PALAEONTOLOGICAL IMPACT ASSESSMENT

(DESKTOP STUDY)

PROPOSED VREDELUS 132/22 KV SUBSTATION AND VERLORE-VREDELUS 132 KV OVERHEAD POWERLINE

WITH FOSSIL FIND PROCEDURES

Project Reference 0104439, Task 1, Eskom Verlore/Vredelus

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Updated 15 December 2009

CONTENTS

SUMMARY

This Palaeontological Impact Assessment (PIA) has been prepared at the request of Environmental Resources Management (ERM), the environmental management consultants appointed by parastatal power-provider ESKOM to undertake the Environmental Impact Assessment (EIA) for proposed upgrading of the electric power supply in the Redelinghuys area, Western Cape (Figure 1).

Eskom therefore proposes to install a new 132 kV overhead powerline (approximately 13 km long route) linking between a switching station on the existing Verlore powerline and a new substation at Vredelus, near Redelinghuys. Initially, two possible routes were considered in the EIA (Figures 1-3), *viz*. the Proposed Route and the Alternative Route. Subsequently, the Botanical Assessment recommended a third alternative, Alternative 3, to ameliorate the impact of the powerline upon the critically-endangered Leipoldtville Sandy Fynbos.

The affected area is situated in the Verlorevlei catchment, an area known for its rich landscape and archaeological heritage. The geological setting (Figure 2) of the affected area is outlined. The proposed powerline traverses Sandveld which in this area is the youngest geological unit added to the coastal plain. The Sandveld is embodied in a geological unit of coversand labelled Q1 (Figure 2). These sands have accumulated by wind (aeolian) activity, as sandsheets and small dunes, during the last ~70 thousand years (ka). Underlying Unit Q1 is an older coversand unit, labelled Q2, which manifests outside the immediate area as "heuweltjiesveld" where it is not covered by the pale, loose sands of Q1.

The potential for fossils being present relates to the processes of aeolian accumulation and erosion and environments that occur is such a landscape; these are sketched in "Palaeontology of Aeolian Sands". As the sands accumulated intermittently during climatic fluctuations, there are buried palaeosurfaces caused by stability, omission and erosion upon which fossil material (and archaeological) will preferentially occur. There could be buried, fossiliferous spring/pond/vlei deposits relating to past higher water tables.

Specific details of the structures to be erected are not yet available. For the present, an assumption is that foundations for the substation and footings for the pylons will involve excavations that do not exceed 3 m in depth.

The probability of fossils being found in shallow excavations into units Q1 and Q2 is overall low.

The monitoring of the excavations by a professional specialist is not readily justified.

However, as is outlined above, the potential for finding fossils, although low, is not altogether lacking.

Interventions are required if bones are turned up during excavation. These are rare and valuable and every effort should be made to spot them and effect rescue of them.

It is therefore proposed that ESKOM personnel or their Contractor involved in the making of excavations keep a lookout for fossil material during digging.

To this end, an overall responsible person must be designated. This may be the Environmental Control Officer (ECO) for the project.

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to watch for fossil bones and buried potential 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 ERM who will contact the palaeontologist contracted to be on standby in case of fossil finds.

The palaeontologist will liaise with ERM and the ECO and a suitable response will be established.

"Fossil Find Procedures" are provided in the event of discovery of fossil material.

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INTRODUCTION

This assessment has been prepared at the request of Environmental Resources Management (ERM), the environmental management consultants appointed by parastatal power-provider ESKOM to undertake the Environmental Impact Assessment (EIA) for proposed improvements to the electric power supply in the Redelinghuys area, Western Cape (Figure 1).

Due to the increase in power demand, the supply to the Redelinghuys area has become inadequate and unreliable. Eskom therefore proposes a new 132 kV overhead powerline (approximately 13 km long route) linking between a switching station on the existing Verlore powerline and a new substation at Vredelus, near Redelinghuys. Three possible routes are being considered in the EIA (Figures 1-3). Alternative 3 is recommended in the Botanical Assessment.

The EIA for the proposed project is being undertaken in terms of the EIA Regulations under the National Environmental Management Act (NEMA) (Act No. 107 of 1998) as amended. The regulatory authority is the national Department of Environmental Affairs (DEA).

The National Heritage Resources Act (No. 25 of 1999) protects archaeological and palaeontological sites, graves/cemeteries, battlefield sites and buildings, structures and features over 60 years old. According to the Act, it is an offence to destroy, damage, excavate, alter of remove from its original place, or collect, any archaeological, palaeontological and historical material or object, without a permit issued by the South African Heritage Resources Agency (SAHRA) or applicable Provincial Heritage Resources Agency, *viz*. Heritage Western Cape (HWC).

The main purposes of this palaeontological assessment are to:

- Outline the nature of possible palaeontological heritage resources in the subsurface of the affected area.
- Suggest the mitigatory actions to be taken during the installation of the infrastructure with respect to the occurrence of fossils.

The report also outlines a fossil finds procedure for the appropriate responses to the discovery of paleontological materials during construction excavations when a palaeontologist is not on site.

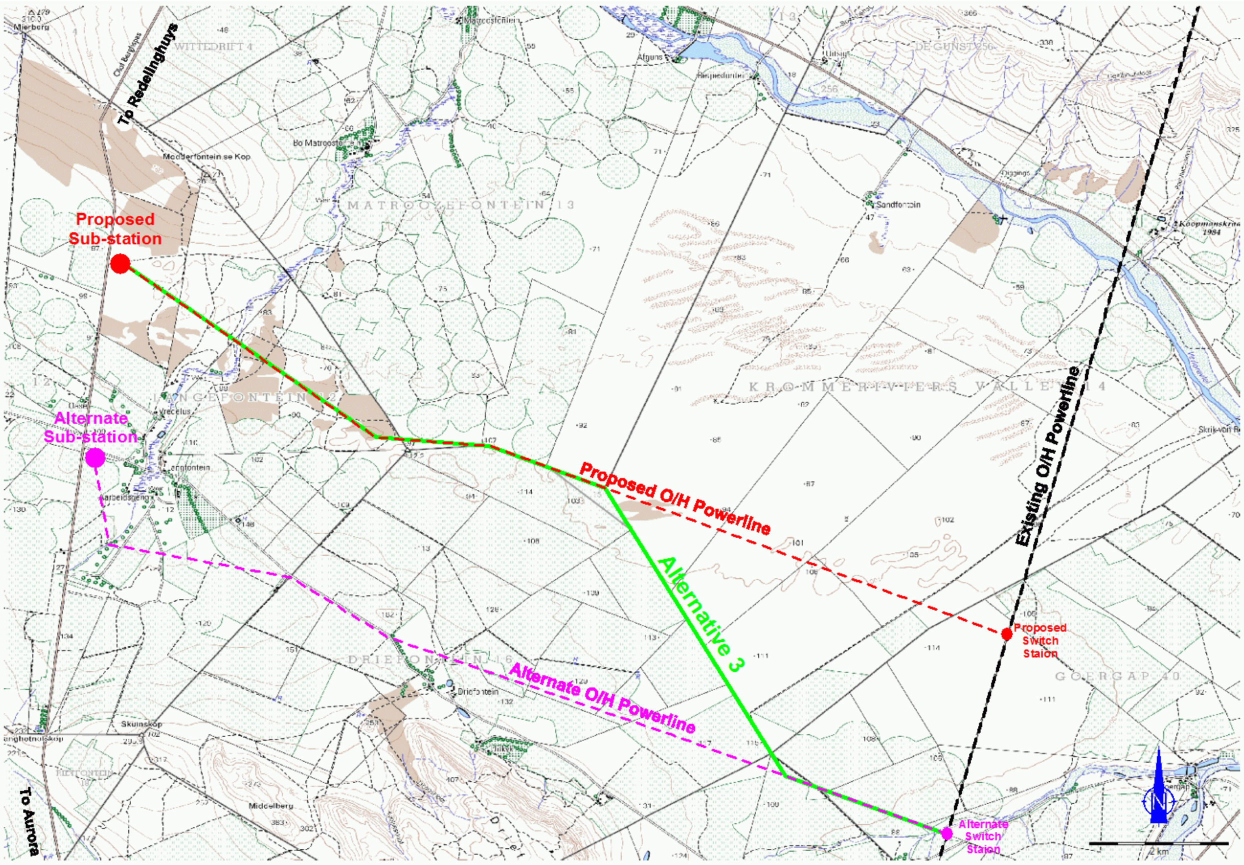

Figure 1. Location of the proposed installation. Extract of 1:50 000 3218DA_2003_ED3_GEO.TIF. Chief Directorate: Surveys & Mapping.

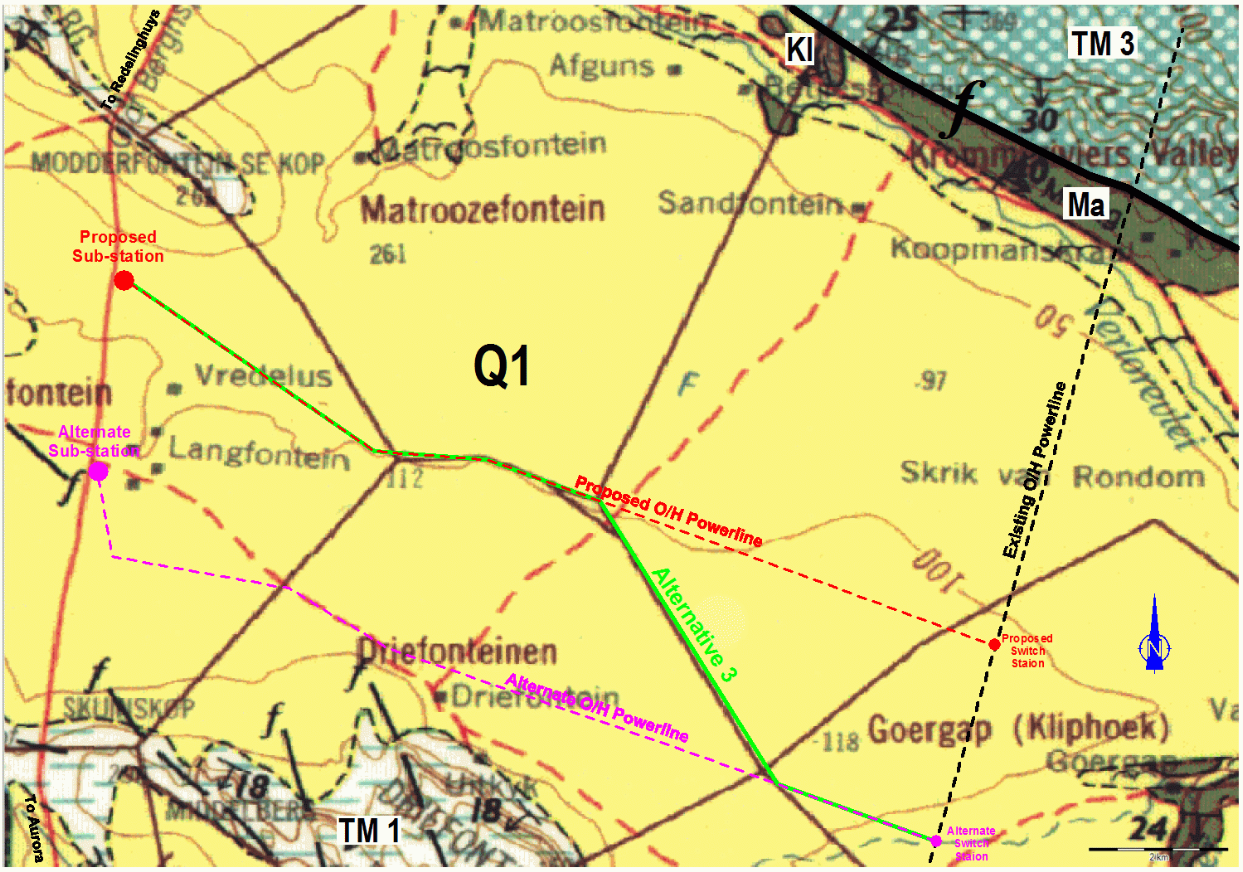

Figure 2. Geology of the area. Extract of 1:250 000 Geological Series. 3218 CLANWILLIAM. Department of Mines, South Africa.

GEOLOGICAL SETTING

The affected area is situated in the Verlorevlei catchment, an area known for its rich landscape and archaeological heritage. The Verlorevlei flows along a major ancient fault line, last most active during the breakup of the supercontinent Gondwana. It has been suggested that the ancient Berg River flowed past Piketberg and then along the fault-controlled present course of the Verlorevlei River during Cretaceous times 120-60 Ma (Hendey, 1983) (1 Ma = 1 million years ago). The Verlorevlei River of today thus occupies a valley that dates back to the earliest existence of the West Coast. The geological map of the relevant area (Figure 2) shows this fault (marked by a large ***f***) in the upper-right corner. The faulting, together with subsequent river erosion, has determined the topography of the area and the spatial distribution of the bedrock types. The strata to the north of the fault are downthrown, so that erosion has exposed older strata in the south (**Ma** & **Kl**) that are abruptly juxtaposed against younger strata (**TM 2**) on the north side of the Verlorevlei valley.

The area under assessment is covered by Sandveld, coloured yellow and labelled **Q1,** the latter being the youngest geological unit added to this part of the coastal plain. From the geological map (Figure 2) it can be seen that the area must be largely underlain at depth by a bedrock that is the oldest substratum of the region, namely the **Malmesbury Group** (**Ma)**. These are shaly, deformed and metamorphosed sediments, deposited as muds 570-540 Ma in a Precambrian ocean basin that subsequently was closed and squeezed up due to an ancient continental collision (Gresse *et al*. 2006). Malmesbury Group metasediments are easily-weathered and easily-eroded and form the topographically-lowest bedrock underlying the coastal plain, buried beneath sediments and weathered mantles.

Klipheuwel Group (**Kl**) mudstones and sandstones, dating from the Cambrian Period 540-500 Ma, also occur in places in the area, usually bounded by smaller-scale faults. Deposition on coastal alluvial plains grading to shallow-marine environments is envisaged (Gresse *et al*. 2006). Interestingly, the only fossils known from the Klipheuwel Group are sparse trace fossils (*Merostomichnites* - arthropod scratch marks) that occur near Elandsbaai (Almond, 2008). These are probably the oldest fossils certainly known from the area.

Overlying the previous are the well-lithified sandstones of the **Table Mountain Group** (TMG) (Thamm & Johnson 2006). These resistant quartzite sandstones and conglomerates form the local mountains, hills and ridges surrounding the area of interest. The lowermost or oldest formation of the TMG and is named the Piekenierskloof Formation (labelled **TM1** in Figure 2). North of the major Verlorevlei fault, the sandstone ridge is comprised of the Peninsula Formation (**TM3**). The Graafwater Formation (TM2) is sandwiched between, but does not outcrop in the area of current interest. The Piekenierskloof and Peninsula formations were deposited by braiding rivers, as the river courses wandered, unrestricted by any vegetation, across wide fluvial plains between 480-440 Ma in the Ordovician Period. The Graafwater Formation, exposed just outside the area of interest, comprises distinctively reddish strata of mudstones and siltstones probably deposited on tidal-flats. This is the oldest formation in the Cape wherein trace fossils (burrows and arthropod tracks) become common.

A vast amount of geological time intervenes between these bedrock formations and the deposits that cover them on the coastal plain and up the lower-lying valley areas. Much has been eroded away subsequent to continental breakup from ~150 Ma and by the beginning of the Cenozoic Era ~65 Ma the essentials of the coastal topography were probably in place. High sea levels during the Eocene (56-34 Ma) may have transgressed across the area, but it is unlikely that any such deposits remain.

The oldest deposits are found infilling ancient, buried valleys and are river and marsh deposits of the **Elandsfontyn Formation** (Rogers, 1980, 1982). The Elandsfontyn Formation is not exposed and is only sampled in boreholes. The depositional environments are interpreted to be those of meandering rivers under humid climatic conditions (Rogers, 1980, 1982). The Elandsfontyn Formation contains fossil pollen indicative of forest vegetation with palms and is considered to be Miocene in age (Coetzee, 1978; Rogers, 1982; Hendey, 1981a), but more precise age constraints are lacking.

In general, the oldest Cenozoic marine deposits found on the coastal plain are of mid-Miocene age ~16 Ma. These occur up to about 100 m asl., but are poorly preserved unless they are very coarse (cobbles and boulders), or have been sheltered from erosion beneath a cliffed palaeoshoreline. Subsequent Pliocene palaeoshoreline deposits (5-4 Ma) are found below ~50 m asl. (Pether *et al*., 2000).

Leached silica sands and muddy sands, locally with peats, occur extensively beneath the coversands of the coastal plain. This has been named the **Papkuils Formation** in the area between the Berg River and Verlorevlei (Rogers, 1980). This formation is seldom exposed, being encountered in boreholes and wells, but is exposed in some cuttings along the Saldanha-Sishen railway line. These deposits are much altered from their original state by groundwater leaching and pedogenesis. Deposition in a variety of setting is likely; some parts could be aeolian, other parts coastal marshes and parts could have originally been marine.

Ancient dunes of the late Miocene Prospect Hill Formation (<10 Ma) and the Plio-Pleistocene Langebaan Formation (<5 Ma), comprised of calcareous aeolianites that form ridges or low hills with capping calcrete carapaces (Roberts *et al*., 2006), do not crop out in the area of interest.

As mentioned, Unit **Q1** is the youngest geological unit and it forms a surface cover blanketing more ancient formations. It is described as “white to slightly-reddish sandy soil” (Visser & Toerien, 1971; Visser & Schoch, 1973). Visser & Schoch (1973) consider the sands to be largely derived from older, underlying sands and to a lesser extent from the erosion of bedrock (Klipheuwel and Table Mountain Group sandstones), the coastal dunes, and fluviatile deposits of past and present drainage systems.

Unit Q1 overlies an older surface unit labelled **Q2**. Q2 is light reddish-brown, sandy soil that manifests as the distinct “heuweltjiesveld”, the “polka-dot patterned landscape of low hillocks that are termitaria. The “heuweltjies” have internal calcretes due to enrichment in calcium by the plant-gathering activity of the termites. Ferruginous concretions also occur locally in this older soil.

Significantly, Q2 heuweltjiesveld has not formed on the Last Interglacial (LIG) Velddrif Formation raised beach deposits adjacent to the coast (Visser & Schoch, 1973). This suggests that this soil cover is older than ~125 ka. More recently, Chase & Thomas (2007) have cored Q1 sands and applied optically stimulated luminescence (OSL) dating techniques to establish the timing of sand accumulation. Their results indicate activity/deposition at 4–5, 16–24, 30–33, 43–49 and 63–73 ka. Underlying sands produced dates from ~150 to ~300 ka, evidently reflecting the accumulation of Unit Q2. Unit Q2 may be underlain by the Papkuils Formation in this area (or the Langebaan Formation in other areas).

The aerial image (Figure 3) shows that Unit Q1 over the northern part of the area, where if mantles the slope below ~100 m asl. down towards the Verlorevlei River, consists of pale sand and is therefore the youngest part of Q1. Linear ridges of approximately E-W orientation attest to recent sand mobility, apparently by topographically-steered wind. Parts of the sand cover have lost stabilizing vegetation and are remobilized. In the southern part of the area, on the higher ground closer to the hills of TMG, Unit Q1 is tinted to very pale yellow or reddish, reflecting older sands.

Closer to the hills it is possible that colluvial slope deposits may underlie or be interbedded with the windblown sands. A small local drainage rises from a wetland on Langefontein 12, near the site of the Alternate Substation.

A DWAF map (Lewarne, 2009) indicates a sand thickness of 0-3 m over most of the area. This is probably an underestimate and sand thicknesses of a few metres (2-5 m?) is more likely. Thicker sand, apparently up to 10 m, occurs beneath the wetland just east of the Alternate Substation site.

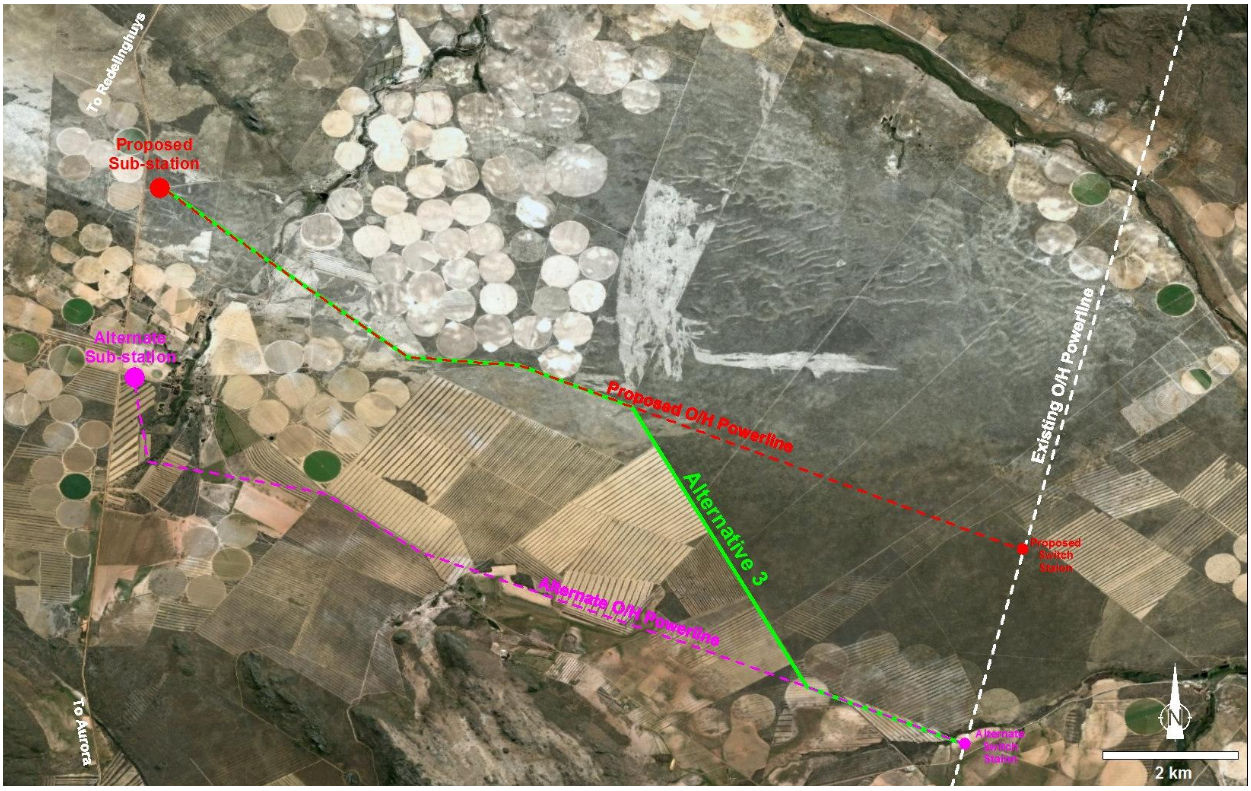

Figure 3. Aerial view of the area. From Google Earth.

PALAEONTOLOGY OF AEOLIAN SANDS

The proposed installations will disturb Unit Q1 and possibly Unit Q2. The palaeontological potential thus relates to the contexts of fossils in aeolian sands.

Fossils will be very scarce within the main bulk of dune and coversands, but they will be found in greater numbers in association with the buried surfaces that represent pauses in sand accumulation, when the surface was stabilized and colonized by vegetation and animals. The causes of diminished sand supply are inter-related factors of climate change, such as changes in windiness, rainfall and sand availability. These old buried surfaces, called palaeosurfaces, are usually marked by various degrees of soil formation. This can vary from very immature soil layers, grey-coloured with more organic content (from plants) than the main sand, to more developed, pink to brown soils with additional mud/clay content from the weathering of unstable mineral grains. Soils could also be marked by fossil root zones.

Although fossils in aeolian accumulations are more common in association with longer-lived, more-stable surfaces, the best concentrations of fossils are formed where the wind scours away and removes previously-deposited sand, producing a scoop-shaped palaeosurface called a “blowout”. The fossils that were sporadically distributed within the sands are then concentrated on the bottom of the “deflation” blowout.

This erosional scenario can be extended to larger areas in which sand is moving through on the long term, in the form of migrating dunes at various scales. At any one time there are numerous blowout areas between migrating sand forms. Objects on or within the migrating sand end up on the stable surface across which it is moving. This basal surface could be a compact, semi-consolidated soil palaeosurface capping previously-deposited sands. It may also be a surface controlled by the water table, where the damp/wet sand at depth is prevented from being blown away. These sorts of “floors” or “omission surfaces” are an absolute must as a target for fossil hunting and rescue.

Not unexpectedly, the most common fossils in the dunes are land snail shells, tortoise shells/bones and the bones of moles. Less easily seen, but obtainable by sieving, are “micromammal” bones of rodents and small birds and reptiles. These fossils may occur anywhere in the dune sand, but as mentioned, are more common in and just below a palaeosurface “soil”. This is particularly noticeable for the more common snail shells – a concentration of these is a clue indicating a closer look may worthwhile.

Fossil bones of larger animals (antelopes, ostriches, jackals, porcupines) usually occur very sparsely over a broader area. In many cases these appear to be isolated finds, but what appears to be a single bone may lead to further finds at the spot, such as a scatter of bones accumulated by hyaenas, which may include quite a variety of animals. Hyaena bone concentrations are also found in the holes made by aardvarks, which the hyaena has taken over to use as a lair.

A deeper blowout may subsequently become a pond of standing water, due to increased rainfall, lack of a drainage outlet between surrounding dunes and rising local water table. This occurs on a variety of scales, from a mere small boggy area to small vleis. As local sources of water, they attract the larger herbivores from the surrounding area, their predators and scavengers and thus become a spot where fossils occur. Larger vleis occur where groundwater seepage surfaces and these are the real fossil bonanzas of the dunefield setting for they preserve a great variety of fossil material. Larger vleis are mysteriously detected by hippos, which plod over the dunes to take up residence. Then there is the fossil record of the pond/vlei life itself, a lot of which also turns up rather mysteriously, like the frogs, aquatic snails and small fish. The best bet is for their eggs being inadvertently brought in by birds, a sample of which are also entombed. Microfossils include the ostracods (microscopic crustaceans with often very specific requirements) and the diatoms (minute plants with glass shells). More locally, reeds, leaves, fruiting bodies and root masses are preserved in the muds. Ancient ponds and vleis, as natural traps of windborne material, also provide a glimpse of the greater, surrounding vegetation, in the form of pollen capsules from near and far, and windborne charcoal fragments from fires, usually of fairly close origin.

Ancestral South Africans were around during the times of formation of units Q1 and Q2. Thus it is perfectly possible that some of the bones found in the sands may be associated with past human activities. This is indicated by the co-occurrence of mussel and limpet shells, stone tools, pottery and charcoal from cooking hearths. Archaeological material and bones are often exposed where blowouts have formed, due to loss of vegetation and disturbance.

ASSUMPTIONS AND LIMITATIONS

Specific details of the structures to be erected are not yet available. For the present, an assumption is that foundations for the substation and footings for the pylons will involve excavations that do not exceed ~3 m in depth.

Specific details of the geological section in the area are not readily available. The most likely source of subsurface information would be water boreholes logged during investigations by DWAF, but these usually contain just basic lithological information. The DWAF website lists some reports of possible relevance to the area in question, but these were not available online. An internet search uncovered a MA thesis (Lewarne, 2009) that reproduces a DWAF-sourced map of sand thickness.

It is not possible to predict the buried fossil content of an area other than in general terms. Fossil bones are sparsely scattered in coastal deposits and much depends on spotting them as they are uncovered during digging *i.e.* by monitoring excavations.

EXPECTED PALAEONTOLOGY

The Proposed Powerline Route initially crosses less disturbed veld on younger Q1 sands for ~5.5 km, along which the surface visibility of fossil or archaeological material is likely to be low. The remainder of the route to the Proposed Substation traverses disturbed terrain with less shrub cover and possibly local blowout areas within which previously-buried material may be visible.

The Alternate Powerline Route traverses ploughed agricultural lands where the surface visibility of fossil or archaeological material is also likely to be low.

Excavations that penetrate to ~3 m depth will penetrate Q1 sands, within which there are likely to be palaeosurfaces, as is indicated by the OSL dating that shows intermittent accumulation.

In places where Q1 is thinner, Q2 sands may be reached. The palaeosurface between units Q1 and Q2 is the main buried surface in the broader area. It is expect to be marked by Q2 sands being distinctly darker, more brownish in colour and more compact than looser, paler Q1 sands.

Unit Q2 may be underlain by bedrock or possibly the Papkuils Formation. However, the latter are unlikely to be encountered in shallow excavations unless both Q1 and Q2 are very thin.

In the area in question, the above comments pertaining to vleis would apply to the wetland adjacent to the Alternate Substation on Langefontein 12. It has very likely fluctuated in size over millennia and probably has the greatest fossil potential. However, the Alternate Substation is evidently situated too high upslope on its flank for potential buried vlei deposits to be intersected in shallow excavations.

IMPACT ASSESSMENT

SIGNIFICANCE

Fossil finds in this context stand to have heritage/scientific benefits in increasing the knowledge of the coversands of the coastal plain. The various periods during which the coversand formations (units Q1 and Q2) were deposited in different areas are not well-constrained by fossil evidence, as very few fossils have been collected/rescued. Only recently has a modern dating method (OSL) been applied at a few localities.

There are two key localities that show that the fossil potential within coversands and dunes can be very significant. The most well-studied is Elandsfontein, where blowouts of the coversand exposed thousands of underlying fossil bones and Stone Age tools, the occurrence of which is associated with a fossil vlei formed due to higher water tables in the past (Klein *et al*., 2007). The other is the Geelbek Dunefield, where the deflation hollows located between the wind-blown, actively-mobile sand dunes are a source of mammalian fossils and Stone Age tools, with more being constantly exposed (Kandel *et al*., 2003).

Although the excavations involved in the installation are of limited depth and the fossil potential is low overall, the number of excavations involved increases the probability of fossils being turned up.

It is also possible that fossil material may be exposed by "deflation" in areas of remobilized sand.

Notably, prior to the wind erosion of Q1 sands at Elandsfontein, there would have been no indication of the fossil wealth just below.

In summary, the significance of fossils that may be found involves:

- Significance in the history of coastal-plain evolution.
- For future radiometric and chemical dating purposes (rates of coastal change).
- Preservation for the application of yet unforeseen investigative techniques.
- Rescuing of fossil bones is very important. These may not necessarily represent species that we would expect nowadays. Modern analytical techniques such as stable isotopic analyses can reveal indications of diets and environmental conditions of the past.

NATURE OF THE IMPACT

Extents

The physical extent of impacts on potential palaeontological resources relates directly to the extents of subsurface disturbance during construction.

Duration

According with the above, the initial duration of the impact is shorter term (< year) and primarily related to the period over which infrastructural excavations are made. This is the "time window" for mitigation.

Intensity

The impact of construction on fossil resources is high in the absence of mitigation. This is because 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 w.r.t. palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources and loss of the opportunity to recover them and their contexts when exposed at a particular site is irreversible.

Probability

The likelihood of impact is low, but probable. Although coastal sands are not generally very fossiliferous, it is quite possible that fossiliferous material could occur. The very scarcity of fossils makes for the added importance of them being sought.

Confidence

The level of confidence of the probability and intensity of impact is medium to high.

Status of the impact

The status of the potential impact for palaeontology is not neutral. Fossils and/or significant observations will be lost in the absence of management actions to mitigate such loss.

There remains a medium 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.

On the other hand, from the point of view that the "windows" into the coastal plain deposits, that provide access to fossils, would not exist without excavations being made, the impact is positive for palaeontology, provided that efforts are made to watch out for and rescue the fossils.

RECOMMENDATIONS

As the probability of fossils being found during the making of excavations in this area is overall low and the excavations individually are relatively small and shallow (*cf*. more extensive infrastructure for housing estates, deeper borrow pits and mine quarries/pits), the monitoring of the excavations by a professional specialist is not readily justified.

However, as is outlined above, the potential for finding fossils, although low, is not altogether lacking.

Interventions are required if bones are turned up during excavation. These are rare and valuable and every effort should be made to spot them and effect rescue of them.

It is therefore proposed that ESKOM personnel or their Contractor involved in the making of excavations keep a lookout for fossil material during digging.

To this end, an overall responsible person must be designated. This may be:

- The Environmental Control Officer (ECO) for the project.
- The Project Manager.
- Preferably, whoever is going to be most often in the field (the ECO?).

The field supervisor/foreman and workers involved in digging excavations must be informed of the need to watch for fossil bones and buried potential archaeological material. Also, in areas of denuded vegetation and wind scour, to look out for fossils and stone tools being exposed in the vicinity of the powerline.

Workers seeing potential objects are to report to the field supervisor who, in turn, will report to the ECO. The ECO will inform ERM who will contact the palaeontologist contracted to be on standby in the case of fossil finds.

Below are proposed procedures in the event of discovery of fossil material.

FOSSIL FIND PROCEDURES

In the context of the sites under consideration, it is improbable that fossil finds will require declarations of permanent "no go" zones. At most a temporary pause in activity at a limited locale may be required. The strategy is to rescue the material as quickly as possible.

Bone finds can be classified as two types: isolated bone finds and bone cluster finds.

ISOLATED BONE FINDS

In the process of digging the excavations, isolated bones may be spotted in the hole sides or bottom, or as they appear on the spoil heap. By this is meant bones that occur singly, in different parts of the excavation. If the number of distinct bones exceeds 6 pieces, the finds must be treated as a bone cluster (below).

Response by personnel in the event of isolated bone finds

- **Action 1:** An isolated bone exposed in an excavation or spoil heap must be retrieved before it is covered by further spoil from the excavation and set aside.
- **Action 2:** The site foreman and ECO must be informed.
- **Action 3:** The responsible field person (site foreman or ECO) must take custody of the fossil. The following information to be recorded:
    - Position (excavation position).
    - Depth of find in hole.
    - Digital image of hole showing vertical section (side).
    - Digital image of fossil.
- The fossil should be placed in a bag (e.g. a Ziplock bag), along with any detached fragments. A label must be included with the date of the find, position info., depth.
- **Action 4:** ECO to contact ERM and ERM contacts standby palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of isolated bone finds

The palaeontologist will liaise with ERM and the ECO and a suitable response will be established. This involves description of the occurrence. It is desirable that the images of the find are relayed to ERM and the palaeontologist.

BONE CLUSTER FINDS

A bone cluster is a major find of bones, *i.e*. several bones in close proximity or bones resembling part of a skeleton. These bones will likely be seen in broken sections of the sides of the hole and as loose bones appearing in the bottom of the hole and on the spoil heap. Bone clusters may involve:

- Human burials.
- Archaeological sites.
- Hyaena bone accumulations.
- Bone concentrations on a palaeosurface or in a blowout.
- Bone concentrations associated with a waterhole or vlei.

Response by personnel in the event of a bone cluster find

- **Action 1:** Immediately stop excavation in the vicinity of the potential material.
- **Action 2:** Inform the site foreman and the ECO.
- **Action 3:** ECO to contact ERM. ERM contacts standby palaeontologist. ECO to describe the occurrence and provide images asap. by email.

Response by Palaeontologist in the event of a bone cluster find

The palaeontologist will liaise with ERM and the ECO and a suitable response will be established.

It is likely that a field assessment by the palaeontologist will be carried out asap.

In the case of excavations for pylons, it is feasible to "leapfrog" the find and continue farther along, so that the work schedule is minimally disrupted. In the case of excavations for substation foundations, digging could continue at the farther away by 10 m.

The field assessment could have the following outcomes:

- If a human burial, the appropriate authority is to be contacted (see AIA). The find must be evaluated by a human burial specialist to decide if Rescue Excavation is feasible, or if it is a Major Find.

- If the fossils are in an archaeological context, an archaeologist must be contacted to evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.
- If the fossils are in an palaeontological context, the palaeontologist must evaluate the site and decide if Rescue Excavation is feasible, or if it is a Major Find.

Rescue Excavation

Rescue Excavation refers to the removal of the material from the just the "design" excavation. This would apply if the amount or significance of the exposed material appears to be relatively circumscribed and it is feasible to remove it without compromising contextual data. The time span for Rescue Excavation should be 1-3 days and definitely less than 1 week.

Should there be indications that the fossil material extends beyond the immediate excavation site, where it will not be rendered inaccessible (covered) by the installation, it is possible that the surrounding area could be left alone for later excavation after installation of the pylon or substation.

Major Find

A Major Find is the occurrence of material that, by virtue of quantity, importance and time constraints, cannot be feasibly rescued without compromise of detailed material recovery and contextual observations.

A Major Find is not expected.

MANAGEMENT OPTIONS FOR MAJOR FINDS

In consultation with ERM and ESKOM the following options should be considered when deciding on how to proceed in the event of a Major Find.

Option 1: Avoidance

Avoidance of the major find through project redesign or relocation. This ensures minimal impact to the site and is the preferred option from a heritage resource management perspective.

When feasible, it can also be the least expensive option from a construction perspective.

The find site will require site protection measures, such as erecting fencing or barricades. Alternatively, the exposed finds can be stabilized and the site refilled or capped. The latter is preferred if excavation of the find will be delayed substantially or indefinitely. Appropriate protection measures should be identified on a site-specific basis and in wider consultation with the heritage and scientific communities.

This option is preferred as it will allow the later excavation of the finds with due scientific care and diligence.

Option 2: Emergency Excavation

Emergency excavation refers to the "no option" situation wherein avoidance is not feasible due to design, financial and time constraints. It can delay construction and emergency excavation itself will take place under tight time constraints, with the potential for irrevocable compromise of scientific quality.

Consequently, emergency excavation is not a preferred option.

COMMUNICATION

ESKOM

ECO: To be provided.

Site Foreman: To be provided.

Project Manager: To be provided.

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FOSSIL FINDS: ADDITIONAL NOTES

APPLICATION FOR A PALAEONTOLOGICAL PERMIT

A permit from Heritage Western Cape (HWC) is required to excavate fossils. The applicant should be the qualified specialist responsible for assessment, collection and reporting (palaeontologist).

However, as the probability of fossil finds is low, a permit has not been applied for prior to the making of excavations.

Should fossils be found, application for a retrospective palaeontological permit will be made to HWC immediately.

The application requires details of the registered owners of the sites, their permission and a site-plan map.

All samples of fossils must be deposited at a SAHRA-approved institution.

REPORTING

Should fossils be found a detailed report on the occurrence/s must be submitted. This report is in the public domain and copies of the report must be deposited at the IZIKO S.A. Museum and Heritage Resources Western Cape. It must fulfil the reporting standards and data requirements of these bodies.

The report will be in standard scientific format, basically:

- A summary/abstract.
- Introduction.
- Previous work/context.
- Observations (incl. graphic sections, images).
- Palaeontology.
- Interpretation.
- Concluding summary.
- References.
- Appendices

The draft report will be reviewed by the client, or externally, before submission of the Final Report.

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ABBREVIATIONS

AIA — Archaeological Impact Assessment

asl. — above (mean) sea level.

DWAF — Department of Water Affairs and Forestry. (Now the Department of Water and Environmental Affairs (DWEA).

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. Generally not used for durations not extending from the Present. Sometimes “kyr” is used instead.

LIG — Last Interglacial. Warm period 128-118 ka BP. Relative sea-levels higher than present by 4-6 m. Also referred to as Marine Isotope Stage 5e or “the Eemian”.

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. Generally not used for durations not extending from the Present.

w.r.t. — with respect to.

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John Pether

5 November 2009. (Updated 15 December 2009).