Nurture, Grow, Treasure

TITLE: PALAEONTOLOGICALIMPACT ASSESSMENT FOR THE PROPOSEDHELIOS-JUNO 765KV TRANSMISSION POWER LINE AND SUBSTATIONS UPGRADE, WESTERN AND NORTHERN CAPE PROVINCES

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DECLARATION OF INDEPENDENCE

This report has been compiled by Professor Marion Bamford, lead Palaeontologist for NGT Consulting. The views expressed in this report are entirely those of the author and NGT Consulting no other interest was displayed during the decision making process for the project.

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EXECUTIVE SUMMARY

There is a chance of finding fossils in the Nama and Vanrhynsdorp Group sediments but they are rare and difficult to recognize. There is an extremely low chance of finding fossils in the sediments of the Dwyka Group. There is a slightly greater chance of fossils occurring in theWhitehill and Tierberg Formations but again reports; are rare. Along palaeodrainage channels, watercourses or around pans; there is a better chance of finding Quaternary aged fossils of wood and bones.

It is recommended that once the routes have been selected and the sites for road access and excavation of foundations of towers have been determined;then a geologist or environmentalist should be engaged to monitor the work.

When fossils are discovered; a palaeontologistshould be engaged to check the potential fossils and decide what should be removed and preserved (with the relevant permit from SAHRA or HWC). The rescued fossils would then be housed and catalogued in a recognized institution such as the McGregor Museum in Kimberley or Iziko Museum in Cape Town.

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1. BACKGROUND

Eskom Holding SOC Limited proposes to construct a 765kV transmission power line for the "Proposed Northern Alignment 765kV Power Line Project". A section of this line is to run from the existing Juno Substation near Vredendal in the Western Cape Province to the Helios Substation north of the town of Loeriesfontein in the Northern Cape Province. The total length of the power line would be approximately 160km. For this purpose; three alternative alignments have been identified, one of which will be selected as the most viable proposition.

The access roads and foundations for the towers are likely to impact on the palaeonotological heritage in certain sections of the proposed route but it is anticipated that overall the impact will be minimal.

A broad area between Juno substation (31°36'06.25"S and 18°26'32.59"E) near Vredendal and Helios substation (30°30'01.26"S and 19°33'27.05"E) near Loeriesfontein (Fig 1) has been assessed for the potential impact of this project.

2. METHODS

Published geological and palaeontological literature, unpublished records and databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there. The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that proposed developments must be preceded by the relevant impact assessment, in this case for palaeontology.

2.1 STAGES

1. In order to determine the likelihood of fossils occurring in the affected area; geological maps, literature, palaeontological databases and published and unpublished records must be consulted.
2. If fossils are likely to occur then a site visit must be conducted by a qualified palaeontologist to locate and assess the fossils and their importance.
3. Unique or rare fossils should either be collected (with the relevant SAHRA permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site.
4. Common fossils can be sacrificed only if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

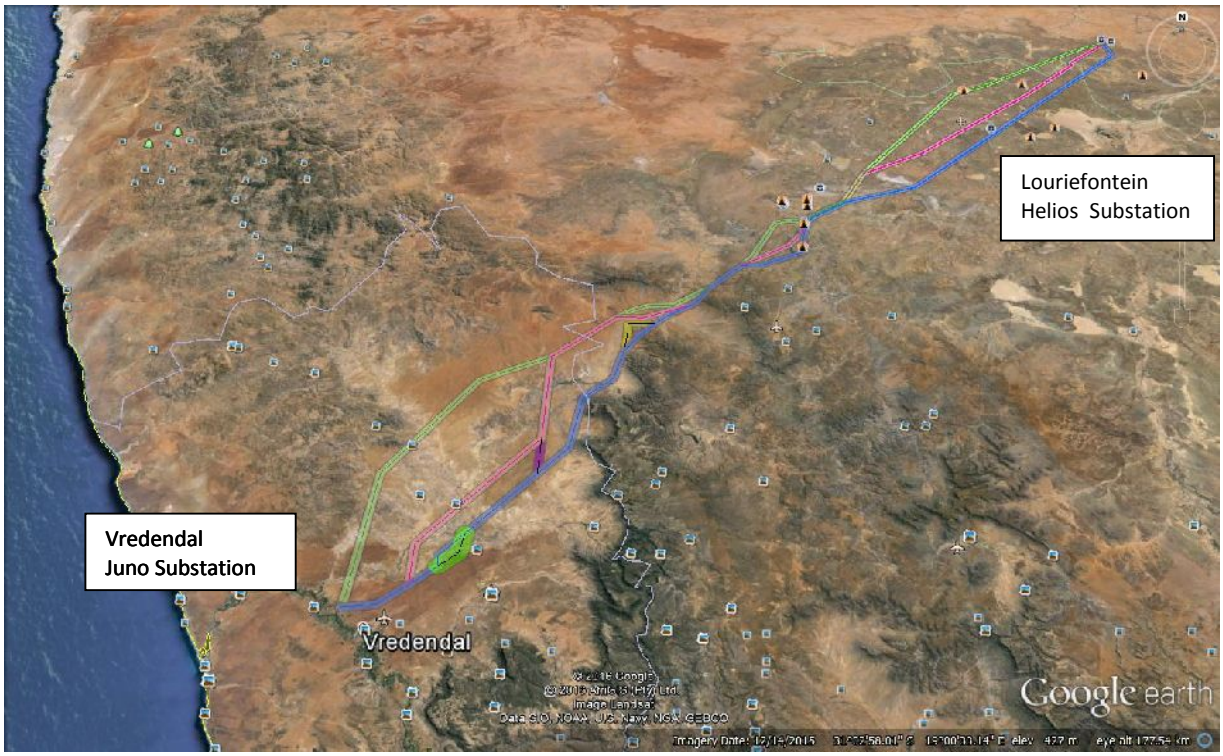

Figure 1 – Google map of the proposed routes and corridor from the existing Juno Substation northwest of Vredendalrdt to the Helios Substation north of the town of Loeriesfontein in the Northern Cape Province. The total length of the power line would be approximately 160km. For this purpose; three alternative alignments have been identified, one of which will be selected as the most viable proposition.

3. A GEOLOGICAL AND PALAEONTOLOGICAL CONTEXT OF THE SITE

The oldest rocks occurring in the region are near Kenhardt but these are small outcrops of granites. Because these rocks are of volcanic origin, they do not contain fossils. The rest of the sediments are much younger but have been studied in great detail by palaeontologists.

Most of the region contains sediments of the Nama and Vanrhynsdorp Groups which are Late Proterozoic in age, 770-550 Ma and are not listed by Almond and Pether as being fossiliferous (2009). The Vanrhynsdorp and Nama Groups however; are known to have fossils: stromatolites, fish, trace fossils and shells. The localities of these recorded fossils are Namaqualand, SE of Garies(Grootriet / Arondegas area)and Bokkeveld Plateau eastof Vanrhynsdorp.

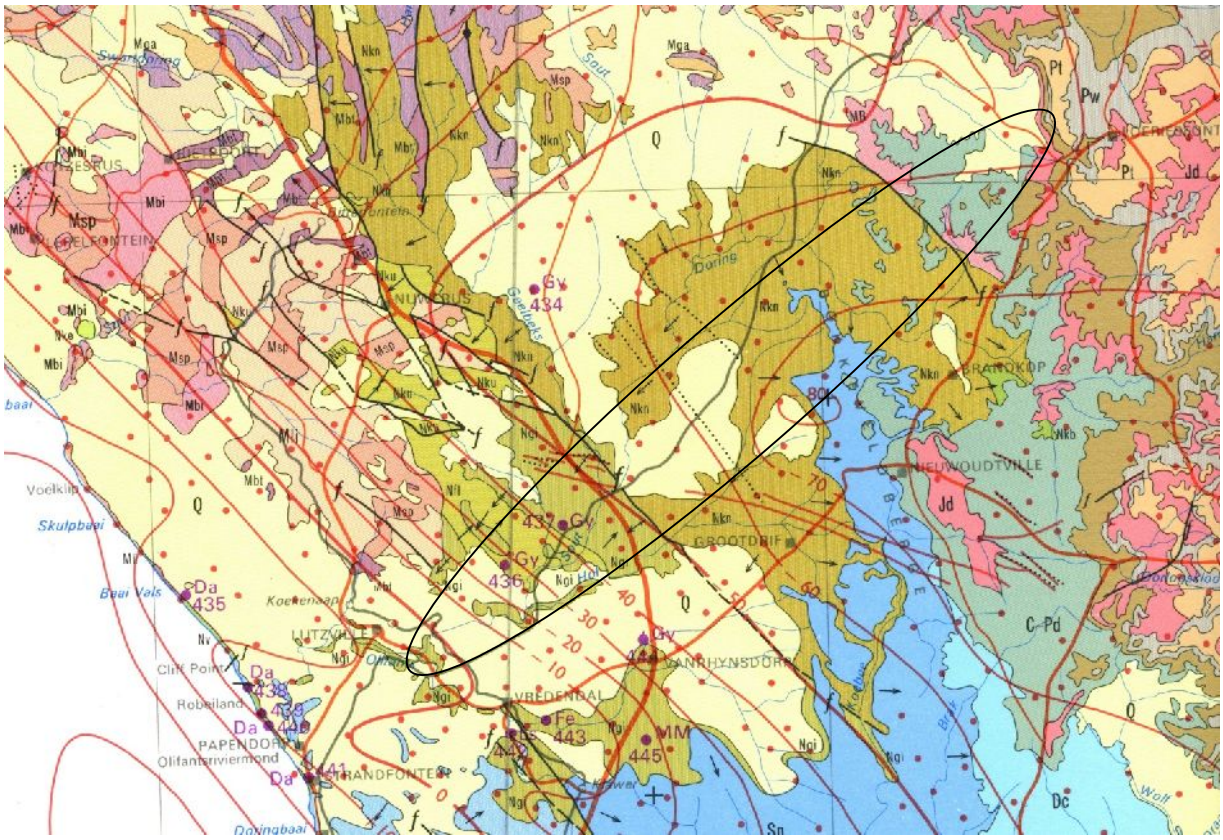

Figure 2 – Geological map of the area between Vredendal and Loeriesfontein between which are the proposed routes for the powerlines as indicated by the oval outline. Abbreviations of the rock types are explained in Table 1. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 1 – Abbreviations for the geological formations, lithology and approximate ages taken from Cornell et al. (2006), Johnson et al. (2006).

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, silcrete	Quaternary (last 2.5 Ma)
T-Qk	Kalarahari Group	Sand, limestone	Quaternary (last 2.5 Ma
Pc	Carnarvon Fm, Ecca Group	Sandstone, shale	Ca 260 Ma
Pt	TierbergFm, Ecca Group	shale	Ca 270 Ma
Pw	WhitehillFm, Ecca Group	Carbonaceous shale	Ca 280 Ma
C-Pd	Dwyka Group	Diamictites, tillites, shales	Late Carboniferous-Early Permian
Sn		Quartzite, sandstone, shale, tillite	Devonain, Silurian
Nkb	KlipbakFm, Vanrhynsdorp Group	Sands, shale	550-530 Ma
Nkn	Knersvlakte Subgroup, Nama and Vanrhynsdorp Groups	Shale, sandstone, siltstone, limestone	Latest Proterozoic (Ediacaran) – Early Cambrian
Nfl	FlaminkbergFm, Vanrhynsdorp Group	Quartzite	550-530 Ma
Ngi	Gifberg Group, GariepSupergroup	Schist, limestone, dolomite	Early Cambrian?Late Proterozoic (Cryogenian – Ediacaran) <770 Ma - >550 Ma

The Dwyka Group is Late Carboniferous to Early Permian in age and in the northwestern part of the Karoo basin overlies the glaciated Precambrian bedrock (Visser, 1989). It is considered to have been deposited in a marine basin and comprises a number of different lithofacies types, including massive diamictites, stratified diamictites, massive carbonate-rich diamictite facies, conglomerate facies, sandstone, mudrock with stones and mudrock facies. The latter contains rare examples of fossil pollen, spores, plant remains, arthropod and fish trackways (Anderson and McLachlan, 1976; Anderson, 1981). These fossils have been recovered from sites in the southwest of the Karoo basin and northwest near the South African-Namibian border.

The Whitehill Formation comprises mudrocks (which weather out with a white colour) and black carbonaceous pyrite-bearing shale (Johnson et al., 2006). A few fossils have been reported from Namibia and the northern part of the basin, and include plant fragments, rare insect wings (Anderson and McLachlan, 1977), palaeoniscid fish, *Notocharistapscotii*(arthropod) and the marine(?) reptile *Mesosaurus* (Oelofen and Araujo, 1987) near Kimberley and Nieuwoudville.

The Tierberg Formation (Early Permian) mostly comprises well-laminated dark shales and represent settling in deep low energy environments (Johnson et al., 2006). Thickness of this unit varies from 350-700m and the surface exposure is extensive in the Northern Cape Province. Rare fossils have been recorded from this formation and include trace fossils and sponge spicules. There are no vertebrate fossils preserved and terrestrial plants are extremely rare.

Quaternary alluvium, sands and silcretes overlie much of the rocks in this central part. While these sediments do not preserve fossils per se they are associated with river gravels, pans, ancient water courses and the like which may preserve isolated patches of fossils. These include silicified wood (for example Miocene woods from the Brandvlei and Sak Rivers in the central part of the proposed routes (Bamford and de Wit, 1993)), vertebrate bones (Kangnaas, Koa River / GeelvloerPalaeovalley system, Bosluis Pan, Carnarvon Leegte,Orange and Vaal River gravels.

4. CONCLUSIONS

There is a chance of finding fossils in the Nama and Vanrhynsdorp Group sediments but they are rare and difficult to recognize. There is an extremely low chance of finding fossils in the sediments of the Dwyka group because these are deep water marine deposits and there are reports of isolated finds from elsewhere in this stratum. There is a slightly greater chance of fossils occurring in theWhitehill and Tierberg Formations but again reports are rare. Along palaeodrainage channels, watercourses or around pans there is a better chance of finding Quaternary aged fossils of wood and bones.

5. RECOMMENDATIONS

Based on the low chance of fossils occurring in the area it is recommended that once the routes has been selected and the sites for road access and excavation of foundations of towers have been determined a geologist or environmentalist is engaged to monitor the work.If fossil material is found, a paleontologist should be engaged to check the potential fossils and decide what should be removed and preserved (with the relevant permit from SAHRA or HWC). The rescued fossils would then be housed and catalogued in a recognized institution such as the McGregor Museum in Kimberley or Iziko Museum in Cape Town.

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