably unidentifiable, so is of limited research or conservation interest. Some bones are encased within ferruginous carbonate pedocrete concretions or sandstone. However, a number of specimens are of scientific value and, if threatened by the proposed development, should be formally collected for storage in a museum collection (*e.g.* Iziko Museums, Cape Town). These include a concentration of several cranial fragments of very thick-skulled tapinocephalids (probably *Criocephalosaurus*) from the lower Poortjie Member on the Farm Bloemendal (Loc. 724), just N of and outside the WEF project area. These specimens may represent the remains of some of the last dinocephalians that survived the end-Middle Permian Extinction Event; a few other examples of this genus are recorded in the Beaufort West area (*cf* Day *et al.* 2015a, Almond 2020a).

- Small-bodied herbivorous **dicynodonts** are the commonest fossils found in both the lower Karelskraal Member and the Poortjie Member. Many of these are referrable to the common dassie-sized genus *Diictodon* (**Figure *29***). A number of specimens showing a broader skull table or (rarely) post-canine teeth belong to other dicynodont genera and are of higher palaeontological interest. Dense local concentrations of small *Diictodon* and other dicynodont skulls are found within mudrock intervals of the Poortjie Member at several sites.

- Sparse records of **trace fossils** include several (mostly equivocal) sandstone burrow casts of tetrapods, possible smaller-scale invertebrate burrows as well as fine horizontal burrows associated with subaqueous or pond margin microbial mats. No lungfish burrows were seen.

- Small carnivorous **therocephalians**, often preserved within fine-grained sandstones or pedocrete concretions, are known from several sites on the margins of the WEF project area but were not recorded during the recent field survey.

- Likewise, poorly preserved, ferrugnised, **petrified wood** which is recorded weathering out of the Poortjie Member just to the east of the present study area as well as closer to Beaufort West (Almond 2020a) was not encountered here.

The Lower Beaufort Group fossil sites lie within both the uppermost Abrahamskraal Formation (Karelskraal Member) as well as the lower part of the overlying Poortjie Member of the Teekloof Formation. They therefore span the critical end-Guadalupian Mass Extinction event of *c*. 260 million years ago (*cf* **Figure *28***) and are of special biostratigraphic and palaeobiological interest for this reason. It is notable that the thick packages of silty mudrocks within the uppermost Karelskraal Member are generally largely unfossilferous, even where they are very well exposed within the WEF project area. As mentioned in Section 5.1, the sedientology of these mudrock intervals suggests strongly fluctuating climates with more pluvial, lacustrine intervals aith high water tables alternating with periods of intense floodplain aridification. These highly unstable environmental conditions may be related to the end Middle Permian extinction episode. As noted previously, several thin tuff (volcanic ash) or tuffite horizons recorded within the Abrahamskraal – Poortjie contact zone are datable and could potentially constrain the age of the mass extinction event. The possible role of centemporary extra-basinal volcanism in the Karoo vertebrate extinctions has yet to be explored.

The diverse Late Caenozoic superficial deposits within the South African interior, including the Great Karoo region, have been comparatively neglected in palaeontological terms. However, sediments associated with ancient drainage systems, springs and pans in particular may occasionally contain important fossil biotas, notably the bones, teeth and horn cores of mammals as well as remains of reptiles like tortoises (*e.g.* Skead 1980, Klein 1984b, Brink, J.S. 1987, Bousman *et al.* 1988, Bender & Brink 1992, Brink *et al*. 1995, MacRae 1999, Meadows & Watkeys 1999, Churchill *et al*. 2000, Partridge & Scott 2000, Brink & Rossouw 2000, Rossouw 2006, De Ruiter *et al.* 2010, Backwell *et al.* 2017). Other late Caenozoic fossil biotas that may occur within these superficial deposits include non-marine molluscs (bivalves, gastropods), ostrich egg shells, trace fossils (*e.g.* calcretised termitaria, coprolites, invertebrate burrows, rhizocretions), and plant material such as peats or palynomorphs (pollens) in organic-rich alluvial horizons (Scott 2000) and diatoms in pan sediments. In Quaternary deposits, fossil remains may be associated with human artefacts such as stone tools and are also of archaeological interest (*e.g.* Smith 1999 and refs. therein). Ancient solution hollows within extensive calcrete hardpans may have acted as animal traps in the past. As with coastal and

interior limestones, they might occasionally contain mammalian bones and teeth (perhaps associated with hyaena dens) or invertebrate remains such as snail shells. Although a number of Late Caenozoic deposits (including thicker alluvium, spring-related calcretes) were examined during the palaeontological survey, no fossil remains were recorded within them.

Figure 32: Large proximal limb bone of a large-bodied tetrapod (probably dinocephalian) embedded within dark Karelskraal Member mudrocks (Loc. 665) (Scale is 15 cm long).

Figure 33: Weathered-out large vertebrae collected from stream gravels downslope of the in situ specimen illustrated above and probably belonging to the same animal (Loc. 665) (Top RHS block 15 cm across).

Figure 34: Partial skull roof of a tapinocephalid dinocephalian – probably *Criocephalosaurus* (Loc. 724) found on the Farm Bloemendal, just N of the Koup WEF project area (Scale is 15 cm long). The specimen probably comes from the lower Poortjie Member and, if so, would count among the last surviving members of the Dinocephalia known (See also following figure).

Figure 35: Oblique ventral view of the tapinocephalid specimen illustrate above. The skull is *c.* 25 cm wide and the skull roof as seen here is over 15 cm thick.

Figure 36: In situ, ferruginized partial postcranial skeleton of a dinocephalian therapsid embedded within Karelskraal Member mudrocks (Loc. 603) (Scale = 15 cm). Pyrite pseudomorph crystals within some of the bones as well as rippled sandstones in the vicinity suggest preservation of a corpse along a waterlogged lake margin.

Figure 37: Heap of fragmentary, disarticulated postcranial and cranial material collected in the immediate vicinity of the *in situ* dinocephalian skeleton illustrated above (Loc. 603) (Hammer = 30 cm).

Figure 38: Weathered jaw fragment of a dinocephalian with deep-rooted teeth associated with the skeleton in Figure 36 above (Loc. 603) (Block is *c.* 10 cm across).

Figure 39: Probable fragmentary cranial and other remains associated with the skeleton in Figure 36 (Loc. 603) (Scale = 15 cm).

Figure 40: Fragments of limb bones from the same individual (Loc. 603) (Scale = 15 cm). These are potentially of taxonomic value.

Figure 41: Further fragments of limb bones from the same individual (Loc. 603) (Scale = 15 cm).

Figure 42: Surface scatter of white, weathered bone material of an unidentified large-bodied tetrapod found as surface float overlying the upper Karelskraal Member (Loc. 660) (Scale = 15 cm). Such material is usually unidentifiable and accordingly of limited scientific value.

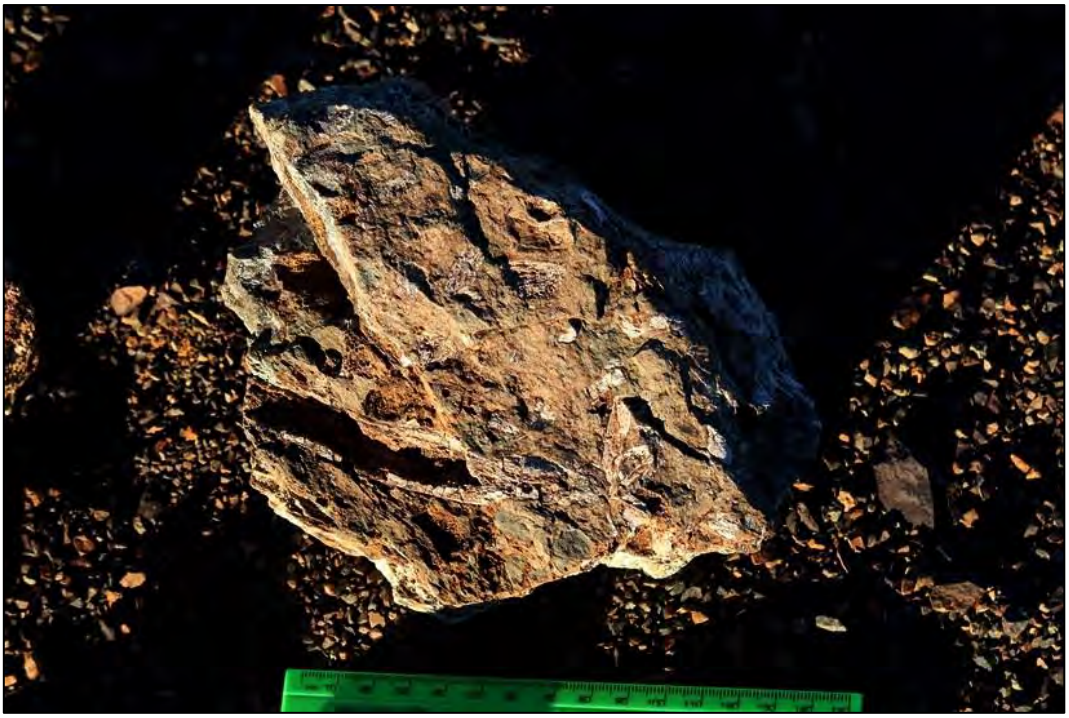

Figure 43: Close up of one of the sandstone and bone blocks illustrated above showing highly fragmentary preservation, possibly due to sun-cracking during pre-burial exposure on the ancient Karoo floodplain (Loc. 660) (Scale in cm).

Figure 44: Typical sparse scatter of fragmentary postcranial bones of an unidentified large-bodied tetrapod – pareiasaur or dinocephalian - from the Karelskraal Member, found as surface float (Loc. 623) (Largest block is *c.* 15.5 cm across). Such poorly-preserved post-cranial material is mostly of limited scientific value.

Figure 45: Thin channel sandstone containing dispersed, reworked post-cranial remains of a large-bodied tetrapod (arrowed) in the upper Karelskraal Member (Loc. 675) (Scale = 15 cm). This site is associated with a downslope trail of weathered-out bones within sandstone blocks.

Figure 46: Pedogenic calcrete nodule in float containing several articulated vertebrae, possibly from the tail, of a medium- to large-bodied tetrapod, upper Karelskraal Member (Loc. 613) (Block is *c.* 9 cm across).

Figure 47: Ferruginized calcrete concretion within cleaved overbank mudrocks of the upper Karelskraal Member containing a row of ribs of a large-bodied tetrapod (Loc. 668) (Concretion is *c.* 30 cm across).

Figure 48: Articulated complete skull of a small dicynodont therapsid almost entirely enclosed in a pedogenic calcrete concretion, found among float overlying the Karelskraal Member (Loc. 577) (Scale in cm and mm). The specimen shows several post-canine teeth (not illustrated here) and so does not belong to the common dicynodont genus *Diictodon*.

Figure 49: Skull of a small dicynodont from the Karelskraal Member (Loc. 631) showing a broad skull table, *i.e.* not *Diictodon* (Specimen is 7 cm long).

Figure 50: Poorly preserved dicynodont skull within a pedogenic calcrete concretion, Karelskraal Member) (Loc. 693) (Specimen is *c.* 10 cm long).

Figure 51: Possible (but equivocal) large, inclined vertebrate burrow cast within cleaved mudrocks of the Karelskraal Member (Loc. 594) (Hammer = 30 cm).

Figure 52: Possible (but equivocal) large, inclined vertebrate burrow cast in the Karelskraal Member (Loc. 595), recorded within a few meters of the previous specimen (Hammer = 30 cm).

Figure 53: Skull of a small-bodied dicynodont – probably *Diictodon* - from a mudrock interval within the Poortjie Member, seen in dorsal view (Loc. 641) (Specimen is *c.* 6.5 cm long).

Figure 54: Postcranial remains of a small-bodied therapsid, probably dicynodont, preserved within a pedogenic calcrete concretion from Poortjie Member mudrocks (Loc. 641) (Block is *c.* 11 cm across).

Figure 55: Well-preserved skull with articulated lower jaw and clear canine tusk preserved *in situ* within Poortjie Member mudrocks, oblique dorso-lateral view (Loc. 649) (Specimen is *c.* 8.5 cm long).

Figure 56: Small pedogenic calcrete concretion from the Poortjie Member enclosing the skull of a small-bodied dicynodont (Loc. 699) (Scale in cm).

Figure 57: *In situ* skull of a small dicynodont within cleaved siltstones of the Poortjie Member (Loc. 706) (Scale in cm and mm).

Figure 58: Post-crania, including limbs and rib cage, of a small-bodied dicynodont preserved inside a calcrete concretion embedded within cleaved Poortjie Member mudrocks (Loc. 687) (Scale = 15 cm).

Figure 59: Skull of small dicynodont within cleaved Poortjie Member mudrocks (Loc. 689) (Scale in cm).

Figure 60: Skull of small dicynodont with a broad skull table and clear pineal foramen weathering out of Poortjie Member mudrocks (Loc. 696).

Figure 61: Convex sandstone cast of a small vertebrate burrow weathering out of cleaved Poortjie Member mudrocks (Loc. 688) (Scale in cm and mm).

Figure 62: Cast of small subhorizontal burrow, either a small tetrapod or perhaps an invertebrate, within Poortjie Member mudrocks (Loc. 647) (Scale in cm).

Figure 63: Sandstone cast of small, inclined burrow (sloping down to the LHS) with a smooth central zone, possibly constructed by a small vertebrate (Loc. 648) (Scale = 15 cm).

6. IDENTIFICATION AND ASSESSMENT OF IMPACTS

The potential impact of the proposed Koup 1 WEF development and the associated grid connection on legally-protected local fossil heritage resources is evaluated in this section of the report and summarized in Tables 2 to 8 below. This assessment applies only to the *construction phase* of the developments since further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the facility are not anticipated. The first assessment (Table 2) applies to all the key infrastructure described in Section 3 that will be situated within the main WEF project area (*i.e.* wind turbine foundations, access roads, on-site substation, pylons, underground cables, as well as the construction camp, laydown areas and operational and maintenance buildings, BESS *etc*). Impacts of the grid connection options under consideration (See Fig. 3) are separately assessed in Table 3. Potential impacts here refer mainly to any associated new access roads, which may entail substantial surface disturbance or clearance, since bedrock excavations for the pylon footings are generally small.

6.1 Palaeontological sensitivity of the project area

The proposed Koup 1 WEF and grid connection project area is located in a region of the Great Karoo that is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary, age. In particular, these include (1) Middle to Late Permian continental sediments of the Abrahamskraal and Teekloof Formations (Lower Beaufort Group, Karoo Supergroup) which contain scientifically important fossils of vertebrates, trace fossils and terrestrial plants, as well as (2) Late Caenozoic alluvium that may contain important mammalian remains such as teeth and bones (These rock units and their fossils are described in more detail in Section 5 of this report).

The generally high palaeontological heritage sensitivity of the Lower Beaufort Group bedrocks in the Great Karoo is emphasized on the SAHRIS palaeosensitivity map maintained by SAHRA. The palaeontological heritage Site Sensitivity Map prepared by SiVEST Environmental for the Koup 1 WEF project area identifies areas underlain by the Lower Beaufort Group as being of a Very High Sensitivity (**Figure *64***). However, both desktop and field studies within this and neighbouring WEF project areas (*e.g.* Trakas, Beaufort West, Heuweltjies, Kraaltjies, Kwaggas 1-3 WEFs) demonstrate that, while a significant number of scientifically valuable, well-preserved fossils do indeed occur here, sometimes in high concetrations, in practice they are often scarce in this region and their distribution is to a large extent unpredictable. However, as a consequence of the considerably higher topographic relief – and hence bedrock exposure levels - encountered within the combined Koup 1 and 2 WEF and grid connection project areas, a significantly higher concentration of fossil sites is recorded here than within WEF project areas towards the east.

It is concluded that, applying the precautionary principle, the Koup 1 WEF and grid connection project areas are best assigned an overall High Sensitivity as far as palaeontological heritage is concerned, while recognising that, in practice, fossil sites are scarce at surface throughout much of the area (*N.B.* Additional fossils are preserved in the subsurface and may be impacted by excavations during the construction phase).

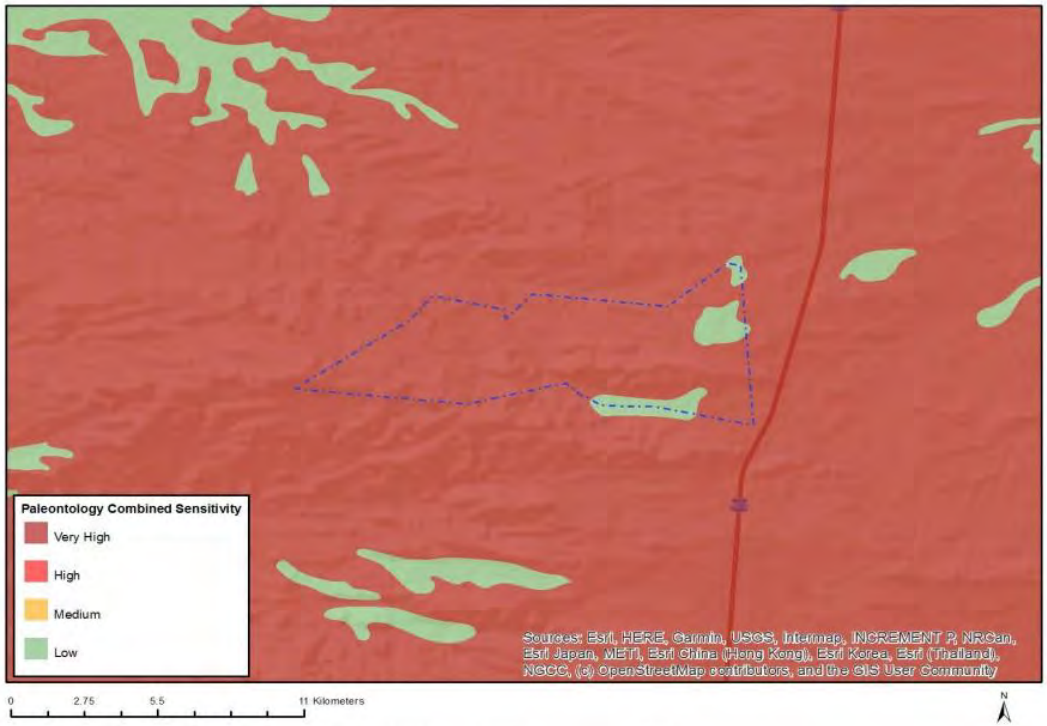

Figure 64: Paleontological sensitivity map for the Koup 1 WEF project area, abstracted from the DEFF Screening Report for an environmental authorization prepared by SiVEST Environmental (April 2021). Due to the scarcity of well-preserved, scientifically important fossils over much of this region, based on desktop studies and fieldwork, it is inferred that large parts of the project area are in practice of LOW palaeontologically sensitivity. However, there is also a substantial number of, dispersed and unpredictable fossil sites here of HIGH to VERY HIGH sensitivity. Applying the precautionary principle, the Koup 1 WEF and associated grid connection project area are best assigned an overall High Sensitivity as far as palaeontological heritage is concerned. Areas underlain by thick alluvial sediments are generally of LOW sensitivity, although important concentrations of Caenozoic mammal remains might occur here.

6.2 Results of the Palaeontological Desktop and Field Study

6.2.1 WEF project area

A desktop review of the palaeontology of the Middle Permian Lower Beaufort Group in the southern Great Karoo region, including palaeontological heritage impact assessments for a number of other authorized or proposed renewable energy developments in the region, shows that well-preserved fossil remains are generally scarce in this sector of the Great Karoo. However, a substantial number of scientifically important occurrences of vertebrate fossils are recorded here, and the vertebrate fossils may occur locally in high concentrations along the ridges as well as in low-lying terrain (Section 5). The 5-day palaeontological heritage survey of numerous exposures of Karoo Supergroup bedrocks as well as Late Caenozoic superficial sediments within the combined Koup 1 and Koup 2 WEF project area (See Appendix 2 and fossil locality maps,

Figure *65*, **Figure *66*** and A2.2) indicates that well-preserved, scientifically valuable fossils are present, for the most part sparsely distributed but occasionally in dense concentrations. Most of the fossils recorded here

lie outside the project footprint and are assigned a moderate to low provisional field rating (Appendix 2). The occurrence of important fossil remains in the subsurface obviously cannot be excluded and only a small subsample of all surface fossil sites have been detected by the reconnaissance-level field survey. Broadly comparable palaeontological findings have previously been obtained for the adjoining Trakas and Beaufort West WEF project areas (Almond 2018) as well as further WEF PIA work in the region (Almond, in prep.). However, as a result of the much higher bedrock exposure levels in the Koup 1 and Koup 2 WEF project areas, the total number and density of fossil sites recorded and expected here is considerably higher.

The potentially fossiliferous Permian bedrocks within the WEF project area are mostly mantled with Late Caenozoic colluvial and alluvial deposits as well as surface gravels and gravelly soils, none of which is palaeontologically sensitive in general. Few of the recorded fossil sites lies within or very close to (< 10 m) the proposed footprint of the WEF (

Figure *65* & **Figure *66***) and therefore most of them should not be directly threatened by the proposed development. Several of the recorded fossil sites are associated with areas of good bedrock exposure that tend to occur along drainage lines and that are therefore generally protected by standard environmental buffer zones for water courses. No palaeontological Very High Sensitivity or No-Go areas have been identified within the project area. However, given the very incomplete coverage of the project footprint during the short field survey (see tracks in Fig. A2.1) - driven largely by access roads and the distribution of good bedrock exposure - many additional, unrecorded fossil sites must lie within or close to the footprint. The great majority (and probably all) of these unrecorded sites can be effectively mitigated through (1) judicious professional recording and collection during the recommended pre-construction specialist palaeontological walkdown of the project footprint complemented by (2) consistent application of a Chance Fossils Finds Procedure during the construction phase itself, as outlined in Section 8 and Appendix 4.

6.2.2 Grid connection project area

No new fossil sites are recorded within the grid connection project area for the Koup 1 WEF (

Figure 65*). The corridor terrain traversing the eastern sector of the WEF project area in part comprises topographically subdued vlaktes mantled by palaeontologically insensitive alluvial deposits and surface gravels. Substantial sectors of the corridor options extending north and south outside of the WEF project area have not been surveyed. According to the geological map (***Figure 7***) as well as satellite imagery, grid connection Option 3 extending to the north traverses more dissected, hilly terrain from which numerous vertebrate fossil sites have been recorded in the past. Comparable hilly terrain to the south of the WEF project area has yielded a concentration of fossil sites close to but west of the grid corridor Option 2 (Almond 2018; yellow symbols in*

Figure *65*). Corridor Option 1 lies within the Poortjie Member outcrop area which contains local concentrations of vertebrate fossils in this region of the Karoo. As for the Koup 1 WEF development, a pre-construction specialist palaeontological walkdown of the finally selected grid connection footprint - *viz*. Option 2 (**Figure 3b**) - complemented by consistent application of a Chance Fossils Finds Procedure during the construction phase (Appendix 4) is recommended here.

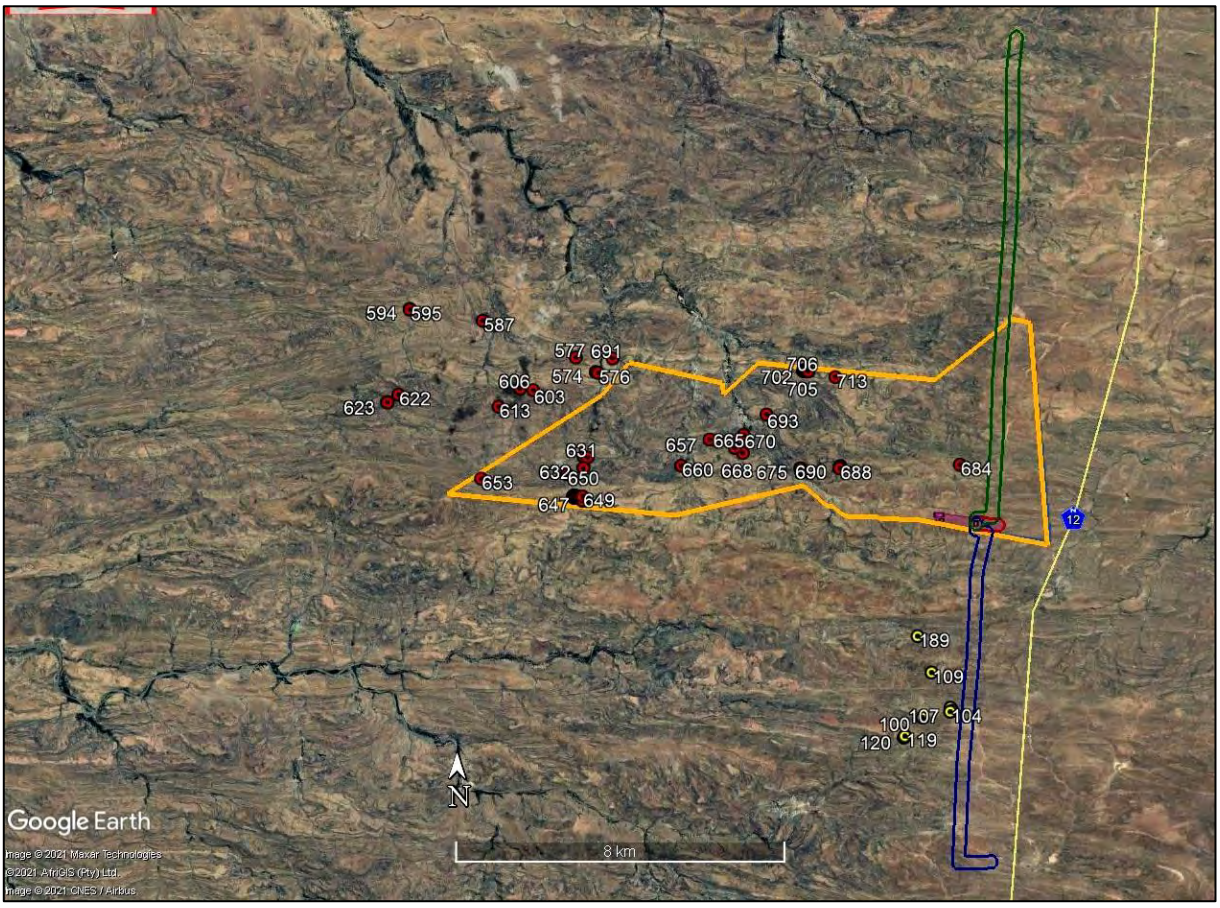

Figure 65: Google Earth© satellite image showing new (red) and previously recorded (yellow) fossil sites within the Lower Beaufort Group in the context of the Koup 1 WEF and grid connection project areas originally assessed (Please see following satellite map for more detail). Please note that Grid Option 2 (blue corridor) has now been chosen.

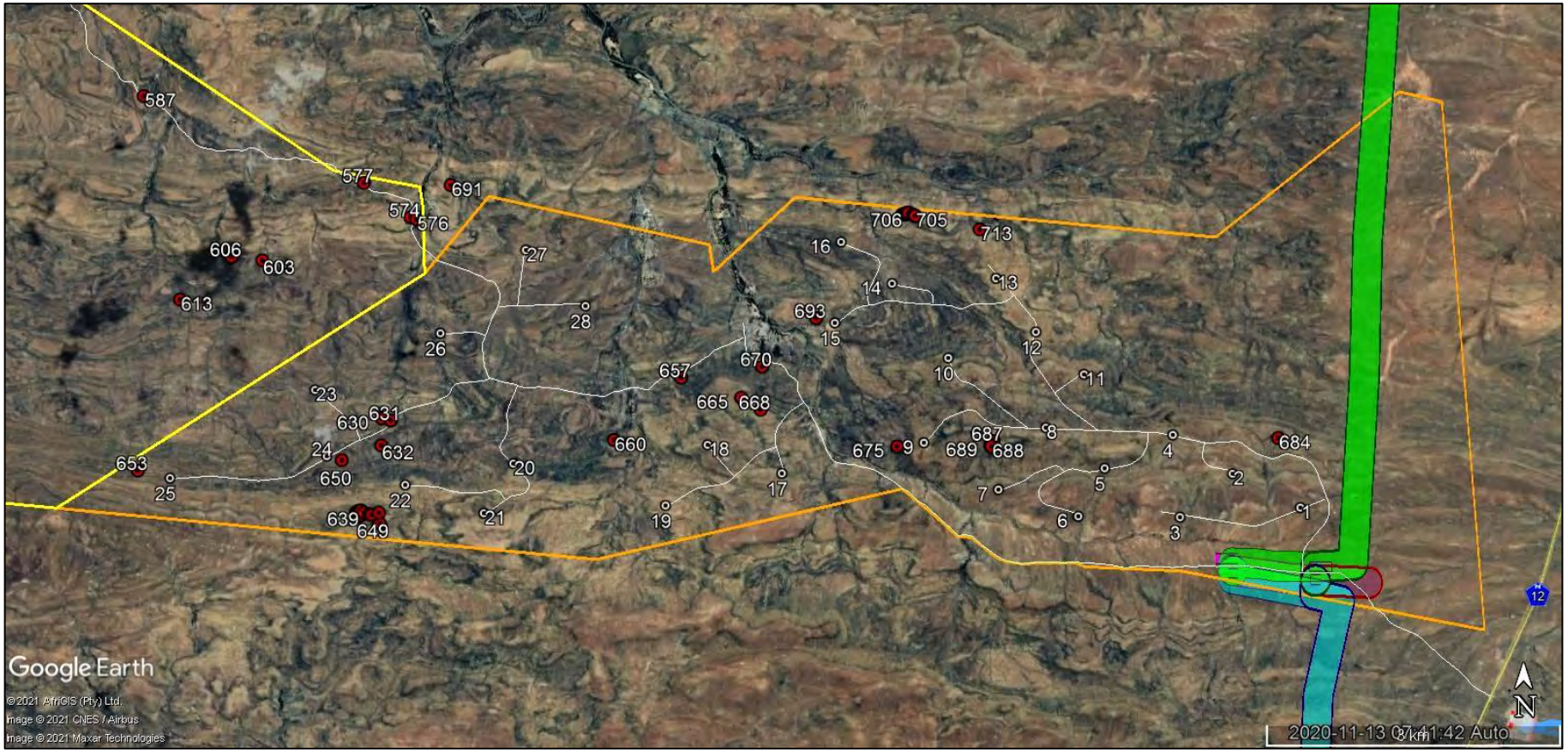

Figure 66: Google Earth© satellite image showing new fossil sites (numbered in red) in the context of the Koup 1 WEF and grid connection project areas and the provisional WEF layout (access roads and turbine locations shown in white). No No-Go palaeontological heritage sites or areas have been identified. Most recorded fossil sites lie outside the project footprint and all can be mitigated through pre-construction collection. Most of the WEF and grid connection footprint has not been palaeontologically surveyed on foot and is likely to contain additional fossil sites at surface that are of palaeontological and conservation value. A pre-construction palaeontological walkdown of the final Koup 1 WEF and grid connection footprints is therefore recommended here.

6.3 Identification of Potential Impacts

The construction phase of the proposed WEF will entail extensive surface clearance as well as excavations into the superficial sediment cover and underlying bedrock (*e.g.* for widened or new access roads, wind turbine foundations, hardstanding areas, on-site substation, underground cables, construction laydown area, O&M building and BESS). Construction of the facility may adversely affect potential fossil heritage within the development footprint by damaging, destroying, disturbing or permanently sealing-in fossils preserved at or beneath the surface of the ground that are then no longer available for scientific research or other public good. The planning, operational and de-commissioning phases of the facility are unlikely to involve further adverse impacts on local palaeontological heritage and are therefore not separately assessed in this report. The potential palaeontological heritage resource impacts identified during the PIA assessment can be briefly summarized as follows:

- ***Planning / Pre-construction Phase***

No significant impacts on palaeontological heritage anticipated.

- ***Construction Phase***

Potential Impact 1: Disturbance, damage or destruction of fossil heritage resources preserved at or below the ground due to surface clearance and excavations (especially into sedimentary bedrock).

- ***Operational Phase***

No significant impacts on palaeontological heritage anticipated.

- ***Decommissioning Phase***

No significant impacts on palaeontological heritage anticipated

- ***Cumulative impacts***

Potential loss of a significant fraction of scientifically important fossil heritage – especially fossil vertebrates - preserved within the Abrahamskraal and Teekloof Formations of the southern Great Karoo south of Beaufort West through multiple renewable energy developments in the region.

6.4 Assessment of WEF and grid connection project impacts

Potential impacts of the construction phase of the proposed Koup 1 WEF and associated grid connection on local fossil heritage resources, with and without mitigation, are assessed below in Tables 2 and 3 respectively, according to the Environmental Impact Assessment (EIA) Methodology developed by SiVEST. Further significant impacts on fossil heritage during the planning, operational and decommissioning phases of the facility are not anticipated.

Given the closely comparable geology of the WEF and grid connection project areas, the inferred impact ratings are the same in both cases.

6.4.1 Construction Phase: Disturbance, damage or destruction of fossils

The destruction, damage or disturbance out of context of legally-protected, scientifically-important fossils preserved at the ground surface or below ground that may occur during construction of the WEF / grid connection entail *direct negative* impacts to palaeontological heritage resources that are confined to the development footprint (*site*). These impacts can often be mitigated but cannot be fully rectified (*i.e.* they are *irreversible*). All the sedimentary formations represented within the study area contain fossils of *some* sort, and bedrock exposure levels within the development footprint are good, so impacts at some level on fossil heritage are *definite*. While most (but *not* all) of the fossils concerned are probably of widespread occurrence elsewhere within the outcrop areas of the formations concerned*, some* unique, well-preserved, scientifically-important fossils are known to occur in this region of the Great Karoo. The potential losses of irreplaceable fossil resources without mitigation is therefore conservatively rated as *significant*. Such impacts are of *permanent* duration. Their intensity / magnitude during the construction phase is rated as *medium* without mitigation as a precautionary measure since most of the project footprint has not been surveyed on foot. Without mitigation, a NEGATIVE MEDIUM impact significance is accordingly inferred for both the WEF and grid connection projects.

Potential negative impacts can be substantially reduced through implementation of the proposed mitigation measures, *viz*. a pre-construction palaeontological specialist walkdown of the final WEF and grid connection footprint (with recording and judicious collection of fossil material) backed up by a Chance Fossil Finds Procedure during the construction phase. With mitigation, the impact significance of the proposed WEF / grid connection project falls to NEGATIVE LOW.

Due to the reconnaissance level of the field survey of the extensive study area, confidence levels for this palaeontological heritage assessment are only moderate (*medium*). These conclusions are supported, however, by several previous palaeontological field assessments undertaken in the broader southern Karoo region by the author (See References and discussion on cumulative impacts below).

6.4.2 No-Go Option impacts

The No-Go Option, as assessed by the SiVEST system, is rated as NEGATIVE LOW (Table 4) in so far as even without development fossils will still be destroyed by natural weathering and erosion. In the case of the No-Go Alternative (*i.e.* no WEF / grid development), the possible loss of local heritage resources through construction activities (negative impact) would be avoided while potential improvements in palaeontological understanding through professional mitigation - *i.e.* recording and collection of palaeontological material and data (positive impacts) - would be lost. The slow destruction of fossils exposed at the surface through natural weathering and erosion would continue, but at the same time new fossils are revealed for scientific study. On balance, it is concluded that No-Go alternative would have a *neutral* impact on palaeontological heritage.

6.5 Cumulative impacts

Cumulative impacts addressed here principally concern the *potential* loss of a significant fraction of scientifically valuable and legally-protected fossil heritage preserved within the upper Abrahamskraal and

lower Teekloof Formations of the southern Karoo margins through multiple alternative energy developments in the region to the south of Beaufort West (Fig. 65 and Table 1). The cumulative impacts analysis shown in Table 5 is based on the Environmental Impact Assessment (EIA) Methodology developed by SiVEST.

Relevant renewable energy projects within a 35 km radius of the combined Koup 1 and 2 WEF and grid connection project areas are mapped in Figure 78 below (No data is available for any other large-scale industrial developments in the region). PIA data for the proposed Leeu Gamka Solar Power Plant is not yet available. PIA studies for the authorized Mainstream Trakas and Beaufort West WEFs as well as the Lombardskraal Renewable Energy Facility have been undertaken by the present author (Almond 2018, 2020a). In addition, there are the proposed Mainstream Heuweltjies WEF and Kraaltjies WEF to the SE and E of the Koup WEF project area as well as for the proposed ABO Kwagga 1 to Kwagga 3 WEFs further to the east, for all of which palaeontological heritage impact assessments have been or are being conducted by the present author (Almond in prep., Almond 2021a-c). A number of further wind and solar renewable energy projects have been proposed on the southern outskirts of Beaufort West but these largely lie outside the 35 km cut-off radius applied here. Relevant published palaeontological literature for the region has also been considered (*e.g.* Day & Rubidge 2014, Rubidge & Day 2020, Day & Rubidge 2020). This cumulative impact assessment applies only to the construction phases of the renewable energy developments, since significant additional impacts on palaeontological heritage during the planning, operational and de-commissioning phases are not anticipated.

It should be emphasized that, in the case of palaeontological heritage, it only makes sense to consider cumulative impacts on *comparable fossil assemblages* present in the same rock units (groups, formations, members *etc*) that are represented in the present study area as well as in the broader study region. For example, impacts on Mid-Palaeozoic aquatic fossil invertebrates in the Cape Supergroup that crops out in the Cape Fold Mountains to the south of the present study area are not directly relevant to - or cannot be reasonably weighed against - impacts on Middle Permian fossil assemblages of terrestrial vertebrates in the Lower Beaufort Group that is represented in the present study area. The analysis in Table 5 is therefore restricted to considering cumulative impacts on fossil heritage preserved within rock units and fossil assemblages that are represented in the Koup 1 and 2 WEF project areas as well as in nearby WEF and solar project areas – specifically the uppermost Abrahamskraal Formation and lowermost Teekloof Formation (upper *Tapinocephalus* Assemblage Zone). Since potentially fossiliferous, consolidated Late Caenozoic alluvial deposits will normally not be impacted in WEF developments because they usually lie along well-buffered drainage lines they are not considered for the purpose of this analysis.

In all the strictly *relevant* field-based Karoo palaeontological studies listed above the palaeontological sensitivity of the project area and the palaeontological heritage impact significance for the developments concerned has been rated as *low*. In all cases it was concluded by the author that, despite the undoubted occurrence of scientifically-important fossil remains (notably fossil vertebrates, petrified wood), the overall impact significance of the proposed developments was low because the probability of significant impacts on *scientifically important, unique or rare fossils* was slight. While fossils do indeed occur within most of the formations present, they tend to be sparse – especially as far as fossil vertebrates are concerned - while the great majority represent common forms that occur widely within the outcrop areas of the rock units concerned. Important exceptions include rare, semi-articulated skeletal remains of therapsids and pareiasaur reptiles as well as well-preserved dicynodont skulls of biostratigraphic significance from the *Tapinocephalus* Assemblage Zone.

Anticipated cumulative impacts of the known renewable energy projects proposed or authorised for the margins of the Great Karoo region to the south of Beaufort West – *including* the proposed adjoining Koup 1 and Koup 2 Wind Energy Facilities - are assessed as *NEGATIVE MEDIUM* without mitigation. Overall impact significance may fall to NEGATIVE LOW with full mitigation since impacts will then occur at a lower intensity and will be partially offset by valuable new scientific data. The analysis only applies *provided that* all the proposed monitoring and mitigation recommendations made for all these various projects are followed through (*N.B.* This is inherently unpredictable, and, sadly, unlikely). Unavoidable residual negative impacts may be partially offset by the improved understanding of Karoo palaeontology resulting from appropriate professional mitigation. This is regarded as a *positive* impact for Karoo palaeontological heritage.

In conclusion, the cumulative impacts on local fossil heritage anticipated for the various renewable energy projects in the southern Great Karoo margins region due south of Beaufort West – including the proposed Koup 1 and Koup 2 Wind Energy Facilities - are acceptable, *provided that* all recommended mitigation recommendations for these projects are followed through.

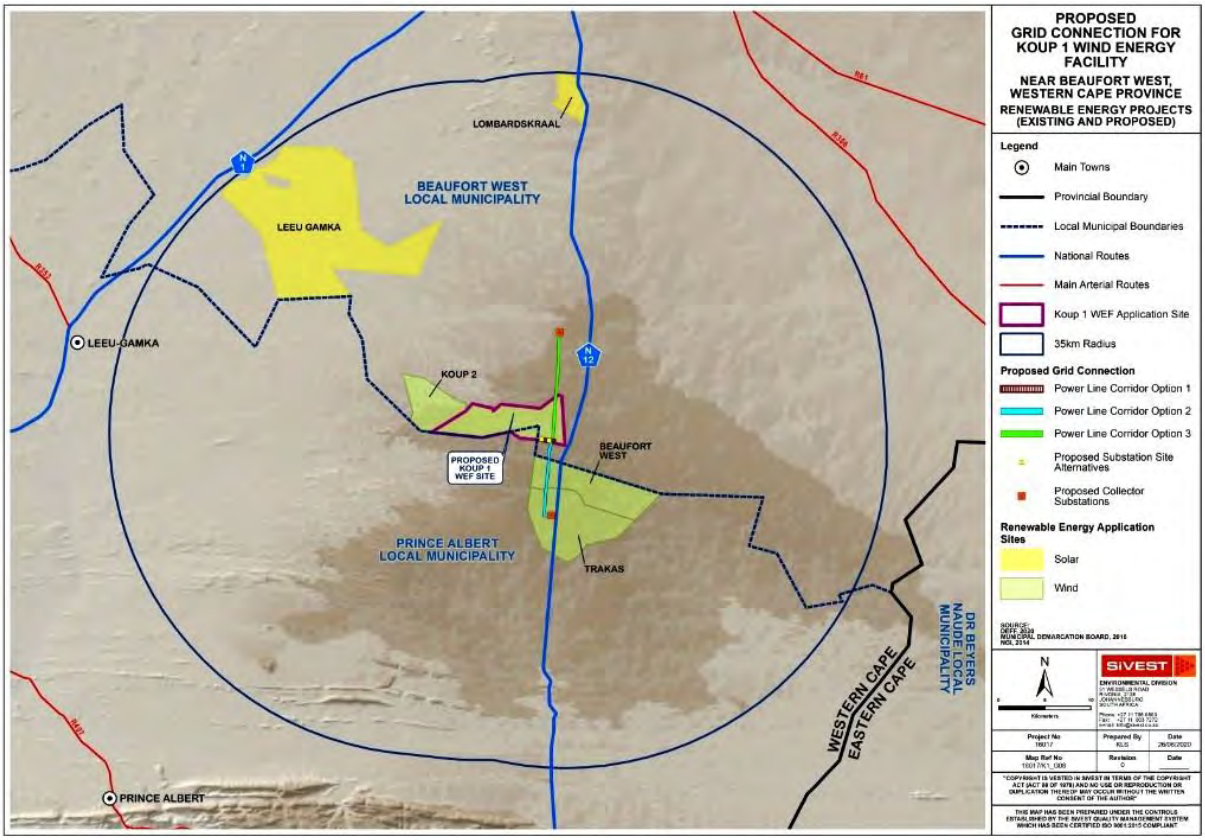

Figure 67: Map showing project areas for authorized and proposed renewable energy projects within a 35 km radius of the Koup 1 and Koup 2 WEF and grid connection project areas (Image provided by SiVEST). Additional unmapped WEFs proposed to the east and southeast of the Koup project area (Heuweltjies WEF, Kraaltjies WEF, Kwagga 1-3 WEFs) have also been taken into consideration here.

Table 1: Renewable energy developments proposed within a 35km radius of the Koup 1 WEF application site (See also text for Heuweltjies WEF, Kraaltjies WEF, Kwagga 1-3 WEFs not listed here).

Project	DEA Reference No	Technology	Capacity	Status of Application / Development
Proposed Beaufort West Wind Farm	12/12/20/1784/1	Wind	140MW	Approved
Proposed Trakas Wind Farm	12/12/20/1784/2	Wind	140MW	Approved
Proposed Wind and Solar Facility on the Farm Lombardskraal 330	14/12/16/3/3/2/406	Solar	20MW	EIA in Process
Proposed Leeu Gamka Solar Power Plant	12/12/20/2296	Solar	-	EIA in Process
Proposed Koup 2 WEF	TBA	Wind	140MW	EIA in Process

Table 2: Assessment of paleontological heritage impacts for the proposed Koup 1 Wind Energy Facility (Construction Phase)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S
Construction Phase																				
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	-	Medium	Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during construction phase.	1	2	4	2	4	1	13	-	Low

Table 3: Assessment of paleontological heritage impacts for the proposed Koup 1 Wind Energy Facility grid connection (Construction Phase)

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S
Construction Phase																				
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	-	Medium	Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during construction phase.	1	2	4	2	4	1	13	-	Low

Table 4: Assessment of impacts for the No Go Option

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S
Construction Phase																				
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to natural weathering and erosion	1	4	4	2	4	1	15	-	Low	N/A									N/A

Table 5: Assessment of cumulative impacts for the Koup 1 & 2 WEFs and other renewable energy developments in the region.

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ / -)	S
CumulativePhase																				
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	-	Medium	(*N.B.* Vary between projects) Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during construction phase.	1	2	4	2	4	1	13	-	Low

6.6 Overall Impact Rating

Overall impact ratings for the Koup 1 WEF and associated grid connection projects are provided in Tables 6 & 7 below. The significance of relevant cumulative impacts is assessed in Table 8. Recommended monitoring and mitigation measures for these developments are outlined in more detail in Section 8 of this report.

Table 6: Overall impact rating for the Koup 1 WEF project

KOUP 1 WEF																				
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																				
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	–	M	Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during construction phase	1	2	4	2	4	1	13	–	L

Table 7: Overall impact rating for the Koup 1 WEF grid connection project

KOUP 1 WEF GRID CONNECTION																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																					
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	_	M	Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during construction phase	1	2	4	2	4	1	13	_	L

Table 8: Overall cumulative impact rating for the Koup 1 WEF and grid connection project

Cumulative																					
Fossil heritage resources	Disturbance, damage or destruction of fossils at or beneath the ground surface due to surface clearance and bedrock excavations	1	4	4	3	4	2	32	_	M	(N.B. Vary between projects) Pre-construction walkdown (with fossil recording / collection) of final footprint by specialist palaeontologist. Chance Fossil Finds Procedure during	1	2	4	2	4	1	13	_	L

7. COMPARATIVE ASSESSMENT OF ALTERNATIVES

7.1 Koup 1 WEF

A comparable NEGATIVE MEDIUM impact significance (without mitigation), as assessed in Table 2 applies equally to all project infrastructure alternatives and layout options originally under consideration that are outlined in Section 3.3 of this report. This includes the various site options for the on-site substation and construction laydown area. Given their very similar geological - and hence palaeontological - contexts, there are no preferences on palaeontological heritage grounds for any layout among the various options under consideration. The proposed final layout of the Koup 1 WEF is shown in **Figure 4b**.

Key

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 9: Comparative assessment of WEF layout options

Alternative	Preference	Reasons (incl. potential issues)
SUBSTATION SITE ALTERNATIVES		
Substation Option 1	None	Similar geological / palaeontological context
Substation Option 2	None	
CONSTRUCTION LAYDOWN AREA SITE ALTERNATIVES		
Construction Laydown Area Option 1	None	Similar geological / palaeontological context
Construction Laydown Area Option 2	None	

7.2 Koup 1 grid connection

Either of the Grid Option1 alternatives was originally preferred on palaeontological heritage grounds since impacts on potential fossil heritage are minimised through the shortness of the line and accompanying access road. The Grid Option 2 and 3 alternatives entail much longer grid lines (more pylon footings, longer access roads) and traverse terrain of high palaeontological sensitivity, with known fossil sites in the region. However, there is no preference on palaeontological heritage grounds between any one of these four longer options, given their very similar geological and palaeontological context, and there are no objections to the chosen Option 2 (See **Figure 3b**).

Table 10: Comparative assessment of WEF grid connection options (Note the Option 2 is now the preferred option on non-palaeontological grounds)

Alternative	Preference	Reasons (incl. potential issues)
GRID CONNECTION ALTERNATIVES		
Grid Option 1 (Sub1)	Preferred	Shortest grid line. Either option has similar impact significance due to similar geological context.
Grid Option 1 (Sub2)		
Grid Option 2 (Sub1)	Least preferred	Longer grid line. All options have similar impact significance due to similar geological context.
Grid Option 2 (Sub2)		
Grid Option 3 (Sub1)		
Grid Option 3 (Sub2)		

8. PROPOSED MONITORING AND MITIGATION: INPUT TO EMPR

A significant number of new fossil sites are recorded within the combined Koup 1 and Koup 2 WEF project areas (Section 5, Appendix 2) as well as in the vicinity of some of the grid connection options originally under consideration. However, (1) the majority of these fossil sites lie well away from the proposed infrastructure footprints (see satellite images Figs. 76 & 77), (2) many of them are rated as being of low scientific or conservation significance (See Appendix 2) while (3) all of them can be mitigated, if necessary, through professional palaeontological collection during the construction phase. ***The distribution of fossil sites need therefore have no influence on the proposed layout of the WEFs or associated grid connections.***

A pre-construction palaeontological heritage walkdown of the final WEF and grid connection layout by a suitably qualified palaeontologist is recommended here. This motivated by:

- the very incomplete coverage of the WEF and grid connection project areas (including provisional infrastructure footprints) during the short, reconnaissance-level palaeontological site visit;
- the highly unpredictable distribution of important fossil sites, which may occur within both mudrock and sandstone facies;
- the documented presence of a substantial number of scientifically-valuable fossil remains in the region based on desktop and field studies, favoured by extensive areas of good bedrock exposure.

The recommended palaeontological walkdown should involve the recording and judicious collection of valuable fossil material as well as relevant geological data (*e.g.* on stratigraphic context, preservation style / taphonomy) within or close to (within ~10 m) the project footprint. This mitigation phase is *essential* because all fossil heritage resources in the RSA are protected by law and it is illegal to disturb, damage or destroy fossils here without a permit from the relevant provincial heritage resources agency (South African Heritage Resources Act, Act No. 25 of 1999). The palaeontological heritage mitigation report would then make recommendations for further studies and mitigation (if any are necessary) during the construction phase of

the renewable energy project. Since mitigation through recording and collection is almost invariably feasible, late-stage modifications to the final WEF / grid infrastructure layout (*e.g.* micro-siting changes to access roads, turbine or pylon locations) are not anticipated here.

The palaeontologist responsible for the mitigation work will be required to submit a Work Plan for approval by Heritage Western Cape (HWC) and a Mitigation Report must be submitted to HWC for consideration. All fieldwork and reporting should meet the standards of international best practice as well as those developed for PIA reports by SAHRA (2013) and Heritage Western Cape (2021). Fossil material collected must be safeguarded and curated within an approved palaeontological repository (*e.g.* museum or university collection) with full collection data.

During the construction phase the Chance Fossil Finds Protocol summarized in Appendix 4 should be fully implemented.

The Environmental Control Officer (ECO) / Environmental Site Officer (ESO) responsible for the development should be made aware of the possibility of important fossil remains (vertebrate bones, teeth, petrified wood, plant-rich horizons *etc.*) being found or unearthed during the construction phase of the development. Monitoring for fossil material of all major surface clearance and deeper (>1m) excavations by the Environmental Site Officer on an on-going basis during the construction phase is therefore recommended. Significant fossil finds should be safeguarded and reported at the earliest opportunity to Heritage Western Cape for recording and sampling by a professional palaeontologist (Contact details: Heritage Western Cape. 3rd Floor Protea Assurance Building, 142 Longmarket Street, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 5959 Email: ceoheritage@westerncape.gov.za).

These recommendations must be included within the EMPr for the Koup 1 WEF and associated grid connection development.

9. SUMMARY & CONCLUSIONS

9.1 Summary of Findings

The combined Koup 1 WEF and grid connection project area is underlain by continental (fluvial / lacustrine) sediments of the Abrahamskraal and Teekloof Formations (Lower Beaufort Group, Karoo Supergroup) which are of Middle to Late Permian age. These bedrocks contain sparse, unpredictable to locally concentrated vertebrate fossils as well as rare trace fossils (*e.g.* tetrapod burrows) and plant material of scientific and conservation value. A substantial number of new fossil vertebrate sites (cranial and post-cranial material of large-bodied dinocephalians, small dicynodonts, rare tetrapod burrow casts) have been recorded during within the WEF project area during the short site visit, while several more sites have previously been mapped shortly outside its margins. These palaeontological sites, together with their sedimentological context, provide important data for on-going research into the pattern and causes of the Middle Permian Mass Extinction Event on land around 260 million years ago.

Scientifically-valuable and legally-protected fossil heritage resources preserved at or beneath the ground surface within the project footprint are potentially threated by clearance and bedrock excavations during the construction phase of the WEF and grid connection (*e.g.* for access roads, wind turbine foundations). The majority of the recorded fossil sites lie outside the project footprint but most of the WEF and grid connection footprint has yet to be palaeontologically surveyed on foot. A significant number of unrecorded sites almost undoubtedly lies within of very close to the project footprint.

No Very High Sensitivity or No-Go palaeontological sites or areas have been identified within the Koup 1 WEF or grid connection project areas. Since all known fossil sites can be readily mitigated through professional recording and collection of fossil material in the pre-construction phase, no recommendations for micro-siting of infrastructure such as wind turbine, pylon positions or access roads are therefore made here. There are no preferences on palaeontological heritage grounds for specific site options for the Koup 1 WEF on-site substation and construction laydown area. Grid Option 1 (either alternative) was originally preferred for the grid connection since, being much shorter that Options 2 and 3, it is least likely to impact potential fossil sites. However, there are no objections to authorization of the chosen Option 2 grid corridor.

The proposed Koup 1 WEF and associated grid connection developments are assigned a similar overall impact significance rating (Construction Phase) of NEGATIVE MEDIUM without mitigation and NEGATIVE LOW following mitigation. No significant further impacts on fossil heritage resources are anticipated in the planning, operational and decommissioning phases. The No-Go Option might have a NEGATIVE LOW or perhaps neutral impact significance; fossils will continue to be exposed and destroyed by natural weathering processes while the positive benefits of professional mitigation (*viz*. improved palaeontological database) will be lost. Anticipated cumulative impacts in the context of several planned or authorized renewable energy projects in the region are assessed as NEGATIVE MEDIUM before mitigation and NEGATIVE LOW after mitigation.

Recommended mitigation comprises (1) a specialist palaeontological walk-down of the final WEF and grid connection project areas in the pre-construction phase and (2) implementation of a Chance Fossil Finds Protocol (See Appendix 4) by the ECO / ESO during the construction phase. The palaeontologist responsible for the mitigation work will be required to submit a Work Plan for approval by Heritage Western Cape (HWC)

The proposed WEF and grid connection developments are not fatally flawed and, on condition that the recommended mitigation measures are included within the relevant EMPrs and implemented in full, there are no objections on palaeontological heritage grounds to their authorization.

9.2 Conclusions and Impact Statement

In terms of palaeontological heritage resources, the proposed Koup 1 WEF and associated grid connection developments are assigned a similar overall impact significance rating (Construction Phase) of NEGATIVE MEDIUM without mitigation and NEGATIVE MEDIUM following mitigation. No significant further impacts on fossil heritage resources are anticipated in the planning, operational and decommissioning phases. The No-Go Option might have a NEGATIVE LOW impact significance. Anticipated cumulative impacts in the context of several planned or authorized renewable energy projects in the region are assessed as NEGATIVE MEDIUM without mitigation and NEGATIVE LOW after mitigation.

The proposed WEF and grid connection developments are not fatally flawed and, on condition that the recommended mitigation measures are included within the EMPr and implemented in full, there are no objections on palaeontological heritage grounds to their authorization.

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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, 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: JOHN ALMOND SHORT CV

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).

APPENDIX 2: KOUP 1 & 2 WEFS FOSSIL SITE DATA – JUNE 2021

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

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 project area but only those sites recoded during the 5-day field survey. 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 and has yet to be confirmed.

Loc.	GPS data	Comments
574	S32° 50' 42.7" E22° 26' 07.3"	Farm 1/380. Karelskraal Member. Isolated, small fragment of bone within cleaved massive grey mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation required.
576	S32° 50' 43.3" E22° 26' 09.5"	Farm 1/380. Karelskraal Member. Thick, grey, sandy to finely gravelly semi-consolidated alluvium exposed in banks of stream showing range of subfossil insect burrows (probably termite) as well as plant root moulds. Proposed Field Rating IIIC Local Resource. No mitigation required.
577	S32° 50' 31.2" E22° 25' 48.8"	Farm 1/380. Karelskraal Member. Articulated skull and lower jaw of small dicynodont entirely enclosed within pedogenic calcrete concretion in float. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
587	S32° 50' 02.3" E22° 24' 21.6"	Farm 8/380. Karelskraal Member. Float block of sandstone containing unidentifiable white postcranial bones of medium-sized tetrapod. Proposed Field Rating IIIC Local Resource. No mitigation required.
594	S32° 49' 52.9" E22° 23' 13.3"	Farm 8/380. Karelskraal Member. Shallow stream bed exposures of hackly, cleaved blue-grey mudrock with ferruginous carbonate concretions and *equivocal*, gently-inclined vertebrate burrow cast (*c*. 30 c wide) in sandstone (requires confirmation). Proposed Field Rating IIIB Local Resource. Specimen to be recorded in more detail if it falls within or close to project footprint.
595	S32° 49' 53.4" E22° 23' 13.3"	As above. *Possible* second example of a large vertebrate burrow cast (c. 50 cm wide) (requires confirmation). Proposed Field Rating IIIB Local Resource. Specimen to be recorded in more detail if falls within or close to project footprint.
603	S32° 50' 56.8" E22° 25' 09.0"	Farm 1/380. Karelskraal Member. Grey-green mudrocks exposed alongside shallow stream bed with concentration of partially weathered-out, ferrugunized, semi-articulated postcranial bones of a dinocephalian therapsid with trail of bone material extending into adjacent stream gravels. Majority of material is post-cranial (limb bones, vertebrae, ribs, girdle fragments *etc*) but several pieces are probably of cranial origin, including a badly-weathered jaw fragment with series of dinocephalian-type teeth. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
606	S32° 50' 55.7" E22° 24' 57.0"	Farm 1/380. Karelskraal Member. Surface scatter of white, postcranial bone fragments of large-bodied tetrapod preserved within pedogenic concretions overlying cleaved grey-green mudrocks. Proposed Field Rating IIIC Local Resource. No mitigation required.
613	S32° 51' 09.8" E22° 24' 36.8"	Farm 1/380. Karelskraal Member. Pedogenic calcrete concretion in float containing series of vertebrae of a medium-sized tetrapod. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
622	S32° 51' 00.2" E22° 23' 03.4"	Farm 1/380. Karelskraal Member. *Possible* horizontal, convex-upwards invertebrate burrow with grey-green hackly mudocks. Proposed Field Rating IIIC Local Resource. No mitigation required.
623	S32° 51' 06.2" E22° 22' 53.1"	Farm 1/380. Karelskraal Member. Fragmentary postcranial remains, including end of large limb bone, of large-bodied tetrapod in float, probably weathered out of

		sandstone. Some elements show evidence of sun-cracking. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
625	S32° 51' 06.1" E22° 22' 52.7"	Farm 1/380. Karelskraal Member. Further post-cranial fragments – probably of same animal as at Loc. 623. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
630	S32° 51' 48.9" E22° 25' 56.3"	Farm 5/380. Karelskraal Member. Fragmentary postcranial remains, including vertebra and probably fragmentary limb bone, of large-bodied tetrapod in float. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
631	S32° 51' 49.6" E22° 25' 59.9"	Farm 5/380. Karelskraal Member. Skull of small dicynodont (broad skull table – not *Diictodon*) preserved within pedogenic calcrete concretion, in float. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
632	S32° 51' 57.8" E22° 25' 56.2"	Farm 5/380. Karelskraal Member. Fragment of highly weathered bone of medium / large tetrapod in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
638	S32° 52' 19.1" E22° 25' 48.6"	Farm 11/380. Poortjie Member mudrock. Skull with lower jaw of small dicynodont preserved within pedogenic calcrete nodule in float (broad skull table – not *Diictodon*). Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
639	S32° 52' 20.6" E22° 25' 52.8"	Farm 11/380. Poortjie Member mudrock. Partially preserved skull of small dicynodont *in situ*, facing side-upwards with articulated lower jaw. Calcretised, flattened-cylindrical horizontal burrow cast (*c*. 4 cm wide) of *possible* invertebrate origin. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
640	S32° 52' 20.3" E22° 25' 51.9"	Farm 11/380. Poortjie Member mudrock. Incomplete snout of small dicynodont preserved in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
641	S32° 52' 19.9" E22° 25' 49.7"	Farm 11/380. Poortjie Member mudrock. Weathered-out pedogenic calcrete concretions containing skull of small dicynodont (probably *Diictodon*) as well as incomplete postcrania of similar animal. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
642	S32° 52' 19.4" E22° 25' 48.1"	Farm 11/380. Poortjie Member mudrock. Weathered-out, ferruginized pedogenic calcrete concretions containing skull of small dicynodont (probably *Diictodon*) as well as postcranial bones of similar animal. Proposed Field Rating IIIC Local Resource. No mitigation required.
643	S32° 52' 19.3" E22° 25' 47.6"	Farm 11/380. Poortjie Member mudrock. Several poorly-preserved skulls and postcranial bones of small dicynodonts preserved within pedogenic calcrete concretions. Proposed Field Rating IIIC Local Resource. No mitigation required.
644	S32° 52' 19.8" E22° 25' 46.6"	Farm 11/380. Poortjie Member mudrock. Float skull specimen of small dicynodont with articulated lower jaw. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
645	S32° 52' 20.8" E22° 25' 47.9"	Farm 11/380. Poortjie Member mudrock. Poorly-preserved, ferruginized skull specimen of small dicynodont with articulated lower jaw in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
646	S32° 52' 21.2" E22° 25' 47.7"	Farm 11/380. Poortjie Member mudrock. Small bone fragment of medium-sized or larger tetrapod in float. Field Rating IIIC Local Resource. No mitigation required.
647	S32° 52' 23.2" E22° 25' 55.4"	Farm 5/380. Poortjie Member mudrock. Calcretised sandstone cast (*c*. 5 cm wide) of small, gently inclined burrow – possibly of small tetrapod or invertebrate – preserved within grey mudrock. Proposed Field Rating IIIB Local Resource. Specimen to be collected / recorded if falls within or close to project footprint.
648	S32° 52' 23.4" E22° 25' 56.0"	Farm 11/380. Poortjie Member mudrock. Gently inclined sandstone cast of small tetrapod or invertebrate burrow *c*. 8 cm wide with smooth, possibly bioturbated interior. Proposed Field Rating IIIB Local Resource. Specimen to be collected / recorded if falls within or close to project footprint.
649	S32° 52' 19.9" E22° 25' 55.6"	Farm 11/380. Poortjie Member mudrock. Well-preserved *in situ* skull of small dicynodont (broad skull table – not *Diictodon*) preserved within pedogenic calcrete concretion in grey-green mudrocks. Proposed Field Rating IIIB Local Resource. Specimen to be collected / recorded if falls within or close to project footprint
650	S32° 52' 02.6" E22° 25' 40.8"	Farm 11/380. Karelskraal Member. Poorly-preserved, incomplete snout of small dicynodont within sandstone float block. Proposed Field Rating IIIC Local Resource. No mitigation required.
653	S32° 52' 06.0"	Farm 10/380. Karelskraal Member. Poorly-preserved skull of small dicynodont

	E22° 24' 20.9"	within pedogenic calcrete concretion in float. Proposed Field Rating IIIC Local Resource. No mitigation required.
657	S32° 51' 35.5" E22° 27' 53.7"	Farm 5/380. Karelskraal Member. Sandstone float block containing white, weathered indeterminate bone of large tetrapod. Probable separate rib fragment enclosed within calcrete concretion. Proposed Field Rating IIIC Local Resource. No mitigation required.
660	S32° 51' 56.0" E22° 27' 27.4"	Farm 5/380. Karelskraal Member. Surface scatter of numerous white fragments of postcranial bone of large-bodied tetrapod, some showing extensive sun-cracking. Proposed Field Rating IIIC Local Resource. No mitigation required.
665	S32° 51' 42.1" E22° 28' 17.3"	Farm 5/380. Karelskraal Member. Dispersed postcranial bones of large tetrapod (dinocephalian / pareiasaur) embedded *in situ* within grey-green mudrocks as well as weathered-out into neighbouring stream gravels. Material includes several large limb bones and vertebrae. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
668	S32° 51' 46.1" E22° 28' 24.9"	Farm 5/380. Karelskraal Member. Ferruginous carbonate concretion within grey-green mudrocks containing several ribs of medium-sized tetrapod. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
670	S32° 51' 31.9" E22° 28' 25.5"	Farm 5/380. Karelskraal Member. Float block of pedogenic calcrete concretion containing bone fragments of large tetrapod (possibly ribs or vertebral neural spines). Proposed Field Rating IIIC Local Resource. No mitigation required.
675	S32° 51' 58.1" E22° 29' 18.3"	Farm 5/380. Karelskraal Member. Thin channel sandstone containing concentration of disarticulated postcranial bones of large-bodied tetrapod, with numerous fragments of white bone in sandstone within colluvial gravels downslope. Probably unidentifiable. Proposed Field Rating IIIC Local Resource. No mitigation required.
684	S32° 51' 55.2" E22° 31' 46.8"	Farm 11/374. Poortjie Member. Small dicynodont skull within pedogenic calcrete concretion. Proposed Field Rating IIIB Local Resource. Specimen to be collected if falls within or close to project footprint.
687	S32° 51' 56.2" E22° 29' 55.7"	Farm 11/374. Poortjie Member. Ferruginous pedogenic calcrete concretion within cleaved grey-green mudrocks containing post-crania (limb bones, ribs *etc*) of small tetrapod. V. close by is *in situ* skull of small dicynodont as well as float block of ferruginous carbonate (2 parts) with incomplete skull of larger dicynodont. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
688	S32° 51' 58.0" E22° 29' 55.0"	Farm 11/374. Poortjie Member. Sandstone cast of small tetrapod burrow (possibly dicynodont), *c*. 10 cm wide, preserved within cleaved grey-green mudrock. Proposed Field Rating IIIC Local Resource. No mitigation required.
689	S32° 51' 57.6" E22° 29' 54.7"	Farm 11/374. Poortjie Member. *In situ* skull of small dicynodont within cleaved grey-green mudrocks. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
690	S32° 51' 57.6" E22° 29' 54.7"	Farm 11/374. Poortjie Member. *In situ* skull of small dicynodont within cleaved grey-green mudrocks. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
691	S32° 50' 32.0" E22° 26' 23.0"	Farm 6/380 (just outside and N of WEF project area). Karelskraal or Poortjie Member. *In situ* postcranial remains of a large tetrapod preserved within channel sandstone (Marietjie Mostert., pers. comm., June 2021). No mitigation requires (outside project area).
693	S32° 51' 16.0" E22° 28' 46.7"	Farm 5/ 380. Karelskraal Member. 4 skulls of small dicynodonts preserved within pedogenic calcrete concretions weathered out into gulley gravels. Possibly not all *Diictodon*. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
696	S32° 50' 41.8" E22° 29' 20.5"	Farm 5/ 380. Poortjie Member. *In situ* small dicynodont skull preserved *in situ*, dorsal side-up, within pedogenic calcrete concretion (broad skull table – not *Diictodon*). Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
697	S32° 50' 41.6" E22° 29' 21.4"	Farm 5/ 380. Poortjie Member. Float pedogenic calcrete concretions with small dicynodont skull, postcrania of similar animal. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
698	S32° 50' 41.6" E22° 29' 21.6"	Farm 5/ 380. Poortjie Member. Cluster of several pedogenic calcrete concretions in float with skulls and postcrania of small dicynodonts. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
699	S32° 50' 41.7" E22° 29' 21.8"	Farm 5/ 380. Poortjie Member. Cluster of several pedogenic calcrete concretions in float with skulls, postcrania of small dicynodonts (some with broad skull tables). Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within

		or close to project footprint.
700	S32° 50' 41.4" E22° 29' 22.3"	Farm 5/ 380. Poortjie Member. Cluster of several pedogenic calcrete concretions in float with skulls, postcrania of small dicynodonts (some with broad skull tables). Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
701	S32° 50' 41.3" E22° 29' 22.4"	Farm 5/ 380. Poortjie Member. Pedogenic calcrete concretions in float with poorly-preserved skulls of small dicynodonts (some with broad skull tables). Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
702	S32° 50' 41.5" E22° 29' 22.5"	Farm 5/ 380. Poortjie Member. Pedogenic calcrete concretion with postcranial bones of small tetrapod. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
703	S32° 50' 41.2" E22° 29' 22.9"	Farm 5/ 380. Poortjie Member. Poorly-preserved bones of small tetrapod(s) within pedogenic calcrete concretions. Proposed Field Rating IIIC Local Resource. No mitigation required.
704	S32° 50' 41.8" E22° 29' 24.8"	Farm 5/ 380. Poortjie Member. Skulls and postcrania of small tetrapods / dicynodonts within pedogenic calcrete concretions. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
705	S32° 50' 42.2" E22° 29' 25.5"	Farm 5/ 380. Poortjie Member. *In situ* skull of small dicynodont within pedogenic calcrete concretion. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
706	S32° 50' 42.2" E22° 29' 25.5"	Farm 5/ 380. Poortjie Member. *Several in situ* skulls of small dicynodonts. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
713	S32° 50' 46.7" E22° 29' 50.8"	Farm 5/ 380. Poortjie Member. Pedogenic calcrete concretion I float with small dicynodont skull. Proposed Field Rating IIIB Local Resource. Specimens to be collected if fall within or close to project footprint.
724	S32° 50' 09.8" E22° 25' 22.0"	Farm 380 Bloemendal (outside and just N of WEF project area). Mudrockor sandstone interval within Poortjie Member (as mapped, but requires checking). Several very thick-boned skull fragments as well as fragmentary postcranial remains of tapinocephalid dinocephalians (probably several individuals, perhaps including juveniles), probably all belonging to the genus *Criocephalosaurus*. Proposed Field Rating IIIA Local Resource. No mitigation recommended because specimens lie *outside* project footprint.

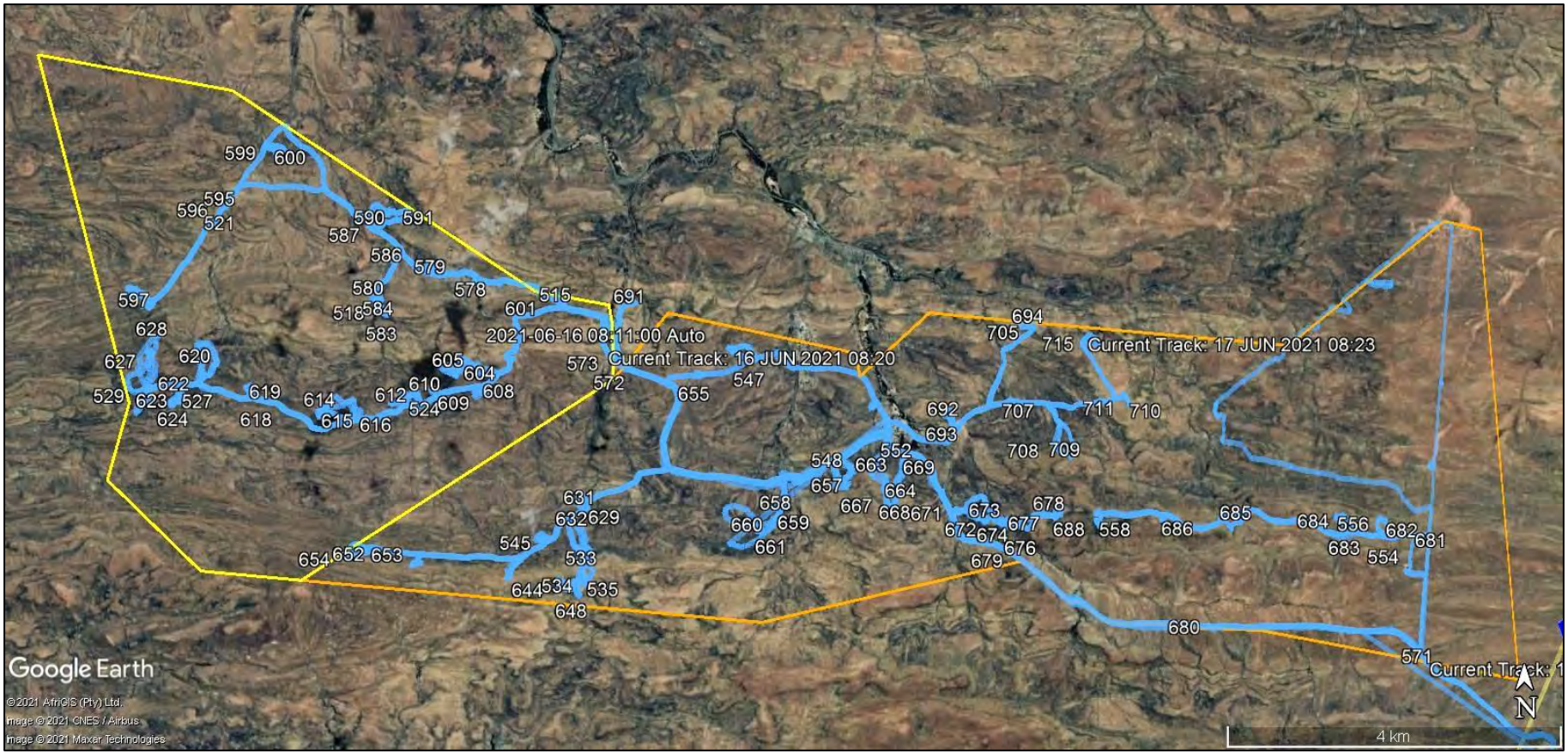

Figure A2.1: Google Earth© satellite image of the adjoining Koup 1 WEF (orange polygon) and Koup 2 WEF (yellow polygon) project areas to the south of Beaufort West showing the tracks (blue lines) and numbered waypoints of localities visited during the 5-day palaeontological site visit. Due to a GPS technical error, no waypoints were recorded in the north-eastern sector of the area (Fortunately this area is largely of low palaeosensitivity). The sites visited were largely determined by access and the presence of good bedrock exposure. Substantial portions of the project area (including most of the provisional WEF and grid connection footprints) have not yet been surveyed.

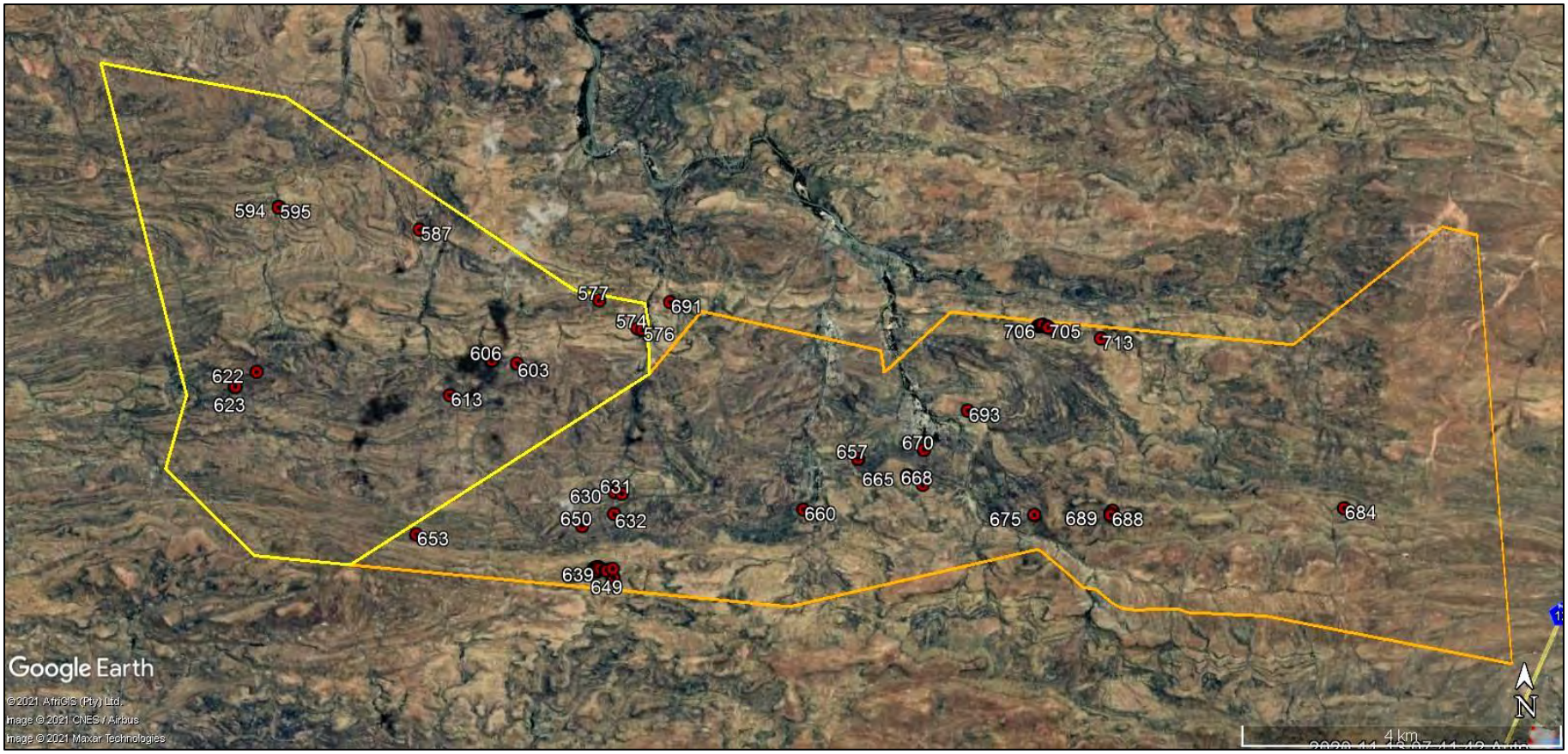

Figure A2.2: Google Earth© satellite image of the adjoining Koup 1 WEF (orange polygon) and Koup 2 WEF (yellow polygon) project areas to the south of Beaufort West showing the numbered new fossil sites recorded during the site visit (Please see Appendix 1 for GPS locality details and brief description). These are necessarily only a small subset of the fossil sites within the project areas; blank areas may well also contain important fossil remains.

APPENDIX 3: SITE SENSITIVITY VERIFICATION REPORT (IN TERMS OF PART A OF THE ASSESSMENT PROTOCOLS PUBLISHED IN GN 320 ON 20 MARCH 2020)

1. Introduction

Genesis Enertrag Koup 1 Wind (Pty) Ltd is proposing to construct the Koup 1 WEF, comprising twenty-eight wind turbines with a maximum total energy generation capacity of up to 140MW, with a 132kV overhead power line connection to the national grid. A Battery Energy Storage System (BESS) will be located next to the onsite 33/132kV substation. The WEF and grid project areas are located in the Great Karoo region some 60 km south of Beaufort West, falling within the Beaufort West and Prince Albert Local Municipalities (Central Karoo District Municipality) of the Western Cape Province.

In accordance with Appendix 6 of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) Environmental Impact Assessment (EIA) Regulations of 2014, a site sensitivity verification has been undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area as identified by the National Web-Based Environmental Screening Tool (Screening Tool).

2. Site sensitivity verification

The site sensitivity verification of the proposed Koup 1 WEF and associated grid connection is based on:

- A desktop review of (a) the relevant 1:50 000 scale topographic maps and the 1:250 000 scale topographic map 3222 Beaufort West, (b) Google Earth© satellite imagery, (c) published geological and palaeontological literature, including 1:250 000 geological maps (3222 Beaufort West) and relevant sheet explanations (Johnson & Keyser 1979) as well as (d) several previous and on-going fossil heritage (PIA) assessments in the Great Karoo region to the south of Beaufort West by the author .

- A five-day field assessment of the combined Koup 1 and Koup 2 WEF project area by the author and an experienced field assistant during the period 14 to 19 November 2020. Accessible sectors of the Grid Connection project area within the combined WEF project areas were surveyed in part, but *not* those sectors lying outside the WEF project area itself.

3. Outcome of site sensitivity verification

The proposed Koup 1 WEF and grid connection project area is located in a region of the Great Karoo that is underlain by potentially fossiliferous sedimentary rocks of Late Palaeozoic and younger, Late Tertiary or Quaternary, age. In particular, these include (1) Middle to Late Permian continental sediments of the Abrahamskraal and Teekloof Formations (Lower Beaufort Group, Karoo Supergroup) which contain scientifically important fossils of vertebrates, trace fossils and terrestrial plants, as well as (2) Late Caenozoic alluvium that may contain important mammalian remains such as teeth and bones (These rock units and their fossils are described in more detail in Section 5 of the PIA report).

The generally high palaeontological heritage sensitivity of the Beaufort Group bedrocks in the Great Karoo is emphasized on the SAHRIS palaeosensitivity map maintained by SAHRA. Both desktop and field studies within this and neighbouring WEF project areas demonstrate that, while a significant number of scientifically valuable, well-preserved fossils do indeed occur here, in practice they are often scarce in this region and their distribution is to a large extent unpredictable. As a consequence of the considerably higher topographic relief – and hence bedrock exposure levels - encountered within the combined Koup 1 WEF and grid connection project area, a higher concentration of fossil sites is recorded here than within WEF project areas towards the east.

It is concluded that, applying the precautionary principle, the Koup 1 WEF and grid connection project areas are best assigned an overall High Sensitivity as far as palaeontological heritage is concerned, while recognising that, in practice, fossils are scarce at surface throughout much of the area (*N.B.* Additional fossils are preserved in the subsurface and may be impacted by excavations during the construction phase).

4. National Environmental Screening Tool

The palaeontological heritage Site Sensitivity Map for the Koup 1 WEF project area prepared using the DFFE screening tool by SiVEST Environmental identifies areas underlain by the Lower Beaufort Group as being of a Very High Sensitivity while those mantled by substantial alluvial deposits are assigned a Low Sensitivity (Fig. A3.1).

Due to the scarcity of well-preserved, scientifically important fossils in this region, based on desktop studies and fieldwork, it is inferred herein that the much of project area is in fact largely of Low palaeontologically sensitivity but with a substantial number of dispersed and unpredictable fossil sites of High to Very High sensitivity. Applying the precautionary principle, the Koup 1 WEF and grid connection project areas are best assigned an overall High Sensitivity as far as palaeontological heritage is concerned. The DFFE screening tool sensitivity map in Figure A3.1 is therefore supported in essence.

5. Conclusion

The palaeontological heritage site sensitivity of the combined Koup 1 WEF and associated grid connection project areas has been verified on the basis of desktop studies as well as a 5-day site visit. Applying the Precautionary Principle, an overall High Palaeontological Sensitivity is inferred for the WEF and grid connection project areas.

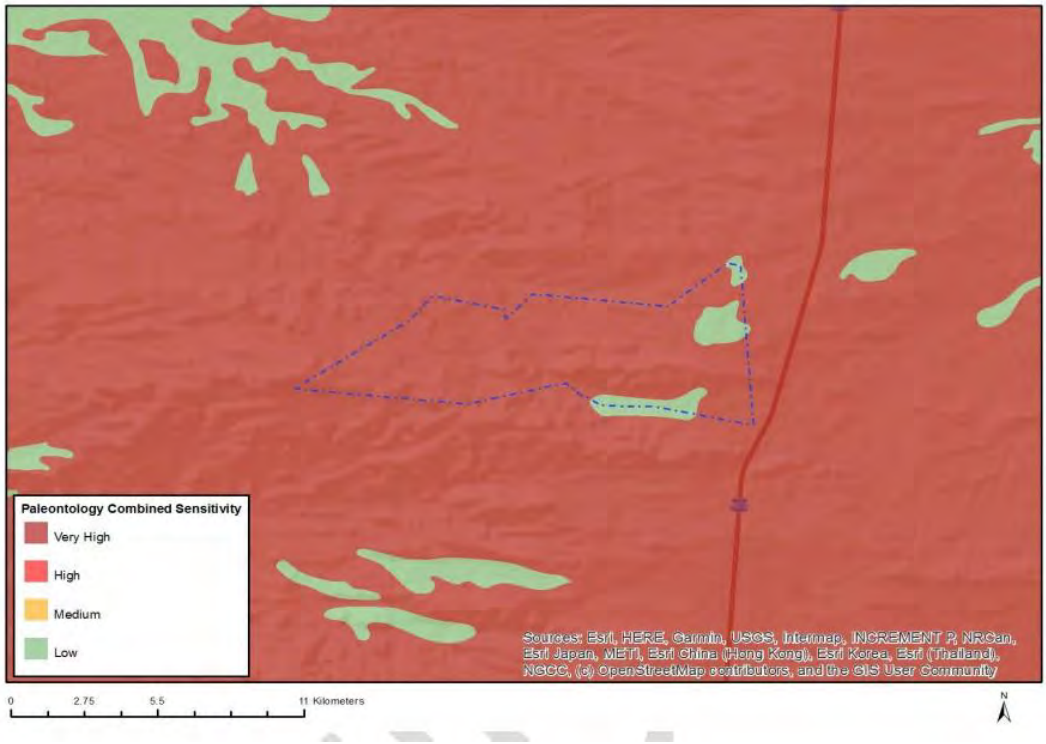

Figure A3.1: Paleontological sensitivity map for the Koup 1 WEF project area abstracted from the DFFE Screening Report for an environmental authorization prepared by SiVEST Environmental (April 2021). Due to the scarcity of well-preserved, scientifically important fossils in this region, based on desktop studies and fieldwork, it is inferred herein that much of the project area is in fact largely of LOW palaeontological sensitivity but with a substantial number of dispersed and unpredictable fossil sites of HIGH to VERY HIGH sensitivity. Applying the precautionary principle, the Koup 1 WEF and grid connection project area are best assigned an overall High Sensitivity as far as palaeontological heritage is concerned.

APPENDIX 4: CHANCE FOSSIL FINDS PROTOCOL

<table>
<tr><th colspan="3">KOUP 1 & 2 WIND ENERGY FACILITIES and GRID CONNECTIONS south of Beaufort West</th></tr>
<tr><td>Province & region:</td><td colspan="2">Western Cape (Central Karoo District): Beaufort West and Prince Albert Local Municipalities</td></tr>
<tr><td>Responsible Heritage Resources Agency</td><td colspan="2">Heritage Western Cape (Contact details: Heritage Western Cape. 3rd Floor Protea Assurance Building, 142 Longmarket Street, Green Market Square, Cape Town 8000. Private Bag X9067, Cape Town 8001. Tel: 021 483 5959 Email: ceoheritage@westerncape.gov.za)</td></tr>
<tr><td>Rock unit(s)</td><td colspan="2">Abrahamskraal & Teekloof Formations (Lower Beaufort Group), Late Caenozoic alluvium</td></tr>
<tr><td>Potential fossils</td><td colspan="2">Fossil vertebrate bones, teeth, trace fossils, trackways, petrified wood, plant-rich beds in the Lower Beaufort Group bedrocks.
Fossil mammal bones, teeth, horn cores, freshwater molluscs, plant material in Late Caenozoic alluvium.</td></tr>
<tr><td rowspan="5">ECO protocol</td><td colspan="2">1. Once alerted to fossil occurrence(s): alert site foreman, stop work in area immediately (N.B. safety first!), safeguard site with security tape / fence / sand bags if necessary.</td></tr>
<tr><td colspan="2">2. Record key data while fossil remains are still in situ:
• Accurate geographic location – describe and mark on site map / 1: 50 000 map / satellite image / aerial photo
• Context – describe position of fossils within stratigraphy (rock layering), depth below surface
• Photograph fossil(s) in situ with scale, from different angles, including images showing context (e.g. rock layering)</td></tr>
<tr><td>3. If feasible to leave fossils in situ:
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation
• Ensure fossil site remains safeguarded until clearance is given by the Heritage Resources Agency fo work to resume</td><td>3. If not feasible to leave fossils in situ (emergency procedure only):
• Carefully remove fossils, as far as possible still enclosed within the original sedimentary matrix (e.g. entire block of fossiliferous rock)
• Photograph fossils against a plain, level background, with scale
• Carefully wrap fossils in several layers of newspaper / tissue paper / plastic bags
• Safeguard fossils together with locality and collection data (including collector and date) in a box in a safe place for examination by a palaeontologist
• Alert Heritage Resources Agency and project palaeontologist (if any) who will advise on any necessary mitigation</td></tr>
<tr><td colspan="2">4. If required by Heritage Resources Agency, ensure that a suitably-qualified specialist palaeontologist is appointed as soon as possible by the developer.</td></tr>
<tr><td colspan="2">5. Implement any further mitigation measures proposed by the palaeontologist and Heritage Resources Agency</td></tr>
<tr><td>Specialist palaeontologist</td><td colspan="2">Record, describe and judiciously sample fossil remains together with relevant contextual data (stratigraphy / sedimentology / taphonomy). Ensure that fossils are curated in an approved repository (e.g. museum / university / Council for Geoscience collection) together with full collection data. Submit Palaeontological Mitigation report to Heritage Resources Agency. Adhere to best international practice for palaeontological fieldwork and Heritage Resources Agency minimum standards.</td></tr>
</table>

APPENDIX 5: SiVEST SPECIALIST TERMS OF REFERENCE

Specialist Assessment Reports / Compliance Statements

Specialists are requested to provide *one (1)* scoping phase report and / or compliance statement that provides an assessment of the proposed Koup 1 WEF *and* the associated grid connection infrastructure (132kV overhead power line on-site switching / collector substation). The report should however include separate assessment and impact rating chapters/sections for the WEF and the grid connection proposals respectively.

During the EIA phase, specialists will be required to update the scoping phase specialist report to provide a review of their findings in accordance with revised site layouts and to address any comments or concerns arising from the public participation process.

The specialist assessment reports and / or compliance statements should include the following sections:

8.2.1 Project Description

The specialist report must include the project description as provided by SiVEST.

8.2.2 Terms of Reference

The specialist report must include an explanation of the terms of reference (TOR) applicable to the specialist study. The gazetted Environmental Assessment Protocols of the NEMA EIA Regulations (2014, as amended), prescribes Procedures for the Assessment and Minimum Criteria for Reporting on the Identified Environmental Themes in terms of Sections 24(5)(A) and (H) and 44 of the National Environmental Management Act, 1998. These procedures must be considered.

Where a specialist assessment is required and no specific environmental theme protocol has been prescribed, the required level of assessment must be based on the findings of the site sensitivity verification and must comply with Appendix 6 of the EIA Regulations; and any relevant legislation and guidelines deemed necessary

Where relevant, a table must be provided at the beginning of the specialist report, listing the requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations, 2014 (as amended) and cross referencing these requirements with the relevant sections in the report.

8.2.3 Legal Requirements and Guidelines

The specialist report must include a thorough overview of all applicable best practice guidelines, relevant legislation, prescribed Assessment Protocols and authority requirements.

8.2.4 Methodology

The report must include a description of the methodology applied in carrying out the specialist assessment.

8.2.5 Specialist Findings / Identification of Impacts

The report must present the findings of the specialist studies and explain the implications of these findings for the proposed development (e.g. permits, licenses etc.). This section of the report should also identify any sensitive and/or ‘no-go’ areas on the development site or within the power line assessment corridors. These areas must be mapped clearly with a supporting explanation provided.

This section of the report should also specify if any further assessment will be required.

8.2.6 Environmental Impact Assessment

The impacts (both direct and indirect) of the proposed WEF and the proposed grid connection infrastructure (during the Construction, Operation and Decommissioning phases) are to be assessed and rated *separately* according to the methodology developed by SiVEST. Specialists will be required to make use of the impact rating matrix provided (in Excel format) for this purpose, and *separate tables* must be provided for the WEF and for the grid connection infrastructure respectively. Please note that the significance of Cumulative Impacts should also be rated in this section. Both the methodology and the rating matrix will be provided by SiVEST.

Please be advised that this section must include mitigation measures aimed at minimising the impact of the proposed development.

8.2.7 Input To The Environmental Management Programme (EMPr)

The report must include a description of the key monitoring recommendations for each applicable mitigation measure identified for each phase of the project for inclusion in the Environmental Management Programme (EMPr) or Environmental Authorisation (EA).

Please make use of the Impact Rating Table (in Excel format) for each of the phases i.e. Design, Construction, Operation and Decommissioning.

8.2.8 Cumulative Impact Assessment

Cumulative impact assessments must be undertaken for the proposed WEF and associated grid connection infrastructure to determine the cumulative impact that will materialise if other Renewable Energy Facilities (REFs) and large scale industrial developments are constructed within 35kms of the proposed development.

The cumulative impact assessment must contain the following:

- A cumulative environmental impact statement noting whether the overall impact is acceptable; and
- A review of the specialist reports undertaken for other REFs and an indication of how the recommendations, mitigation measures and conclusion of the studies have been considered.

In order to assist the specialists in this regard, SiVEST will provide the following documentation/data:

- A summary table listing all REFs identified within 35kms of the proposed WEF;

It should be noted that it is the specialist's responsibility to source the relevant EIA / BA reports that are available in the public domain. SiVEST will assist, where possible.

8.2.9 No Go Alternative

Consideration must be given to the "no-go" option in the EIA process. The "no-go" option assumes that the site remains in its current state, *i.e.* there is no construction of a WEF and associated infrastructure in the proposed project area and the status quo would be preserved.

8.2.10 Comparative Assessment Of Alternatives

As mentioned, alternatives for the Substation location, construction / laydown area and power line route alignment have been identified. These alternatives are being considered as part of the EIA / BA

processes and as such specialists are required to undertake a comparative assessment of the alternatives mentioned above as per the latest table provided by SiVEST.

8.2.11 Conclusion / Impact Statement

The conclusion section of the specialist report must include an Impact Statement, indicating whether any fatal flaws have been identified and ultimately whether the proposed development can be authorised or not (i.e. whether EA should be granted / issued or not).

8.2.12 Executive Summary

Specialists must provide an Executive Summary summarising the findings of their report to allow for easy inclusion in the EIA / BA reports.

8.2.13 Specialist Declaration of Independence

A copy of the Specialist Declaration of Interest (DoI) form, containing original signatures, must be appended to all Draft and Final Reports. This form will be provided to the specialists. *Please note that the undertaking / affirmation under oath section of the report must be signed by a Commissioner of Oaths.*