THE BASIC ASSESSMENT FOR THE PROPOSED KOMAS WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR KLEINSEE IN THE NORTHERN CAPE PROVINCE.

APPENDIX C.6

Heritage Assessment (including Archaeology, Cultural Landscape and Palaeontology)





HERITAGE IMPACT ASSESSMENT:
BASIC ASSESSMENT FOR THE PROPOSED KOMAS WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR KLEINSEE, NAMAKWA MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

SAHRA Case No.: TBC

Required under Section 38 (8) of the National Heritage Resources Act (No. 25 of 1999).

Report for:

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Final report: 19th October 2020

EXECUTIVE SUMMARY

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction and operation of the Komas Wind Energy Facility (WEF) on Portion 1 of the Farm Zonnekwa 326, Portions 2, 3 and 4 of Zonnekwa 328 and Portion 4 of Kap Vley 315 near Kleinsee in the Northern Cape Province. The mid-point of the development is located at approximately S29° 50' 20" E17° 17' 40".

The proposed project would include up to 50 wind turbines along with associated roads, hardstands, offices an on-site Substation, Battery Energy Storage System (BESS), laydown area and a 132 kV power line which will be assessed as part of a separate Basic Assessment (BA) process.

The study area is an undulating, sandy coastal plain with a light vegetation covering. Dune ridges occur with deflation hollows generally located along the crests of these ridges. Infrastructure is absent aside from a few gravel roads through the area, occasional power lines and some farmsteads. The proposed site falls within a Renewable Energy Development Zone (REDZ) i.e. the Springbok REDZ (REDZ 8), but no renewable energy facilities have yet been constructed in the area.

The vast majority of impacts would occur during construction. Palaeontological resources are likely to consist of isolated bones and their locations cannot be predicted. Any fossils present could be of high significance and, if found and reported, impacts are expected to be of **low positive** significance after mitigation. This is because of the difficulty of finding fossils outside of the development context – their recovery would be a benefit to science. The region is well-known for its very high density of archaeological sites but their number and significance often decreases away from the coast. The survey revealed many small Later Stone Age archaeological sites with occasional historical artefacts also present. None of these was of high cultural significance and the WEF has avoided all known sites. Although it is possible that some sites were missed during the survey, these are likely to be less important ones and would be easily recorded during a pre-construction survey. Because of the ease with which mitigation can be effected, the impacts are expected to be of **very low negative** significance after mitigation. Although culturally important, graves are very unlikely to be impacted and their locations generally cannot be predicted. The impact significance is therefore expected to be **very low negative**. Impacts to the cultural landscape cannot be mitigated because of the size of the turbines but the expected impacts would be of **moderate negative** significance. There are no fatal flaws associated with the proposed development of the Komas WEF. Impacts during operation and decommissioning would be of equal or lesser significance. Cumulative impacts are again similar, except that cumulative impacts to archaeology are considered to be of **moderate negative** significance after mitigation, because there is the possibility that a large number of sites could be lost with extensive development of the area.

It is recommended that the proposed Komas WEF should be authorised, but subject to the following conditions which should be incorporated into the Environmental Authorisation (EA):

- A chance fossil finds procedure needs to be incorporated into the Environmental Management Programme (EMPr);
- A pre-construction survey should be commissioned to check for any remaining archaeological sites that might have been missed during the original survey. Mitigation would then be suggested if required;
- Landscape scarring must be kept to an absolute minimum; and
- If any archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities, i.e. Ngwao-Boswa Ya Kapa Bokoni and the South African Heritage Resources Agency (SAHRA), and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

Glossary

Early Stone Age: Period of the Stone Age extending approximately between 2 million and 200 000 years ago.

Handaxe: A bifacially flaked, pointed stone tool type typical of the Early Stone Age.

Holocene: The geological period spanning the last approximately 10-12 000 years.

Hominid: a group consisting of all modern and extinct great apes (i.e. gorillas, chimpanzees, orangutans and humans) and their ancestors.

Later Stone Age: Period of the Stone Age extending over the last approximately 20 000 years.

Middle Stone Age: Period of the Stone Age extending approximately between 200 000 and 20 000 years ago.

Abbreviations

APHP: Association of Professional Heritage Practitioners

ASAPA: Association of Southern African Professional Archaeologists

BA: Basic Assessment

CSIR: Council for Scientific and Industrial Research

CRM: Cultural Resources Management

EA: Environmental Authorisation

ECO: Environmental Control Officer

EMPR: Environmental Management Programme

ESA: Early Stone Age

GPS: global positioning system

GP: General Protection

HIA: Heritage Impact Assessment

LSA: Later Stone Age

MSA: Middle Stone Age

NBKB: Ngwao-Boswa Ya Kapa Bokoni

NEMA: National Environmental Management Act (No. 107 of 1998)

NHRA: National Heritage Resources Act (No. 25) of 1999

SAHRA: South African Heritage Resources Agency

SAHRIS: South African Heritage Resources Information System

WEF: Wind Energy Facility

Compliance with Appendix 6 of the 2014 EIA Regulations

Requirements of Appendix 6 – GN R326 (7 April 2017)	Addressed in the Specialist 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;	Section 1.4 Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 2
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1.3
(cA) an indication of the quality and age of base data used for the specialist report;	Section 3
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 7.3, 7.1.4, 7.4
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3
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 alternatives;	Section 1.1.3 & 5 [no alternatives]
g) an identification of any areas to be avoided, including buffers;	Section 11
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;	Section 11
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.6
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 5
k) any mitigation measures for inclusion in the EMPr;	Section 9
l) any conditions for inclusion in the environmental authorisation;	Section 12
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 9
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and 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;	Section 11.1 & 12
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not Applicable
q) any other information requested by the competent authority.	Not Applicable
2. Where a government notice gazetted by the Minister provides for any	Part A of the Assessment

protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Protocols published in Government Notice No. 320 on 20 March 2020 is applicable (i.e. Site sensitivity verification requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix 3.

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1. INTRODUCTION

ASHA Consulting (Pty) Ltd was appointed by the Council for Scientific and Industrial Research (CSIR) to conduct an assessment of the potential impacts to heritage resources that might occur through the proposed construction of the Komas Wind Energy Facility (WEF) on Portion 1 of the farm Zonnekwa 326, Portions 2, 3 and 4 of Zonnekwa 328 and Portion 4 of Kap Vley 315 (Figures 1 & 2). The mid-point of the development is located at approximately S29° 50’ 20” E17° 17’ 40”.

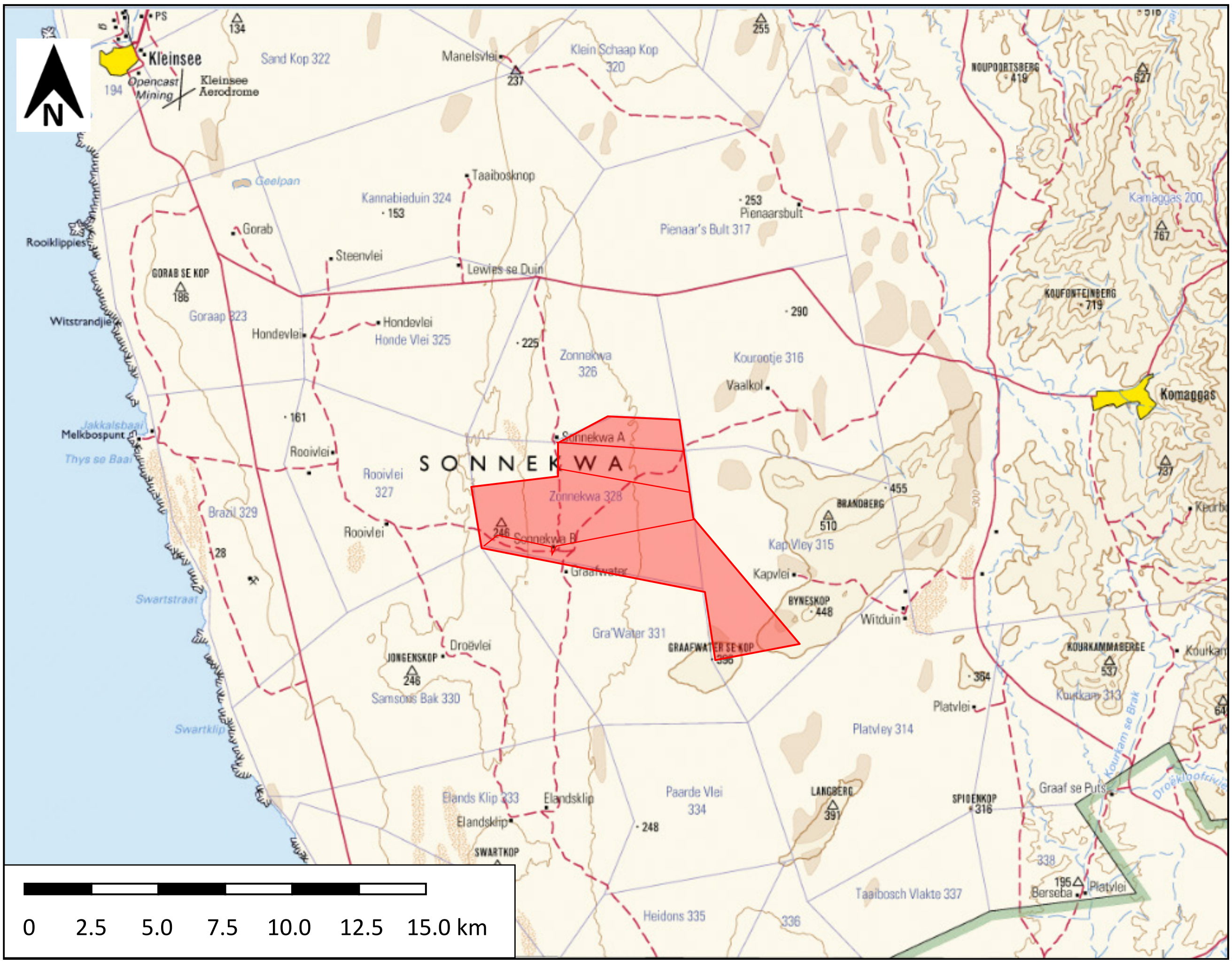

__Figure 1:__ Extract from 1:250 000 topographic map 2916 showing the location of the site (red polygons show the four properties). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.

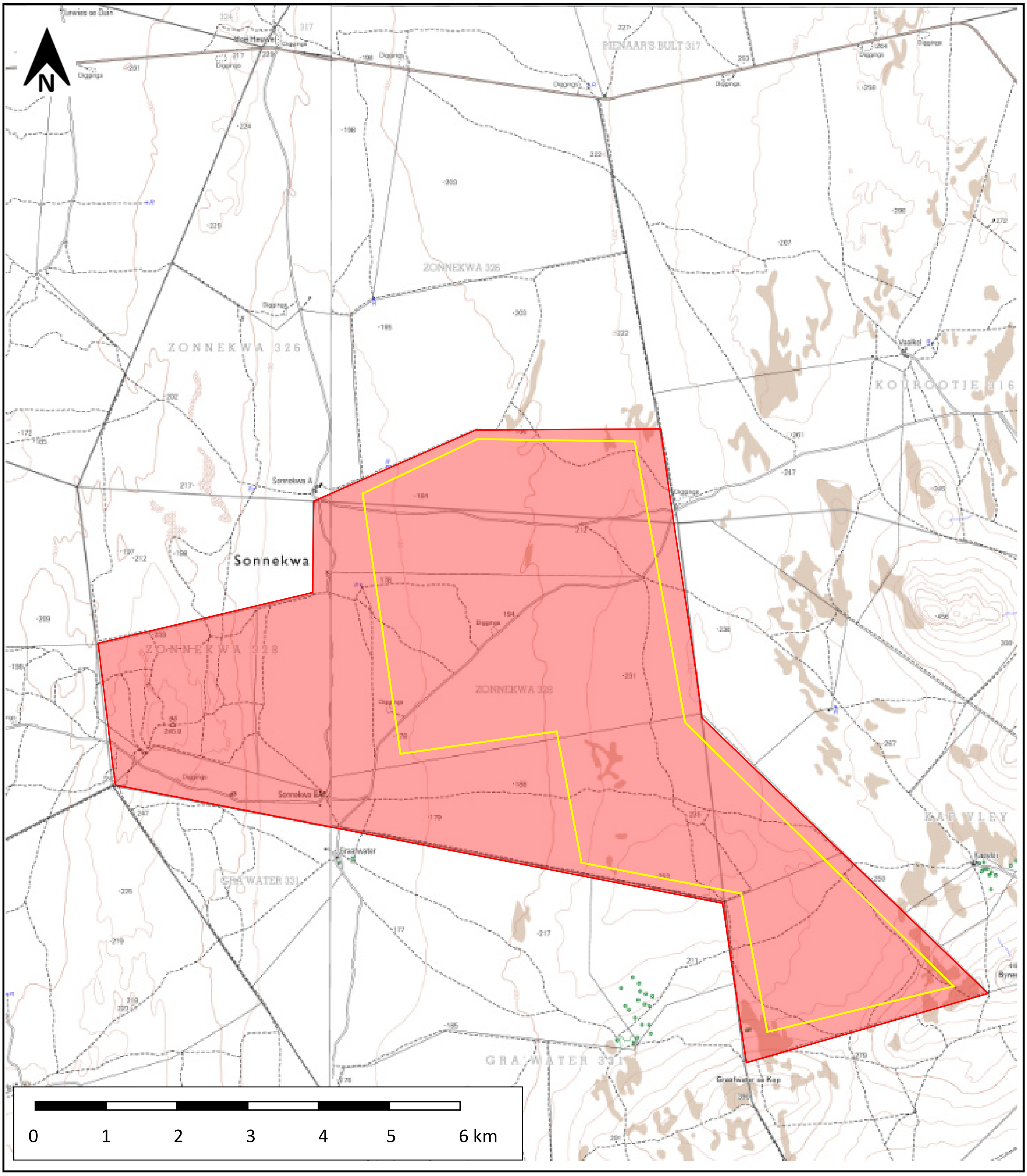

Figure 2: *Extract from 1:50 000 topographic maps 2917CC and 2917CD showing the location of the affected farm portions (red polygon) and application site (yellow polygon). Source: Chief Directorate: National Geo-Spatial Information. Website: www.ngi.gov.za.*

1.1. The proposed project

1.1.1. Project description

The proposed WEF development would be on a site measuring approximately 5 070 ha in extent and would include the following components:

- Up to 50 wind turbine generators (WTGs) with a maximum capacity of up to 300MW.
- Turbines with a hub height of up to 200m and a rotor diameter of up to 200m.
- Hardstand areas of approximately 1 500m^2 per turbine.
- Temporary construction laydown and storage area of approximately 4 500m^2 per turbine.
- Medium voltage cabling connecting the turbines will be laid underground.
- A 33/132kV on-site substation (SS) to feed electricity generated by the proposed Komas WEF into the national grid.
- A Lithium-ion Battery Energy Storage comprising of several utility scale battery modules within shipping containers or an applicable housing structure on a concrete foundation alongside the SS. BESS capacity to be up to 300MW/1200MWh and structure up to 10 m high.
- Internal roads with a width of up to 10 m providing access to each turbine, the BESS, on-site SS and laydown area. The roads will accommodate cable trenches and stormwater channels (as required) and will include turning circle/bypass areas of up to 20m at some sections during the construction phase. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.
- A temporary construction laydown/staging area of approximately 4.5 hectares (ha) which will also accommodate the operation and maintenance (O&M) buildings.
- Galvanised steel fencing of up to 3 m high around the SS and buildings.

The BESS and 33/132kV on-site SS will be located within a 4ha battery and substation complex to allow for micro-siting of the BESS components and to a accommodate internal roads (as required), a temporary construction laydown area and a firebreak around the BESS footprint.

The proposed grid infrastructure including an Eskom Switching SS, 132kV gridline and collector SS (if required) will be assessed as part of a separate basic assessment (BA) process.

1.1.2. Identification of alternatives

Only one site has been selected for assessment for the WEF. The site is partially constrained by surrounding projects and is within a Renewable Energy Development Zone (REDZ). Only one technology type (onshore wind) was selected because the site is best suited to wind energy development. Only one layout is assessed, but it must be noted that this layout was revised after the specialist field surveys in order to have as little impact as possible The project site and location were screened and assessed in detail in order to develop the proposed Komas WEF. The determination of the development footprint within the sites was determined through detailed sensitivity screening which was done by the specialists on the team to identify possible areas that should be avoided by the proposed development (i.e. exclusion zones or no-go areas). These no-go areas have been excluded from the proposed development footprints. The specialist assessments and studies have highlighted sensitive features within the original development footprint, and thus the footprint has been revised to avoid such features. Following the exclusion of the required sensitive areas, sufficient developable area is still available on the site which does not compromise the current ecological integrity of the site. There are two on-site BESS and SS complex location alternatives which have been assessed (i.e. Option 1 and Option 2). The No-Go alternative has also been assessed.

1.1.3. Aspects of the project relevant to the heritage study

All aspects of the proposed development are relevant since excavations for foundations may impact on archaeological and/or palaeontological remains, while the above-ground aspects create potential visual (contextual) impacts to the cultural landscape and any significant heritage sites that might be visually sensitive.

1.2. Terms of reference

ASHA Consulting was asked to conduct a field survey of the site and to provide heritage sensitivity mapping to aid development of a low impact project layout. ASHA was also asked to source a palaeontological specialist study for the project. All data collected from the field survey and from a desktop study were to be used in the production of a Heritage Impact Assessment (HIA) report that assessed the final project layout generated by the developer.

The specific Terms of Reference of the HIA comprise the following:

Archaeology and Cultural Landscape:

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- Provide a Site Sensitivity Verification Report based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Compile a Heritage Impact Assessment in compliance with Appendix 6 of the 2014 NEMA EIA Regulations (as amended). The Specialist Assessment must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary.
- The specialist must undertake a site visit in order to identify the sensitivity and land-use of the project area, and to verify and confirm this against the findings of the National Screening Tool.
- Determination, description and mapping of the baseline environmental condition and sensitivity of the study area. Specify set-backs or buffers, and provide clear reasons for these recommendations.
- Provide sensitivities in KMZ or similar GIS format.
- Describe and map the heritage and features of the site and surrounding area. This is to be based on desktop reviews, fieldwork, available databases, findings of the REDZ Phase 1 SEA (DEA 2015), and findings from other heritage studies in the area, where relevant. Include reference to

the grade of heritage feature and any heritage status the feature may have been awarded. The assessment must also consider the maps generated by the National Screening Tool.

- Map heritage sensitivity for the site. Clearly show any "no-go" areas in terms of heritage (i.e. "very high" sensitivity), and provide recommended buffers or set-back distances. Indicate which very high sensitivity areas are regarded as complete no-go areas.
- Identify and assess the potential direct, indirect and cumulative impacts of the proposed development on the full scope of heritage features, including archaeology, palaeontology and the cultural-historical landscape, as required by heritage legislation. Impact significance must be rated both without and with mitigation, and must cover the construction, operational and decommissioning phases of the project. The Impact Assessment Methodology must follow that as provided by the CSIR.
- Liaise with the relevant authority (i.e. SAHRA) in order to obtain a letter of approval, comments or a Permit in terms of National Heritage Resources Act, 1999 (Act No. 25 of 1999), including Regulations issued thereunder, as applicable.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the Environmental Management Programme (EMPr).
- Incorporate and address all review comments made by the Project Team (CSIR and Project Applicant) during the various revisions of the specialist report.
- Incorporate and address all issues and concerns raised by Stakeholders, Competent Authority, I&APs and the public during the Public Participation Process (e.g. following the review of the Draft BA Report or where relevant and applicable).
- Review the Generic EMPr Substations (GN 435) and confirm if there are any specific environmental sensitivities or attributes present on the site and any resultant site specific impact management outcomes and actions that are not included in the pre-approved generic EMPr (Part B – Section 1). If so, provide a list of these specific impact management outcomes and actions.

1.3. Scope and purpose of the report

An HIA is a means of identifying any significant heritage resources before development begins so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This HIA report aims to fulfil the requirements of the heritage authorities such that a comment can be issued by them for consideration by the National Department of Environment, Forestry and Fisheries (DEFF) who will review the BA and grant or refuse authorisation. The HIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation should this be granted.

1.4. The author

Dr Jayson Orton has an MA (UCT, 2004) and a D.Phil (Oxford, UK, 2013), both in archaeology, and has been conducting Heritage Impact Assessments and archaeological specialist studies in South Africa (primarily in the Western Cape and Northern Cape provinces) since 2004 (please see curriculum vitae included as Appendix 1). He has also conducted research on aspects of the Later Stone Age in these provinces and published widely on the topic. He is an accredited heritage practitioner with the Association of Professional Heritage Practitioners (APHP; Member #43) and also holds archaeological accreditation with the Association of Southern African Professional Archaeologists (ASAPA) CRM section (Member #233) as follows:

- Principal Investigator: Stone Age, Shell Middens & Grave Relocation; and
- Field Director: Colonial Period & Rock Art.

2. HERITAGE LEGISLATION

The National Heritage Resources Act (NHRA) No. 25 of 1999 protects a variety of heritage resources as follows:

- Section 34: structures older than 60 years;
- Section 35: palaeontological, prehistoric and historical material (including ruins) more than 100 years old as well as military remains more than 75 years old;
- Section 36: graves and human remains older than 60 years and located outside of a formal cemetery administered by a local authority; and
- Section 37: public monuments and memorials.

Following Section 2, the definitions applicable to the above protections are as follows:

- Structures: “any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith”;
- Palaeontological material: “any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace”;
- Archaeological material: a) “material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures”; b) “rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation”; c) “wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation”; and d) “features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found”;

- Grave: "means a place of interment and includes the contents, headstone or other marker of such a place and any other structure on or associated with such place"; and
- Public monuments and memorials: "all monuments and memorials a) "erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government"; or b) "which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual."

Section 3(3) describes the types of cultural significance that a place or object might have in order to be considered part of the national estate. These are as follow:

a) its importance in the community, or pattern of South Africa's history;
b) its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
d) its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
e) its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
f) its importance in demonstrating a high degree of creative or technical achievement at a particular period;
g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa; and
i) sites of significance relating to the history of slavery in South Africa.

While landscapes with cultural significance do not have a dedicated Section in the NHRA, they are protected under the definition of the National Estate (Section 3). Section 3(2)(c) and (d) list "historical settlements and townscapes" and "landscapes and natural features of cultural significance" as part of the National Estate. Furthermore, Section 3(3) describes the reasons a place or object may have cultural heritage value; some of these speak directly to cultural landscapes.

Section 38(8) of the NHRA states that if an impact assessment is required under any legislation other than the NHRA then it must include a heritage component that satisfies the requirements of Section 38(3). Furthermore, the comments of the relevant heritage authority must be sought and considered by the consenting authority prior to the issuing of a decision. Under the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended (NEMA) the project is subject to a BAR. The present report provides the heritage component. Ngwao-Boswa Ya Kapa Bokoni (Heritage Northern Cape; for built environment and cultural landscapes) and the South African Heritage Resources Agency (SAHRA for archaeology and palaeontology) are required to provide comment on the proposed project in order to facilitate final decision making by the DEFF.

3. METHODS

3.1. Literature survey and information sources

A survey of available literature was carried out to assess the general heritage context into which the development would be set. This literature included published material, unpublished commercial reports and online material, including reports sourced from the South African Heritage Resources Information System (SAHRIS). The 1:50 000 and 1:250 000 topographic maps and the historical aerial images were sourced from the Chief Directorate: National Geo-Spatial Information. Data were also collected via a field survey.

3.2. Field survey

The site was subjected to a detailed foot survey on 6th,7th, 10th and 11th January 2020. This was during summer but, in this very dry area, the season makes no meaningful difference to vegetation covering and hence the ground visibility for the archaeological survey. Other heritage resources are not affected by seasonality. During the survey the positions of finds and survey tracks were recorded on a hand-held Global Positioning System (GPS) receiver set to the WGS84 datum. Photographs were taken at times in order to capture representative samples of both the affected heritage and the landscape setting of the proposed development.

It should be noted that amount of time between the dates of the field inspection and final report do not materially affect the outcome of the report.

3.3. Specialist studies

Most aspects of heritage are discussed by the present author within the HIA. However, a palaeontological specialist was commissioned to provide a separate report on the potential palaeontological impacts. This report dealt with two WEFs and two powerlines, although the four projects are all being submitted as separate Basic Assessments. This combined approach to the palaeontology is because the expected palaeontology and potential impacts are similar throughout the area. The report is contained in Appendix 4.

3.4. Impact assessment

For consistency among specialist studies, the impact assessment was conducted through application of a scale supplied by the CSIR.

3.5. Grading

Section 7 of the NHRA provides for the grading of heritage resources into those of National (Grade 1), Provincial (Grade 2) and Local (Grade 3) significance. Grading is intended to allow for the identification of the appropriate level of management for any given heritage resource. Grade 1 and 2 resources are intended to be managed by the national and provincial heritage resources authorities, while Grade 3 resources would be managed by the relevant local planning authority. These bodies are responsible for grading, but anyone may make recommendations for grading.

It is intended under Section7(2) that the various provincial authorities formulate a system for the further detailed grading of heritage resources of local significance but this is generally yet to happen. SAHRA (2007) has formulated its own system[1] for use in provinces where it has commenting authority. In this system sites of high local significance are given Grade IIIA (with the implication that the site should be preserved in its entirety) and Grade IIIB (with the implication that part of the site could be mitigated and part preserved as appropriate) while sites of lesser significance are referred to as having 'General Protection' (GP) and rated as GPA (high/medium significance, requires mitigation), GP B (medium significance, requires recording) or GPC (low significance, requires no further action).

3.6. Assumptions and limitations

The study is carried out at the surface only and hence any completely buried archaeological sites will not be readily located. Similarly, it is not always possible to determine the depth of archaeological material visible at the surface. Due to the large size of the site it was not possible to cover the site comprehensively. Although the survey targeted areas that looked most likely to host archaeological resources, some of these may have been missed.

Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in the vicinity. It is assumed that the list of projects provided for the assessment is correct.

3.7. Consultation processes undertaken

The NHRA requires consultation as part of an HIA but, since the present study falls within the context of an EIA which includes a public participation process (PPP), no dedicated consultation was undertaken as part of the HIA. Interested and affected parties would have the opportunity to provide comment on the heritage aspects of the project during the PPP.

4. PHYSICAL ENVIRONMENTAL CONTEXT

4.1. Site context

The site is in a rural area and is included within the Springbok REDZ 8. It is serviced only by gravel roads and infrastructure aside from farm buildings and occasional powerlines is lacking (Figure 3). The main land use in the area is small stock grazing, but along the coast to the west and northwest and along the Buffels River to the north mining for diamonds has occurred for nearly a century. The Komaggas Communal Reserve lies a short distance to the east of the study area.

[1] The system is intended for use on archaeological and palaeontological sites only.

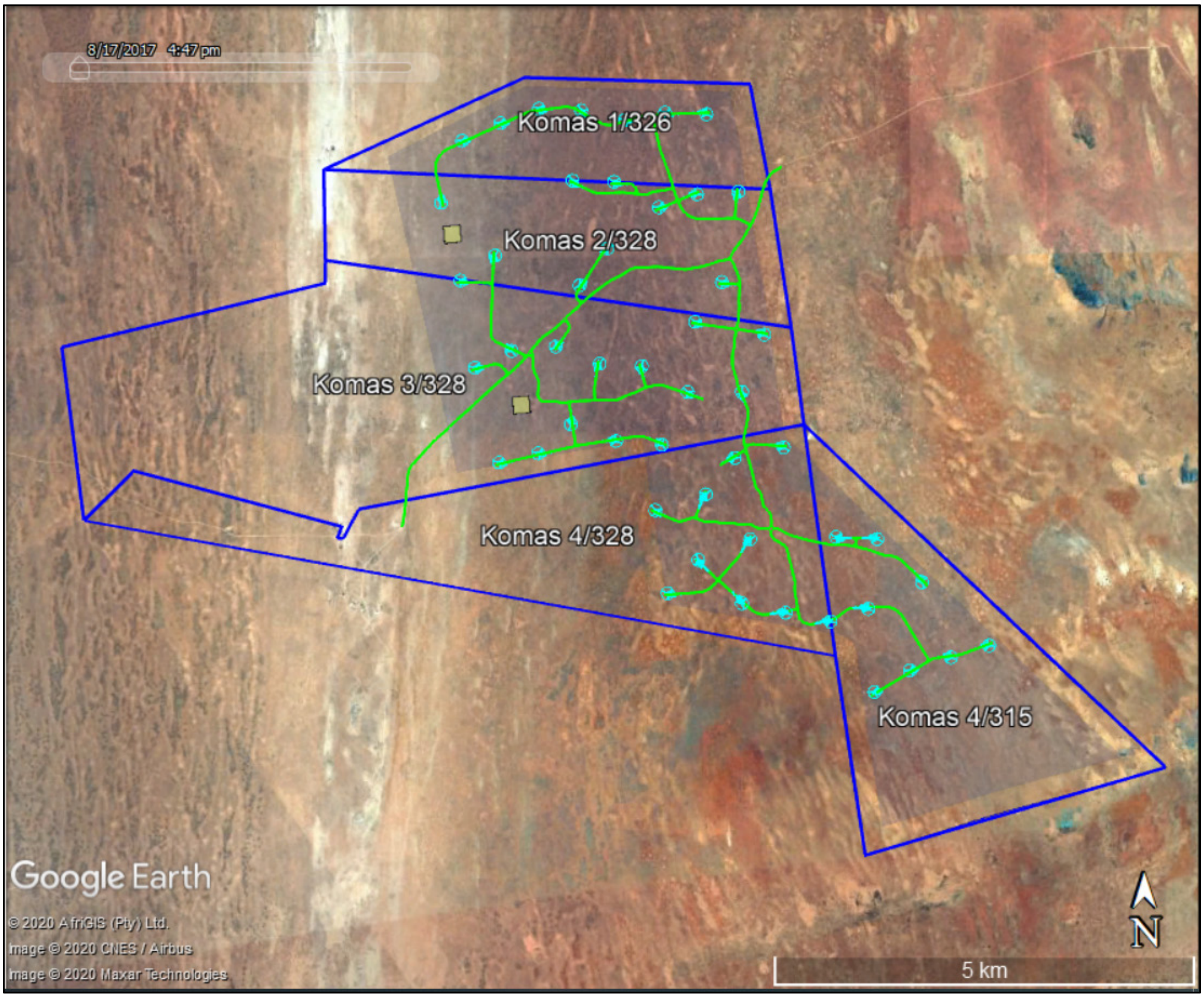

Figure 3: *Aerial view of the study area showing the farm portions (blue polygons) and wind farm study area (blue shading) within their undeveloped rural context. Project roads (green lines) and turbines (turquoise) are indicated. A gravel road is visible running through the northern part of the site from southwest to northeast and is to be upgraded as part of the proposal. Key landscape features are the elongated, pale-coloured, calcrete-floored shallow valley passing the western edge of the study area and the ridge of Byneskop and Graafwater se Kop (running parallel to the southern edge of the study area and extending out of view towards the east [just above the scale bar]).*

4.2. Site description

The study area is largely an undulating sandy plain – the Namaqualand Sandveld – but has several distinct dune ridges that run south to north, especially in the western part of the site. The dunes are covered in vegetation, but many open spaces and some deflation hollows are present. An elongated low-lying area, referred to here as the Zonnekwa Valley, runs between two of these dune ridges through the western part of the overall site but just outside the western edge of the study area. The extreme south-eastern edge of the site and study area just encroach on the (at this point) low ridge of Byneskop and Graafwater se Kop. This ridge extends north-eastwards away from the study area to eventually join the far taller Brandberg, a rocky hill that has been surmounted by wind-blown dune sand. Figures 4 to 9 show views of the study area, highlighting its features.

Figure 4: *View towards the south across the northern part of the study area showing the undulating sandy plain with a deflated area in the foreground.*

Figure 5: *View towards the southeast showing an example of a dune that has a deflation hollow on its crest.*

Figure 6: *View towards the southeast through the eastern part of the study area. The Graafwater se Kop ridge forms part of the skyline with the more distant Langberg rising behind it in mid-picture.*

Figure 7: *View towards the east showing a prominent dune with a deflation hollow on its crest. Byneskop rises in the background to the left (outside the study area).*

Figure 8: View towards the northeast from a deflation hollow on the slopes of Graafwater se Kop. Byneskop and Brandberg lie in the distance.

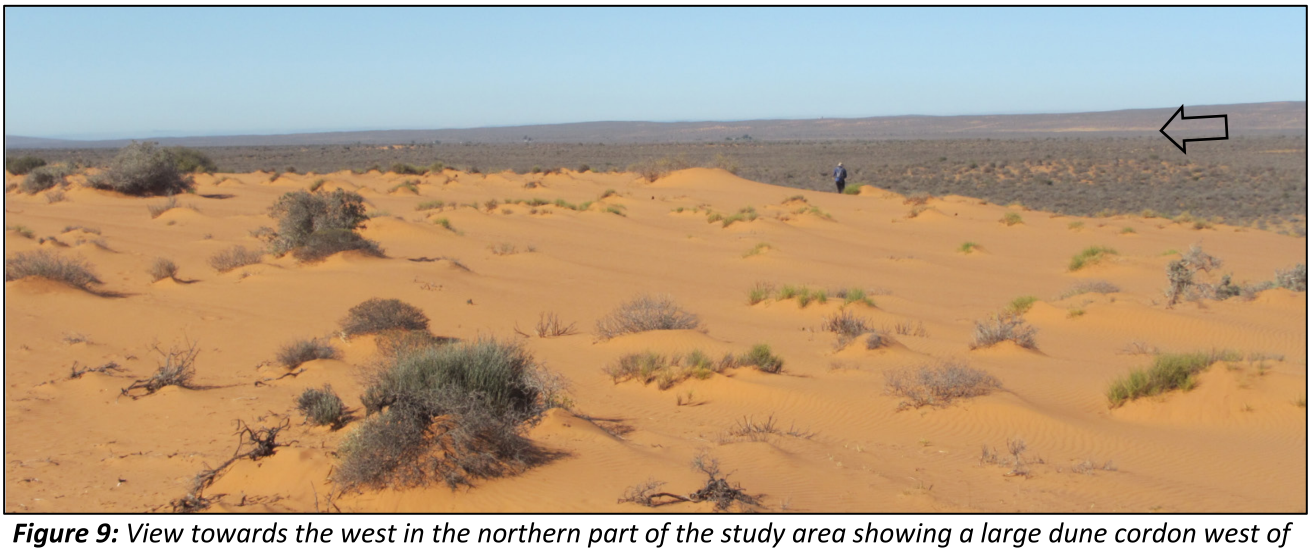

Figure 9: *View towards the west in the northern part of the study area showing a large dune cordon west of the site (skyline). The shallow calcrete-floored valley (arrowed) lies just below this ridge.*

5. FINDINGS OF THE HERITAGE STUDY

This section describes the heritage resources recorded in the study area during the course of the assessment.

5.1. Palaeontology

Pether (2020:i) notes that "the affected surficial formations include Holocene dunes of the Hardevlei Formation and earlier late Quaternary coversands of the Koekenaap Formation. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed the Dorbank Formation which are fossil dune plumes of later mid-Quaternary age." Between two large dune ridges in the western part of the site (but just outside the study area) is a low-lying, calcrete-floored non-depositional area – referred to as the Zonnekwa Valley. The bedrocks (only exposed in the extreme southeast of the study area) are very altered ancient quartzites and schists of the Springbok Formation and are entirely unfossiliferous.

The aeolian formations (Hardevlei and Koekenaap) are assumed to contain the typical fossil content seen in similar deposits elsewhere. The most common fossils are related to the ambient fossil content of dune sands, i.e. land snails, tortoise shells and mole bones. The bones of larger animals (e.g. antelopes, zebra, rhinos) are sparse, but occur more often on the palaeosurfaces between the major formations where they are enclosed in palaeosols and pedocretes. They can also occur on less easily visible palaeosurfaces within formations and particularly within the dorbank. The calcrete-floored Zonnekwa Valley likely hosted pans during wetter periods and some pan deposits – or fossil bones eroded from such deposits – may still be present in places. Large caches of bones can be found in old burrows and were collected by hyaenas (Pether 2020).

Although Pether (2020) considers fossil finds to be unlikely, he does note that any finds made could be scientifically significant in the interpretation of the local geological stratigraphy.

5.2. Archaeology

5.2.1. Desktop study

Early Stone Age (ESA) materials in Namaqualand have mostly been found fairly close to the coastline and are often found in the same contexts as Middle Stone Age (MSA) artefacts. Halkett (2002) reported a large scatter of ESA artefacts from Kleinsee, while Orton and Webley (2012b) found ESA and MSA artefacts associated with fossil bones on the high ground to the north of the Buffels River, northeast of Kleinsee. Much further south, in the Western Cape, Hart and Halkett (1994) excavated an ESA sample adjacent to a quarried silcrete outcrop, while not far away Orton (2017) found extensive scatters of ESA material – including abundant handaxes – at the interface of the dorbank and aeolian cover sands. Some 20 km north of Kleinsee, Orton and Halkett (2006) described an extensive silcrete outcrop that displayed evidence of quarrying. There were scatters of ESA and MSA artefacts located across the outcrop. Further inland, to the southeast of the present study area, Morris and Webley (2004) reported scatters of ESA artefacts, including handaxes, amongst sand dunes on the coastal plain and around pans.

Middle Stone Age material is generally more commonly reported, but further inland, probably only because the landscape is less eroded and deflated there, it tends to occur as isolated artefacts or as very ephemeral scatters. To the northwest of Komaggas Dreyer (2002) reported MSA artefacts on quartzite and hornfels associated with river gravel about 1 km from the Buffels River. Van Pletzen-Vos and Rust (2011) found MSA quartz artefacts on the western and northern outskirts of Komaggas. In the Kamiesberg Mountains, Howieson's Poort-type implements belonging to the MSA were found in Keurbos Cave some 15km north-east of Garies (Webley 1992), while MSA implements were found in excavations at a small rock shelter called Wolfkraal close to Kharkams (Webley 1984). Near Garies in central Namaqualand, Webley and Halkett (2010) reported on an MSA factory site on Swartkop, an outcrop of dark, fine-grained rock which appears to have been targeted by prehistoric populations. Closer to the coast Orton and Halkett (2005) found some Howieson's Poort bifacial points associated with shell in a dunefield to the southwest of the present study area, but the relationship between the shell and artefacts might be spurious. Halkett and Hart (1997) and Jerardino *et al.* (1992) reported scatters of MSA artefacts north of Kleinsee and at the Groen River Mouth respectively.

Later Stone Age (LSA) material is regularly found throughout Namaqualand. The coastal and near-coastal areas, however, have by far the greatest number of reported sites (Dewar 2008; Orton 2012). Many thousands of shell middens and scatters occur along the coast, some of them preserving rich assemblages of cultural materials and food remains. While these focus on the area within about 2 km to 3 km of the coast, shell scatters have been found along the Buffels River up to 10 km inland (Orton & Webley 2012b) as well as immediately to the west of the present study area and some 12 km from the coastline (Orton 2019). Almost all sites are open sites with just one coastal rock shelter known to contain LSA deposits (Webley 1992. 2002). Other sites on the coastal plain are often deflation hollows of varying size (Orton 2019a, 2019b, 2019c, 2019d). Orton (own data) has observed many sites in the white dunefield known as Witduin located 5 km east of the south-eastern corner of the study area. Inland the best sites tend to be rock shelters with the majority of other sites being relatively ephemeral open artefact scatters. Most work in the inland region has been done by Webley (1986, 1992, 2007) with a focus on rock shelters. Although not common, rock art has been recorded at various locations in the central part of Namaqualand (Orton 2013; Morris & Webley 2004). Orton (2013) ascribes the geometric rock art designs to Khoekhoe herders. Southeast of the present study area, in the Namaqualand National Park, both representational and geometric rock art sites were recorded (Morris & Webley 2004).

The last 2000 years are especially important for archaeological research in Namaqualand. Archaeological sites from this period with pottery are reported from a number of sites and are believed to be associated with the introduction of herding and/or pastoralism to the region some 2000 years ago. The region is known to be important in terms of the beginnings of herding, but the details of how it happened are still highly contested (Orton 2015). The archaeology supports the historic information that pastoralist groups (the ancestors of the Little Namaqua Khoekhoen) were occupying this area at and before the time of colonial contact.

Several other surveys have been conducted away from the coastline and in close proximity to the present study area. Magoma's (2016) linear survey passing the western edge of the study area yielded only isolated artefacts, while further to the west and closer to the coast Orton and Webley (2012a) found large numbers of LSA sites spread across the landscape. To the east of the present study area, Orton (2018) found a number of LSA sites on the ridges of the inselberg formed by

Brandberg, Byneskop and Graafwater se Kop. The sites consisted only of stone artefacts. Finally, Orton's (2019c, 2019d) surveys just north and west of the study area yielded many small LSA sites with their size, density and shell content generally reducing towards the east. The sites were strongly focused on dune ridges. Figure 10 shows the distribution of archaeological sites known to the author in the vicinity of the wind farm site.

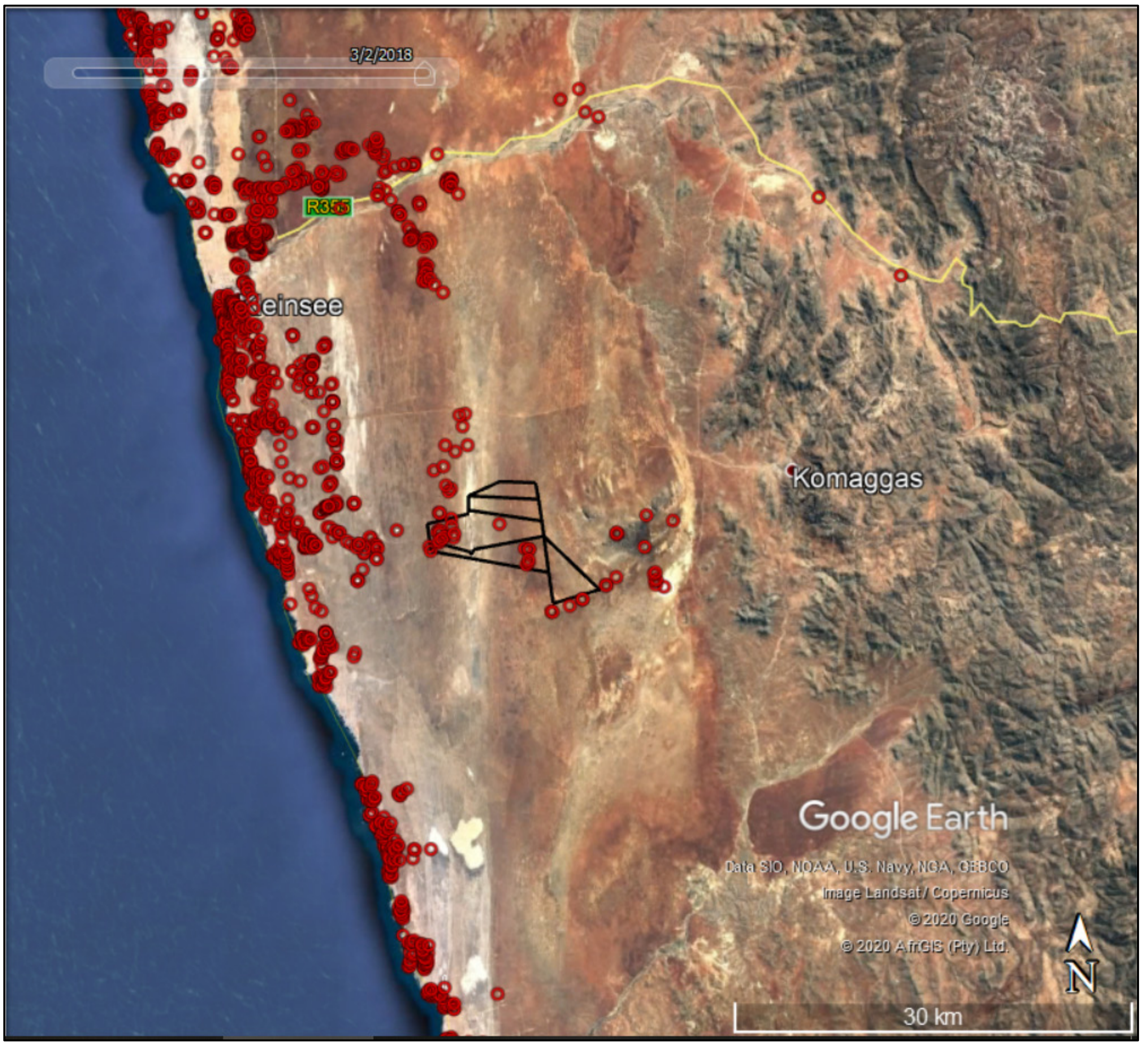

Figure 10: *Map showing the distribution of local archaeological sites known to the author. The wind farm site is shown by the black polygons.*

5.2.2. Site visit

The survey revealed many archaeological sites scattered throughout the study area but clearly located in some areas and absent from others (Figure 11). The low-lying Zonnekwa Valley lacks sites, but a few deflation hollows due occur in dunes along its eastern periphery. The vast majority of sites were located in deflation hollows or deflating areas on the crests of dunes. Table 1 lists the sites and descriptions, and illustrations of some of the sites follow.

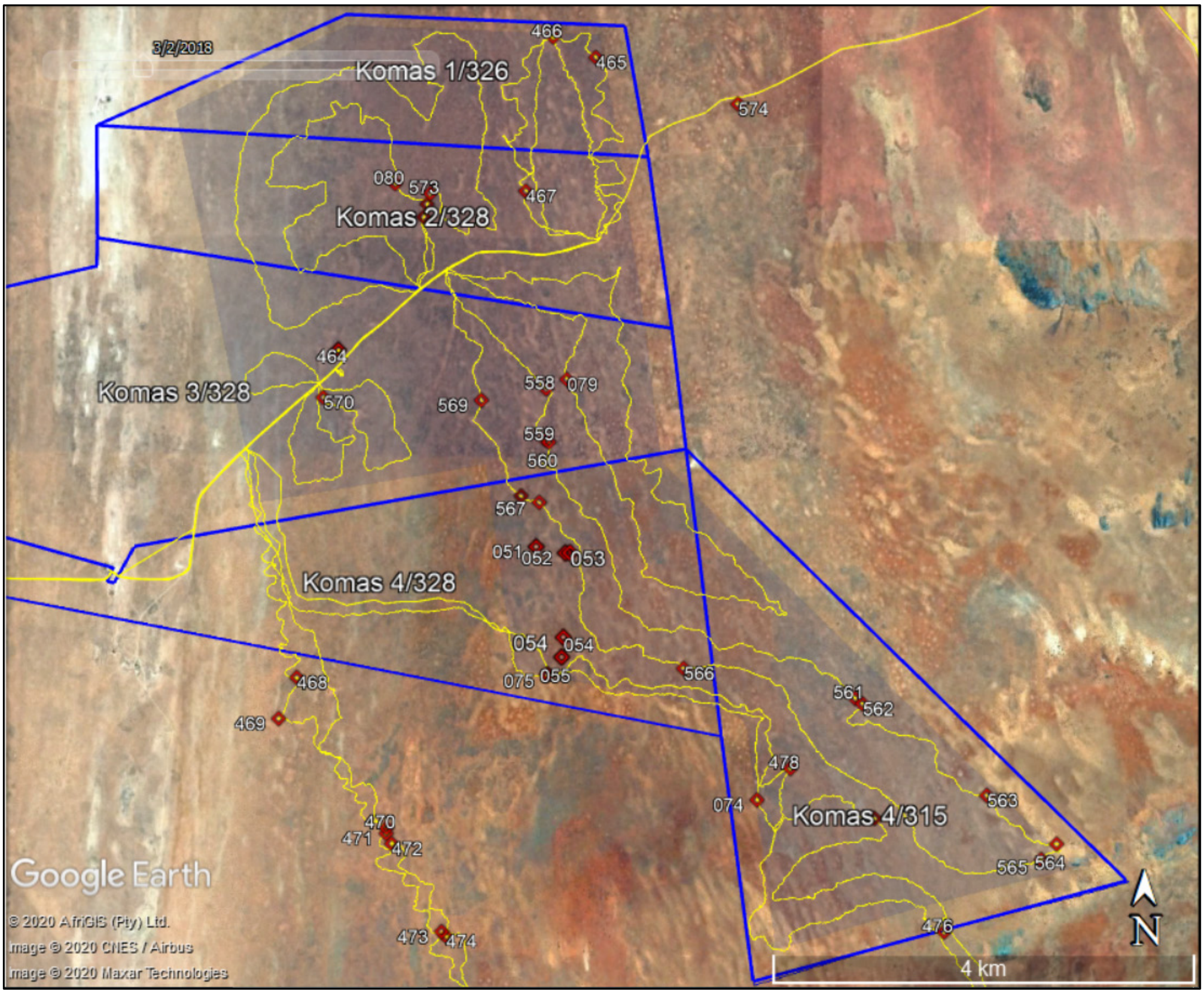

Figure 11: *Aerial view of the study area showing all sites recorded during the survey (numbered red symbols). A few sites from earlier work are also included where these fall within the present study area. The blue shaded area denotes the WEF study area, while the blue polygons are the farm portion boundaries. The yellow lines are the survey tracks.*

***Table 1:** List of archaeological sites recorded during the survey (includes some sites from earlier work).*

Way point	Site name	GPS co-ordinates	Description	Significance / Grade	Mitigation requirement
051	ZN2018/014	S29 51 04.2 E17 17 28.4	A deflation hollow with a light artefact scatter in the eastern side and only very ephemeral artefacts over the rest. It has quartz and CCS artefacts. Recorded (but not reported) in 2018.	Low-medium GPB	**2 hours**
052	ZN2018/015	S29 51 06.1 E17 17 38.8	A deflation hollow with a light artefact scatter over most of its floor but one moderate density patch. It includes artefacts in quartz and CCS and also a quartzite anvil. Recorded (but not reported) in 2018.	Low-medium GPB	**2 hours**
053	ZN2018/016	S29 51 06.0 E17 17 40.5	A deflation hollow with a light artefact of quartz, CCS and quartzite as well as a grooved lower grindstone. Also some glass present. Recorded (but not reported) in 2018.	Low-medium GPB	**2 hours**
054	ZN2018/017	S29 51 32.1 E17 17 38.1	A deflation hollow with a light quartz scatter over most of its floor but with one moderate density path in the eastern side. Recorded (but not reported) in 2018.	Low-medium GPB	**2 hours**
055	ZN2018/018	S29 51 38.2 E17 17 37.5	A small deflation hollow with an ephemeral quartz scatter in it. Recorded (but not reported) in 2018.	Low GPC	---
074	KAP2020/001	S29 52 22.1 E17 18 47.1	Deflation hollow of 15 x 40 m. Light scatter of quartz flaked artefacts and quartzite manuports. Recorded (but not reported) in 2018.	Very low GPC	---
075	ZN2018/019	S29 51 43.5 E17 17 33.2	Deflation hollow of 50 x 70m. Light scatter of quartz, CCS, quartzite, 'other' faked artefacts and some quartzite manuports. There is a grooved lower grindstone with two very short grooves on one face and one very short groove on the back. Also a hammerstone/single platform core. Recorded (but not reported) in 2018.	Low-Medium GPB	**4 hours**
079	ZN2020/001	S29 50 12.5 E17 17 39.2	Deflation hollow of 15 x 20 m. Scatter of quartz and CCS flaked artefacts, ostrich eggshell and some glass.	Low GPC	---
080	ZN2020/002	S29 49 11.9 E17 16 37.8	A deflating area on a dune top with a scatter of quartz flaked artefacts and some quartzite manuports. Also a shotgun cartridge.	Very low GPC	---
464	ZN2018/013	S29 50 03.4 E17 16 17.6	Deflation hollow of 15 x 30 m. Scatter with LSA and historical materials including quartz and CCS flaked artefacts, some *Cymbula granatina* shell (minimal), ostrich eggshell, granite manuports, glass, wire, bullet cartridges and bone.	Low-Medium GPB	**4 hours**
465	ZK2020/001	S29 48 33.1 E17 17 49.4	Deflated area of 10 x 15 m on a dune ridge. Scatter of quartz and CCS flaked artefacts, quartzite manuports, ostrich eggshell and *Aulacomya ater* shell (looks quite fresh, probably just one shell and located at north end of the site). There is a brown Talana bottle on the ridge about 10 m off the site.	Low-Medium GPB	**2 hours**
466	ZK2020/002	S29 48 26.7 E17 17 34.2	Deflation hollow of 30 x 40 m. Scatter of quartz, CCS (x1), silcrete (x1) flaked artefacts, a quartzite hammerstone/upper grindstone and some quartzite manuports.	Low-Medium GPB	**2 hours**
467	ZN2020/003	S29 49 14.4 E17 17 24.5	Deflation hollow of 25 x 40 m. Light scatter of quartz, quartzite (x1) and CCS (x5) flaked artefacts. There are two subscatters: quartz in the west of the hollow and quartz and CCS in the southeast.	Low GPC	---
477	KAP2020/004	S29 52 27.1 E17 19 28.3	Two isolated potsherds on a low dune ridge.	Very low GPC	---
478	KAP2020/005	S29 52 12.1 E17 18 58.8	Small scatter of historical wine bottle fragments (x5).	Very low GPC	---
558	ZN2020/004	S29 50 15.4	Deflation hollow of 20 x 40 m. Scatter of quartz and	Low-Medium	**4 hours**

Way point	Site name	GPS co-ordinates	Description	Significance / Grade	Mitigation requirement
		E17 17 31.9	CCS flaked artefacts as well as quartzite manuports and ostrich eggshell fragments over a wide area.	GPB	
559	ZN2020/005	S29 50 31.2 E17 17 31.7	A light ostrich eggshell scatter but one fragment is burnt showing anthropogenic involvement (i.e. a camp fire).	Very low GPC	---
560	ZN2020/006	S29 50 31.9 E17 17 32.9	Deflation hollow of 20 x 40 m. Scatter of quartz and CCS flaked artefacts as well as quartzite manuports, a hammer stone/upper grindstone and plenty of ostrich eggshell fragments.	Low-Medium GPB	**6 hours**
561	KAP2020/006	S29 51 50.4 E17 19 21.5	Deflation hollow of 15 x 20 m. Scatter of quartz and CCS flaked artefacts as well as quartzite manuports.	Low-Medium GPB	**6 hours**
562	KAP2020/007	S29 51 52.1 E17 19 24.1	Deflation hollow of 15 x 25 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---
563	KAP2020/008	S29 52 19.6 E17 20 07.4	Deflation hollow of 20 x 25 m. Scatter of quartz and CCS flaked artefacts as well as quartzite manuports.	Low-Medium GPB	**2 hours**
564	KAP2020/009	S29 52 34.1 E17 20 31.5	Deflation hollow of 40 x 80 m. Scatter of quartz and CCS flaked artefacts as well as quartzite manuports. There are three clusters in the northern end of the deflation hollow with minimal artefacts in the southern end.	Low-Medium GPB	**2 hours**
565	KAP2020/010	S29 52 38.9 E17 20 26.2	Deflation hollow of 10 x 15 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---
566	ZN2020/007	S29 51 41.5 E17 18 20.8	Deflation hollow of 30 x 40 m. Scatter of quartz and CCS flaked artefacts as well as quartzite manuports.	Low-Medium GPB	**8 hours**
567	ZN2020/008	S29 50 50.5 E17 17 29.5	Deflation hollow of 15 x 15 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---
568	ZN2020/009	S29 50 48.4 E17 17 23.0	Deflation hollow of 25 x 40 m. Ephemeral scatter of quartz and CCS flaked artefacts. There are two quartzite manuports, one silcrete flake and one pot sherd just over the northern crest of the deflation hollow.	Very low GPC	---
569	ZN2020/010	S29 50 18.9 E17 17 08.8	Deflation hollow of 25 x 40 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---
570	ZN2020/011	S29 50 18.1 E17 16 12.1	Deflation hollow of 8 x 30 m. Ephemeral scatter of quartz and CCS flaked artefacts.	Very low GPC	---
571	ZN2020/012	S29 49 22.3 E17 16 48.1	Deflation hollow of 30 x 100 m. Light quartz flaked artefact scatter throughout the southern part of the deflation hollow. Also a hammer stone/upper grindstone, a lower grindstone with a groove on both sides and a piece of 'fishing club' quartzite (outcrop known to occur at the Kleinsee Angling Club). The middle part of the deflation hollow has a scatter of quartz, CCS and silcrete flaked stone artefacts.	Low-Medium GPB	**8 hours**
572	ZN2020/013	S29 49 18.3 E17 16 49.2	The northern end of the above deflation hollow has a scatter of quartz and CCS flaked stone artefacts, two quartzite lower grindstones with hollows on both sides (one on a sub-rounded block, one on a beach cobble), a hammer stone ('sausage-shaped stone') and some ostrich eggshell fragments.		
573	ZN2020/014	S29 49 15.0 E17 16 50.4	Deflation hollow of 10 x 15 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---
574	KOU2020/001	S29 48 47.7 E17 18 39.9	Deflation hollow of 15 x 10 m. Ephemeral scatter of quartz flaked artefacts.	Very low GPC	---

All the sites consisted of scatters of stone artefacts, sometimes with a few other items as well. The vast majority were LSA occurrences in deflation hollows. Figures 12 to 23 show examples of these deflation hollow sites and some of the finds they contain. None of the hollows were especially dense (compared to deflation hollows in other areas). Aside from stone artefacts, some sites contained ostrich eggshell fragments in variable quantities. Pottery, bone and marine shells were very rare, each being recorded in only one or two instances. In places there were also some historical items such as ceramics, glass and pieces of metal (Figures 22 to 23). All of these were no older than the late 19th century and some were likely early 20th century in age and likely relate to shepherds using the landscape.

Figure 12: *A large deflation hollow at ZK2020/002 (waypoint 466) in the far north.*

Figure 13: *Marine shell fragments on the surface of ZN2018/013 (waypoint 464).*

Figure 14: *View of the dune top on which the deflation hollow at ZN2020/004 (waypoint 558) lies.*

Figure 15: *The surface of the ZN2020/004 (waypoint 558) deflation showing flaked stone artefacts and ostrich eggshell fragments.*

Figure 16: *The deflation hollow at ZN2020/006 (waypoint 560).*

Figure 17: *A hammerstone/upper grindstone with very heavily worn ends from ZN2020/006 (waypoint 560). Scale in cm.*

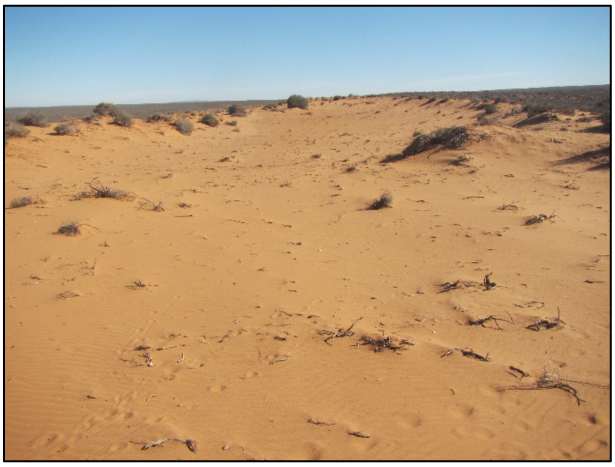

Figure 18: *The deflation hollow at ZN2020/012 (waypoint 571) which contained multiple components.*

Figure 19: *One face of a broken lower grindstone with a prominent groove on it. The reverse face has a shallower groove. Scale in cm.*

Figure 20: *Lower grindstone with two grooves on one face and another on the opposite face from ZN2018/019 (waypoint 075).*

Figure 21: *Two small pot sherds from KAP2020/004 (waypoint 477). Scale in cm.*

Figure 22: *Historical wine bottle fragments from KAP2020/005 (waypoint 478). Scale in cm.*

Figure 23: *Isolated glass medicine bottle from the southern part of the study area.*

5.3. Graves

No graves were seen anywhere in the study area but a single modern grave is known to occur just outside the study area near its north-western corner. It is not a heritage resource. Unmarked precolonial graves can occur almost anywhere and their locations cannot be predicted.

5.4. Historical aspects and the Built environment

5.4.1. Desktop study

Namaqualand is quite remote, poorly watered and relatively unproductive from an agricultural point of view. As a result, it does not have as deep a history as many other parts of South Africa. Although the little settlement of Grootmis just inland of Kleinsee and the mission station at Komaggas date back into the 19th century, the larger towns of Kleinsee and Koingnaas – both originally developed as 'company towns' – relate to 20th century diamond mining.

Grootmis was historically important because it had water. An annotation on a 1907 British Military map states that Grootmis had an unlimited water supply (Source: Pietermaritzburg Archives). The very large number of shell scatters found in the area by Orton and Webley (2012b) suggests that this water source had been available for some time. It probably stopped yielding water when De Beers dammed the river and commenced with the abstraction of water.

Komaggas (Camaggas) is first mentioned by Gordon in 1779. Komaggas (the farm is spelled Kamaggas, a form that also appears on some early maps) received a Certificate of Occupation on 9 November 1843, granting the Cloete family the right of occupation on the land.

There are various oral accounts of the relationship between Ryk Jasper Cloete and the Nama kaptein kXurib who used the Komaggas Fountain as his main water source. Bregman (2010) suggests that Cloete acquired the land through his marriage to the kaptein's daughter. Jasper Cloete utilised land up to the Orange River to graze his stock. A mission station of the London Missionary Society (LMS) was set up at Komaggas in 1829 and the farm was surveyed in 1831. It became a station of the Rhenish Missionary Society in 1843 and then the N.G. Church from 1936 (Raper n.d.).

Bregman (2010) provides a list of the farms surrounding and in the vicinity of Komaggas, including the date that they were first registered. Farms to the west of Komaggas were granted to colonists under quitrent title only after 1855. Mining companies were seeking land in the area because of the commencement of copper mining. Closer to the coast, the dry plains between the Swartlintjies and Buffels Rivers were left open as Crown Land – this is the zone in which the present study area lies. Despite the increasing private ownership of farms in the area over time, herders from Komaggas were still able to access grazing lands outside of the reserve because the farms were not completely fenced and access was gained at certain places. However, they had no formal title to the land.

In 1925 diamonds were discovered on the farm Oubeep, south of Port Nolloth, and in 1926 at Kleyne Zee, both by Jack Carstens. Mining commenced at the latter in 1927 and the town of Kleinsee was soon established (Rebelo 2003). Much of the coastline was then bought up for diamond mining and access for grazing was closed.

5.4.2. Site visit

The site visit showed the site to be in a very remote area with little infrastructure. The study area lacks any sign of development aside from the gravel road passing through its northern part, although some recent/historical materials (see above) did betray a historical presence on the land. Four farmsteads occur in the vicinity, but none are within the study area. One lies just outside the site (700 m from the edge of the study area) to the northwest, two lie to the west of the study area (1.5 and 1.9 km from the study area) with one of these being inside the site and the last is east of the site some 1.5 km outside the study area. They have been considered during other assessments and, while some structures have been found from aerial photography to be greater than 60 years of age, it is clear that none of them are of much heritage significance (Orton 2019c, 2019d). Two are shown in Figures 24 and 25.

Figure 24: *Farm house on Farm 128/4 to the west of the site (photographed in 2018).*

Figure 25: *One of the houses on Farm 326/0 to the northwest of the site (photographed in 2018).*

About 9 km and more to the east of the site, many small stock posts occur in the Komaggas Reserve. They generally have temporary structures, and sometimes caravans, as well as wire stock pens. Although these sites are modern, they are reminders of an important historical way of life practised by local Nama herders for at least the last two centuries since missionaries encouraged settlement. This effectively makes the Komaggas Reserve a living heritage site. Prior to this, the people would have been far more mobile and would likely have moved over greater distances.

5.5. Cultural landscapes and scenic routes

The site is situated in a remote location and, being only very minimally developed, the cultural landscape is largely considered a natural landscape rather than a rural one. The exception, of course, is the mining landscape located along the coast where the human imprint is far greater. Natural heritage also requires consideration because of the visual amenity provided by aesthetically pleasing landscapes. Aside from rare structures, the only other anthropogenic features on the landscape are farm tracks/roads and fences, along with occasional borrows pits alongside the larger gravel roads. The landscape conveys a sense of remoteness and inhospitability that is a result of the very frequent strong winds, the low scrubby vegetation and seemingly endless sand flats and dunes. While most of the broader landscape is fairly flat with the tallest anthropogenic features being wind pumps (aside from the mine dumps further afield), inselbergs occur to the east and southeast of the site forming a long ridge (the southern limit of the project will be about 1.8 km from this ridge). Another prominent inselberg (Langberg) lies several kilometres to the southeast. The escarpment edge lies further to the east with these inselbergs effectively being outlying hills at the base of the escarpment.

The archaeological cultural landscape should also be considered, although it is not typically visible to the lay person. This cultural landscape consists of a multitude of individual archaeological sites classifiable as a Type 3 precolonial cultural landscape (Orton 2016). Figure 26 shows another view of Figure 13 but with the newly reported sites (identified during the site visit) added onto it. It is clear that with wider survey this landscape would be shown to host many more sites, although densities would naturally reduce away from the sea. The obvious exception here is Witduin 6 km to the east which, because of its water supply, contains an extremely high density of archaeological sites.

It is important to note that the study area lies within a REDZ and that renewable energy facilities are therefore expected to be focussed in this area. A number of renewable energy facilities are proposed and authorised within 50 km of the proposed Komas WEF site (see the list of projects in Table 6 and Figure 28 of the cumulative impact section) and with construction, would add a new 'layer' to the cultural landscape which will intensify the presence of industry and infrastructure development in the area. Also, the 400 kV Eskom power line has been authorised and will be constructed in the near future.

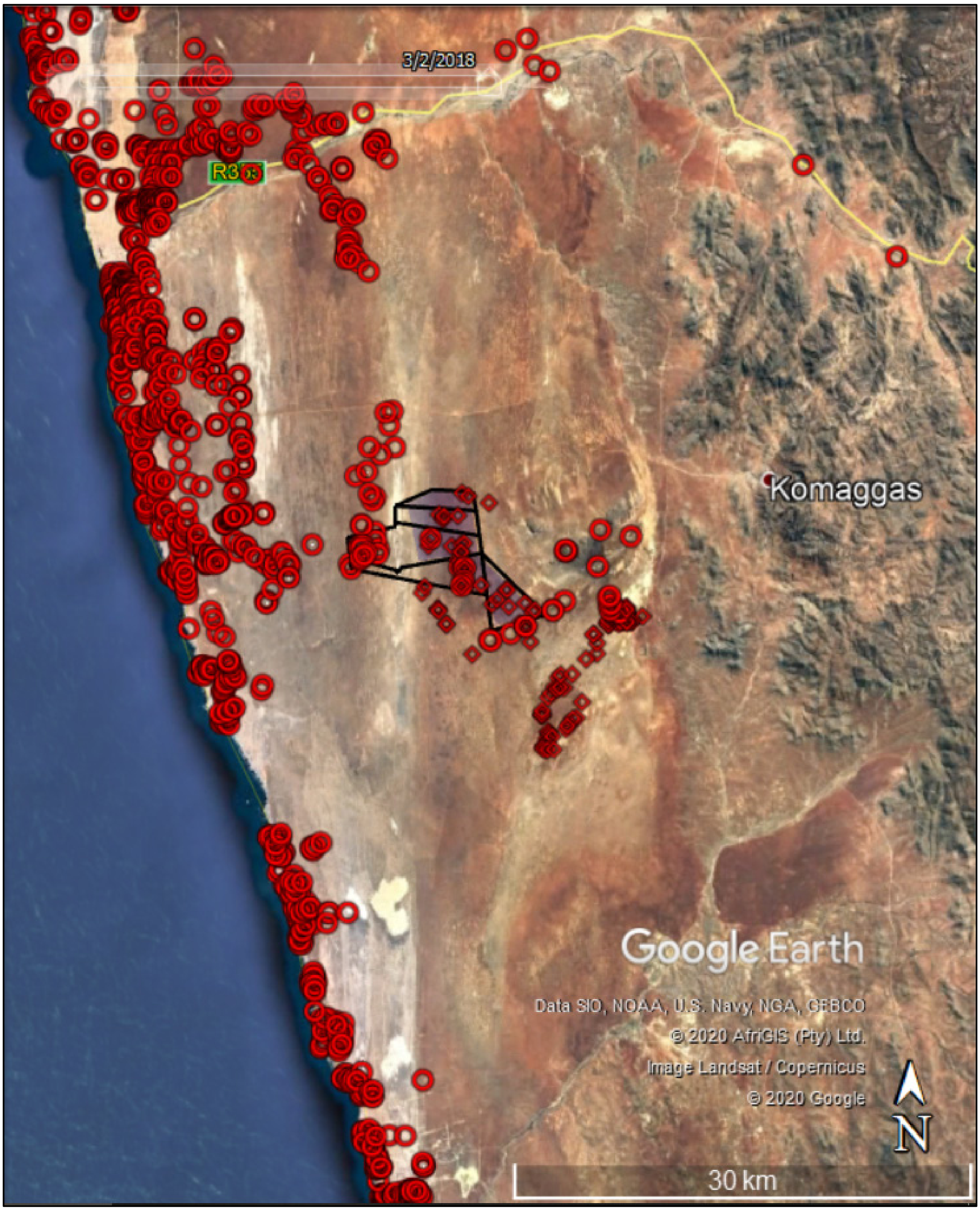

Figure 26: *Aerial view of the study area and wider surroundings showing previously known archaeological resources (red circles) as well as those discovered during the survey (including finds in another wind farm site and the power line corridor which will be reported on separately).*

5.6. Statement of significance and provisional grading

Section 38(3)(b) of the NHRA requires an assessment of the significance of all heritage resources. In terms of Section 2(vi), ‘‘cultural significance’’ means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. The reasons that a place may have cultural significance are outlined Section 3(3) of the NHRA (see Section 2 above).

Any fossil bones found would have high cultural significance for their scientific value and would be rated as ‘GPA’ resources.

The archaeological resources on site are deemed to have low-medium cultural significance for their scientific value. Those more important sites are assigned a field rating of ‘GPB’, but many others are considered to be ‘GPC’. No archaeological sites were rated ‘GPA’.

Graves (older than 60 years) are deemed to have high cultural significance for their social value but none are yet known from the study area. They would be allocated a rating of IIIA.

The built environment is deemed to be of low cultural significance for its architectural, historical and social values.

The historical/recent cultural landscape is deemed to have low-medium cultural significance for its aesthetic value but the archaeological cultural landscape is of medium significance for its scientific value and could be assigned a field rating of IIIB.

Heritage resources are mapped by grade in Figure 27.

5.7. Summary of heritage indicators

Palaeontological resources may be present beneath the surface anywhere in the study area. Although accidental impacts cannot be avoided, the chance finding of any fossil bones should be reported so that further actions can be taken if required and so minimise the intensity of the impact.

- Indicator: The intensity of impacts to palaeontological resources should be minimised.

Archaeological materials are widespread across the study area but many are of low significance. Impacts can be readily avoided due to the ease with which sites can be located at the surface.

- Indicator: Impacts to significant archaeological resources should be minimised.

Although the cultural landscape is generally not of very high significance, impacts to the landscape should be minimised where possible. Because turbines cannot be hidden, the reduction of landscape scarring at ground level becomes the most important aspect of this.

- Indicator: Landscape scarring should be minimised through disturbance of the minimum required footprint.

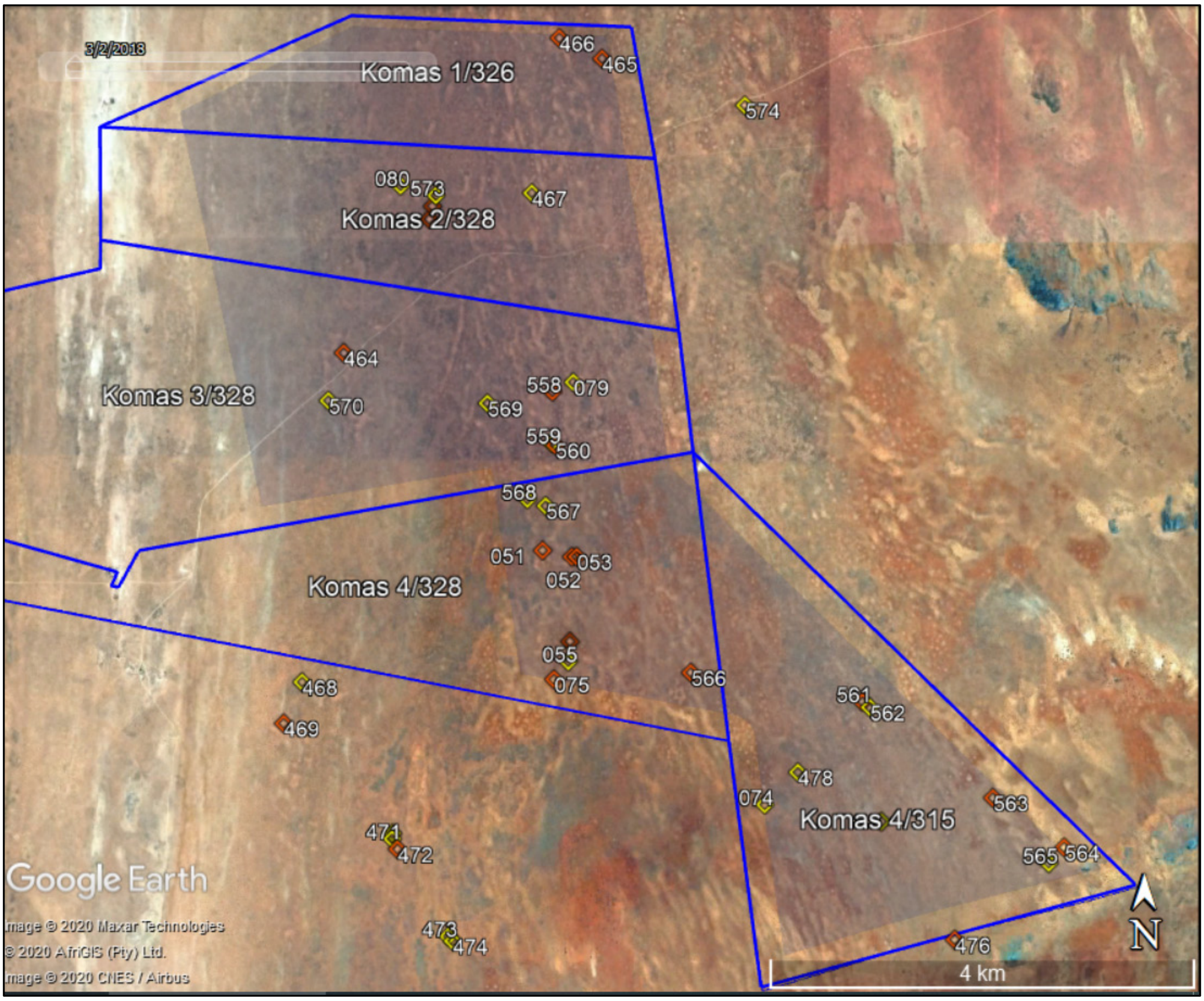

Figure 27: *Aerial view of the Komas WEF study area showing the distribution of archaeological sites by grade. Orange = GPB, yellow = GPC. Note that buffers are not shown as they would be hidden by the symbols and numbers.*

6. ISSUES, RISKS AND IMPACTS

6.1. Summary of issues identified

The potential heritage issues identified include:

- The damage and/or destruction of fossil bones;
- The damage and/or destruction of archaeological sites;
- The damage and/or destruction of graves; and
- Impacts to the cultural landscape.

No specific consultation has been undertaken in the preparation of this report.

6.2. Identification of potential impacts/risks

The potential impacts identified during the assessment are:

Construction Phase
- Impacts to palaeontology;
- Impacts to archaeology;
- Impacts to graves; and
- Impacts to the cultural landscape.

Operational Phase
- Impacts to the cultural landscape.

Decommissioning Phase
- Impacts to the cultural landscape.

Cumulative impacts
- Impacts to palaeontology;
- Impacts to archaeology; and
- Impacts to the cultural landscape.

7. IMPACT ASSESSMENT

Please note that the only alternatives provided for assessment are the two on-site BESS and on-site SS complex locations. No heritage impacts are expected at either location and the assessments below thus apply equally to either the Option 1 or Option 2 BESS and on-site SS complex location alternative. There is no preference between Option 1 and Option 2, and therefore both alternatives are acceptable from a heritage perspective.

7.1. Direct Impacts

7.1.1. Construction Phase

Impacts to palaeontology

Impacts to palaeontological resources would occur as a result of earthmoving and excavations for roads, foundations and electrical cables. Fossils can be moved from their original contexts and can be damaged or destroyed. Their context is often as important as the bones themselves. Because fossils are expected to be very sparsely distributed in the ground with a very low probability of impacts actually occurring, the impacts are only expected to be of **low negative** significance. If fossil bones are successfully spotted, reported and studied they would make a positive contribution to science. Nevertheless, because of the difficulty of spotting bones, it is still expected that most fossils would not be seen during excavation and with even a few being found the post-mitigation significance is expected to be **low positive** (Table 2).

Impacts to archaeology

Impacts to archaeological resources on site would occur as a result of earthmoving and excavations for roads, foundations and electrical cables. Archaeological sites and the materials they contain can be damaged or destroyed. Because the distribution of most archaeological sites is known and all these have been avoided by the proposed facility layout (two buffers have been slightly transgressed by WEF roads), the impacts are only expected to be of **low negative** significance. It is still possible that some sites might have been missed but these are likely to be less important ones. A pre-construction survey will be required to locate these sites and mitigation measures will need to be proposed and effected where necessary. If this is successfully carried out, the post-mitigation significance is expected to be **very low negative** (Table 2).

Impacts to graves

Impacts to graves would occur as a result of earthmoving and excavations for roads, foundations and electrical cables. Graves can be damaged or destroyed. Although the distribution of graves can never be determined from the surface, the probability of graves being present and impacted is so small that the impact significance is expected to be **very low negative**. If graves are found, reported and rescued then the impacts would still be **very low negative** significance (Table 2).

Impacts to the cultural landscape

The cultural landscape would be impacted through the introduction of incompatible elements and construction activity. Wind turbines are industrial-type structures which contrast strongly with the remote, rural/natural setting of the study area. It is noted, however, that the area does fall within the Springbok REDZ 8 which means that, although no WEFs have yet been built, such impacts are to be expected in the future. Nevertheless, the impacts to the landscape are considered to be of **moderate negative** significance. It is not possible to hide or screen such large structures which means that no mitigation measures will ever reduce the significance of the impacts. Mitigation measures should aim to reduce the amount of land that gets disturbed and scarred because in this dry climate rehabilitation will be slow. The post-mitigation significance will remain at the **moderate negative** level (Table 2).

7.1.2. Operation Phase

Impacts to the cultural landscape

The presence of the large turbines in the landscape would continue to provide visual impacts that cannot be mitigated. However, once all the construction activity is over and the facility is in operation the impacts will likely be of **low negative** significance. No mitigation measures are applicable to the operation phase and the significance thus remains **low negative** (Table 3).

7.1.3. Decommissioning Phase

Impacts to the cultural landscape

During this phase the impacts would be very similar to the construction phase impacts and would be as a result of both the wind turbines and the construction equipment on site to decommission the facility. The significance of impacts would likely be **moderate negative**. Once more, impacts cannot be mitigated to the degree that their significance will be reduced. Nevertheless, mitigation should aim to ensure the best possible rehabilitation of the site in order to reduce long term landscape scarring. The significance of impacts post mitigation would still be **moderate negative** (Table 4).

7.1.4. Cumulative Impacts

Several other renewable energy facilities (nine WEFs and two solar PV) have been proposed in the surrounding area (Figure 28 & Table 6). Although this may mean that more impacts to palaeontology and archaeology are anticipated, there is also the likelihood that there will be a gain in terms of the state of knowledge of these disciplines if mitigation measures are successfully applied. The nature and expected sparse distribution of palaeontological heritage resources is expected to be fairly consistent across the wider area and the same mitigation is required throughout (i.e. application of a chance finds procedure). For archaeology, there is also consistency in the nature of sites but the density increases on dune ridges located closer to the sea. Once more, mitigation measures are the same throughout (i.e. pre-construction survey with excavation of any significant sites still found to be within the final construction footprint. The significance of impacts is expected to be the same as that for the construction phase with a **low positive** impact to palaeontology and a **very low negative** impact to archaeology. Once more, because of the very sparse distribution of graves in the wider landscape, the impacts are expected to be **very low negative**. Impacts to the landscape would increase slightly as a result of multiple WEFs being constructed in the area. It is likely that the cumulative impacts to the landscape would be at least **moderate negative** through all phases of the development. There are no feasible mitigation measures to reduce impacts to the landscape.

7.2. The No-Go alternative

The No-Go option would entail the site staying as it currently is. This means its continued use for small stock grazing and the continued natural erosion, weathering and trampling by animals. Palaeontological resources would not likely be affected because significant fossils will remain buried, but archaeological materials would suffer very minimal impacts. The landscape would remain unchanged. Overall, the significance of impacts related to the no-go option is considered to be **very low negative**.

7.3. Existing impacts to heritage resources

There are currently no obvious threats to heritage resources on the site aside from the natural degradation, weathering, erosion and trampling that will affect fossils and archaeological materials.

7.4. Levels of acceptable change

Any impact to an archaeological or palaeontological resource or a grave is deemed unacceptable until such time as the resource has been inspected and studied further if necessary. Impacts to the landscape are difficult to quantify but in general a development that visually dominates the landscape from many vantage points is undesirable. Because of the height of the majority of the proposed Komas WEF development, such an impact is unavoidable but can be tolerated because it is reversible. However, it is noted that the site falls within a REDZ which will help to protect other areas from such visual intrusions and that much landscape scarring has already occurred in the past to the north and northwest through mining.

Table 2: *Impact assessment summary table – Construction Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability: Without mitigation /management	Significance of impact/risk = consequence x probability: With mitigation /management (residual risk/impact)	Ranking of residual impact/risk	Confidence level
CONSTRUCTION PHASE													
Clearing of site and excavation of foundations and trenches and contextual/visual impacts	**Loss of palaeontological resources**	Negative	Local	Permanent	Moderate	Unlikely	Non-reversible (fossils cannot be recreated)	High	Monitoring, inspection, sampling, curation as required	Low -	Low +	4	High
	Loss of archaeological resources on site	Negative	Site	Permanent	Moderate	Unlikely	Non-reversible (archaeological resources cannot be recreated)	High	Pre-construction survey, sampling and curation as required	Low -	Very low -	5	High
	Loss of graves	Negative	Site	Permanent	Extreme	Extremely unlikely	Non-reversible (graves cannot be recreated)	High	Protect and report graves found during construction so they can be rescued.	Very low -	Very low -	5	High
	Impacts to the cultural landscape	Negative	Local	Medium term	Substantial	Very Likely	Moderate (landscape can be rehabilitated but scars will remain long term)	Low	Minimise area disturbed	Moderate -	Moderate -	3	High

Table 3: *Impact assessment summary table – Operation Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of residual impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
OPERATION PHASE													
Contextual/visual impacts	**Impacts to the cultural landscape**	Negative	Local	Long term	Moderate	Very Likely	Moderate (landscape can be rehabilitated but scars will remain long term)	Low	None	Low -	Low-	4	High

Table 4: *Impact assessment summary table – Decommissioning Phase direct impacts.*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of residual impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
DECOMMISSIONING PHASE													
Contextual/visual impacts	**Impacts to the cultural landscape**	Negative	Local	Medium term	Substantial	Very Likely	Moderate (landscape can be rehabilitated but scars will remain long term)	Low	Minimise area disturbed	Moderate -	Moderate -	3	High

Table 5: *Impact assessment summary table – Cumulative impacts*

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk = consequence x probability		Ranking of residual impact/risk	Confidence level
										Without mitigation /management	With mitigation /management (residual risk/impact)		
CONSTRUCTION PHASE													
Clearing of site and excavation of foundations and trenches and contextual/visual impacts	**Loss of palaeontological resources**	Negative	Local	Permanent	Moderate	Unlikely	Non-reversible (fossils cannot be recreated)	High	Monitoring, inspection, sampling, curation as required.	Low -	Low +	4	High
	Loss of archaeological resources	Negative	Site	Permanent	Substantial	Unlikely	Non-reversible (archaeological resources cannot be recreated)	High	Pre-construction survey, sampling and curation as required.	Moderate -	Very low -	5	High
	Loss of graves	Negative	Site	Permanent	Extreme	Extremely unlikely	Non-reversible (graves cannot be recreated)	High	Protect and report graves found during construction so they can be rescued.	Very low -	Very low -	5	High
	Impacts to the cultural landscape	Negative	Local	Medium term	Substantial	Very Likely	Moderate (landscape can be rehabilitated but scars will remain long term)	Low	Minimise area disturbed.	Moderate -	Moderate -	3	High

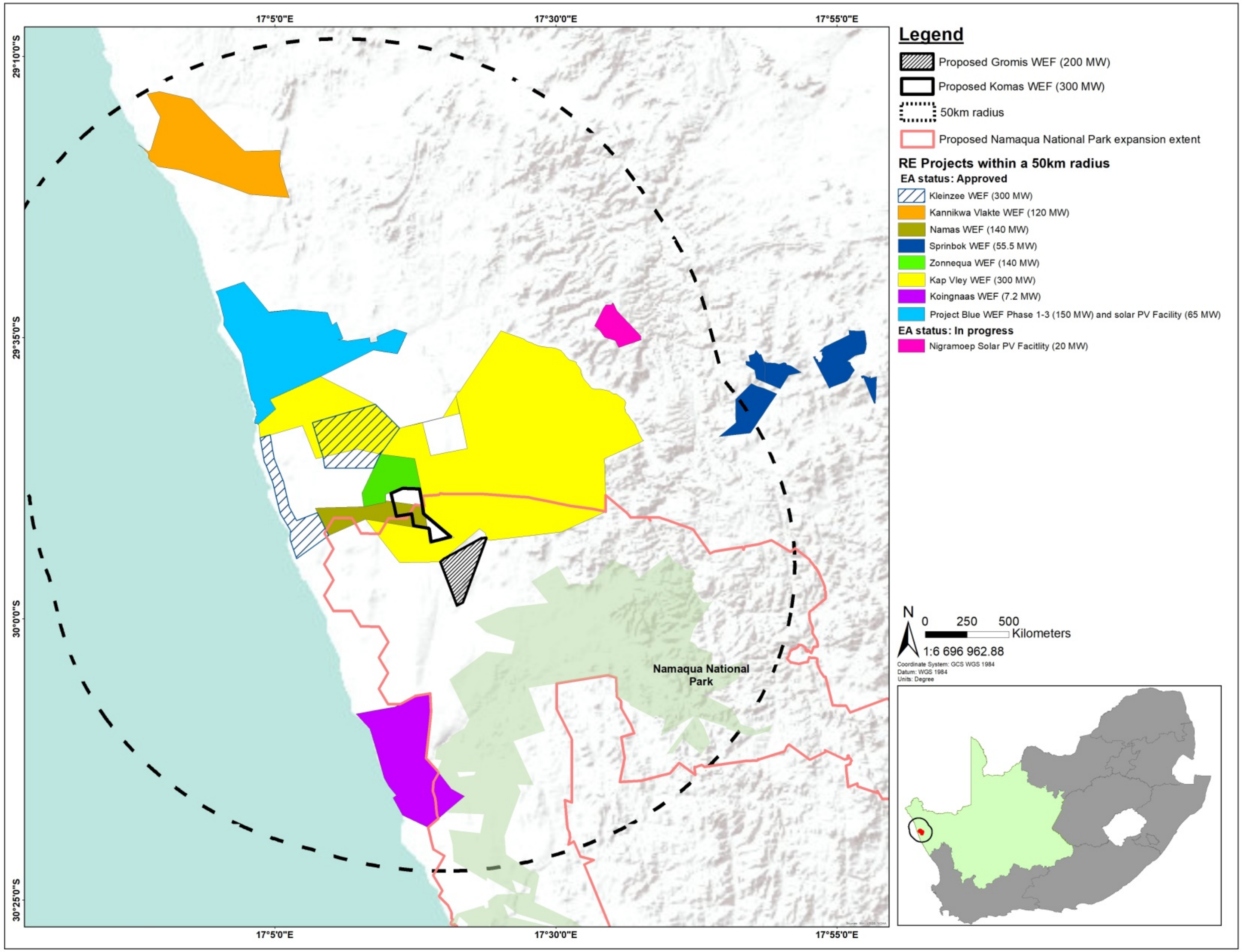

Figure 28: *Map showing the other renewable energy facilities within a 50 km radius of the proposed Komas WEF site.*

Table 6: *Renewable energy facilities proposed within a 50 km radius of the proposed development.*

DEA REFERENCE NUMBER	PROJECT TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT	STATUS
12/12/20/2331/1 12/12/20/2331/1/AM1 12/12/20/2331/2 12/12/20/2331/3	Project Blue Wind Energy Facility Near Kleinsee within the Namakwa Magisterial District, Northern Cape Province. (Phase 1-3)	Diamond Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind and Solar PV	150 MW Wind 65 MW Solar PV	Approved
12/12/20/2212	Proposed 300 MW Kleinzee WEF in the Northern Cape Province.	Eskom Holdings SOC Limited	Savannah Environmental Consultants (Pty) Ltd	Wind	300 MW	Approved
14/12/16/3/3/2/1046	The proposed Kap Vley WEF and its associated infrastructure near Kleinzee, Nama Khoi Local Municipality, Northern Cape Province.	Kap Vley Wind Farm (Pty) Ltd	Council for Scientific and Industrial Research	Wind	300 MW	Approved
14/12/16/3/3/1/1971	Proposed Namas Wind Farm near Kleinsee, Namakwaland Magisterial District, Northern Cape.	Genesis Namas Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	140 MW	Approved
14/12/16/3/3/1/1970	Proposed Zonnequa Wind Farm near Kleinsee, Namakwaland Magisterial District, Northern Cape.	Genesis Zonnequa Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	140 MW	Approved
12/12/20/2154	Proposed construction of the 7.2 MW Koingnaas Wind Energy Facility Within The De Beers Mining Area on the Farm Koingnaas 745 near Koingnaas, Northern Cape Province.	Just PalmTree Power Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	7.2 MW	Approved
12/12/20/1807	Proposed establishment of the Kannikwa Vlakte wind farm.	Kannikwa Vlakte Wind Development Company Pty Ltd	Galago Environmental cc	Wind	120 MW	Approved

DEA REFERENCE NUMBER	PROJECT TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT	STATUS
12/12/20/1721 12/12/20/1721/AM1 12/12/20/1721/AM2 12/12/20/1721/AM3 12/12/20/1721/AM4 12/12/20/1721/AM5	The proposed Springbok Wind Energy facility near Springbok, Northern Cape Province.	Mulilo Springbok Wind Power (Pty) Ltd	Holland & Associates Environmental Consultants	Wind	55.5 MW	Approved
TBA	The proposed Gromis WEF and associated infrastructure near Kleinsee in the Northern Cape Province.	Genesis ENERTRAG Gromis Wind (Pty) Ltd	Council for Scientific and Industrial Research	Wind	200 MW	In process
14/12/16/3/3/1/416	Nigramoep Solar PV Solar Energy Facility on a site near Nababeep, Northern Cape.	South African Renewable Green Energy (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	20 MW	In process

8. LEGISLATIVE AND PERMIT REQUIREMENTS

This report will need to be approved by SAHRA. There are no further legislative requirements for the approval process but if archaeological mitigation is needed then the appointed archaeologist will need to apply for and be granted a permit from SAHRA to do the work. This work must be carried out well in advance of construction to ensure that there is enough time for SAHRA to approve this work before construction commences.

9. ENVIRONMENTAL MANAGEMENT PROGRAMME INPUTS

Impact	Mitigation / management objectives & outcomes	Mitigation / management actions	Monitoring		
			Methodology	Frequency	Responsibility
Impacts to fossils					
Damage or destruction of fossils.	Locate, protect, report and rescue fossils in excavations through implementation of a fossil finds procedure.	Ensure that project staff and Environmental Control Officer (ECO) are aware of the possibility of seeing fossil bones.	Inform staff and carry out inspections of excavations.	Whenever on site (at least weekly).	ECO
Impacts to archaeology and graves					
Damage or destruction of archaeological sites.	Locate and sample sites before disturbance.	Pre-construction survey.	Appoint archaeologist to conduct survey.	Once-off.	Project developer
Damage or destruction of graves.	Minimise damage to graves discovered accidentally.	Reporting chance finds.	Inform staff and carry out inspections of excavations.	Whenever on site (at least weekly).	ECO
Impacts to the cultural landscape					
Visible landscape scarring.	Minimise landscape scarring.	Ensure disturbance is kept to a minimum and does not exceed project requirements.	Monitoring of surface clearance.	As required.	ECO

10. EVALUATION OF IMPACTS RELATIVE TO SUSTAINABLE SOCIAL AND ECONOMIC BENEFITS

Section 38(3)(d) of the NHRA requires an evaluation of the impacts on heritage resources relative to the sustainable social and economic benefits to be derived from the development.

Impacts to heritage resources are not likely to be of high significance and many can be easily mitigated. The benefit of providing more electricity to help grow South Africa's economy is a considerable one and this is considered to outweigh the negative impacts to heritage that might occur.

11. CONCLUSIONS

The main identified issues are the potential impacts to fossils, archaeological sites and the cultural landscape. Mitigation of the first two impacts can be easily effected and, in any case, fossils are not very likely to be found. The landscape can only be mitigated at the site-specific level with the broader impacts deemed unmitigable. This impact is not of high significance, especially given the project location within a REDZ. Table 7 lists the heritage indicators proposed in Section 5 and shows how they have been or will be responded to. None of them remain problematic. There are no fatal flaws and the proposed Komas WEF development is acceptable from a heritage perspective, subject to the implementation of the recommended mitigation measures.

Table 7: *Heritage indicators and design responses.*

Indicator	Project Response
The intensity of impacts to palaeontological resources should be minimised.	Design response not possible, but monitoring of excavations will help reduce the intensity of impacts during construction.
Impacts to significant archaeological resources should be minimised.	Layout designed to avoid known sites and a pre-construction survey will identify any remaining impacts that might occur and make recommendations for their mitigation.
Landscape scarring should be minimised through disturbance of the minimum required footprint.	Design response not possible, but monitoring of site clearance will ensure that only the required areas are disturbed.

Figure 29 shows the distribution of archaeological sites with 50 m buffers around the waypoints (this accounts for the diameter of the site plus a buffer of at least 30 m). Buffers around known archaeological sites have been respected in all but two cases and no further buffers require implementation. The two cases are sites of very low significance and the sites themselves would still not be impacted. After the conclusion of this assessment some changes to the layout were made. Rather than updating the report at such a late stage, Figure 30 shows the final preferred layout and it is confirmed here that this layout is completely acceptable from a heritage point of view and that it would not alter the conclusions or recommendations of this report. Layout changes have no bearing on palaeontology and thus no changes are required to the palaeontological heritage specialist study.

12. RECOMMENDATIONS

It is recommended that the proposed Komas WEF should be authorised but subject to the following conditions which should be incorporated into the Environmental Authorisation:

- A chance fossil finds procedure needs to be incorporated into the EMPr;
- A pre-construction survey should be commissioned to check for any remaining archaeological sites that might have been missed during the original survey. Mitigation would then be suggested if required;
- Landscape scarring must be kept to an absolute minimum; and

- If any archaeological material or human burials are uncovered during the course of development, then work in the immediate area should be halted. The find would need to be reported to the heritage authorities and may require inspection by an archaeologist. Such heritage is the property of the state and may require excavation and curation in an approved institution.

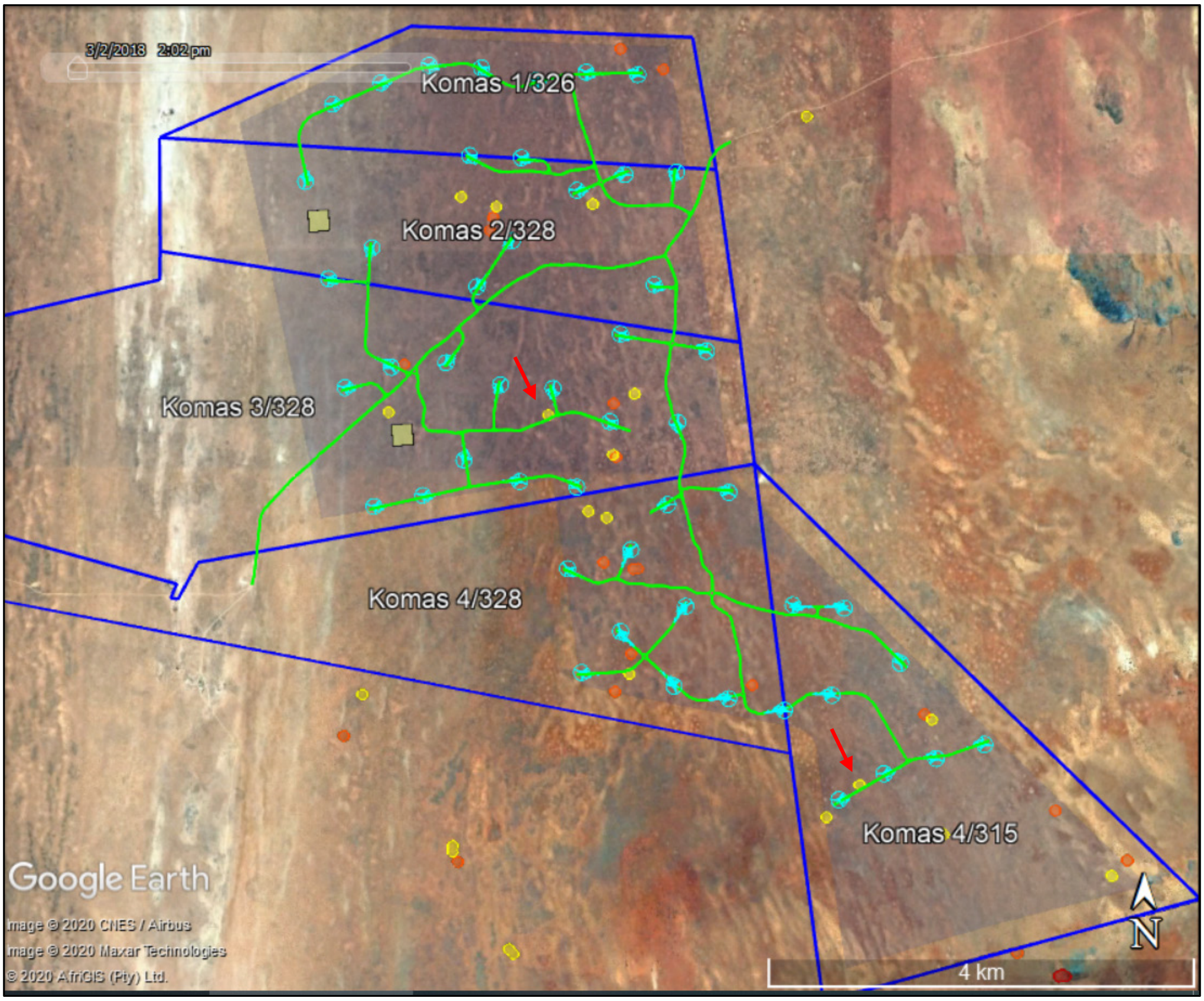

Figure 29: *Aerial view of the Komas study area showing the distribution of archaeological sites by grade and including their buffers. Orange = GPB, yellow = GPC. All waypoints are buffered by 50 m which allows for the size of the site plus at least a 30 m buffer. The WEF is shown by green lines (roads) and turquoise symbols (turbines). The two locations where buffers are intersected are highlighted by red arrows.*

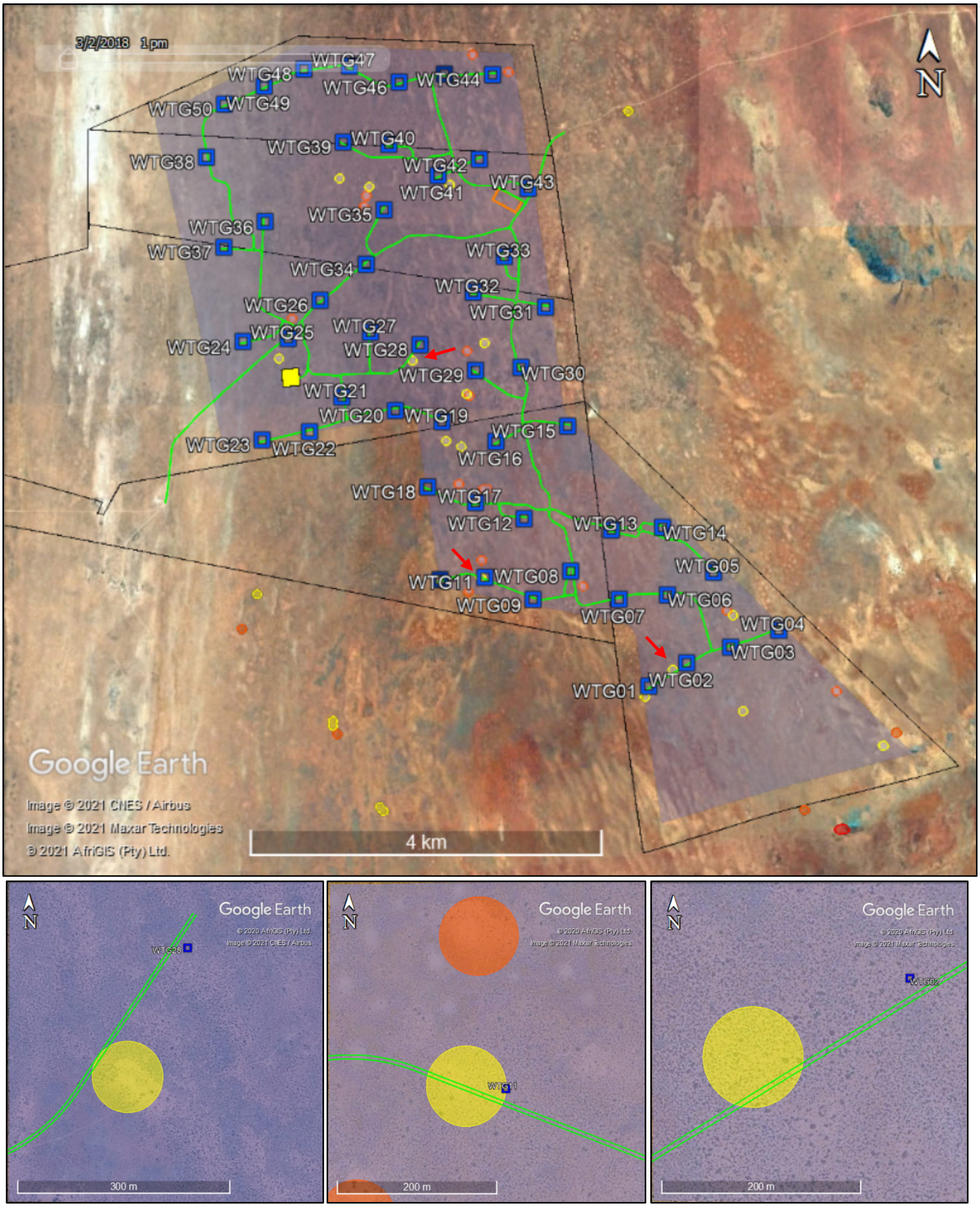

Figure 30: *Aerial view of the Komas study area showing the final layout relative to heritage resources (key as per Figure 29). Only the preferred BESS and SS complex site is shown (yellow square) and the expanded laydown area is shown by the orange rectangle near WTG43. The three smaller maps show the places where heritage buffers are intersected by the layout.*

12.1. Reasoned opinion of the specialist

Given that no significant impacts are expected and that mitigation of any potential impacts to archaeological and palaeontological resources can easily be effected before or during construction, it is the opinion of the heritage specialist that the project may be authorised in full. Both BESS and on-site SS complex site options (Option 1 and Option 2) are acceptable from a heritage perspective and either option may be developed.

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APPENDIX 1 – Curriculum Vitae

Curriculum Vitae

Jayson David John Orton

ARCHAEOLOGIST AND HERITAGE CONSULTANT

Contact Details and personal information:

Address: 40 Brassie Street, Lakeside, 7945
Telephone: (021) 789 0327
Cell Phone: 083 272 3225
Email: jayson@asha-consulting.co.za

Birth date and place: 22 June 1976, Cape Town, South Africa
Citizenship: South African
ID no: 760622 522 4085
Driver's License: Code 08
Marital Status: Married to Carol Orton
Languages spoken: English and Afrikaans

Education:

SA College High School	Matric	1994
University of Cape Town	B.A. (Archaeology, Environmental & Geographical Science) 1997	
University of Cape Town	B.A. (Honours) (Archaeology)*	1998
University of Cape Town	M.A. (Archaeology)	2004
University of Oxford	D.Phil. (Archaeology)	2013

*Frank Schweitzer memorial book prize for an outstanding student and the degree in the First Class.

Employment History:

Spatial Archaeology Research Unit, UCT	Research assistant	Jan 1996 – Dec 1998
Department of Archaeology, UCT	Field archaeologist	Jan 1998 – Dec 1998
UCT Archaeology Contracts Office	Field archaeologist	Jan 1999 – May 2004
UCT Archaeology Contracts Office	Heritage & archaeological consultant	Jun 2004 – May 2012
School of Archaeology, University of Oxford	Undergraduate Tutor	Oct 2008 – Dec 2008
ACO Associates cc	Associate, Heritage & archaeological consultant	Jan 2011 – Dec 2013
ASHA Consulting (Pty) Ltd	Director, Heritage & archaeological consultant	Jan 2014 –

Professional Accreditation:

Association of Southern African Professional Archaeologists (ASAPA) membership number: 233
CRM Section member with the following accreditation:

- Principal Investigator: Coastal shell middens (awarded 2007)
  Stone Age archaeology (awarded 2007)
  Grave relocation (awarded 2014)
- Field Director: Rock art (awarded 2007)
  Colonial period archaeology (awarded 2007)

Association of Professional Heritage Practitioners (APHP) membership number: 43

- Accredited Professional Heritage Practitioner

➢ *Memberships and affiliations:*

South African Archaeological Society Council member	2004 – 2016
Assoc. Southern African Professional Archaeologists (ASAPA) member	2006 –
UCT Department of Archaeology Research Associate	2013 –
Heritage Western Cape APM Committee member	2013 –
UNISA Department of Archaeology and Anthropology Research Fellow	2014 –
Fish Hoek Valley Historical Association	2014 –
Kalk Bay Historical Association	2016 –
Association of Professional Heritage Practitioners member	2016 –

Fieldwork and project experience:

Extensive fieldwork and experience as both Field Director and Principle Investigator throughout the Western and Northern Cape, and also in the western parts of the Free State and Eastern Cape as follows:

Feasibility studies:
- Heritage feasibility studies examining all aspects of heritage from the desktop

Phase 1 surveys and impact assessments:
- Project types
  - Notification of Intent to Develop applications (for Heritage Western Cape)
  - Desktop-based Letter of Exemption (for the South African Heritage Resources Agency)
  - Heritage Impact Assessments (largely in the Environmental Impact Assessment or Basic Assessment context under NEMA and Section 38(8) of the NHRA, but also self-standing assessments under Section 38(1) of the NHRA)
  - Archaeological specialist studies
  - Phase 1 archaeological test excavations in historical and prehistoric sites
  - Archaeological research projects
- Development types
  - Mining and borrow pits
  - Roads (new and upgrades)
  - Residential, commercial and industrial development
  - Dams and pipe lines
  - Power lines and substations
  - Renewable energy facilities (wind energy, solar energy and hydro-electric facilities)

Phase 2 mitigation and research excavations:
- ESA open sites
  - Duinefontein, Gouda, Namaqualand
- MSA rock shelters
  - Fish Hoek, Yzerfontein, Cederberg, Namaqualand
- MSA open sites
  - Swartland, Bushmanland, Namaqualand
- LSA rock shelters
  - Cederberg, Namaqualand, Bushmanland
- LSA open sites (inland)
  - Swartland, Franschhoek, Namaqualand, Bushmanland
- LSA coastal shell middens
  - Melkbosstrand, Yzerfontein, Saldanha Bay, Paternoster, Dwarskersbos, Infanta, Knysna, Namaqualand
- LSA burials
  - Melkbosstrand, Saldanha Bay, Namaqualand, Knysna
- Historical sites
  - Franschhoek (farmstead and well), Waterfront (fort, dump and well), Noordhoek (cottage), variety of small excavations in central Cape Town and surrounding suburbs
- Historic burial grounds
  - Green Point (Prestwich Street), V&A Waterfront (Marina Residential), Paarl

Awards:

Western Cape Government Cultural Affairs Awards 2015/2016: Best Heritage Project.

APPENDIX 2 – Specialist Declaration

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

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

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

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

PROJECT TITLE

Basic Assessment for the proposed Komas Wind Energy Facility and associated infrastructure near Kleinsee in the Northern Cape Province

Kindly note the following:

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

Departmental Details

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

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

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

1. SPECIALIST INFORMATION

Specialist Company Name:	ASHA Consulting (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	0
Specialist name:	Dr Jayson Orton			
Specialist Qualifications:	D.Phil (Archaeology, Oxford, UK) MA (Archaeology, UCT)			
Professional affiliation/registration:	ASAPA CRM member No. 233 APHP member No. 043			
Physical address:	40 Brassie Street, Lakeside, 7945			
Postal address:	40 Brassie Street, Lakeside			
Postal code:	7945	Cell:	083 272 3225	
Telephone:	021 788 1025	Fax:	n/a	
E-mail:	jayson@asha-consulting.co.za			

2. DECLARATION BY THE SPECIALIST

I, JAYSON ORTON, declare that –

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

Signature of the Specialist

ASHA CONSULTING (PTY) LTD

Name of Company:

02-10-2020

Date

Details of Specialist, Declaration and Undertaking Under Oath

Page 2 of 3

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, JAYSON ORTON, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

ASHA CONSULTING (PTY) LTD

Name of Company

06-10-2020

Date

Signature of the Commissioner of Oaths

2020/10/06

Date

SOUTH AFRICAN POLICE SERVICE
KIRSTENHOF SAPS
2020 -10- 06
CSC

Details of Specialist, Declaration and Undertaking Under Oath

Page 3 of 3

APPENDIX 3 – Site Sensitivity Verification

A site sensitivity verification was undertaken in order to confirm the current land use and environmental sensitivity of the proposed project area. The details of the site sensitivity verification are noted below:

Date of Site Visit	*6-7 & 10-11 January 2020*
Specialist Name	*Dr Jayson Orton & Anja Huisamen*
Professional Registration Number	*Association of Southern African Professional Archaeologists (ASAPA): 233* *Association of Professional Heritage Practitioners (APHP): 043*
Specialist Affiliation / Company	*ASHA Consulting (Pty) Ltd*

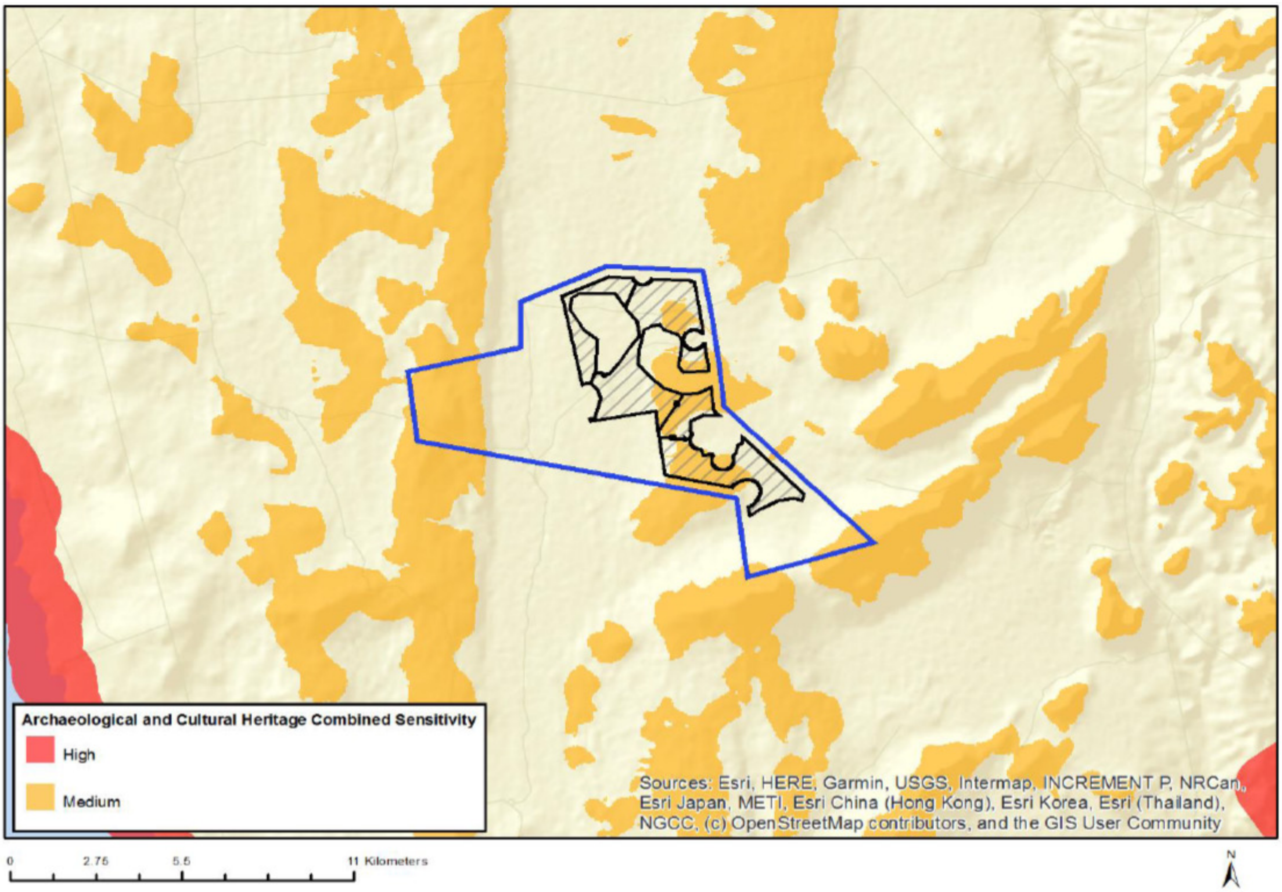

***Figure A2.1:** Screening Tool map showing the site to be of medium to low 'archaeological and cultural heritage' sensitivity.*

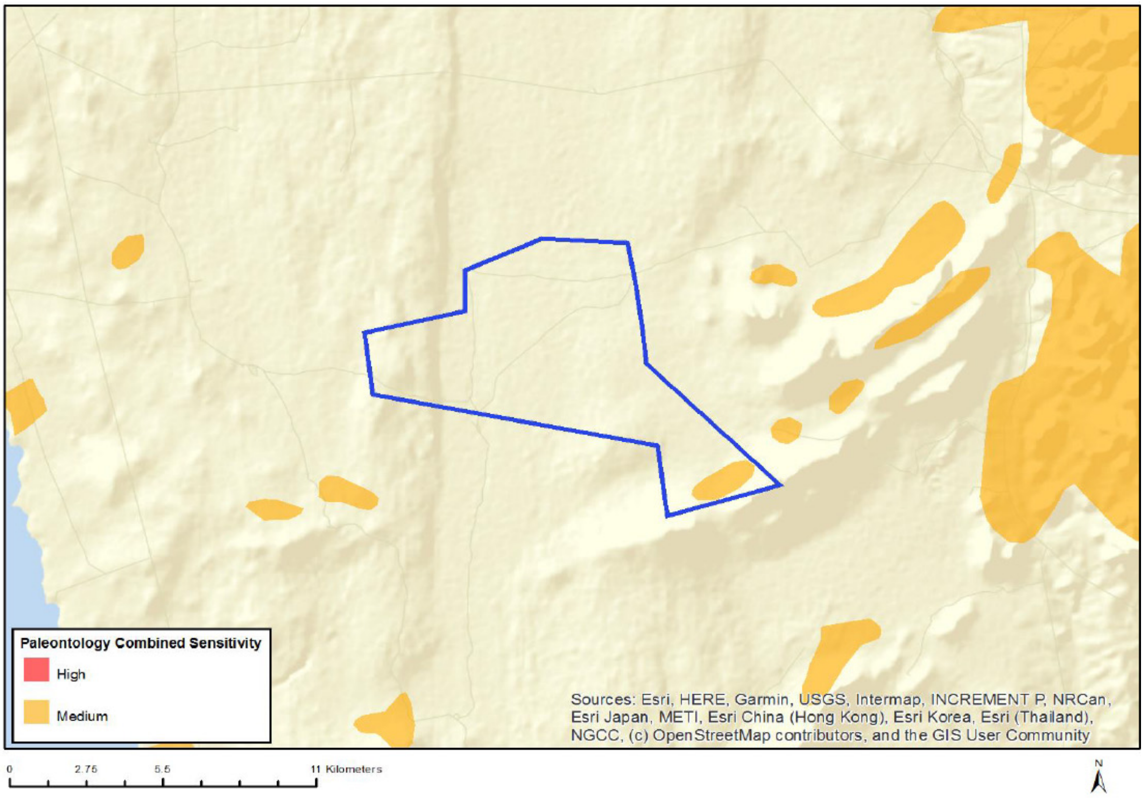

Figure A2.2: *Screening Tool map showing the site to be of medium to low 'palaeontological' sensitivity.*

Method of the Site Sensitivity Verification

Desktop research was conducted to determine the nature of heritage resources expected in the area. Satellite imagery was consulted to determine parts of the landscape most likely to house archaeological sites (e.g. deflation hollows).

A thorough site survey was done which attempted to cover as much land as possible and especially to target all areas noted as potentially sensitive.

A palaeontological specialist was subcontracted to provide a specialist palaeontological study which was included in the HIA report. There were no other relevant sources of information used for the site sensitivity verification.

Outcome

The archaeological survey and the site sensitivity verification showed that archaeological sites were located in very specific locations which meant that the site sensitivity is restricted to very small pockets (effectively the buffers around the culturally significant sites). While medium sensitivity is appropriate, this rating only applies to these small areas and they are spread more widely than the single patch of medium sensitivity than indicated by the Screening Tool. The Screening Tool sensitivity is thus largely correct (i.e. mostly low) but is inaccurate in the central part of the site where many small areas of sensitivity occur along a dune cordon (see Figure 28). The data supporting this conclusion are presented in Section 5 of the present report.

The palaeontological desktop study (see Appendix 4) found the study area to be of generally low sensitivity which largely confirms the screening tool map.

APPENDIX 4 – Palaeontological study

Attached as a separate document.

THE BASIC ASSESSMENT FOR THE PROPOSED KOMAS WIND ENERGY FACILITY AND ASSOCIATED INFRASTRUCTURE NEAR KLEINSEE IN THE NORTHERN CAPE PROVINCE.

Palaeontology Assessment

PALAEONTOLOGICAL IMPACT ASSESSMENT

PROPOSED GROMIS AND KOMAS WIND ENERGY FACILITIES AND ASSOCIATED POWER LINES AND ELECTRICAL INFRASTRUCTURE NEAR KLEINSEE IN THE NAMA KHOI LOCAL MUNICIPALITY, NAMAKWALAND MAGISTERIAL DISTRICT, NORTHERN CAPE PROVINCE

By

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For

Genesis ENERTRAG Gromis Wind (Pty) Ltd and Genesis ENERTRAG Komas (Pty) Ltd

September 2020

EXECUTIVE SUMMARY

1. Project Name

The proposed **Gromis and Komas** Wind Energy Facilities (WEFs) and associated power lines and electrical infrastructure near Kleinsee in the Northern Cape Province.

2. Location

The proposed Gromis and Komas WEFs and associated infrastructure are located approximately 25 to 40 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Namakwaland Magisterial District, Northern Cape Province (Figures 1 & 2). The affected properties are listed in Table 1.

3. Locality Plan

See Figures 1 and 2.

4. Proposed Development

It is proposed that the Gromis WEF development will consist of up to 33 wind turbines and associated infrastructure with a total generation capacity of up to 200 MW. The proposed Komas WEF will consist of up to 50 turbines and associated infrastructures with a total generation capacity of up to 300 MW. The dimensions of components for both WEFs and associated infrastructure are as follow:

- Turbines with a hub height of up to 200 m and a rotor diameter of up to 200 m.
- Hardstand areas of approximately 1 500 m^2 per turbine.
- Temporary construction laydown and storage area of approximately 4 500 m^2 per turbine.
- Medium voltage cabling connecting the turbines will be laid underground.
- Internal roads with a width of up to 10 m providing access to each turbine and accommodating cable trenches and stormwater channels, as required. Existing roads will be upgraded wherever possible, although new roads will be constructed where necessary.
- A temporary construction laydown/staging area of approximately 22 500 m^2 which will also accommodate the operation and maintenance (O&M) buildings.
- A 33/132 kV on-site Substation (SS) of approximately 1 hectare (ha) to feed electricity generated by each proposed WEF into the national grid at the Gromis Main Transmission Substation (MTS).

The proposed WEF development areas are indicated by red polygons and power line routes are indicated by yellow lines (Figures 1 and 2). Four separate Basic Assessments (BAs) will be undertaken: one for each WEF and one for each associated power line and electrical infrastructure. The Palaeontological Impact Assessment (PIA) includes the assessments of all four projects.

Please note that the figured maps herein show the interim layouts and not the subsequent adjustments. The adjustments to the layout of the turbines and infrastructure do not affect this assessment as the recommended mitigation measures are applicable in the Project Area regardless of the exact layout. The palaeontological impact relates to the sensitivity of the geological formations and scale of excavations and not the exact positions of project components.

5. Affected Formations

The affected surficial formations include Holocene dunes of the **Hardevlei Formation** and earlier late Quaternary coversands of the **Koekenaap Formation**. Beneath these unconsolidated sands are compact, pedogenically-altered aeolianites termed the **Dorbank Formation** which are fossil dune plumes of later mid-Quaternary age (Figures 2, 5, 8). Between the fossil dune plume ridges is a non-depositional area (Zonnekwa Valley, Figure 8) which is closely underlain by pale calcrete pedocrete which is likely to have formed within the upper part of an older aeolianite formation such as correlates of the Olifantsrivier or Graauw Duinen formations.

6. Palaeontological Resources

The fossil content of the aeolian formations is presumed to be typical of that observed in correlative formations in the wider area. Fossil material most commonly seen is the ambient fossil content of dune sands: land snails, tortoise shells and mole bones. The bones of larger animals (*e.g.* antelopes, zebra, rhinos) are sparse, but are more persistently present along palaeosurfaces which separate the major aeolianite formations where they are enclosed in palaeosols and pedocretes, and also occur on cryptic palaeosurfaces within formations. Rare large caches of bones in large burrows are due to the bone-collecting behaviour of hyaenas.

7. Anticipated Impact

The primary palaeontological concern is the fossil bones that are sparsely distributed in these aeolian deposits. In the Hardevlei and Koekenaap formations the fossil bone and marine shell material that may occur is likely to be in an archaeological context. Both artefacts and fossil bones are most often found on the compact palaeosurface of the Dorbank Formation. beneath the surficial sands. The fossil bone material would be of late Quaternary age and comprised mainly of extant species (modern fauna), but could include species that did not historically occur in the region.

The fossil bone finds in the Dorbank Formation are generally the scattered, disarticulated and sometimes fragmented larger limb bones of antelopes and zebra. Pans and vleis/seep deposits, with greater fossil potential, may occur along buried drainage lines within the Dorbank Formation. Most finds have been at lower elevations in diamond-mine pits and little is known of this formation and its fossils at higher elevations and in this region of the coastal plain. Fossil finds could prove to be a scientifically significant addition to the poorly-known later mid-Quaternary fossil fauna of Namaqualand.

The calcrete-floored Zonnekwa Valley has very likely hosted pans during wetter climate spells in the past. It is possible that some pan deposits may remain, or fossils that have been eroded from them by wind deflation. The calcrete is assumed to have formed within the upper part of an older aeolianite formation. As the capping calcrete has formed along a persistent palaeosurface, fossil bones are more prevalent within it and are expected to be of earlier Quaternary age.

Due to the overall sparse distribution of fossil bones in the affected formations the palaeontological sensitivity and intensity of **impact is considered to be LOW before and after mitigation for all excavations involved in the construction of the proposed Gromis and Komas WEFs and associated infrastructure**. However, when fossils are found in such poorly fossiliferous formations, they provide very significant advances in the geological understanding of the stratigraphy of a region.

There will be a considerable number of excavations for turbine foundations (*e.g*. ~33 for Gromis and 50 for Komas WEFs) distributed over and “sampling” a wide area during the construction phase. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that buried palaeosurfaces bearing fossil bones and archaeological material may be exposed in some of the excavations. The excavations for cabling and other infrastructure such as the substations are relatively shallow and mainly affect the coversands, but the cabling trenches will traverse considerable lengths across the proposed WEFs development areas and intersect the locally-fossiliferous top of the Dorbank Unit in places. **The foundations of the power line pylons that connect to the national grid at the Gromis MTS are more minor in scale and have a lower likelihood of impact, although not altogether absent.**

SUMMARY OF ASSESSMENTS OF IMPACTS TO PALAEONTOLOGICAL RESOURCES DURING THE CONSTRUCTION PHASE– GROMIS AND KOMAS WEFs AND ASSOCIATED INFRASTRUCTURE AS WELL AS POWER LINES AND ASSOCIATED ELECTRICAL INFRASTRUCTURE– ALL AEOLIAN FORMATIONS.		
	Without mitigation	**With mitigation**
Significance	Low	Low
Status	Negative	Positive
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	Partly
Can impacts be mitigated?	Yes, but only partial mitigation is possible. Scientifically significant fossils may be lost in spite of management actions to mitigate such loss.	
Mitigation:	• Monitoring of all construction-phase excavations. • Inspection, sampling and recording of selected exposures in the event of fossil finds. • Fossil finds and contextual reports deposited in a curatorial scientific institution.	
Cumulative impact	• The inevitable and permanent loss of fossils.	

8. Recommendations

For all excavations during the construction phase of the proposed Gromis and Komas WEFs and associated infrastructure as well as the power lines and associated electrical infrastructure the **LOW palaeontological sensitivity and the LOW level of significance indicates that the potential palaeontological impact does not significantly influence the decision to construct the WEFs or the associated power lines and electrical infrastructure,** however appropriate mitigation measures are required. **Therefore, the proposed development of the WEFs and associated infrastructure as well as the power lines and associated electrical infrastructure is considered to be acceptable from a palaeontological perspective and can be authorised, subject to the implementation of the recommended mitigation measures.**

Potential adjustments to the layout of the turbines and infrastructure do not affect this assessment.

A recommendation to be included in the Environmental Management Programme (EMPr) is to be alert for possible fossils and buried archaeological material during the Construction Phase of the proposed Gromis and Komas WEFs and associated infrastructure as well as the power lines and associated electrical infrastructure. A Fossil Finds Procedure (Appendix 4) should also be in place.

The field supervisor/foreman and staff involved in excavations during the construction phase of both WEF and associated power lines and electrical infrastructure projects, must be informed of the need to look out for fossils and buried potential archaeological material. In the event of staff sighting potential fossils or buried archaeological material during construction; staff are to cease work at the location of the sighting and report the potential find to the field supervisor who, in turn, must report to the Environmental Control Officer (ECO). The ECO must inform the developer and contact the palaeontologist contracted to be on standby in the case of fossil finds. The latter must liaise with the South African Heritage Resource Agency (SAHRA) on the nature of the find and consequent actions (permitting and collection of find).

If palaeontological mitigation is applied during the construction phases of the proposed Gromis and Komas WEFs and associated power lines and electrical infrastructure as recommended, it is possible that these WEFs will to some extent alleviate the negative cumulative impact on paleontological resources in the region. The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape Province is very poorly known, with very few fossils to rely on.

Therefore, any fossil bone find will be of considerable importance and could add to the scientific knowledge of the area in a positive manner. The fossil bones that have been found hitherto in the aeolianites of Namaqualand attest to the fossil potential that will be delivered by the continuation of systematic searches for these sparse remains.

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ABBREVIATIONS

asl.:	above (mean) sea level
EPWP:	Early Pliocene Warm Period
ESA:	Early Stone Age
Fm.:	Formation
LIG:	Last Interglacial
LPWP:	Late Pliocene Warm Period
MIS:	Marine Isotope Stage
MMCO:	Mid Miocene Climatic Optimum
MSA:	Middle Stone Age
MTS:	Main Transmission Substation
OSL:	Optically stimulated luminescence
PIA:	Palaeontological Impact Assessment
SAHRA:	South African Heritage Resources Agency
SS:	Substation

GLOSSARY

~ (tilde): Used herein as “approximately” or “about”.

Aeolian: Pertaining to the wind. Refers to erosion, transport and deposition of sedimentary particles by wind. A rock formed by the solidification of aeolian sediments is an aeolianite.

Alluvium: Sediments deposited by a river or other running water (alluvial).

Archaeology: Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Bedrock: Hard rock formations underlying much younger sedimentary deposits.

Calcareous: Sediment, sedimentary rock, or soil type which is formed from or contains a high proportion of calcium carbonate in the form of calcite or aragonite.

Calcrete: An indurated deposit (duricrust) mainly consisting of Ca and Mg carbonates. The term includes both pedogenic types formed in the near-surface soil context and non-pedogenic or groundwater calcretes related to water tables at depth.

Clast: Fragments of pre-existing rocks, *e.g*. sand grains, pebbles, boulders, produced by weathering and erosion. Clastic – composed of clasts.

Colluvium: Hillwash deposits formed by gravity transport downhill. Includes soil creep, sheetwash, small-scale rainfall rivulets and gullying, slumping and sliding processes that move and deposit material towards the foot of the slopes.

Conglomerate: A cemented gravel deposit.

Coversands: Aeolian blanket deposits of sandsheets and smaller dunes.

Duricrust: A general term for a zone of chemical precipitation and hardening formed at or near the surface of sedimentary bodies through pedogenic and (or) non-pedogenic processes. It is formed by the accumulation of soluble minerals deposited by mineral-bearing waters that move upward, downward, or laterally by capillary action, commonly assisted in arid settings by evaporation. Classified into calcrete, ferricrete, silcrete, gypcrete, sepiocrete etc.

Fluvial deposits: Sedimentary deposits consisting of material transported by, suspended in and laid down by a river or stream.

Fossil: The remains of parts of animals and plants found in sedimentary deposits. Most commonly hard parts such as bones, teeth and shells which in lithified sedimentary rocks are usually altered by petrification (mineralization). Also impressions and mineral films in fine-grained sediments that preserve indications of soft parts. Fossils plants include coals, petrified wood and leaf impressions, as well as microscopic pollen and spores. Marine sediments contain a host of microfossils that reflect the plankton of the past and provide records of ocean changes. Nowadays also includes molecular fossils such as DNA and biogeochemicals such as oils and waxes.

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

OSL: Optically stimulated luminescence. One of the radiation exposure dating methods based on the measurement of trapped electronic charges that accumulate in crystalline materials as a result of low-level natural radioactivity from U, Th and K. In OSL dating of aeolian quartz and feldspar sand grains, the trapped charges are zeroed by exposure to daylight at the time of deposition. Once buried, the charges accumulate and the total radiation exposure (total dose) received by the sample is estimated by laboratory measurements. The level of radioactivity (annual doses) to which the sample grains have been exposed is measured in the field or from the separated minerals containing radioactive elements in the sample. Ages are obtained as the ratio of total dose to annual dose, where the annual dose is assumed to have been similar in the past.

Palaeontology: The study of any fossilised remains or fossil traces of animals or plants which lived in the geological past and any site which contains such fossilised remains or traces.

Palaeosol: An ancient, buried soil formed on a palaeosurface. The soil composition may reflect a climate significantly different from the climate now prevalent in the area where the soil is found. Burial reflects the subsequent environmental change.

Palaeosurface: An ancient land surface, usually buried and marked by a palaeosol or pedocrete, but may be exhumed by erosion (*e.g.* wind erosion/deflation) or by bulk earth works.

Pedogenesis/pedogenic: The process of turning sediment into soil by chemical weathering and the activity of organisms (plants growing in it, burrowing animals such as worms, the addition of humus *etc.*).

Pedocrete: A duricrust formed by pedogenic processes.

Rhizolith: Fossil root. Most commonly formed by pedogenic carbonate deposition around the root and developed in palaeosols.

Sepiocrete: A duricrust with a high content of the magnesian clay mineral sepiolite.

Stone Age: The earliest technological period in human culture when tools were made of stone, wood, bone or horn.

Stratotype locality: The place where deposits regarded as defining the characteristics of a particular geological formation occur.

Tectonic: Relating to the structure of the earth's crust and the large-scale processes which take place within it (faulting and earthquakes, crustal uplift or subsidence.

Trace fossil: A structure or impression in sediments that preserves the behaviour of an organism, such as burrows, borings and nests, feeding traces (sediment processing), farming structures for bacteria and fungi, locomotion burrows and trackways and traces of predation on hard parts (tooth marks on bones, borings into shells by predatory gastropods and octopuses).

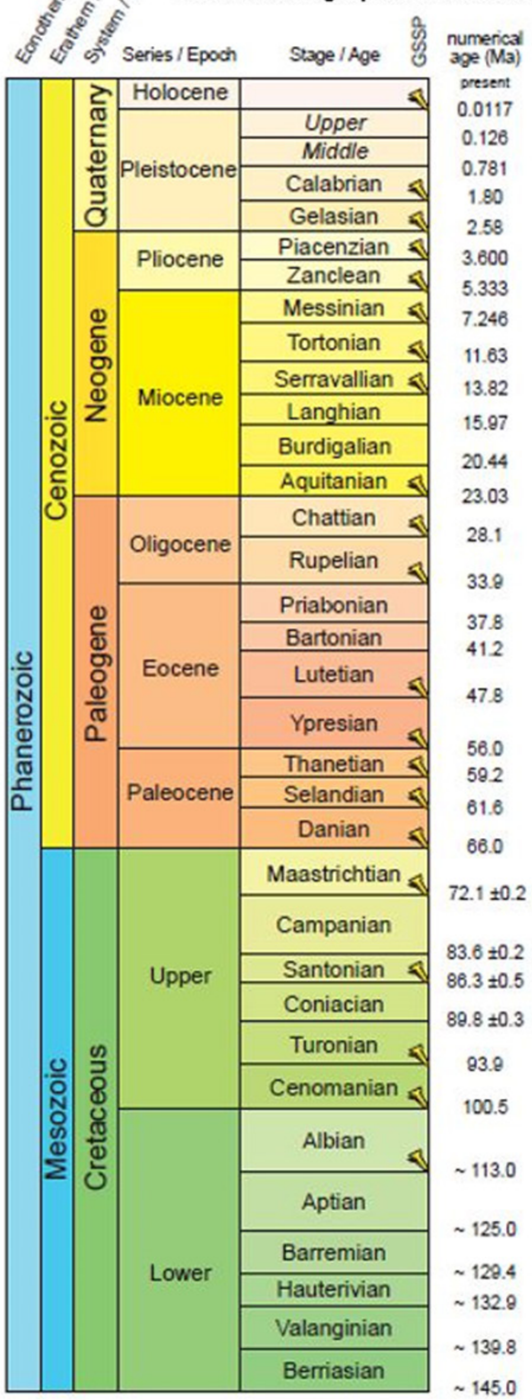
GEOLOGICAL TIME SCALE TERMS

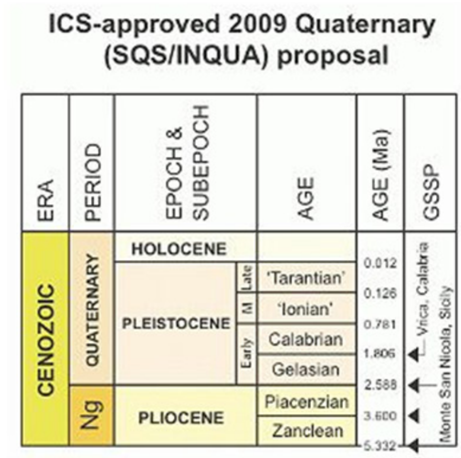
ka: Thousand years or kilo-annum (10^3 years). Implicitly means “ka ago” *i.e*. duration from the present, but “ago” is omitted. The “Present” refers to 1950 AD. Not used for durations not extending from the Present. For a duration only “kyr” is used.

Ma: Millions years, mega-annum (10^6 years). Implicitly means “Ma ago” *i.e.* duration from the present, but “ago” is omitted. The “Present” refers to 1950 AD. Not used for durations not extending from the Present. For a duration only “Myr” is used.

For more detail see www.stratigraphy.org.

Mesozoic and Cenozoic Chronostratigraphy
From: International Commission on Stratigraphy.
Chronostratigraphic Chart 2016-12.pdf





Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka.
Late Pleistocene 11.7–126 ka.
Middle Pleistocene 135–781 ka.
Early Pleistocene 781–2588 ka.

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era.
The Quaternary includes both the Pleistocene and Holocene epochs. As used herein, early and middle Quaternary correspond with the Pleistocene divisions, but late Quaternary includes the Late Pleistocene and the Holocene.

COMPLIANCE WITH APPENDIX 6 OF THE 2014 EIA REGULATIONS

Requirements of Appendix 6 – GN R326 (7 April 2017)	Addressed in the Specialist 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;	Appendix 1
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix 2
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 1
(cA) an indication of the quality and age of base data used for the specialist report;	Section 5
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Sections 9-11
d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 4
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 alternatives;	Section 9
g) an identification of any areas to be avoided, including buffers;	N/A
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;	Section 6
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 4
j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 11
k) any mitigation measures for inclusion in the EMPr;	Section 11
l) any conditions for inclusion in the environmental authorisation;	Section 11
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
n) a reasoned opinion- i. whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity and 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;	Section 11
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not Applicable
q) any other information requested by the competent authority.	Not Applicable
2. Where a government notice gazetted by the Minister provides for any protocol of minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply	Part A of the Assessment Protocols published in Government Notice No. 320 on 20 March 2020 is applicable (i.e. Site sensitivity verification

	requirements where a specialist assessment is required but no specific assessment protocol has been prescribed). See Appendix 3 in the Heritage Impact Assessment.

1 INTRODUCTION

Genesis ENERTRAG Gromis Wind (Pty) Ltd and Genesis ENERTRAG Komas (Pty) Ltd ("the applicants") are proposing to develop the Gromis and Komas Wind Energy Facilities (WEFs) respectively and associated infrastructure near the coastal town of Kleinsee within the Nama Khoi Local Municipality, in the far western parts of the Northern Cape Province (Figure 1). The applicants are also proposing to develop the associated power lines and electrical infrastructure to supports these WEFs. The proposed WEFs are located within the Springbok Renewable Energy Development Zone (REDZ 8) and is therefore subject to a Basic Assessment (BA) instead of a full Environmental Impact Assessment (EIA).

The applicants have appointed the Council of Scientific and Industrial Research (CSIR) as the Environmental Assessment Practitioner to undertake the required BA processes to apply for Environmental Authorisation (EA) for the proposed projects. The CSIR in turn has appointed ASHA Consulting (Pty) Ltd to undertake a Heritage Impact Assessment (HIA) to assess the potential impacts of the proposed projects on the heritage resources.

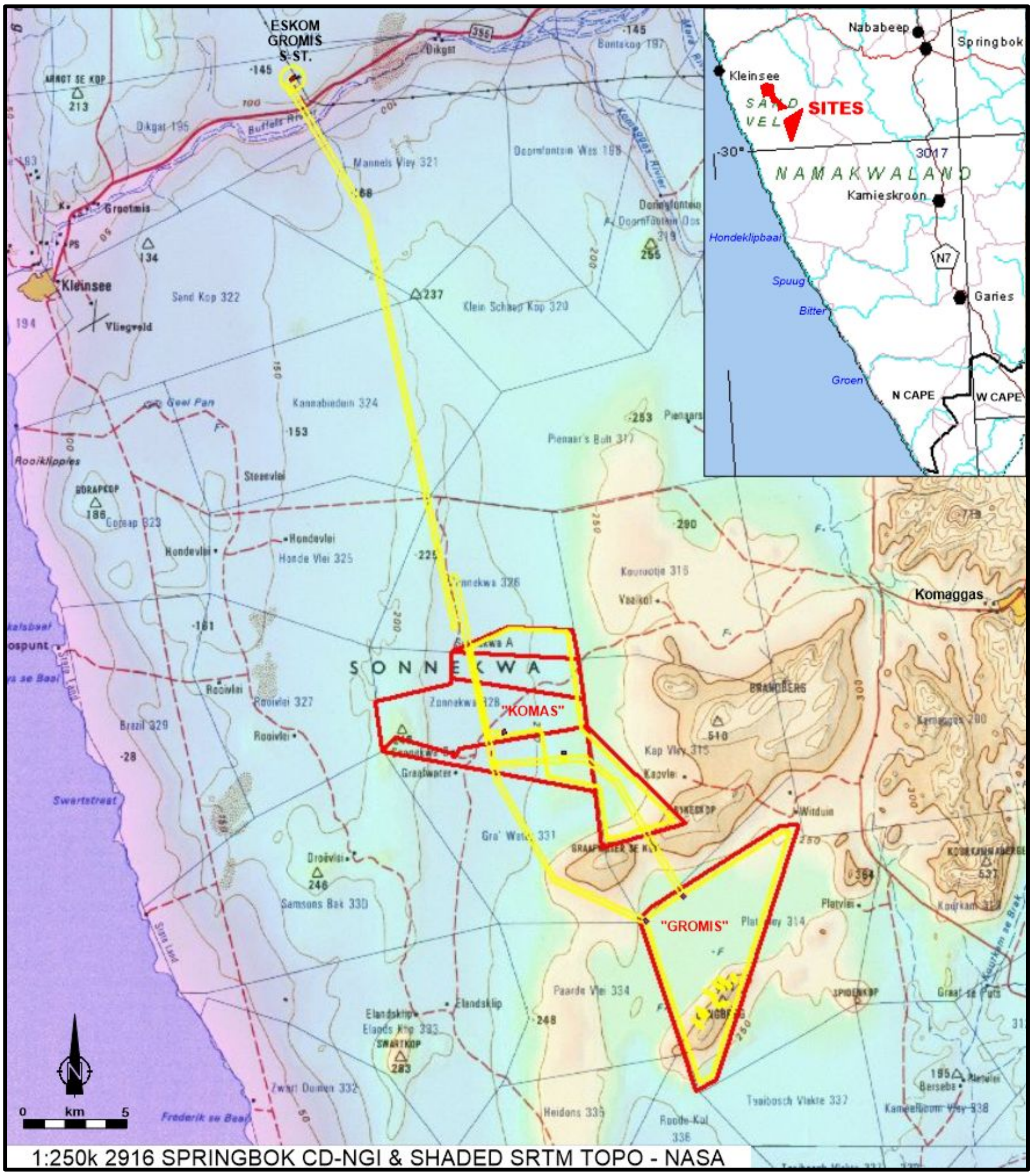


Figure 1. The proposed Gromis and Komas WEF Project Areas. Property boundaries in red and proposed development areas and proposed power line routes shown in yellow.

The Paleontological Impact assessment (PIA) forms part of the HIA and informs on; the palaeontological sensitivity of the proposed Gromis and Komas WEF development area, the probability of palaeontological materials (fossils) being uncovered in the sub-surface and being disturbed or destroyed in the constrution phase. The PIA also provides recommendations for palaeontological mitigation to be included in the Environmental Management Programme (EMPr) for the Construction Phase of the proposed Gromis and Komas WEFs and associated power lines and electrical infrastructrure. Four separate BAs will be undertaken: one for each WEF and one for the associated power line and electrical infrastructure for both the Gromis and Komas WEFs.

2 LOCATION

The proposed Gromis and Komas WEFs are located approximately 25 to 40 km southeast of Kleinsee in the Nama Khoi Local Municipality, Namakwa District Municipality, Namakwaland Magisterial District, Northern Cape Province (Figure 1).

For the proposed WEFs and powerline routes the relevant 1:250 000 map is Sheet 2916 SPRINGBOK and the 1:50 000 topo-cadastral maps are 2917CC BRAZIL, 2917CD KOMAGGAS and 2916DB & 2917CA KLEINSEE.

The properties involved are listed below:

TABLE 1. GROMIS AND KOMAS WEFS - AFFECTED FARM PORTIONS.	
Wind Energy Facility	**Farm portions**
Gromis	Plat Vley 1/314
Komas	Zonnekwa 1/326
Komas	Zonnekwa 2/328
Komas	Zonnekwa 3/328
Komas	Zonnekwa 4/328
Komas	Kap Vley 4/315

The following additional properties are traversed by the proposed power line routes:

Gromis Power line:

- Portion 2 of the Farm Pienaars Bult No. 317
- Portion 4 of the Farm Dikgat No. 195
- Remainder of the Farm Dikgat No. 195
- Remainder of the Farm Mannels Vley No. 321
- Remainder of the Farm Leliefontein No. 322
- Remainder of the Farm Kannabieduin No. 324
- Remainder of the Farm Honde Vlei No. 325
- Remainder of the Farm Zonnekwa No. 326
- Portion 1 of the Farm Zonnekwa No. 326
- Portion 2 of the Farm Zonnekwa No. 328
- Portion 3 of the Farm Zonnekwa No. 328
- Portion 4 of the Farm Zonnekwa No. 328
- Remainder of the Farm Gra Water No. 331
- Remainder of the Farm Platvley No. 334
- Remainder of the Farm Paarde Vlei No. 315
- Portion 1 of the Farm Platvley No. 314

Komas Power line:

- Portion 2 of the Farm Pienaars Bult No. 317
- Portion 4 of the Farm Dikgat No. 195

- Remainder of the Farm Dikgat No. 195
- Remainder of the Farm Mannels Vley No. 321
- Remainder of the Farm Leliefontein No. 322
- Remainder of the Farm Kannabieduin No. 324
- Remainder of the Farm Honde Vlei No. 325
- Remainder of the Farm Zonnekwa No. 326
- Portion 1 of the Farm Zonnekwa No. 326
- Portion 2 of the Farm Zonnekwa No. 328
- Portion 3 of the Farm Zonnekwa No. 328

3 PROPOSED ACTIVITIES

It is proposed that the Gromis WEF will consist of up to 33 wind turbines and associated infrastructure with a total generation capacity of up to 200 MW. The proposed Komas WEF will consist of up to 50 wind turbines and associated infrastructure with a total generation capacity of up to 300 MW. The proposed WEF development areas are indicated by red polygons and proposed power line routes are indicated in yellow (Figures 1, 2, 5 and 8). The main earthworks involved are the excavations for the turbine foundations which have an approximate diameter of up to 25 m and will typically be approximately 3 m deep, however the majority of the site is expected to have hard excavation difficulties and therefore shallow foundation solutions with an anchoring system will likely be required.

The associated infrastructure consists of:

- internal access roads with a width of up to 10 m, including turning circle/bypass areas of up to 15 m providing access to each turbine and accommodating cable trenches and stormwater channels;
- temporary construction laydown and storage areas of approximately 4 500 m^2 per turbine;
- a temporary construction laydown/staging area of approximately 22 500m^2 which will also accommodate the operation and maintenance (O&M) buildings; and
- each WEF will have a 33/132 kV on-site Substation (SS) of approximately 1 hectare (ha) to feed electricity generated by the proposed WEF into the national grid at the Gromis MTS. Two on-site SS location alternatives are proposed for each WEF (i.e. Option 1 and Option 2) (Figures 2 & 8).
- Two power line route alternatives and two Eskom Switching SS assessment site alternatives (Option 1 and Option 2 for both alternatives) have been identified for assessment during the BA processes. The proposed power lines to the national grid at the Gromis MTS are intended to proceed along the planned Eskom Gromis-Juno 400 kV power line (Figure 1). Both power line routing alternatives include a connection into the already authorised Zonnequa Collector SS on the Remainder of the Farm Zonnekwa 326 and a proposed Collector SS on Portion 2 of the Farm Zonnekwa 328 as the location of the Collector SS is still unknown. An access road with a width of up to 8 m will be required to provide access to the substations and power line servitude.

4 APPROACH AND METHODOLOGY

The relatively few fossils from the Namaqualand coastal plain have been vital to our current understanding of the coastal-plain geological history, not only of Namaqualand, but the fossil findings are also relevant to the coastal plains of the wider southern Africa.

Deposits or formations are rated in terms of their potential to include fossils of scientific importance, *viz*. their palaeontological sensitivity. Palaeontological sensitivity refers to the likelihood of finding significant fossils within a geologic unit, which informs the Intensity/Magnitude/Severity rating in an impact assessment. The rating criteria are included in Appendix 3.

4.1 TERMS OF REFERENCE

- Comply with the Assessment Protocols that were published on 20 March 2020, in Government Gazette 43110, GN 320. This specifically includes Part A, which provides the Site Sensitivity Verification Requirements where a Specialist Assessment is required but no Specific Assessment Protocol has been prescribed.
- Provide a Site Sensitivity Verification Report based on the requirements documented in the Assessment Protocols published on 20 March 2020, in Government Gazette 43110, GN 320.
- Compile a Palaeontological Impact Assessment in compliance with the National Environmental Management Act, 1998 (Act 107 of 1998), as amended (NEMA) and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended. The Specialist Assessment must also be in adherence to any additional relevant legislation and guidelines that may be deemed necessary.
- The specialist must identify the sensitivity and land-use of the project area, and verify and confirm this against the findings of the National Screening Tool.
- Determination, description and mapping of the baseline environmental condition and sensitivity of the study area. Specify set-backs or buffers, and provide clear reasons for these recommendations, if relevant.
- Prepare and undertake a study on the palaeontology and fossil heritage within the proposed project area, based on:
  - a review of all relevant palaeontological and geological literature, including geological maps and previous reports;
  - location and examination of fossil collections from the study area (e.g. museums); and
  - data on the proposed development (e.g. location of footprint, depth and volume of bedrock excavation envisaged).
- Describe the type and location of known palaeontology and fossil heritage sites in the study area, and characterize all items that may be affected by the proposed project.
- Note fossils and associated sedimentological features of palaeontological relevance (photos, maps, aerial or satellite images, and stratigraphic columns).
- Evaluate the potential for occurrence of palaeontology and fossil heritage features within the study area.
- Identify and rate potential direct, indirect and cumulative impacts of the proposed project on the palaeontology and fossil heritage during the construction, operational and decommissioning phases of the project. Study the cumulative impacts of the project by considering the impacts of existing renewable energy plants within the area (as well as those proposed), together with the impact of the proposed project. Impact significance must be rated both without and with mitigation. The Impact Assessment Methodology must follow that as provided by the CSIR.
- Identify any protocols, legal and permit requirements that relevant to this project and the implications thereof.
- Provide recommendations and suggestions regarding fossil heritage management on site, including conservation measures, as well as promotion of local fossil heritage (e.g. for public education, schools) to ensure that the impacts are limited.
- Provide recommendations with regards to potential monitoring programmes.
- Determine mitigation and/or management measures which could be implemented to as far as possible reduce the effect of negative impacts and enhance the effect of positive impacts. Also identify best practice management actions, monitoring requirements, and rehabilitation guidelines for all identified impacts. This must be included in the EMPr.
- Incorporate and address all review comments made by the Project Team (CSIR and Project Applicant) during the various revisions of the specialist report.
- Incorporate and address all issues and concerns raised by Stakeholders (i.e. SAHRA, I&APs, Competent Authority and the public during the Public Participation Process (e.g. following the review of the Draft BA Report or where relevant and applicable).
- Review the Generic EMPr for Substations (GN 435) and confirm if there are any specific environmental sensitivities or attributes present on the site and any resultant site specific impact management outcomes and actions that are not included in the pre-approved generic EMPr (Part B – Section 1). If so, provide a list of these specific impact management outcomes and actions.

4.2 AVAILABLE INFORMATION

This assessment is based on the published scientific literature on the origin and palaeontology of the Namaqualand coastal-plain deposits and the author's comprehensive field experience of the formations involved and their fossil content.

The relevant 1:250 000 Council for Geoscience geological maps and their explanations are Sheet 2916 SPRINGBOK (Marais *et al*., 2001) and Sheet 3017 GARIES (De Beer, 2010). The new stratigraphic terminology proposed by De Beer (2010) is mainly used, but is elaborated and modified according to the author's own observations. The annotated pertinent part of Sheet 2916 is presented in Figure 2. Relevant aspects of the regional geology are described below. References are cited in the normal manner and are included in the References section.

4.3 ASSUMPTIONS AND LIMITATIONS

The assumption is that the fossil potential of a formation will be typical of its genesis/depositional environment and more specifically, similar to that observed in equivalent deposits near the project areas. Scientifically important fossil material is expected to be very sparsely scattered in these deposits and much depends on spotting this material as it is uncovered during digging *i.e.* by monitoring excavations.

A limitation on predictive capacity exists in that it is not possible to predict the buried fossil content of an area or formation other than in such general terms.

5 ASPECTS OF THE REGIONAL GEOLOGY

5.1 THE BEDROCK

A sense of the underlying bedrock topography in the wider area is imparted by bedrock outcrops on the flanks and summits of hills and ridges (Figure 2). A prominent ridge with summits named Brandberg, Byneskop and Graafwater se Kop trends southwest between the proposed Gromis and Komas WEF development areas (Figures 1 & 2). The Komas WEF development area extends from ~175 m asl. in the northwest, rising towards the southeast where the southern area of Kap Vley 4/314 laps onto the northern slopes of the ridge at ~270 to 350 m asl. Another bedrock ridge named Langberg occupies the southern corner of the proposed Gromis WEF development area, with the intervening broad valley occupying most of Plat Vley Farm 1/314 and rising from ~220m asl. in the southwest to ~250 m asl. in the northeast.

The bedrock outcrops are quartzites and schists of the **Springbok Formation** (Bushmanland Group, Khurisberg Subgroup) (Ꝁsg) (Figure 2). These strata are very altered, ancient sediments ~1600 Ma (Ma = million years old) which were deeply buried and metamorphosed and now occur as remnant rafts of meta-sediments in the surrounding sea of molten-rock gneisses (locally the **Mesklip Gneiss**, ~1200 Ma) (Marais *et al*., 2001; De Beer, 2010). There are no fossils in these rocks.

5.2 THE WEST COAST GROUP

The bedrock meta-sediments and gneisses are overlain by much younger formations deposited during the last 66 million years of the **Cenozoic Era**. The **West Coast Group** is the name proposed to encompass the various named formations comprising the Cenozoic coastal deposits between the Orange River and Elandsbaai (Roberts *et al*., 2006), of both marine and terrestrial origin (Table 2).

5.2.1 The Early Coastal Plain

The formation of the coastal plain begins with the rifting of the Gondwana supercontinent and the opening of the Atlantic Ocean in the early Cretaceous, 130-120 Ma, which was accompanied by the inception of numerous rivers draining to the new coastline. The rifted landscape was covered by wide coastal plains and deltas formed as many large rivers deposited enormous volumes of sediments eroded from the well-watered hinterland. Marine processes spread the finer sands and muds further to form the continental shelf extending seawards. Slumping at the shelf edge carried sediments downslope into deep water. Successive continental shelves built out and upwards as the underlying crust subsided. These now fill what is called the Orange Basin offshore, which includes an accumulation of Cretaceous sediments exceeding 6 km thickness off the Namaqualand coast.

The ongoing erosion by rivers bevelled the new continental edge, abetted by its uplift in response to the subsiding crust bending beneath the sediment load offshore, and the developing coastal plain, backed by a "Great Escarpment", approached its present configuration. A few kilometres thickness of Nama and Karoo formations had been stripped off, exposing the coastal bedrock of metasediments and gneisses.

TABLE 2. NAMAQUALAND COASTAL STRATIGRAPHY – THE WEST COAST GROUP.

Formation Name	**Deposit type**	**Age**
Witzand	Aeolian pale dunes & sandsheets.	Holocene, <~12 ka.
Curlew Strand, Holocene High	**Marine, 2-3 m Package.**	**Holocene, 7-4 ka.**
Swartlintjies & Swartduine	Aeolian dune plumes.	Latest Quat., <20 ka.
Hardevlei	Aeolian, semi-active surficial dunes, >100 m asl.	Latest Quat., <25 ka.
Koekenaap	Aeolian, surficial red aeolian sands.	later late Quat., 80-30 ka.
Local coastal aeolianite fms.	Aeolianites, limited pedogenesis, weak pedocrete	Mid-late Quat., ~250-80 ka.
Curlew Strand, MIS 5e, LIG.	**Marine, 4-6 m Package.**	**earliest late Quat., ~125 ka.**
Fossil Heuweltjiesveld palaeosurface on Olifantsrivier & Dorbank fms.		
Unnamed "Dorbank" fms.	Aeolian, reddened, semi-lithified.	later mid-Quat., ~400-140 ka.
Curlew Strand, MIS 11.	**Marine, 8-12 m Package.**	**mid Quat., ~400 ka.**
Olifantsrivier	Aeolianite, colluvia, pedocrete.	early-mid Quat., ~2-0.4 Ma.
Graauw Duinen Member 2	Aeolianite, colluvia, pedocrete.	latest Plio-early Quat.
Hondeklipbaai	**Marine, 30 m Package, LPWP.**	**late Pliocene, ~3 Ma.**
Graauw Duinen Member 1	Aeolianite, colluvia, pedocrete.	mid Pliocene.
Avontuur	**Marine, 50 m Package, EPWP.**	**early Pliocene, ~5 Ma.**
Unnamed	Aeolianites, weathered.	later Miocene (14-5 Ma)
Kleinzee	**Marine, 90 m Package, MMCO.**	**mid Miocene, ~16 Ma.**
Unnamed	Aeolianites, leached, faulted.	Oligocene
Koingnaas	Fluvial, kaolinized gravels, sands, plant fossils.	late Eocene
De Toren	Silcreted colluvial palaeosurfaces 200-400 m asl.	Paleocene - Eocene
MMCO – Mid Miocene Climatic Optimum. EPWP – Early Pliocene Warm Period. LPWP – Late Pliocene Warm Period. MIS – Marine Isotope Stage.		

Ongoing erosion has removed nearly all traces of early Cretaceous deposits from the present-day West Coast coastal pain. A rare instance dating from the early Cretaceous rifting is preserved just north of the Buffelsrivier mouth and is evidently the surviving, deepest part of a fault-bounded lake. Discovered by drilling, the lacustrine deposits contain fossil pollen of the early Cretaceous flora (Molyneux, in Rogers *et al*., 1990). Rounded cobbles of petrified, early Cretaceous *Podocarpoxylon* woods are found in the onshore marine gravels of the Quaternary raised beaches near Kleinsee and south of Port Nolloth (Bamford & Corbett, 1995), reworked successively from now-vanished Cretaceous fluvial deposits of the early coastal plain.

A feature of the older erosion surfaces of the coastal plain, preserved in places on the interfluves between the existing ephemeral rivers of Namaqualand, is the presence of pallid, kaolinitic, white "china clay" weathering profiles and associated silcretes, which developed during the humid tropical climates of the early Cenozoic. There are many buried, old river palaeochannels incised into the bedrock between the existing drainage lines. The deposits in these channels have also been kaolinized and silcrete has also formed in places within the waterlogged channels. It is possible that later Cretaceous fluvial deposits once filled the palaeochannels, but it seems that the palaeochannels underwent cycles of infilling and flushing out with fluctuations of sea level during the early Cenozoic, until the deposits finally occupying most of the palaeochannels, namely the **Koingnaas Formation**, are much younger. However, due to the pervasive kaolinitic weathering of the palaeochannel deposits it is possible that remnants of the older, late Cretaceous and/or early Cenozoic deposits may be disguised in places in the bases of the channels.

The **Koingnaas Formation** (De Beer, 2010) deposits in the palaeochannels consist of subangular to subrounded vein-quartz conglomerates, locally rich in diamonds, overlain by beds of clayey sand, clay and carbonaceous material containing plant fossils, in a pale matrix of kaolinite (Molyneux, in Rogers *et al*., 1990), with yellow and red ochreous staining in places. The fossil pollen has provided evidence of the vegetation type present and the age of the Koingnaas Formation. Yellowwood forest with auracaria conifers, ironwoods and palms dominated the West Coast. Fossil wood identified as tropical African mahogany has been found.

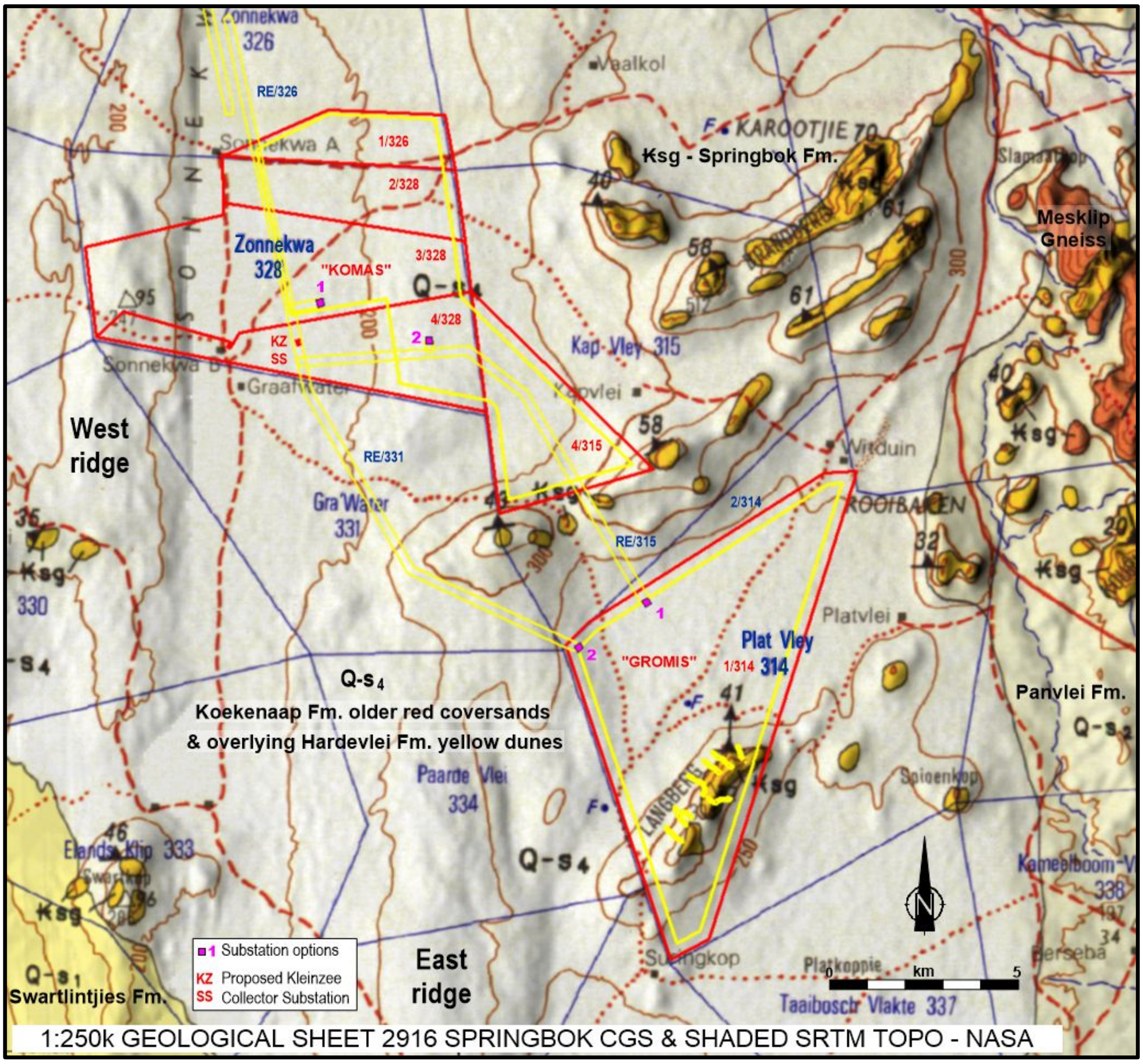


Figure 2. Surface geology of the proposed Gromis and Komas WEF development areas. Property boundaries in red and proposed development areas and power line routings shown in yellow.[1]

The presence of early forms of pollen of the Asteraceae (daisy family) indicates that the age of Koingnaas Formation is late Eocene (Figure 3), with the aggradation of fluvial deposits in the palaeochannels likely correlating with times of rising sea levels between 44-34 Ma. Notably, the Koingnaas pollen assemblage, with many extinct types of uncertain affinity and no analogues elsewhere, indicates that the uniqueness of the Cape Floristic Region is rooted in "deep time" (De Villiers & Cadman, 2002). The Koingnaas Formation deposits are remainders of a fossil landscape when the wooded Namaqualand coast approximately resembled the forests of the South Coast.

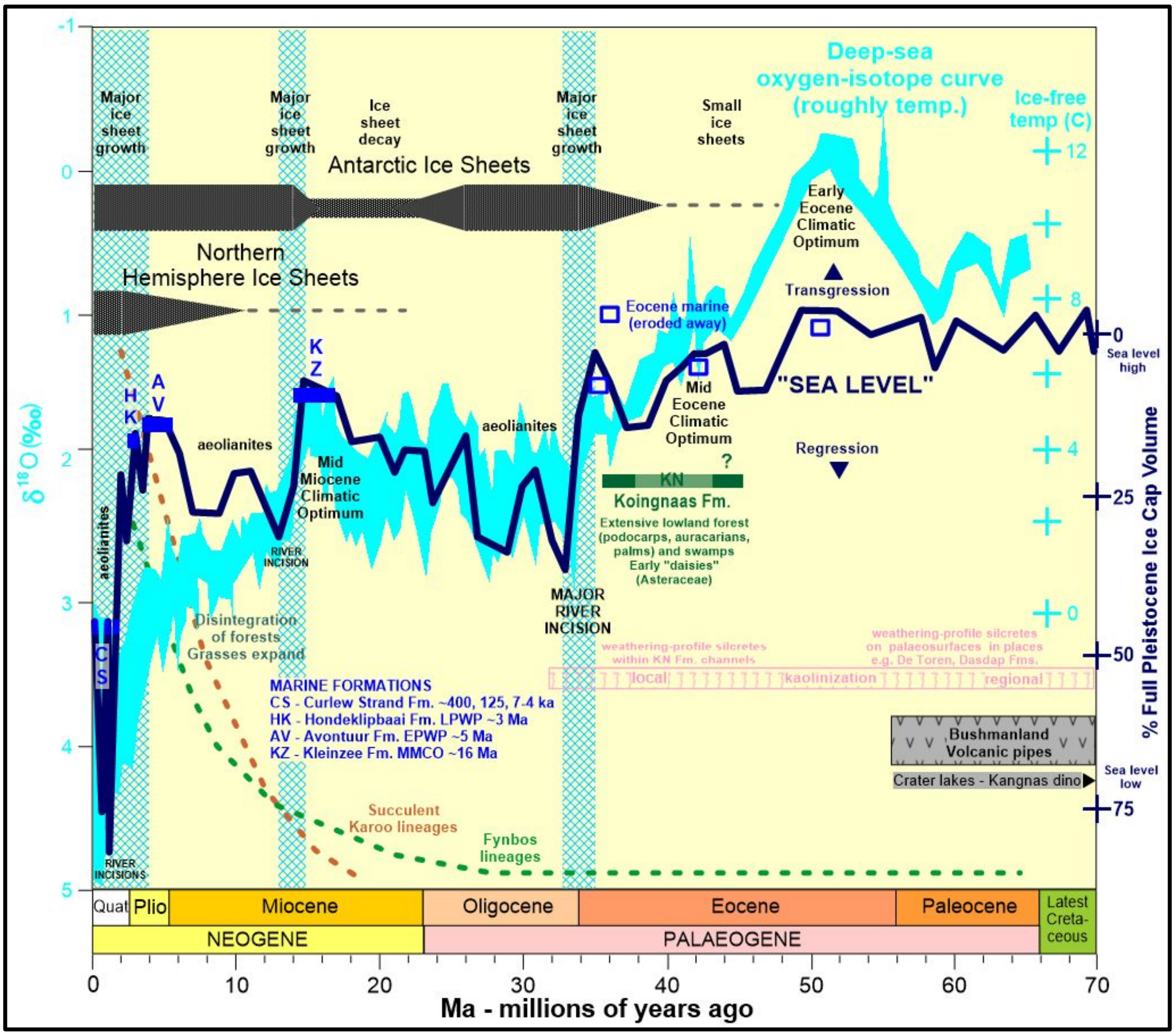
Figure 3: The Cenozoic Era (66 Ma to present) showing global palaeoclimate proxies, aspects of regional vegetation history and the context of marine formations of the West Coast Group, Alexander Bay Subgroup.

[1]The map shows the previous layout and has not been updated as adjustments to the layout of the turbines and infrastructure do not affect the results of the assessment and the same mitigation measures would be applicable in the area at large regardless of the exact layout.

Cyan curve - history of deep-ocean temperatures, adapted from Zachos *et al*. (2008). **Blue curve** is an estimate of global ice volumes, adapted from Lear *et al*. (2000). Global ice volumes roughly indicate sea-level history caused by the subtraction from the sea of water as land-ice. The expansion of Fynbos and Karoo floras is adapted from Verboom *et al*. (2009). MMCO – Mid Miocene Climatic Optimum. EPWP – Early Pliocene Warm Period. LPWM - Late Pliocene Warm Period.

5.2.2 The Marine Formations

The early coastal plain would have been transgressed by the sea during high sea-levels associated with peak global warming intervals during the Paleocene and Eocene (Figure 3), but no deposits of this earlier marine history are known to remain along Namaqualand. Diamondiferous Eocene marine remnants are preserved on the southern Namibian coast and must also have been present on the Namaqualand coastal plain, but were evidently later flushed off into rivers during the late Eocene and Oligocene.



Towards the end of the Eocene and during the Oligocene the global climate underwent major cooling and polar ice built up on the Antarctic continent, lowering sea level significantly (Figure 3), while drier climatic conditions likely pertained along the West Coast. This “**Oligocene Regression**” is thought to have had an impact on the coastal plain by the incision and entrenchment of the present-day river courses and further erosion back into the Escarpment. Towards the end of the Oligocene the cooler global climate began to ameliorate and with large fluctuations this warming trend continued through the early Miocene and peaked in the middle Miocene during the warm **Mid-Miocene Climatic Optimum** ~17-14 Ma (Figure 3). Melting of the Antarctic ice cap raised sea level and the outer part of the coastal plain was inundated by the sea up to an elevation which is now ~90 m asl. When sea level receded again the marine **Kleinzee**

Formation was deposited on the inner, high part of the coastal bevel and extends seawards from ~90 m asl. (also called the 90 m Package).

The previous Miocene marine beds were eroded during rising sea-level of the **Early Pliocene Warm Period** and the **Avontuur Formation** (the 50 m Package) was deposited 5-4 Ma as sea-level receded from the transgression maximum of about 50 m asl. and the shoreline prograded seawards (Figure 4).

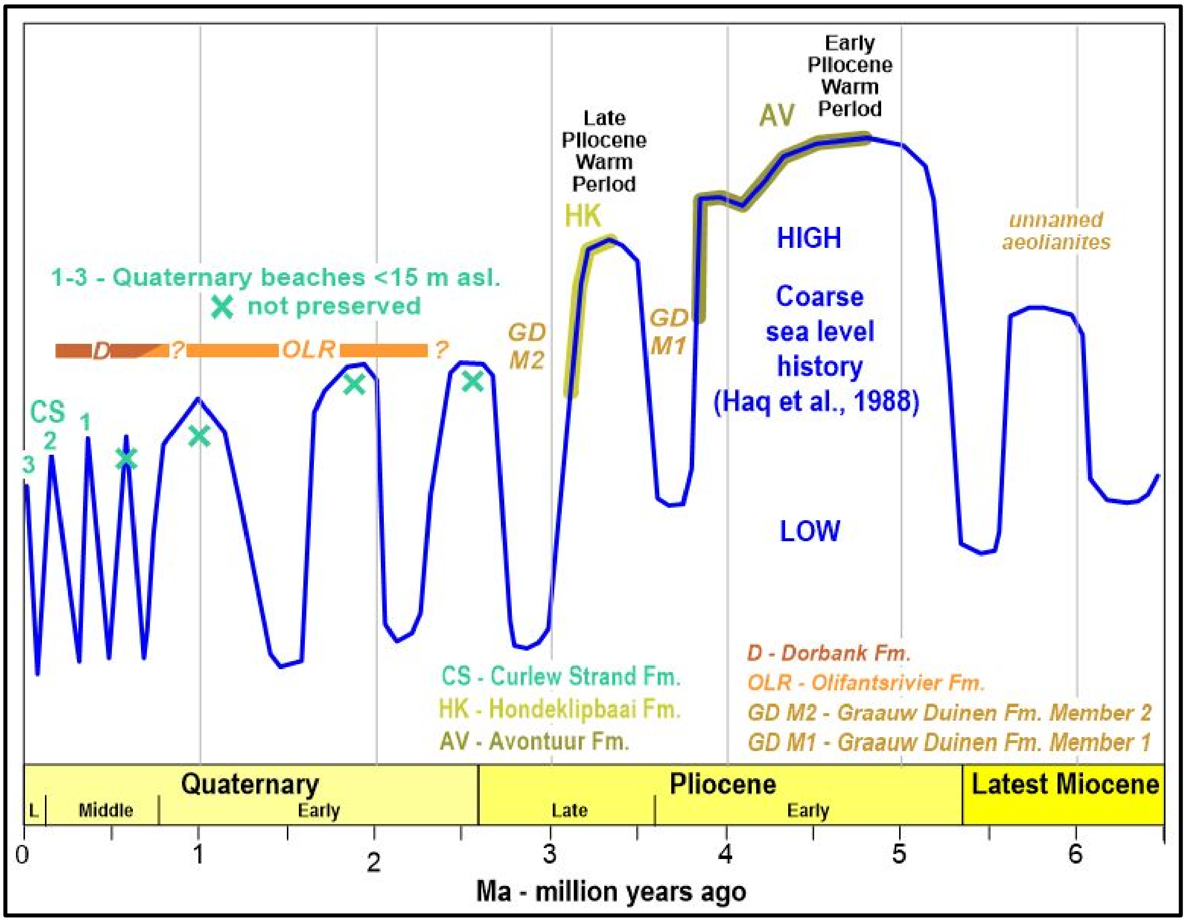


Figure 4. Context of latest Miocene, Pliocene and Quaternary marine and aeolian formations correlated with coarse-scale sea-level history based on major margin unconformities.

The Avontuur Formation in turn was eroded by yet another rising sea-level associated with the **Late Pliocene Warm Period** 3.3-3.0 Ma (Figure 4). The **Hondeklipbaai Formation** or 30 m Package was deposited as sea level declined from a high of about 30-33 m asl. and a substantial, prograded marine formation built out seawards. This formation, up to a few km wide, underlies the outer part of the coastal plains of the West Coast. The actual sea levels were not at the absolute elevations mentioned above – the ancient palaeoshorelines have attained their present elevations due to uplift of the continental margin. Fossil shells are found in places in these Miocene and Pliocene marine formations and each contains warm-water species and also important extinct fossil shell species which are characteristic of that formation and which facilitate correlation of formations over wide regions.

Close to the seaside, the Hondeklipbaai Formation is eroded and overlain by the younger, Quaternary “raised beaches” that extend up to about 12-15 m asl. The name **Curlew Strand Formation** has been proposed for this composite of raised beaches, equivalent to the Velddrif Formation of the SW Cape Coast. It comprises the **8 - 12 m Package** dating to ~400 ka (ka = thousand years ago) during Marine Isotope Stage 11 (MIS 11), the **4 - 6 m Package** of the Last Interglacial (LIG) ~125 ka and the **2 - 3 m Package** (mid-Holocene High, 6-4 ka) (Figure 4, CS 1, 2, 3). The fossil shells in these "raised beaches" are predominantly the cold-water fauna of modern times.

5.2.3 The Aeolian Formations

A variety of terrestrial deposits also make up the coastal plain of Namaqualand. These are predominantly extensive aeolian dune and sandsheet deposits that overlie the eroded tops of the marine sequences near the coast, and as dune plumes extending inland. A glance at the satellite images of the coast show that the dune plumes of various ages occur in specific areas and are linked to topography, sea-level oscillations, the changing locations of sandy beaches and fluvial sediment inputs. Similarly, the deeper-time aeolian record is expected to comprise buried dune fields, dune plumes and sand sheets that accumulated at different times in various areas of the coastal plain. More locally there are colluvial (sheetwash) and ephemeral stream deposits associated with nearby hillslopes; these dominate the thinner cover of the hills of the higher, inner coastal plain. Formed within the terrestrial sequences are pedocretes and palaeosols of a variety of types, compositions and degrees of development which mark times of surface stability and relate to times of reduced aeolian activity (less windy) and/or more humid climatic intervals.

Our embryonic knowledge of the stratigraphic context of these older, buried aeolianite formations comes from the huge mine pits created by diamond and heavy-mineral mining, but these observations are mainly confined to the lower coastal plain (<~100 m asl.) where the dated marine formations underlie or are interbedded with the aeolian formations. The major pedocretes present in the mining pits are regional in extent and will also occur within the unexposed and unknown aeolian sequences of the higher coastal plain, and should be of stratigraphic utility for correlation.

The older aeolian formations, such as the **Graauw Duinen** and **Olifantsrivier** formations (Table 2), which are exposed in mine pits and eroding cliffs close to the coast, are rarely exposed on the higher coastal plain inland from ~100 m asl., except as outcrops of their cappings of well-developed pale pedocretes (calcrete, sepiocrete) in places. For the most part, these older formations are buried beneath more aeolianites of varying ages and thicknesses, from several metres thick up to ~15 m thick, which have been transformed by pedogenesis into yellow-brown to red-brown, semi-cemented beds colloquially called "dorbank". For practical purposes these "dorbank" units are lumped together and referred to as the **Dorbank Formation**.

The **Dorbank Formation** is typically a stack of successive sand sheet and dune beds forming units 0.5 m to ~2 m thick, with slightly differing hues of the neoformed pedogenic clays. The dorbank is quite hard and incipiently to variously cemented, but notably, this formation lacks the development of distinct, laterally continuous, pale pedocrete horizons, other marked, post-depositional features and generally also lacks an evolved pedocrete capping. The Dorbank Formation is widespread along the Namaqualand coast where it occupies a spatio-temporal context as the youngest consolidated aeolianite beneath weakly-compacted to loose surface sands. Notably, Middle Stone Age (MSA) artefacts occur within its upper portion and on its top surface, these suggesting that the age is in the later part of the middle Quaternary, younger than about 400 ka (Figure 6). Dating of the overlying Koekenaap Fm. surficial sands (see below), together with some few dates from the top of the Dorbank Fm. farther south, indicates that the Dorbank Fm. is older than ~130 ka, pre-dating the Last Interglacial.

Overlying the hard surfaces on the tops of the **Dorbank Formation** units are the poorly-consolidated to loose, surficial sandsheets and dunes of the modern landscape. This more recent aeolian history is expressed in features of the topography, dune morphologies, sand colours and vegetation patterns and the distribution of these features in the landscape shows the roles of the sandy beaches and riverbeds as sand sources for southerly wind. The inland surficial sands are not differentiated on the Springbok geological map, being mapped only as Q-s_4 (Figure 2) and described as "*semi-consolidated piedmont deposits, red sand*". These surficial sands may be elaborated by extrapolating the formations recognised farther south (De Beer (2010) and pers. obs.). In the area of interest these are mainly the **Koekenaap** (Qkk) and **Hardevlei** (Qh) formations (Table 2) (Figure 5).

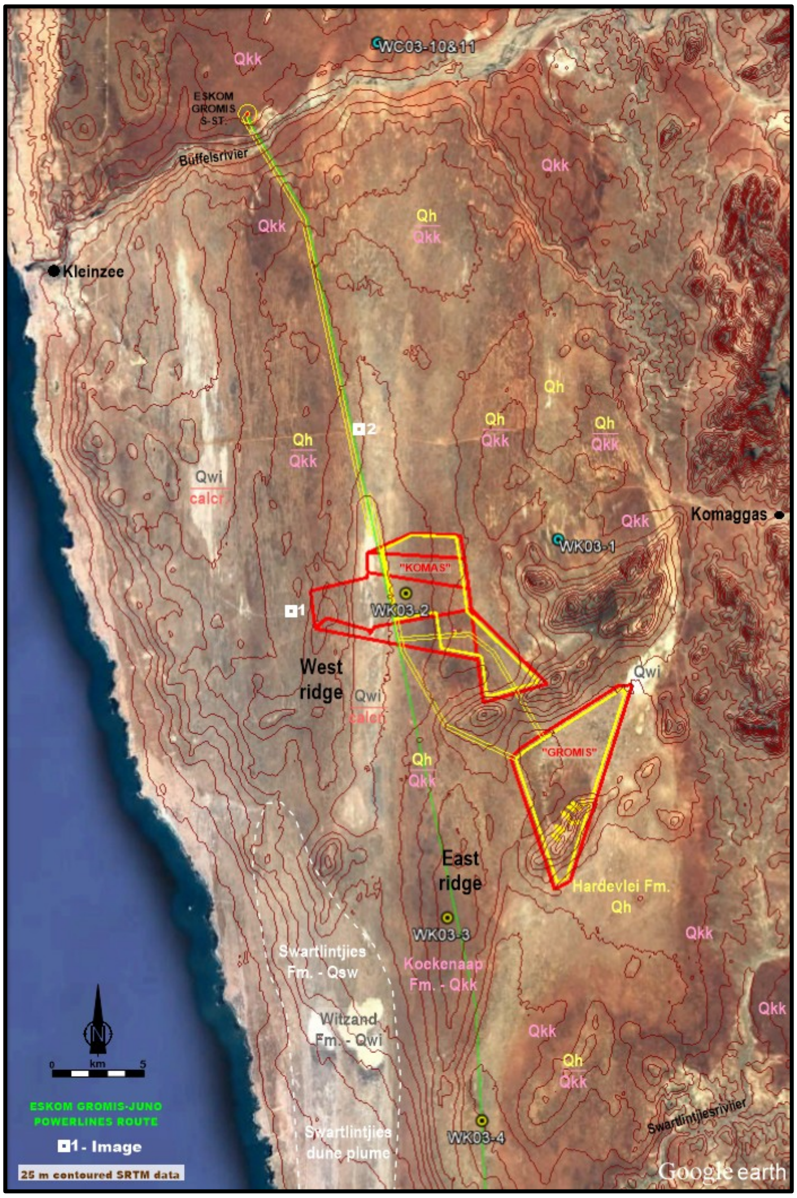
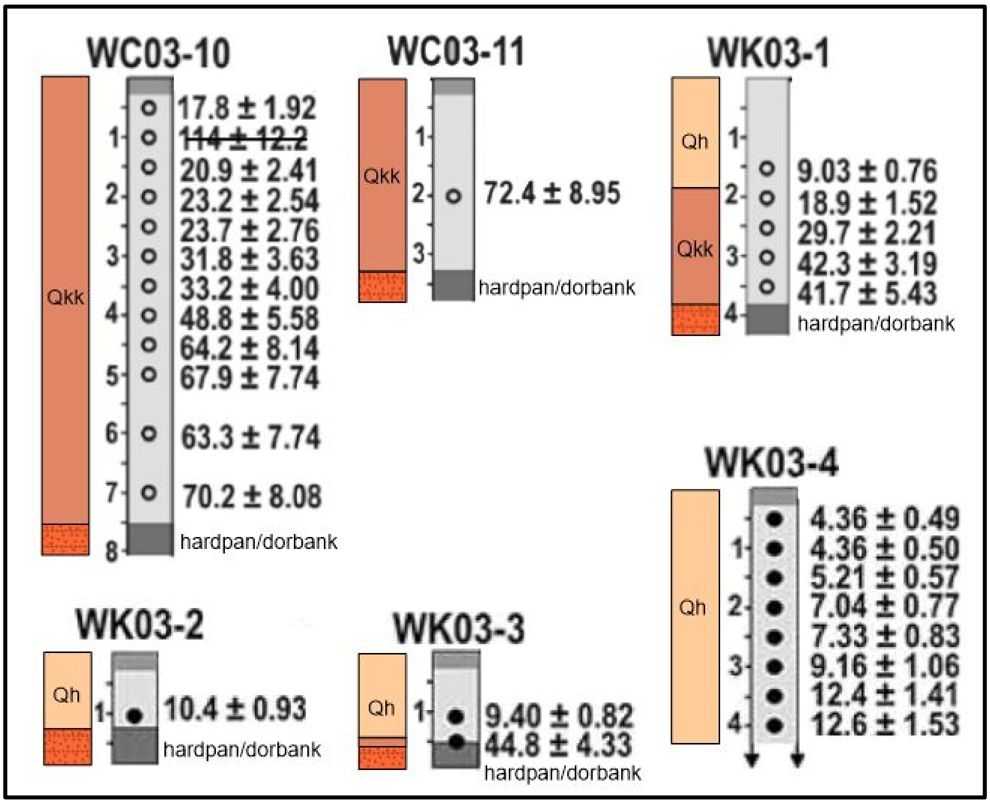


Figure 5. Overview of surficial sand formations in the Swartlintjies-Buffels aeolian compartment.[1]

[1] The map shows the previous layout and has not been updated as adjustments to the layout of the turbines and infrastructure do not affect the results of the assessment and the same mitigation measures would be applicable in the area at large regardless of the exact layout.

Koekenaap Formation (Qkk) (Roberts *et al.*, 2006; De Beer, 2010) refers to the variously-reddened, unconsolidated coversands and low, degraded dunes which mantle much of the surface of the coastal plain, overlying the hard surface of the Dorbank Formation. Where thicker, subunits can be distinguished by subtle variations in hue and grain adhesion. The red sands are underlain by scatters of MSA material on top of the palaeosurface formed on the "Dorbank" or older aeolian formations. Results of Optically-Stimulated-Luminescence (OSL) dating of some reddened coversands (Chase & Thomas, 2006, 2007) produced late Quaternary ages between ~80 ka and ~20 ka (Figure 6) and suggest phases of accumulation which differ between areas. Sand sources include the coast and the reworking of older sands, while the older red sands on the higher, inner coastal plain have apparently been sourced from the local rivers. The typical vegetation types are



Namaqualand Strandveld and Namaqualand Heuweltjie Strandveld.

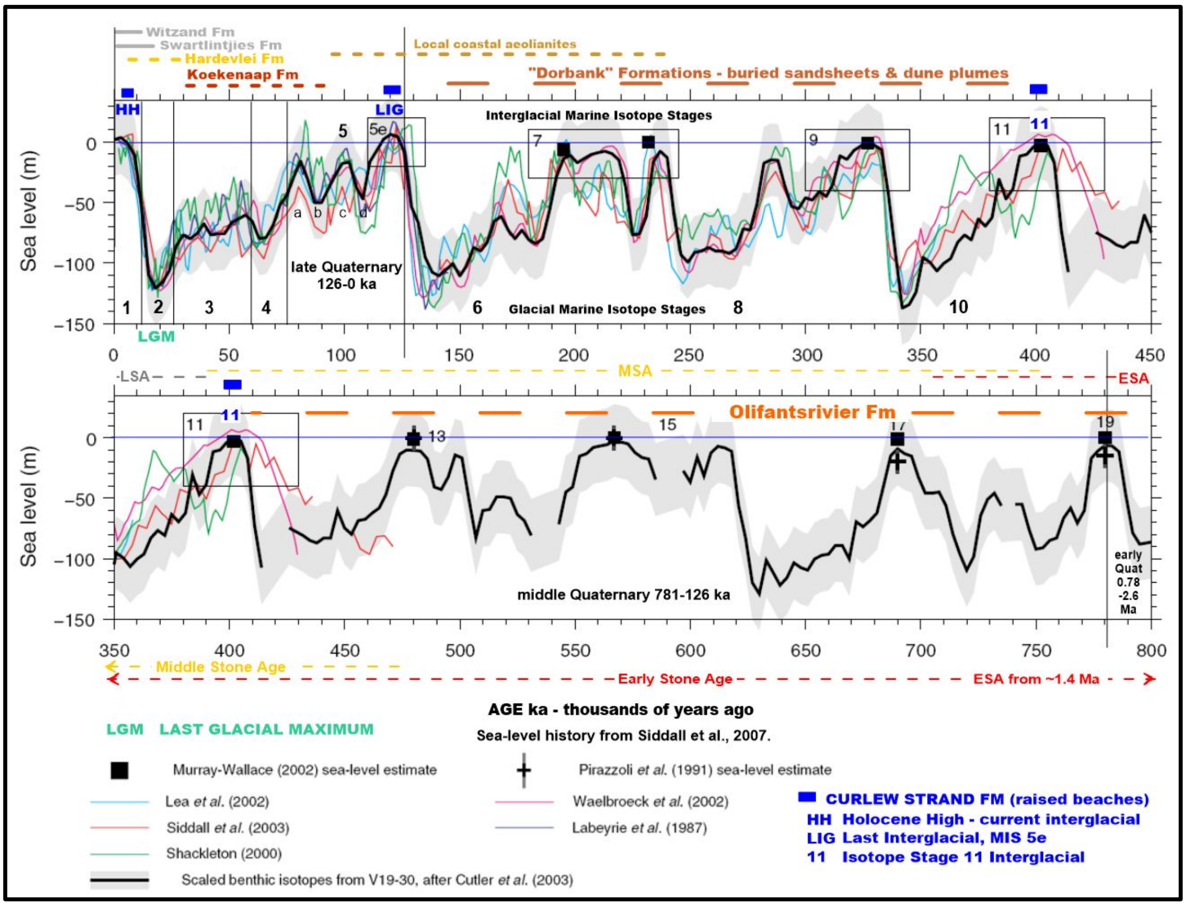
Figure 6. Optically-Stimulated-Luminescence -dated sections of the surficial sands of the Koekenaap (Qkk) and Hardevlei (Qh) formations. Adapted from Chase & Thomas, 2006, 2007. Core site locations indicated in Figure 5.

Subsequent aeolian activity is manifested in the yellow dunes of the **Hardevlei Formation** (Qh) (De Beer, 2010) which encompasses fields of low, pale-yellow dunes of varied morphology overlying the Koekenaap-type red sands or the local Dorbank Formation., and which are developed inland from the coast on the higher, inner parts of the coastal plain. Dune types include both parallel, longitudinal sand ridges formed by the northward migration of vegetation-impeded, parabolic, "hairpin" dunes, and transverse, barchanoid (crescentic) dunes. In southern Namaqualand both morphologies are combined to form reticulate dune fields formed by directionally-variable winds, but in this area longitudinal dune morphologies dominate due to the predominance of the southerly wind. Dating by the OSL technique indicates ages generally less than ~20 ka (Chase & Thomas, 2006, 2007) (Figure 6).

The name **Swartlintjies Formation** (Qsw) is proposed for the large, pale plumes of semi-stabilized parabolic dunes that extend far inland northwards from the beaches north of the main rivers (Roberts *et al*., 2006; De Beer, 2010) and which are the latest large-volume additions to the coastal plain. The Swartlintjies dune plume (Figure 5, Swartlintjies Fm.) is the type example. The plume sands were blown by south winds from the beaches now submerged by rising sea levels since the Last Ice Age maximum ~20 ka (Figure 7, LGM), when the shoreline was ~120 m below present (Tankard & Rogers, 1978). Similarly, large dune plumes blew inland from the coast in the deeper past and are evident as broad low ridges in the landscape.

The **Witzand Formation** (Qwi) accommodates sand and shell fragments blown from sandy beaches during the Holocene, in the form of partly-vegetated dune cordons backing the beach and the attached small dune plumes transgressing inland. Also included in the Witzand Formation are fields of white, mobile dunes that occur inland, where older dune sands have been remobilized, such as at the type locality on the farm Witzand, near Atlantis in the South Western Cape.

The **Panvlei Formation** (Figure 2) refers to pedocreted regolith, colluvium and old aeolianite mantling the slopes of the foothills along the inner margin of the coastal plain. The overlying thin,

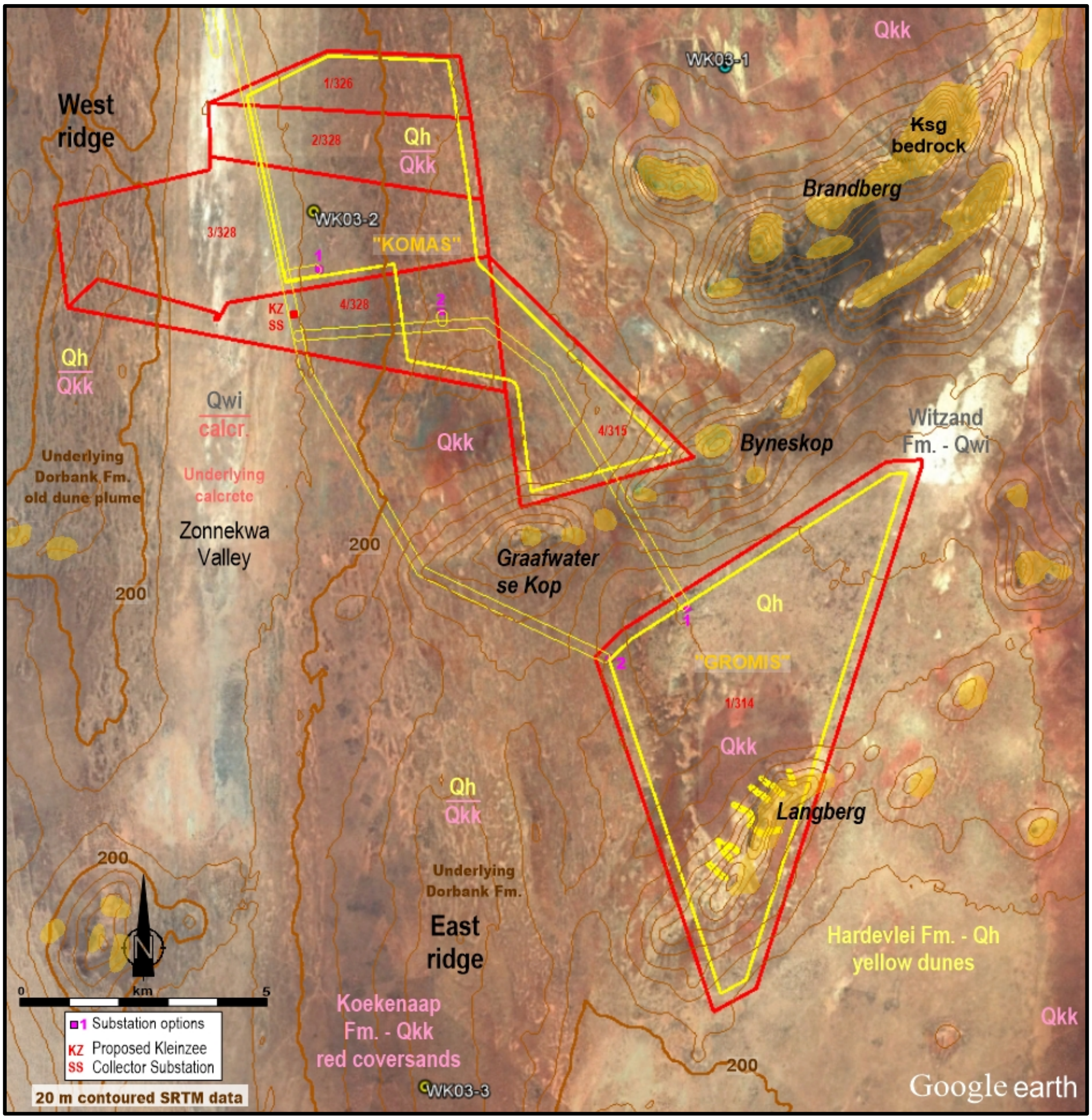


sandy soils have developed the clumped vegetation pattern of Namaqualand Heuweltjieveld.

Figure 7. Sea-level history (from Siddall *et al.*, 2007) and the age ranges of middle and late Quaternary formations of Namaqualand.

6 ASPECTS OF THE LOCAL GEOLOGY OF THE PROJECT AREA

Considerable thicknesses of deposits have accumulated in the valleys between the bedrock hills and are thickest in the ancient palaeochannels incised into the bedrock. The palaeochannel draining to the southwest beneath the proposed Gromis WEF development area may contain deposits of the **Koingnaas Formation**., or possibly older fluvial deposits, and potentially includes overlying, younger fluvial deposits of Miocene and/or Pliocene age. There are less obvious palaeochannels beneath the proposed Komas WEF development area. Excavation for turbine foundations during the construction phase of both the Gromis and Komas WEFs are not expected



to intersect these deeper fluvial formations. Marine deposits are not expected to occur beneath either of the proposed WEFs.

Figure 8. Surficial geology and features of the Project Areas.[1]

Notable large-scale aeolian depositional features ("fossil" dune plumes) are noted beneath thin cover of the surficial sands in the West Ridge and East Ridge of the general project area. These plumes largely comprise of the Dorbank Formation (Figures 5 & 8). A low-lying, pale-hued, shallow valley separates the aeolian ridges. The influence of the quartzite bedrock ridges in topographic steering of the wind is evident in the disposition of the dunes about them.

A shallow pit in the West Ridge (Figure 5, location 1) shows the aeolian unit at the top of the compact Dorbank Formation (Figure 9). Another pit in the ridge flank (Figure 5, location 2) shows a similar unit with steep dune crossbedding (Figure 10). The unit has been subjected to pedogenesis, with the formation of neoformed interstitial clay and typically lacks distinct pedocrete

[1] The map shows the previous layout and has not been updated as adjustments to the layout of the turbines and infrastructure do not affect the results of the assessment and the same mitigation measures would be applicable in the area at large regardless of the exact layout.

horizons. The relatively soft, eroding exposures, indicate that the unit is a relatively young member of the Dorbank Formation, of later mid-Quaternary age (Figure 7). For instance, at the youngest it is of Marine Isotope Stage (MIS) 6 to MIS 5/6 age. It is on trend with the Swartlintjies dune plume and appears to be an earlier plume that extended considerably farther north (Figure 5). The East Ridge is assumed to be an older Dorbank Formation fossil dune-plume.

Most of the surficial cover is typified by red sands of the **Koekenaap Fm**., with clumped vegetation dot patterning visible in the interdune areas between the overlying yellow dunes of the **Hardevlei Fm**. which are generally distributed in the landscape. The proposed Komas WEF development area has this typical surficial cover. In the broad valley between the Dorbank Fm. ridges, herein called the Zonnekwa Valley, are pale sands which are referred to the Witzand Fm. The valley is evidently a sand transport corridor, from the "dusting" of pale sands emanating from it and extending across the north-western part of the proposed Komas WEF. The valley is apparently closely underlain by a pale calcrete pedocrete beneath which the older aeolian formations are expected, equivalent to the **Olifantsrivier** or **Graauw Duinen** formations. In the southeast region of the proposed Komas WEF development area; another pale "dusting" of recent sand mobility evidently relates to the "wind gap" between Byneskop and Graafwater se Kop.

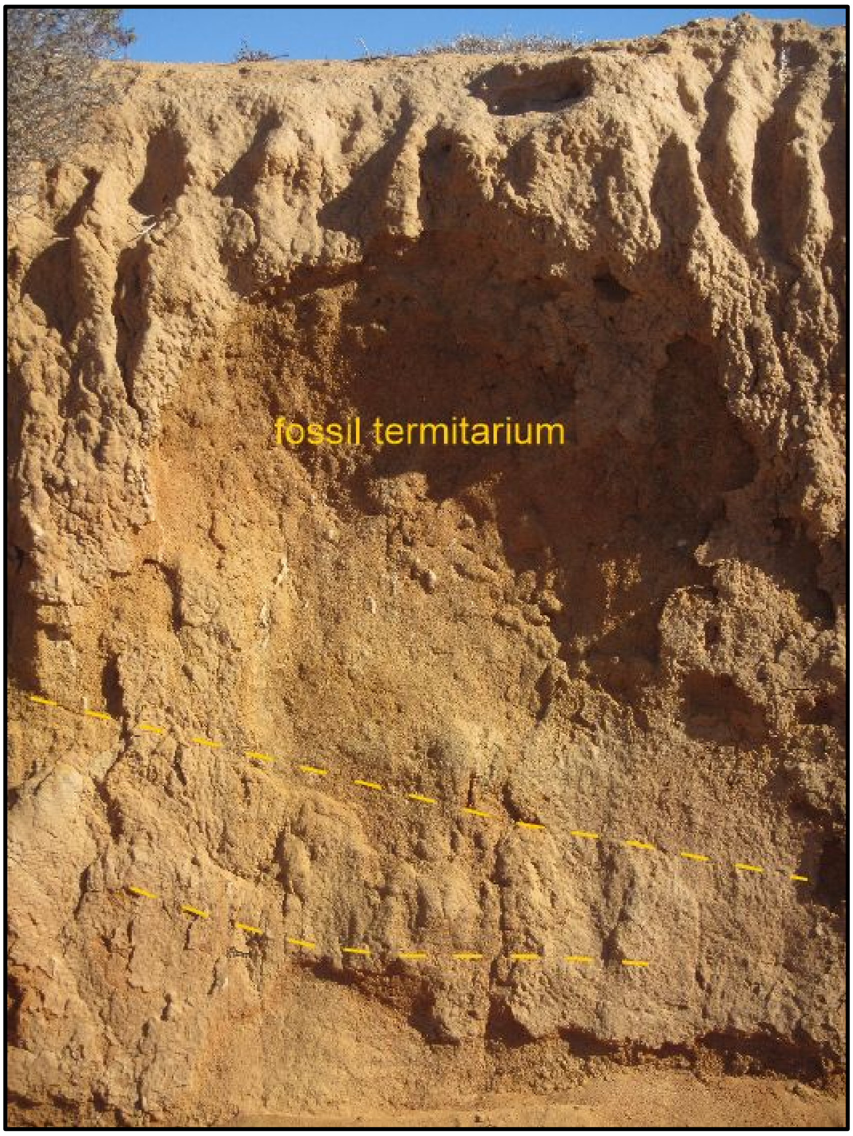
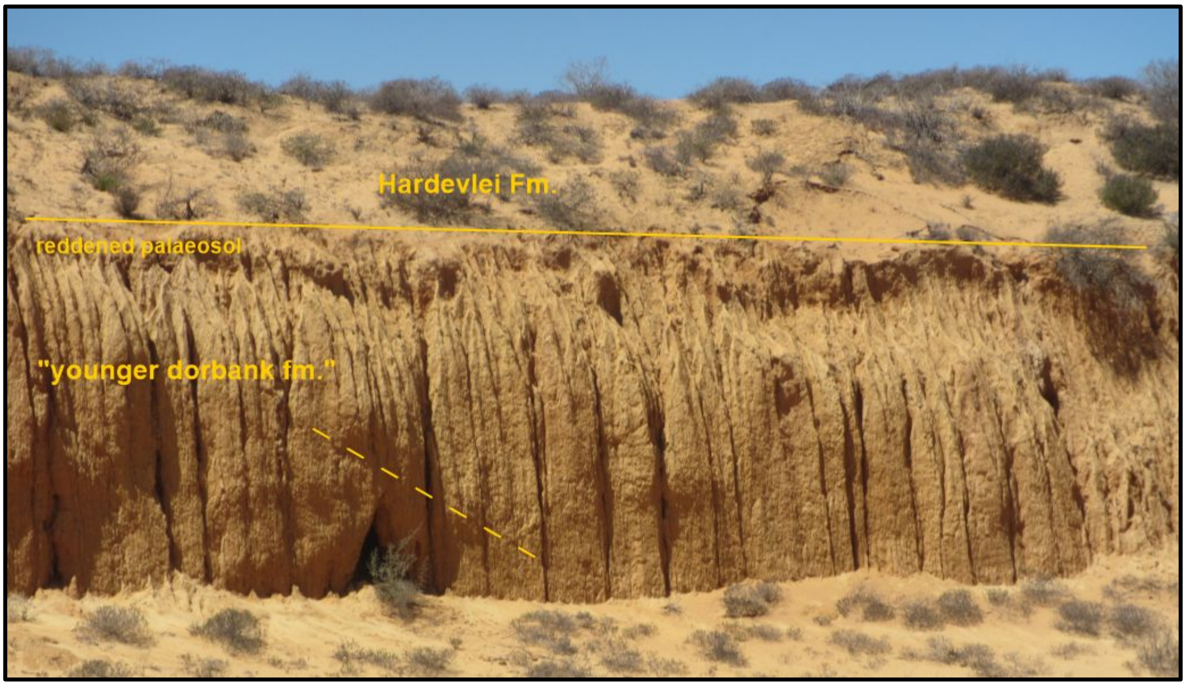


Figure 9. The uppermost Dorbank Formation unit at location 1 in Fig. 5. Dashed lines trace relict dune lower-foreset crossbedding lapping tangentially onto basal wind-ripple laminated interval. Image courtesy of J. Orton.

The surficial sands in the proposed Gromis WEF development area are spatially differentiated, with Koekenaap Fm. patterned red sands surrounding the Langberg ridge, particularly on the northern lee side due apparently to a "wind shadow" effect similar to that seen in the lee of the Brandberg ridge, and where the formation of Hardevlei Fm. dunes has been limited. The northern part of the proposed Gromis WEF development area is covered by Hardevlei Fm. sands which is part of a larger area of Hardevlei sands transport extending from the south along the inner part of the coastal plain. A white patch of mobile dunes to the northeast, referred to the Witzand Fm., corresponds with the zone of flow acceleration around the Brandberg ridge.

A dark reddish patch surrounding a slight hill with outcropping bedrock was noted north of the proposed development areas of the Gromis and Komas WEFs, along the proposed power line route (Figure 5). The slopes are mantled by old, reddened colluvia that have been lithified to hard pedocrete. The dark red heuweltjiesveld which occurs in the general area is evidently a patch of older Koekenaap Fm. coversands thinly covering the bedrock.

Dark red-brown surficial cover attributable to the Koekenaap Fm. dominates immediately north of the Buffelsrivier (Figure 5). Here 7 metres of red sand accumulated between ~70 to ~20 ka (WC03-10, Figure 6). This illustrates the role of the river as an aeolian compartment boundary, supplying sand for northward transport and impeding sand encroachment from the south by its



periodic removal.

Figure 10. The upper Dorbank Formation. unit at location 2 in Fig. 5. Dashed line indicates relict, steep aeolian foreset crossbedding. Unconsolidated dune sand of the Hardevlei Formation overlies a thin palaeosol. Image courtesy of J. Orton.

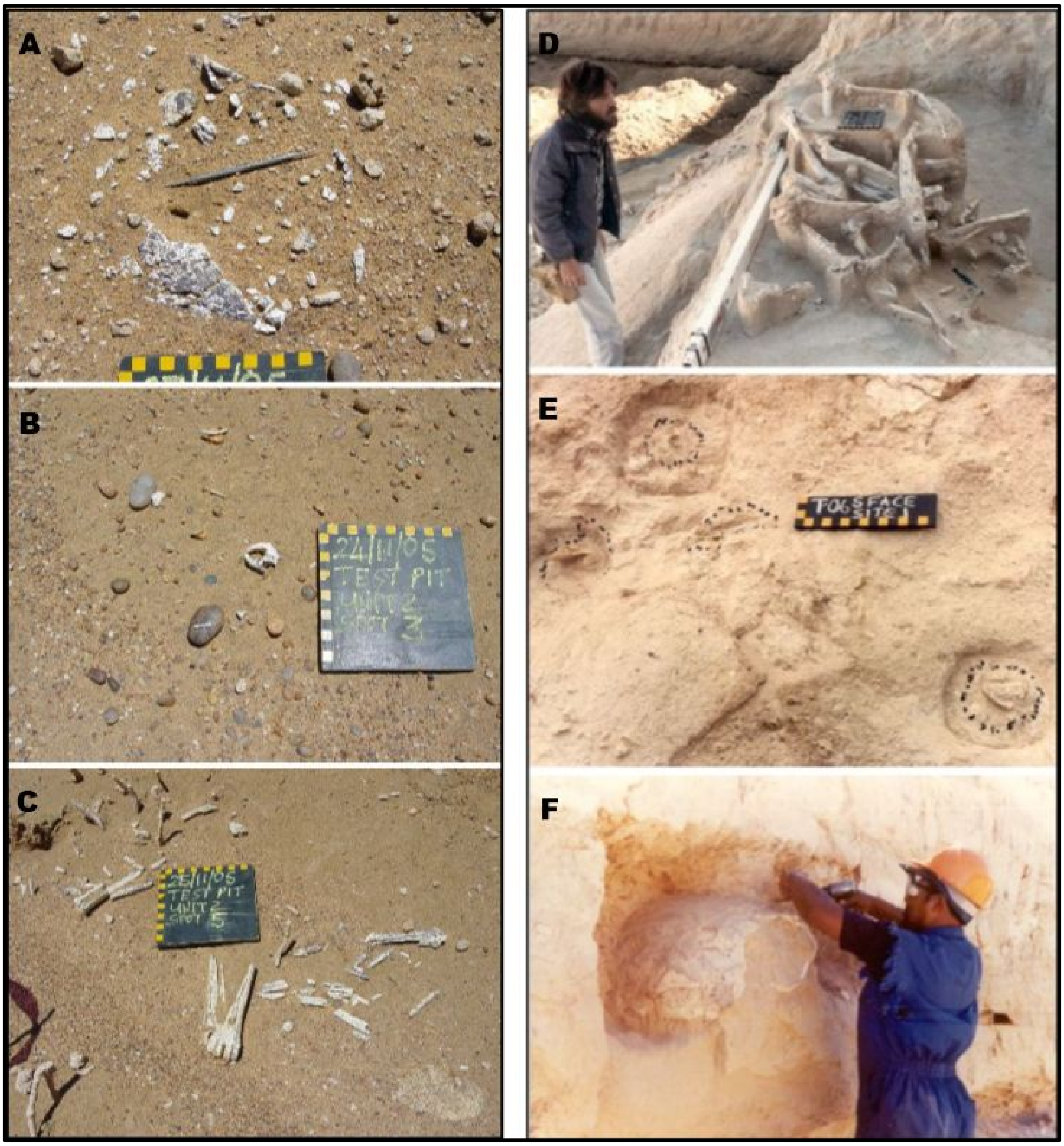
7 AFFECTED FORMATIONS

The thickness of the surficial sand formations is very variable due to the Hardevlei Fm. dune accumulations and in places the underlying Dorbank Fm. is at very shallow depth (WK03-2, WK03-3, Figure 6). The shallow trenches for cabling and building foundations will primarily be made in the surficial sands of the Hardevlei and Koekenaap formations, but it may be expected that the surface and upper part of the Dorbank Fm. will be intersected in shallow excavations in places. The deeper excavations for the wind turbine foundations and the pylon foundations will penetrate the underlying Dorbank Fm. In the north-western parts of the proposed Komas WEF development area the Dorbank Formation is thin and is underlain by the calcrete exposed in the adjacent

Zonnekwa Valley and which has formed in an older early Quaternary or Pliocene aeolian formation. The calcrete and old aeolianite will be intersected by the turbine and pylon foundation excavations situated along the Zonnekwa Valley.

8 EXPECTED PALAEONTOLOGY

The fossil bones that have been found hitherto in the aeolianites of Namaqualand attest to the fossil potential that will be delivered by the continuation of systematic searches for these sparse remains. Fossil material most commonly seen is the ambient fossil content of dune sands: land snails, tortoise shells and mole bones (Figures 11A, B; 12A). Other small bones occur very sparsely such as bird and small mammal bones. The fossil content is more abundant in association with palaeosurfaces and their soils (palaeosols), formed during periods of dune stabilisation and which define aeolian packages and larger formations. Importantly, the sparse

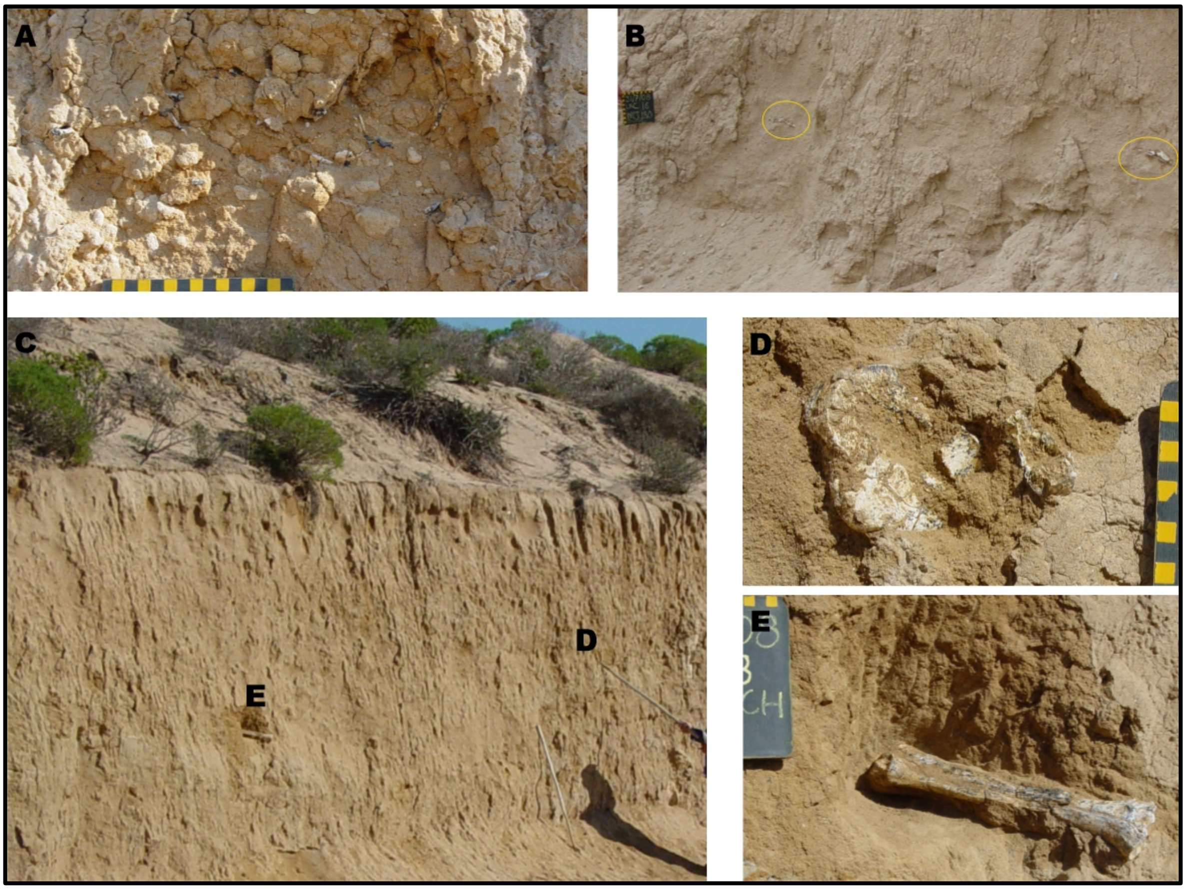


bones of larger animals (*e.g.* antelopes, zebra, rhinos) are more persistently present along palaeosurfaces which separate the major aeolianite formations where they are enclosed in palaeosols and pedocretes, and also occur on cryptic palaeosurfaces within formations (Figure 12). Rare large caches of bones are due to the bone-collecting behaviour of hyaenas and occur in probable aardvark burrows that were subsequently occupied by hyaenas (Figure 11D).

Figure 11. Examples of in situ fossil finds in aeolianites. A & B – ambient fossils in aeolianites, tortoise (A) and rodent (B). C – bovid (antelope) limb bone. D – hyaena bone stash in a burrow. E – poorly visible bones in pedocrete. F – giant tortoise.

Although fossil bones are very sparse in aeolian Dorbank formations and overlying coversands and dunes, they are of high scientific value and important for palaeoclimatic, palaeobiological and biostratigraphic studies. The fossil material in these deposits is a sample of the middle and late Quaternary fauna of the Namaqualand coast. For example, fossil bones in aeolianite near the Swartlintjiesrivier were associated with Early Stone Age (ESA) artefacts and include large species (elephant, sivathere, zebra). *Sivatherium maurusium* was a large, heavily-built short-necked giraffid common in Africa between ~5.0 to ~0.4 Ma. In addition, small species were collected (hare, squirrel, moles, snakes). The estimated age is mid-Quaternary and the large mammals indicate that the coast was better watered than the present-day (Pickford & Senut, 1997).

Another example is a late Quaternary fauna obtained from calcareous interdune deposits exposed between the dunes of the Swartlintjies Formation. The presence of frogs indicates a damp environment. Larger species include ostrich, zebra and steenbok and oddly, giraffe, a tree browser. A variety of small rodent taxa occurred. Other than the giraffe, the fauna is essentially modern. The giraffe suggests that woodland still occurred in Namaqualand as recently as the late Quaternary, probably related to riverine settings and wetter conditions associated with the Last Ice



Age climate (Pickford & Senut, 1997), or wet spells during the deglaciation.

Figure 12. Fossil bones scattered on cryptic palaeosurfaces in Dorbank Formation deposits.

9 ANTICIPATED IMPACTS

Impacts to palaeontological resources would occur as a result of earthmoving and excavations for roads, foundations and electrical cables. Fossils can be moved from their original contexts and can be damaged or destroyed. The main earthworks involved are the excavations for the turbine foundations which have an approximate diameter of up to 25 m and will typically be approximately 3 m deep, however the majority of the site is expected to have hard excavation difficulties and therefore shallow foundation solutions with an anchoring system will likely be required. The Gromis WEF is proposed to comprise of 33 turbines and the Komas WEF is proposed to comprise of 50 turbines. There are a considerable number of them distributed over and “sampling” a wide area. Therefore, in spite of the overall low fossil potential, there is a distinct possibility that fossil bones may be exposed in some of the excavations.

In the Hardevlei and Koekenaap formations the fossil bone and marine shell material that may occur is likely to be in an archaeological context. Both artefacts and fossil bones are most often found on the compact palaeosurface of the Dorbank Fm. beneath the surficial sands. These occurrences usually only come to light when large areas of the surficial sands have been mostly mined away, but leaving some residual sands that are subsequently blown away, exposing the fossil material on top of the Dorbank Fm. The fossils and artefacts are sparse in the Hardevlei and Koekenaap formations, particularly inland from the coast. The fossil bone material would be of late Quaternary age and comprised mainly of extant species (modern fauna), but could include species that did not historically occur in the region. **The palaeontological sensitivity of the surficial sand formations is therefore considered to be of LOW significance** (Appendix 3).

The fossil bone finds in the Dorbank Formation are generally the scattered, disarticulated and sometimes fragmented larger limb bones of antelopes and zebra, but the Swartlintjies occurrence associated with ESA artefacts mentioned above shows that significant finds may occur. Most finds have been at lower elevations in diamond-mine pits and little is known of this formation and its fossils at higher elevations and in this region of the coastal plain. Where the Dorbank Fm. laps onto the slopes of the quartzite ridges it is expected that colluvium and ephemeral runoff deposits are interbedded with the windblown sands. The fossil record in colluvia is very sparse and such deposits are of low fossil bone potential. In the arid terrain the bones of animals remain exposed and have poor preservation potential due to weathering and bioerosion (gnawing) by rodents and insects. Notwithstanding, it is still possible that fossil material may occur. Hills provide vantage of the landscape for carnivores and scavengers and fossil bones from their activities could be present in places.

At lower elevations in the landscape, approximately beneath the middles of broad valley trends such as on Plat Vley Farm 1/314 (farm portion comprising the proposed Gromis WEF) and Kap Vley Farm 4/315 (farm portion comprising part of the Komas WEF), there may be buried drainage lines with ephemeral stream deposits interbedded in the Dorbank Fm., and possibly also pan or vlei/seep deposits. Ephemeral stream deposits are poorly fossiliferous, but abraded bone fragments and teeth may occur sparsely in channel lags. As water sources, pan or vlei deposits, and the surrounding surfaces, are associated with a greater prevalence of fossils.

The **palaeontological sensitivity of the Dorbank Formation is considered to be of LOW significance,** but as noted, given the volume of the excavations there is a distinct possibility of fossil bone and teeth finds which could prove to be a scientifically significant addition to the poorly-known mid-Quaternary fossil fauna of Namaqualand.

The calcrete-floored Zonnekwa Valley has very likely hosted pans during wetter climate spells in the past. It is possible that some pan deposits may remain, or fossils that have been eroded from them by wind deflation.

The calcrete is assumed to have formed within the upper part of an older aeolianite formation such as correlates of the Olifantsrivier or Graauw Duinen formations. Fossil bones seem to be more common in these older aeolianites, presumably reflecting more favourable environmental conditions. As the capping calcrete has formed along a persistent palaeosurface, fossil bones are more prevalent within it, but the hard calcrete renders them less easily recoverable in the field as the embedded fossil bone has to be collected using tools to cut out a block of the calcrete.

10 IMPACT ASSESSMENT

10.1 GENERAL IMPACT OF BULK EARTH WORKS ON FOSSILS

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value with respect to palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources. Provided that no subsurface disturbance occurs, the fossils remain sequestered there.

When excavations are made they furnish the "windows" into the coastal plain depository that would not otherwise exist and thereby provide access to the hidden fossils. The impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils. Fossils and significant observations will be lost in the absence of management actions to mitigate such loss. This lost opportunity to recover them and their contexts when exposed at a particular site is irreversible. The scarcity of fossils makes it more important to look out for them.

There remains a moderate to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. Machinery involved in excavation may damage or destroy fossils, or they may be hidden in "spoil" of excavated material.

The overall significance of potential impacts to the palaeontological resources on the sites are assessed to be of low negative significance as the fossils are expected to be very sparsely distributed in the ground with a very low probability of impacts actually occurring. If fossil bones are successfully spotted, reported and studied they would make a positive contribution to science. Nevertheless, because of the difficulty of spotting bones, it is still expected that most fossils would not be seen during excavation and with even a few being found the post-mitigation significance is expected to be low positive.

10.2 ASSESSMENT OF CUMULATIVE IMPACTS

Several other WEFs have been proposed in the area. Although this may mean that more impacts to palaeontology are anticipated, there is also the likelihood that there will be a gain in terms of the state of knowledge of these disciplines if mitigation measures are successfully applied. The significance of impacts is expected to be the same as that for the construction phase with **a low negative and low positive** impact to palaeontology.

10.3 ASSESSMENT OF ALTERNATIVES

The No-Go option would entail the site staying as it currently is. This means its continued use for small stock grazing and the continued natural erosion, weathering and trampling by animals. Palaeontological resources would not likely be affected because significant fossils will remain buried. Overall, the significance of impacts related to the no-go option is considered to be **very low negative**.

10.4 COMPARATIVE ASSESSMENT OF ALTERNATIVES

Because of the low palaeontological sensitivity of the sites, there is no material difference between the palaeontological impact of the onsite SS, Eskom Switching SS or the power line routing alternatives (Option 1 or Option 2 alternatives for each proposed WEF) and therefore both these alternatives are considered acceptable for all the alternatives.

10.5 EXTENT

The physical extent of impacts on potential palaeontological resources relates directly to the extent of subsurface disturbance involved in the installation of infrastructure during the Construction Phase of both WEFs.

However, unlike an impact that has a defined spatial extent (*e.g.* loss of a portion of a habitat), the cultural, heritage and palaeontological or scientific impacts are of regional to national extent, as is implicit in the National Heritage Resources, 1999 (Act No. 25 of 1999) and, if scientifically important specimens or assemblages are uncovered, are of international interest. This is evident in the amount of foreign-funded palaeontological research that takes place in South Africa by scientists of other nationalities. Lost opportunities that may arise from significant fossil occurrence (tourism, employment) filters down to regional/local levels.

10.6 DURATION

The initial duration of the impact is short to medium term (< 5 years) and occurs with excavations for infrastructure during the Construction Phase. This is the "time window" for mitigation.

The impact of both the finding and the loss of fossils is permanent. The fossils findings must be preserved "for posterity"; the lost, overlooked or destroyed fossils are lost to posterity. The duration of impact is therefore PERMANENT with or without mitigation.

10.7 INTENSITY

As mentioned above, due to the overall very sparse distribution of fossils in the affected formations **the intensity/palaeontological sensitivity is considered to be of LOW significance**. *Conversely, when fossils are found in such poorly fossiliferous formations, they provide very significant advances in the geological understanding of the stratigraphy of a region (Appendix 3).*

10.8 CONSEQUENCE

The negative impact of the potential loss of irreplaceable fossils is permanent, but the extent is specific to the sites of excavations and the palaeontological sensitivity of the aeolian formations is overall low. **The Consequence is therefore rated as MODERATE**.

10.9 PROBABILITY

In consideration of the scale of subsurface disturbance it is **LIKELY** that fossil bones will be unearthed at some stage during the Construction Phase.

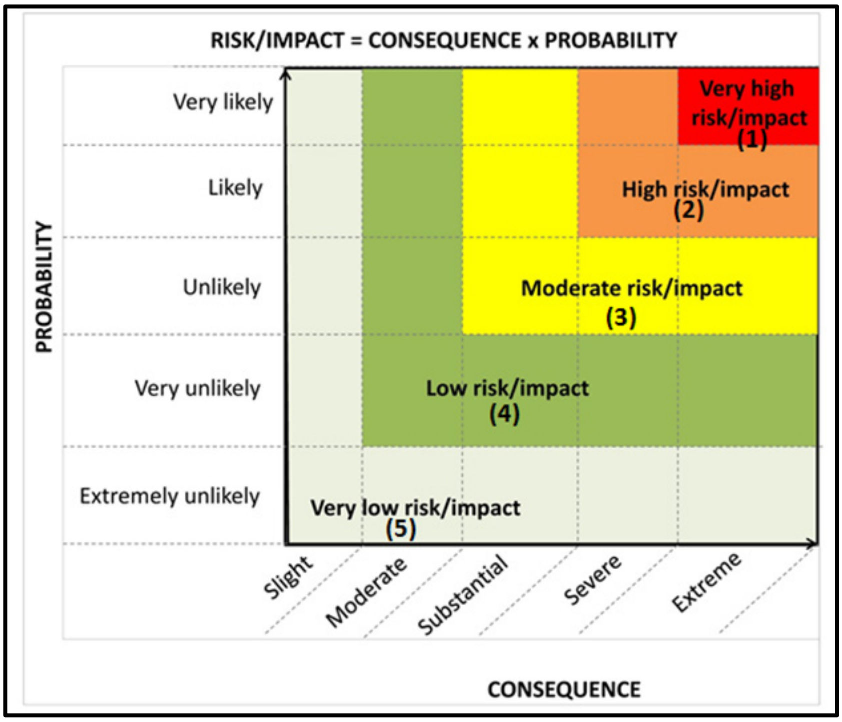


Figure 13. Impact significance as a result of consequence and probability.

10.10 Impact Significance Rating

This assessment of the potential impact of the development on palaeontological resources refers only to the Construction Phase. It does not differentiate between formations as the palaeontological sensitivities of the affected formations with respect to the occurrence of fossil bones are all low. In terms of the rating guide (Figure 13) the **Significance of potential impacts is LOW (4)**.

TABLE 3. IMPACT ASSESSMENT.

Aspect/ Impact pathway	Nature of potential impact/risk	Status	Spatial Extent	Duration	Consequence	Probability	Reversibility of impact	Irreplaceability of receiving environment/resource	Potential mitigation measures	Significance of impact/risk: Without mitigation	Significance of impact/risk: With mitigation (residual risk/impact)	Ranking of impact/risk	Confidence level
CONSTRUCTION PHASE													
ALL BULK EARTH WORKS. Foundations and trenches in all aeolian formations	Direct destruction of fossil resources	Negative	Site*	Permanent	Moderate	Likely	Non reversible	High	Monitoring of all construction-phase excavations by project staff and ECO. Reporting of chance finds. Inspection, sampling and recording of selected exposures in the event of fossil finds. Fossil finds and the compiled contextual report deposited in a curatorial scientific institution.	Low negative	Low positive	4	Medium
CUMULATIVE IMPACTS: CONSTRUCTION PHASE													

ALL BULK EARTH WORKS. Foundations and trenches in all aeolian formations	Direct destruction of fossil resources	Negative	Regio-nal*	Permanent	Moderate	Likely	Non reversible	High	Monitoring of all construction-phase excavations by project staff and ECO. Inspection, sampling and recording of selected exposures in the event of fossil finds. Fossil finds and the compiled contextual report deposited in a curatorial scientific institution.	Low negative	Low positive	4	Medium

*If an important fossil find is uncovered the extent of the impact becomes regional-international.

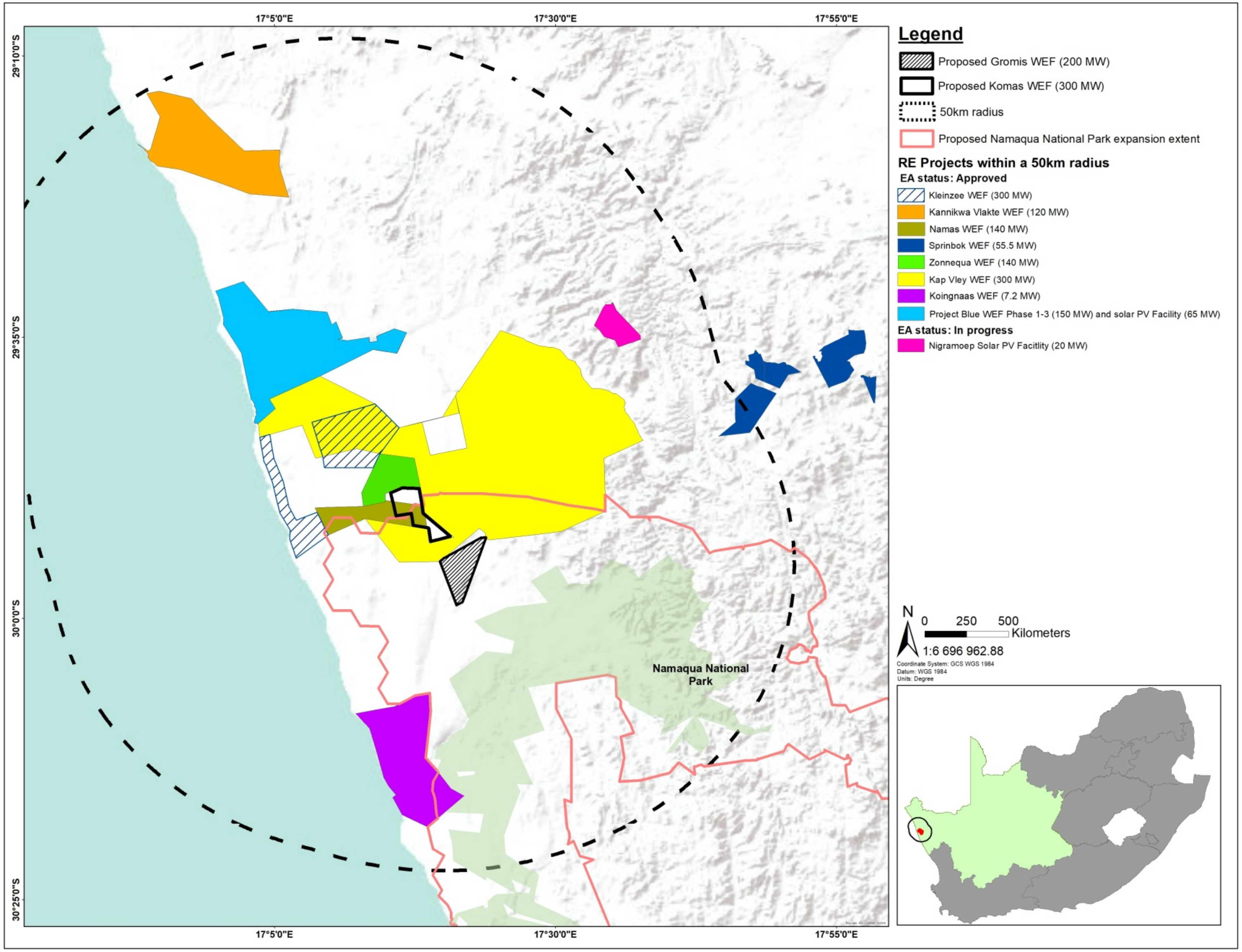


Figure 14. Proposed renewable energy projects within the 50 km radius of the proposed Komas WEF and Gromis WEF sites considered for the Cumulative Impact Assessment

TABLE 4. Proposed renewable energy projects within the 50 km radius of the proposed Komas WEF and Gromis WEF sites considered for the Cumulative Impact Assessment

DEA REFERENCE NUMBER	PROJECT TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT	STATUS
12/12/20/2331/1 12/12/20/2331/1/AM1 12/12/20/2331/2 12/12/20/2331/3	Project Blue Wind Energy Facility Near Kleinsee within the Namakwa Magisterial District, Northern Cape Province. (Phase 1-3)	Diamond Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind and Solar PV	150 MW Wind 65 MW Solar PV	Approved
12/12/20/2212	Proposed 300 MW Kleinzee WEF in the Northern Cape Province.	Eskom Holdings SOC Limited	Savannah Environmental Consultants (Pty) Ltd	Wind	300 MW	Approved
14/12/16/3/3/2/1046	The proposed Kap Vley WEF and its associated infrastructure near Kleinzee, Nama Khoi Local Municipality, Northern Cape Province.	Kap Vley Wind Farm (Pty) Ltd	Council for Scientific and Industrial Research	Wind	300 MW	Approved
14/12/16/3/3/1/1971	Proposed Namas Wind Farm near Kleinsee, Namakwaland Magisterial District, Northern Cape.	Genesis Namas Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	140 MW	Approved
14/12/16/3/3/1/1970	Proposed Zonnequa Wind Farm near Kleinsee, Namakwaland Magisterial District, Northern Cape.	Genesis Zonnequa Wind (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	140 MW	Approved
12/12/20/2154	Proposed construction of the 7.2 MW Koingnaas Wind Energy Facility Within The De Beers Mining Area on the Farm Koingnaas 745 near Koingnaas, Northern Cape Province.	Just PalmTree Power Pty Ltd	Savannah Environmental Consultants (Pty) Ltd	Wind	7.2 MW	Approved

DEA REFERENCE NUMBER	PROJECT TITLE	APPLICANT	EAP	TECHNOLOGY	MEGAWATT	STATUS
12/12/20/1807	Proposed establishment of the Kannikwa Vlakte wind farm.	Kannikwa Vlakte Wind Development Company Pty Ltd	Galago Environmental cc	Wind	120 MW	Approved
12/12/20/1721 12/12/20/1721/AM1 12/12/20/1721/AM2 12/12/20/1721/AM3 12/12/20/1721/AM4 12/12/20/1721/AM5	The proposed Springbok Wind Energy facility near Springbok, Northern Cape Province.	Mulilo Springbok Wind Power (Pty) Ltd	Holland & Associates Environmental Consultants	Wind	55.5 MW	Approved
TBA	The proposed Gromis WEF and associated infrastructure near Kleinsee in the Northern Cape Province.	Genesis ENERTRAG Gromis Wind (Pty) Ltd	Council for Scientific and Industrial Research	Wind	200 MW	In process
14/12/16/3/3/1/416	Nigramoep Solar PV Solar Energy Facility on a site near Nababeep, Northern Cape.	South African Renewable Green Energy (Pty) Ltd	Savannah Environmental Consultants (Pty) Ltd	Solar PV	20 MW	In process

11 RECOMMENDATIONS

The significance of potential impacts to palaeontological resources was assessed to be LOW NEGATIVE before and LOW POSITIVE after mitigation during the construction phase of the proposed Gromis and Komas WEFs and associated power lines and electrical infrastructure. It is therefore the opinion of the specialist that **development of the proposed Gromis and Komas WEFs and associated power lines and electrical infrastructure is considered acceptable from a palaeontological perspective and can be authorized, subject to the implementation of the recommended mitigation measures.**

Potential adjustments to the layout of the turbines and infrastructure do not affect this assessment.

Both on-site SS alternatives (Option 1 and Option 2) are acceptable from a palaeontological perspective and either alternative may be developed. Similarly, both Eskom Switching Substations and both power line routing alternatives (Option 1 and Option 2 for both) are acceptable from a palaeontological perspective and may be approved.

If the recommended mitigation measures are applied to the proposed Gromis and Komas WEFs, it is possible that these WEF developments will to some extent alleviate the negative cumulative impact on paleontological resources in the region.

The history of these vast tracts of sands, gravels and pedocretes of the Northern Cape Province is very poorly known, with very few fossils to rely on. Therefore, although of low probability; any find will be of considerable importance and could add to the scientific knowledge of the area in a positive manner.

11.1 MONITORING

In view of the low fossil potential, monitoring of bulk earth works by a specialist is not justified. Notwithstanding, the sporadic fossil occurrences are then particularly important and efforts made to spot them are often rewarded. Buried archaeological material may also be encountered.

A recommendation to be included in the EMPr is that the field supervisor/foreman and staff involved in excavations during the construction phase of both WEFs and the associated power lines and electrical infrastructure must be informed to look out for fossils and buried potential archaeological material. Construction staff sighting potential objects of archaeological or palaeontological significance are to cease construction at sighted location and report to the field supervisor who, in turn, must report to the ECO. The ECO must inform the developer and contact the contracted palaeontologist to be on standby in the case of potential fossil finds. The latter will liaise with SAHRA on the nature of the find and consequent actions (permitting and collection of find).

The Fossil Finds Procedure included as Appendix 4 provides guidelines to be followed in the event of fossil finds and should be included in the EMPr. Only a professional palaeontologist may excavate uncovered fossils with a valid mitigation permit from SAHRA.

11.2 Input to the Construction Phase Environmental Management Programme

The following mitigation measures apply to all earthworks affecting all formations discussed above.

TABLE 5. MITIGATION MEASURES.				
OBJECTIVE: To notice and rescue fossil material that may be exposed in the excavations during the construction of the WEF.				
ACTIVITY	**POTENTIAL IMPACT**	**MITIGATION**	**RESPONSIBLE PARTY**	**TIME FRAME**
All bulk earthworks, *viz.* turbine foundation excavations, trenches for cabling & infrastructure, power line and substation foundations, spoil from excavations.	Loss of fossils by their being unnoticed and/ or destroyed.	Inform staff of the need to watch for potential fossil occurrences.	The Developer, the ECO and contractors	Pre-construction
		Inform staff of the Fossil Finds Procedures to be followed in the event of fossil occurrences.	ECO/Specialist	Pre-construction
		Monitor for the presence of fossils.	Contracted personnel and ECO	Construction
		Liaise with palaeontologist on the nature of potential finds and appropriate actions.	ECO and Specialist, SAHRA	Construction
		ECO to conduct inspections of open excavations whenever on site.	ECO	Construction
		Obtain a permit from SAHRA for the fossil finds collection should resources be discovered.	Developer and Specialist	Construction
		Excavate main finds, inspect pits and record and sample excavations.	Specialist	Construction
PERFORMANCE INDICATORS		Reporting of and liaison about possible fossil finds. Fossils noticed and rescued. Scientific record of fossil contexts and temporary exposures in earthworks.		

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13 APPENDIX 1 – CURRICULUM VITAE

John Pether, M.Sc., Pr. Sci. Nat. (Earth Sci.)

Independent Consultant/Researcher recognized as an authority with 37 years' experience in the field of coastal-plain and continental-shelf palaeoenvironments, fossils and stratigraphy, mainly involving the West Coast/Shelf of southern Africa. Has been previously employed in academia (South African Museum) and industry (Trans Hex, De Beers Marine). At present an important involvement is in Palaeontological Impact Assessments (PIAs) and mitigation projects in terms of the National Heritage Resources Act 25 (1999) (~300 PIA reports to date) and is an accredited member of the Association of Professional Heritage Practitioners (APHP). Continues to be involved as consultant to offshore and onshore marine diamond exploration ventures. Expertise includes:

- Coastal plain and shelf stratigraphy (interpretation of open-pit exposures, on/offshore cores and exploration drilling).
- Sedimentology and palaeoenvironmental interpretation of shallow marine, aeolian and other terrestrial surficial deposits.
- Marine macrofossil taxonomy (molluscs, barnacles, brachiopods) and biostratigraphy.
- Marine macrofossil taphonomy.
- Sedimentological and palaeontological field techniques in open-cast mines (including finding and excavation of vertebrate fossils (bones).

Membership of Professional Bodies

- South African Council of Natural Scientific Professions. Earth Science. Reg. No. 400094/95.
- Geological Society of South Africa.
- Palaeontological Society of Southern Africa.
- Southern African Society for Quaternary Research.
- Association of Professional Heritage Practitioners (APHP), Western Cape. Accredited Member No. 48.

Past Clients Palaeontological Assessments

AECOM SA (Pty) Ltd.	Guillaume Nel Environmental Management Consultants.
Agency for Cultural Resource Management (ACRM).	Klomp Group.
AMATHEMBA Environmental.	Megan Anderson, Landscape Architect.
Anél Blignaut Environmental Consultants.	Ninham Shand (Pty) Ltd.
Arcus Gibb (Pty) Ltd.	PD Naidoo & Associates (Pty) Ltd.
ASHA Consulting (Pty) Ltd.	Perception Environmental Planning.
Aurecon SA (Pty) Ltd.	PHS Consulting.
BKS (Pty) Ltd. Engineering and Management.	Resource Management Services.
Bridgette O'Donoghue Heritage Consultant.	Robin Ellis, Heritage Impact Assessor.
Cape Archaeology, Dr Mary Patrick.	Savannah Environmental (Pty) Ltd.
Cape EAPrac (Cape Environmental Assessment Practitioners).	Sharples Environmental Services cc
CCA Environmental (Pty) Ltd.	Site Plan Consulting (Pty) Ltd.
Centre for Heritage & Archaeological Resource Management (CHARM).	SRK Consulting (South Africa) (Pty) Ltd.
Chand Environmental Consultants.	Strategic Environmental Focus (Pty) Ltd.
CK Rumboll & Partners.	UCT Archaeology Contracts Office (ACO).
CNdV Africa	UCT Environmental Evaluation Unit
CSIR - Environmental Management Services.	Urban Dynamics.
Digby Wells & Associates (Pty) Ltd.	Van Zyl Environmental Consultants
Enviro Logic	Western Cape Environmental Consultants (Pty) Ltd, t/a ENVIRO DINAMIK.
Environmental Resources Management SA (ERM).	Wethu Investment Group Ltd.
Greenmined Environmental	Withers Environmental Consultants.

Stratigraphic consulting including palaeontology

Afri-Can Marine Minerals Corp	Council for Geoscience
De Beers Marine (SA) Pty Ltd.	De Beers Namaqualand Mines.
Geological Survey Namibia	IZIKO South African Museum.
Namakwa Sands (Pty) Ltd	NAMDEB

14 APPENDIX 2- SPECIALIST DECLARATION

15 APPENDIX 3- PALAEONTOLOGICAL SENSITIVITY RATING

Palaeontological Sensitivity refers to the likelihood of finding significant fossils within a geologic unit.

VERY HIGH: Formations/sites known or likely to include vertebrate fossils pertinent to human ancestry and palaeoenvironments and which are of international significance.

HIGH: Assigned to geological formations known to contain palaeontological resources that include rare, well-preserved fossil materials important to on-going palaeoclimatic, palaeobiological and/or evolutionary studies. Fossils of land-dwelling vertebrates are typically considered significant. Such formations have the potential to produce, or have produced, vertebrate remains that are the particular research focus of palaeontologists and can represent important educational resources as well.

MODERATE: Formations known to contain palaeontological localities and that have yielded fossils that are common elsewhere, and/or that are stratigraphically long-ranging, would be assigned a moderate rating. This evaluation can also be applied to strata that have an unproven, but strong potential to yield fossil remains based on its stratigraphy and/or geomorphologic setting.

LOW: Formations that are relatively recent or that represent a high-energy subaerial depositional environment where fossils are unlikely to be preserved, or are judged unlikely to produce unique fossil remains. A low abundance of invertebrate fossil remains can occur, but the palaeontological sensitivity would remain low due to their being relatively common and their lack of potential to serve as significant scientific resources. However, when fossils are found in these formations, they are often very significant additions to our geologic understanding of the area. Other examples include decalcified marine deposits that preserve casts of shells and marine trace fossils, and fossil soils with terrestrial trace fossils and plant remains (burrows and root fossils)

MARGINAL: Formations that are composed either of volcaniclastic or metasedimentary rocks, but that nevertheless have a limited probability for producing fossils from certain contexts at localized outcrops. Volcaniclastic rock can contain organisms that were fossilized by being covered by ash, dust, mud, or other debris from volcanoes. Sedimentary rocks that have been metamorphosed by the heat and pressure of deep burial are called metasedimentary. If the meta sedimentary rocks had fossils within them, they may have survived the metamorphism and still be identifiable. However, since the probability of this occurring is limited, these formations are considered marginally sensitive.

NO POTENTIAL: Assigned to geologic formations that are composed entirely of volcanic or plutonic igneous rock, such as basalt or granite, and therefore do not have any potential for producing fossil remains. These formations have no palaeontological resource potential.

Adapted from Society of Vertebrate Paleontology. 1995. Assessment and Mitigation of Adverse Impacts to Nonrenewable Paleontologic Resources - Standard Guidelines. News Bulletin, Vol. 163, p. 22-27.

16 APPENDIX 4 - FOSSIL FIND PROCEDURES

16.1 MONITORING

A constant monitoring presence over the period during which excavations for developments are made, by either an archaeologist or palaeontologist, is generally not practical.

The field supervisor/foreman and workers involved in digging excavations must be encouraged and informed of the need to watch for potential fossil and buried archaeological material. Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO.

The ECO will inform the archaeologist and/or palaeontologist contracted to be on standby in the case of fossil finds.

To this end, responsible persons must be designated. This will include hierarchically:

- The field supervisor/foreman, who is going to be most often in the field.
- The Environmental Control Officer (ECO) for the project.
- The Project Manager/Site Agent.

16.2 RESPONSE BY PERSONNEL IN THE EVENT OF FOSSIL FINDS

In the process of excavation fossils may be spotted in the hole sides or bottom, or as they appear in excavated material on the spoil heap.

- Stop work at fossil find. The site foreman and ECO must be informed.
- Protect the find site from further disturbance and safeguard all fossil material in danger of being lost such as in the excavator bucket and scattered in the spoil heap.
- The ECO or site agent must immediately inform the SAHRA and/or the contracted standby palaeontologist of the find and provide via email the information about the find, as detailed below.
    - Date
    - Position of the excavation (GPS) and depth.
    - A description of the nature of the find.
    - Digital images of the excavation showing vertical sections (sides) and the position of the find showing its depth/location in the excavation.
    - A reference scale must be included in the images (tape measure, ranging rod, or object of recorded dimensions).
    - Close-up, detailed images of the find (with scale included).

The SAHRA and/or the contracted standby palaeontologist will assess the information and a suitable response will be established which will be reported to the developer and the ECO, such as whether rescue excavation or rescue collection by a palaeontologist is necessary or not. The response time/scheduling of the rescue fieldwork is to be decided in consultation with developer/owner and the ECO. It will probably be feasible to “leapfrog” the find and proceed to the next excavation, or continue a trench excavation farther along, so that the work schedule and machine time is minimally disrupted. The strategy is to rescue the material as quickly as possible.

16.3 APPLICATION FOR A PERMIT TO COLLECT FOSSILS

A permit from SAHRA is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist). Should fossils be found that require rapid collecting, application for a palaeontological permit must immediately be made to SAHRA. All fossils must be deposited at a SAHRA-approved institution. In addition to the information and images of the find, the application requires details of the registered owners of the sites, their permission and a site-plan map.