

Private Bag 3, WITS 2050, South Africa • Telephone +27 11 717-6682 • Fax +27 11 717-6694

Email: bruce.rubidge@wits.ac.za

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Mr Paul Dacruz SiVEST Environmental Division 51 Wessel Road PO Box 2921 Rivonia 2128

pauld@sivest.co.za

Dear Mr Dacruz,

Eskom Thyspunt Nuclear Integration project: Desktop Palaeontological Study.

As requested by Varsha Naidoo I have undertaken a desk top EIA to assess the effect that the construction of five 400kV transmission lines, the upgrade of two existing substations and the construction of a new Port Elizabeth Substation will have on palaeontological heritage. In my opinion this development will have some affect on palaeontological heritage and have proposed some mitigation measures.

My report is included herewith.

Please come back to me if there is anything you do not understand or are unhappy with in the report.

Yours sincerely

Professor

Bruce

Rubidge

ESKOM THYSPUNT NUCLEAR INTEGRATION PROJECT: DESKTOP PALAEONTOLOGICAL STUDY

Introduction

A desktop palaeontological environmental impact assessment was undertaken on the proposed routes for five 400kV transmission lines from the proposed Thyspunt Nuclear Power Station High Voltage Yard to the existing Grassridge and Dedisa substations to determine the effect that the proposed development may have on palaeontological heritage in the area. Following the map supplied (Figure 1) two corridors are proposed, a Northern Corridor which will contain three lines and a Southern Corridor which will contain three lines and a Southern Corridor which will contain two lines.



Figure 1: Map of the study area showing the proposed routes for the transmission lines

Geology of the area

The proposed routes for the transmission lines will cross a wide spectrum of geological formations which range in age from Precambrian to Plio-Pleistocene. As the different rock formations have differing potential for fossils a short description of the different rock formations traversed is provided with the oldest at the base:

	Nanaga Formation Kinkelbos Formation Alexandria Formation Grahamstown Formation	Tertiary Tertiary Tertiary Tertiary
Uitenhage Group	Sundays River Formation Kirkwood Formation Enon Formation	Cretaceous? Jurassic Jurassic
Bokkeveld Group	Ceres Subgroup	Devonian
Table Mountain Group –	Baviaanskloof Formation Skurweberg Formation Goudini Formation Cederberg Formation Peninsula Formation Sardinia Bay Formation	Devonian Silurian Silurian Ordovician Ordovician Ordovician
Gamtoos Group	Van Stadens Formation Kaan Formation Klein River Lime Bank	Namibian Namibian Namibian Namibian

The following geological description of the different traverses of the power follows the scheme set out in Figure 1.

Northern Corridor

Northern Corridor (2-5km wide): Thyspunt (HV Yard) to Grassridge (3 x 400kV Transmission Power Lines) (Orange shading)

From Thyspunt the route extends northwards and then turns northwest to end at Grassridge.

From the farm Welgelegen in the south till northeast of the farm Dieprivier (northeast of Humansdorp) the traverse covers rocks of the Cape Supergroup. Welgelegen is situated on the Peninsular Formation and the traverse extends stratigraphically upward to cover the Cedarberg, Goudini, Skurweberg and Baviaanskloof formations of the Table Mountain Group. Southwest of Humansdorp the route covers an extensive area underlain by rocks of the Ceres Subgroup of the Bokkeveld Group. Over the anticline north of Humansdorp the route again traverses the formations of the Table Mountain and Bokkeveld groups mentioned above. On the farm Marville the line will cross a small outcrop of the Tertiary Grahamstown Formation. Northwest of the farm Klein Zuurbron the route enters the Gamtoos Basin and traverses rocks of the Jurassic Enon Formation

south of the Gamtoos River, and the Kirkwood Formation north of the River. The banks of the Gamtoos River are flanked by Quaternary alluvial deposits.

North of the farm Kleinrivier (north of the town of Hankey) the line traverses rocks of the Precambrian aged Gamtoos Group for a short distance. Northwest of the farm Otterford the line again traverses the Table Mountain Group beginning with the basal Sardinia Bay Formation and extending up as far as to the Skurweberg Formation over which it has a long southeasterly traverse up to the farm Boschfontein. East of this the route extends over the Ceres Subgroup of the Bokkeveld Group before a long traverse over the Kirkwood Formation in the area southwest and north of Uitenhage. In this area the route also covers Quaternary alluvial deposits on the banks of the Coega and Swartkops rivers.

Close to Grassridge the line will cross rocks of the Sundays River and Alexandria formations.

Northern Corridor – Alternative 1 (2-5km wide): Thyspunt (HV Yard) to Grassridge (3 x 400kV Transmission Power Lines) (Orange diagonal hatching)

Following the traverse shown on the map by orange diagonal hatching, close to the farm Weltevreden (southeast of Hankey) the traverse branches to the east and joins up with the orange shaded traverse close to the farm Boschfontein southwest of Uitenhage.

On the farm Weltevreden the line will crosses a small outcrop of the Tertiary Grahamstown Formation and traverses the Goudini, Skuweberg and Baviaanskloof formations of the Table Mountain Group and the Ceres Subgroup of the Bokkeveld Group. North of the farm Klein Zuurbron the route enters the Gamtoos Basin and traverses rocks of the Jurassic Enon Formation south of the Gamtoos River, and the Kirkwood Formation north of the River. The banks of the Gamtoos River are flanked by Quaternary alluvial deposits.

East of the farm Geelhoutboom (east of the town of Hankey) the line traverses rocks of the Precambrian aged Gamtoos Group for a short distance. Northwest of the farm Longmore the line again traverses the Table Mountain Group beginning with the basal Sardinia Bay Formation and extending up as far as to the Skurweberg Formation where it meets up with the route shaded in orange on the map close to the farm Boschfontein.

Northern Corridor – Alternative 2 (2-5km wide): Thyspunt (HV Yard) to Grassridge (3 x 400kV Transmission Power Lines) (Orange double diagonal Hatching)

East of Hankey a short traverse shown on the map by orange double diagonal hatching branches to the east and again joins up with the orange shaded traverse northwest of the farm Otterford. East of Hankey the line traverses rocks of the Precambrian aged Gamtoos Group for a short distance. Southwest of the farm Otterford the line again traverses the Table Mountain Group. It extends northwesterly along the contact between the Sardinia Bay and Skurweberg formations to again meet up with the route shaded in orange on Figure 1.

Southern Corridor

Southern Corridor (2km wide) Thyspunt (HV Yard) to Gamtoos Northern Alternative (Possibly 5 x 400kV lines from HV Yard to H'dorp and 2 x 400kV lines from H'Dorp to Gamtoos) (Blue cross-shading)

From Thyspunt the route extends northwards following the route shaded in orange until the farm Mariasdal (northeast of Humansdorp) and then turns east to meet the southern corridor close to Gamtoos

From the farm Welgelegen in the south till the farm Krantzplaas (northeast of Humansdorp) the traverse covers rocks of the Cape Supergroup. Welgelegen is situated on the Peninsular Formation and the traverse extends stratigraphically upward to cover the Cedarberg, Goudini, Skurweberg and Baviaanskloof formations of the Table Mountain Group. Southwest of Humansdorp the route covers an extensive area underlain by rocks of the Ceres Subgroup of the Bokkeveld Group. Over the anticline north of Humansdorp the route again traverses the formations of the Table Mountain and Bokkeveld groups mentioned above. On the farm Rondebos the line will cross a small outcrop of the Tertiary Grahamstown Formation. East of the farm Krantzplaas the route enters the Gamtoos Basin and traverses rocks of the Jurassic Enon Formation and has a short crossing over the Tertiary Bluewater Bay Formation which is now considered a palaeosol of the Alexandria Formation. The banks of the Gamtoos River are flanked by Quaternary alluvial deposits.

Southern Corridor (2km wide) Thyspunt (HV Yard) to Port Elizabeth (2 x 400kV Transmission Power Lines) (Blue shading)

The southern route extends roughly parallel to the coastline from north of Thyspunt in the west to Grassridge on the eastern side. The route shaded in blue in Figure 1 from the farm Welgelegen in the east traverses rocks of the Cape Supergroup as far as the farm Krantzplaas. Welgelegen is situated on the Peninsular Formation and the traverse extends stratigraphically upward to cover the Cedarberg, Goudini, Skurweberg and Baviaanskloof formations of the Table Mountain Group. South of Humansdorp the route covers an extensive area underlain by rocks of the Ceres Subgroup of the Bokkeveld Group. Close to The Burns, at the point where the route crosses the R102 road, the route extends over an anticline structure and again traverses the formations of the Table Mountain and Bokkeveld groups mentioned above. East of the farm Krantzplaas the route enters the Gamtoos Basin and traverses rocks of the Jurassic Enon Formation. The banks of the Gamtoos River are flanked by Quaternary alluvial deposits. East of Gamtoos River the route has a short crossing over the Jurassic Kirkwood Formation and an extensive crossing over the Tertiary Nanaga Formation. East of Thornhill the line will again cross the Cape Supergroup and the traverse extends over the Sardinia Bay and Peninsular formations of the Table Mountain Group.

Southern Corridor (100m - 2km wide) Port Elizabeth to Grassridge (2 x 400kV Transmission Power lines) (Green route)

In the area around Witteklip the proposed one of the new proposed substation sites is stationed on rocks of the Ordovician Peninsular and Tertiary Bluewater Bay formations (now considered to be Alexandria Formation).

From here the route curves northeasterly and extends stratigraphically upward to cover the Cedarberg, Goudini, Skurweberg and Baviaanskloof formations of the Table Mountain Group and the Ceres Subgroup of the Bokkeveld Group (on the farm Rietkuil) south of Uitenhage. The traverse extends northeasterly with a short area over the Enon Formation before a long traverse over the Kirkwood Formation in the area south of Uitenhage. The second substation alternative site is planned south of Uitenhage and this will be positioned on the Kirkwood Formation. Southeast and northeast of Despatch the route also crosses the Tertiary Bluewater Bay Formation (Alexandria Formation) and the Cretaceous Sundays River Formation. The Swartkops River is flanked by Quaternary alluvial deposits.

Northeast of the crossing over the Swartkops River there are two alternative traverses shown on the map (respectively in green and green diagonal hatching). Both of these traverses will cross the Sundays River, and Alexandria formations as they approach Grassridge.

Northern Corridor (Existing servitude) Grassridge to Dedisa (2 x 400kV Transmission Power Lines) (Purple route)

The route between the Grassridge and Dedisa substations will have extensive crossing over the Bluewater Bay Formation (Alexandria Formation) and only a short crossings over the Sundays River and Alexandria formations.

Palaeontological Heritage

As all the rocks underlying the study area are of sedimentary origin and are of late Precambrian to Quaternary age they are potentially fossiliferous. Fossils are known from the following stratigraphic successions:

Caenozoic Cover: *Kinkelbos Formation* – Occasional marine trace fossils.

Alexandria Formation - A rich marine and estuarine invertebrate fauna of molluscs, corals, bryozoans, brachiopods, echinoids, crustaceans, microfossils, sharks' teeth

Grahamstown Formation - Fragmentary plant remains

Uitenhage Group

Sundays River Formation - A rich and diverse marine invertebrate fauna (comprising mainly mollusks but also has brachiopods, bryozoans, echinoderms, ostracodes, corals, vertebrates (plesiosaurs), microfossils (foraminifera), trace fossils

Kirkwood Formation - This formation has yielded a reptilian fauna comprising mainly sauropod and theropod dinosaurs, turtles, crocodiles, invertebrates (bivalves, crustaceans), a rich diversity of plant remains of ferns, cycads and conifers, as well as microfossils.

Enon Formation - As this formation comprises mostly cobbles and boulders fossils are scarce but wood and bone fragments have been reported

Bokkeveld Group:

Ceres Subgroup – Diverse marine invertebrate fauna comprising molluscs, brachiopods, bryoans, conulariids, echinoderms, ostracods, trilobites, tentaculitids, trace fossils, the only vertebrates are rare fish remains, primitive vascular plants

Table Mountain Group:

Baviaanskloof Formation - Marine invertebrate fauna comprising brachiopods, molluscs, trilobites and bryozoans.

Goudini Formation – Invertebrate trace fossils.

Cedarberg Formation - Rich variety of marine invertebrates including arthropods, condonts, brachiopods, mollusks, jawless fish.

Peninsula Formation - Invertebrate trace fossils

Sardinia Bay Formation – microscopic acritarchs, and invertebrate trace fossils

Gamtoos Group:

Lime Bank, Klein Rivier, Kaan and Van Stadens formations – Microscopic acritachs, no other fossils yet discovered but there is a potential for stromatolites and early metazoan organisms

Recommendation

From a desktop study utilizing a geological base map it is not possible to determine the nature of outcrops and the degree of plant and overburden cover. However from the summary above it is evident that, considering that all the rocks in the area are sedimentary, it is most likely that the development will have a bearing on palaeontological heritage. As much of the is area is covered by vegetation and soil, some of which will be cleared in the process of erecting of the power lines, this development offers great opportunity for paleontological exploration and research.

Accordingly a qualified palaeontologist must appointed to undertake a ground survey during the Construction EMP walkdown phase of the project once the tower positions have been determined (assuming the project receives environmental authorisation) of at least the following stratigraphic units in the area to be traversed by the power lines:

Caenozoic Cover: Kinkelbos Formation, Alexandria Formation, Grahamstown Formation

Uitenhague Group: Sundays River Formation, Kirkwood Formation (particularly in the area to the south and north of Hankey; area around Uitenhage and along the traverse toward Grassridge)

Bokkeveld Group: Ceres Subgroup (particularly in the area south of Humansdorp, and in the area between Van Stadensberg and Uitenhage)

Table Mountain Group: Baviaanskloof Formation, Cederberg Formation, Peninsula Formation, Sardinia Bay Formation (particularly in the area to the south and north of Humansdorp and in the area flanking the Elandsberg between Hankey and Uitenhage.

Gamtoos Group: (in the area to the northeast of Hankey)

The field survey must be done by a qualified palaeontologist before the development begins, but as the development will expose outcrops this will provide a rare opportunity for the same palaeontologist to identify and search newly exposed outcrops to rescue fossils in suitable areas immediately after the development has taken place.

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Professor Bruce Rubidge PhD, Pr Sci Nat