

**Phase 1 Palaeontological Impact Assessment of the  
proposed construction of the North and South Sidala  
Hydroelectric Power Sites on the Orange River, Siyancuma  
and Thembelile local municipalities. NC**



Report prepared for:  
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## Executive Summary

- A Phase 1 Palaeontological impact assessment was carried out for two proposed new hydroelectric power sites on the Orange River, in the Siyancuma and Thembelile local municipalities situated between Douglas and Hopetown in the Northern Cape Province.
- The pedestrian survey shows that the development footprint for both hydroelectric sites are primarily underlain by Ventersdorp Supergroup lavas, while the powerline options for both hydroelectric sites traverse unfossiliferous glacial tillites (Karoo Supergroup) and variable clasts of surface gravels, reworked calcretes and windblown Kalahari sands.
- The Ventersdorp Group lavas are not palaeontologically significant and although sparse fossil remains have been recorded in the Mbizane Formation (Dwyka Group), the glacial tillites are generally unfossiliferous.
- No fossil remains or localities were observed within the surface deposits during the survey. The palaeontological sensitivity of the overlying aeolian Kalahari sands along the proposed power line footprint options is therefore considered to be low.
- The field assessment has indicated that the development footprint is largely **underlain by sediments and bedrock of low palaeontological sensitivity**.
- The **proposed North Site development, including all three power line options present no significant threats to potential palaeontological heritage resources** in the area.
- The **proposed South Site development, including both power line options also does not present significant threats to potential palaeontological heritage resources** in the area.

## **Introduction**

At the request of Enviroworks Environmental Consultants a Phase 1 Palaeontological impact assessment was carried out for two proposed new hydroelectric power sites for Sidala Energy Solutions on the Orange River, in the Siyancuma and Thembelile local municipalities situated between Douglas and Hopetown in the Northern Cape Province. The study is required in terms of Section 38 of the National Heritage Resources Act 25 of 1999 as a prerequisite for any development which will change the character of a site exceeding 5 000 m<sup>2</sup> in extent or involve a linear development exceeding 300 m in length. The task involved identification and mapping of possible paleontological sites or occurrences within the proposed project area, an assessment of their significance, related impact by the proposed development and recommendations for mitigation where relevant.

### **Terms of Reference**

- Identify and map possible palaeontological sites and occurrences using available resources.
- Determine and assess the potential impacts of the proposed development on potential palaeontological resources;
- Recommend mitigation measures to minimize potential impacts associated with the proposed development.

### **Locality data**

1 : 50 000 scale topographic map: 2923BD Torquay

1 : 250 000 scale geological map 2922 Prieska

North Site general site coordinates: Right Bank, 29°17'3.06"S 23°51'48.71"E;

Left Bank, 29°17'12.64"S 23°51'40.40"E.

Power line option N1: 29°17'10.32"S 23°51'50.87"E to 29°28'21.76"S 23°54'20.65"E;

Power line option N2: 29°17'5.74"S 23°51'43.21"E to 29°20'16.72"S 23°48'11.97"E;

Power line option N3: 29°17'4.31"S 23°51'42.66"E to 29° 9'34.41"S 23°41'58.47"E

South Site general site coordinates: Right Bank, 29°26'28.98"S 23°55'2.93"E;

Left Bank 29°26'28.30"S 23°54'56.78"E

and 29°26'17.65"S 23°55'0.80"E;

Power line option S1: 29°26'29.77"S 23°54'54.67"E to 29°28'22.15"S 23°54'20.50"E;

Power line option S2: 29°26'29.77"S 23°54'54.67"E to 29°27'41.05"S 23°53'49.03"E

The North Site is proposed to be constructed on a section of the Orange River, which falls between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285 (**Fig 1A & Fig. 2**). The South Site is proposed to be constructed on a section of the Orange River, which falls between Portion 3 of Farm Eskdale No. 204 and Portion 1 of Farm Deelfontein No. 237 (**Fig. 1B & Fig. 3**). Both facilities will comprise a weir and associated infrastructure, as well as a 132kV powerline, (represented by five powerline options in **Fig. 4**).

In addition, two alternative sites were identified on the farms Torquay and Slypsteen (**Fig. 4**; coordinates: Torquay 29° 17' 16.07" S and 23° 50' 29.93" E; Slypsteen 29° 22' 59.11" S and 23° 55' 22.09" E). These sites are not included in the current palaeontological assessment.

## **Methodology**

The palaeontological significance of the affected area was evaluated through a desktop study and carried out on the basis of existing field data, database information and published literature. A field survey by foot and 4x4 vehicle was conducted along the footprints demarcated for the respective weirs and five different power line options. A Garmin Etrex Vista GPS hand model (set to the WGS 84 map datum) and a digital camera were used for recording purposes. Relevant palaeontological and geological information, aerial photographs and site records were consulted and integrated with data acquired during the on-site inspection.

## **Geology**

The affected areas are underlain by Precambrian, Ventersdorp Supergroup lavas (Allanridge Formation, *Ra*), which is composed of resistant-weathering, dark green lavas and associated pyroclastic rocks (**Fig. 5**). The Ventersdorp lavas are unconformably overlain by Dwyka Group tillites of the Mbizane Formation, (*C-Pd*, Visser *et al.* 1977-78, 1990; Johnson *et al.* 2006) which represents valley and inlet fill

deposits left behind on Ventersdorp basement rocks by retreating glaciers about 300 million years ago. These Dwyka-aged palaeovalleys bear evidence of glaciated pavements, consisting of well-preserved polished surfaces striations on basement rocks, which abound throughout the area. Localized outcrops of Early Permian, Prince Albert Formation basinal mudrocks (Ecca Group, *Pp*) are mapped on the western side of the river between the North and South Sites (Cole 2005).

The Precambrian basement lavas and overlying Karoo Supergroup rocks (Dwyka and Ecca Groups) are covered with Late Cenozoic superficial deposits made up of cf. Plio-Pleistocene or older terrace gravels, calcretized terraces (*T-Qc*), and aeolian Quaternary sands (*Qs*).

## Background

The glacial tillites of the Dwyka Group are considered to be unfossiliferous, while fossils from the early Permian Prince Albert Formation (Ecca Group) occur mostly in the lowermost part of the formation (Cole 2005). Invertebrates, fish, coprolites, wood and spores are described from a section between 10 and 16 m above the base of the formation near Douglas (McLachlan & Anderson 1973), while sponge spicules, wood and *Glossopteris* leaves, as well as a variety of trace fossils, were reported from a borehole cores taken near Hopetown, Britstown and the Kimberley - Hertzogville area (Cole & McLachlan 1994).

To the west of Prieska the landscape is dissected by the ancient Koa Valley, a Miocene relic with remnants of Cenozoic fluvial deposits that has produced fossil vertebrate bone as well as fossil wood. Southwards, the Koa Valley joins an extensive system of pans fossil where vertebrate fossil remains have been identified.

No fossils have been explicitly reported from late Cenozoic sediments between Douglas and Hopetown yet, but a variety of fossil fauna have been retrieved from alluvial gravel terraces along the Lower Vaal River basin to the northeast (Cooke 1949; Maglio and Cooke 1978; Partridge and Maud 2000). Here, gravel terraces between 21m and 30m above present river level, contain frequent sandy lenses and have yielded vertebrate fauna such as the extinct proboscidian, *Mammuthus subplanifrons* that are estimated to be ranging in age from 4.5 to 3.5 million years old. Other fossil remains include extinct suids and more proboscidian taxa, notably *Notochoerus capensis*, and *Elephas iolensis*.

## **Field Results**

### **North Site Weir**

The North Site weir footprint is entirely underlain by massive, well-jointed basement rocks (Allanridge Formation lavas) that were exposed by river incision (**Fig. 6**). The field survey found no evidence for well-preserved, late Cenozoic, alluvial gravel deposits within the demarcated footprint.

### **North Site Power Line Options**

Powerline options marked N1, N2 and N3 largely transect angular blocky surface gravels overlying Allanridge Formation outcrop, as well as sporadic outcrops of calcretized Dwyka Group tillites (**Fig. 7 & 8**). Further away from the river, the power line options traverse surface gravels that consist of finer, more variable clasts of quartzite, vein quartz and lava. The surface gravels are either embedded in, or covering red-brown Kalahari sands and calcrete fragments (**Fig 9**).

### **South Site Weir**

The South Site weir footprint is entirely underlain by river incised Allanridge Formation lavas (**Fig 10**). The field survey found no evidence for well-preserved, late Cenozoic, alluvial gravel deposits within the demarcated footprint.

### **South Site Power Line Options**

Power line options marked S1 and S2 primarily traverse Allanridge Formation outcrop area, including overlying Dwyka tillite outcrop near the river but polymict surface gravels and aeolian Kalahari sands predominate the landscape towards the west (**Fig. 11**)

## **Impact Statement**

In terms of possible palaeontological heritage, potentially sensitive rock units identified in the region include Prince Albert Formation mudrocks (Ecca Group) and Late Cenozoic alluvial terrace gravel deposits flanking the Orange River. However, the pedestrian survey shows that the development footprint for both hydroelectric sites are primarily underlain by Ventersdorp Supergroup lavas, while the powerline options for both hydroelectric sites traverse unfossiliferous glacial tillites (Karoo Supergroup) and variable clasts of surface gravels, reworked calcretes and windblown Kalahari sands.

The Ventersdorp Group lavas are not palaeontologically significant and although sparse fossil remains have been recorded in the Mbizane Formation (Dwyka Group), the glacial tillites are generally unfossiliferous. Aeolian Kalahari sands (Quaternary-age surface deposits) can be locally fossiliferous, especially those that are directly related to fluvial environments along major river courses, spring areas or pans. However, no fossil remains or localities were observed within the surface deposits during the survey. The palaeontological sensitivity of the overlying aeolian Kalahari sands along the proposed power line footprint options is therefore considered to be low.

## Recommendation

The field assessment has indicated that the development footprint is largely underlain by sediments and bedrock of low palaeontological sensitivity. The proposed North Site development, including all three power line options N1, N2 and N3, present no significant threats to potential palaeontological heritage resources in the area. The proposed South Site development, including power line options S1 and S2, also does not present significant threats to potential palaeontological heritage resources in the area. In the event of fossil remains being uncovered during the construction of the power lines, it is advised that SAHRA and a professional palaeontologist should be notified immediately by the project's responsible Environmental Control Officer in order to facilitate appropriate mitigation measures.

## References

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Figure 2. Aerial view of the proposed North Site between the Remainder of Farm Tullochgorum No. 158 and Remainder of Farm Kameelsdrift No. 285.

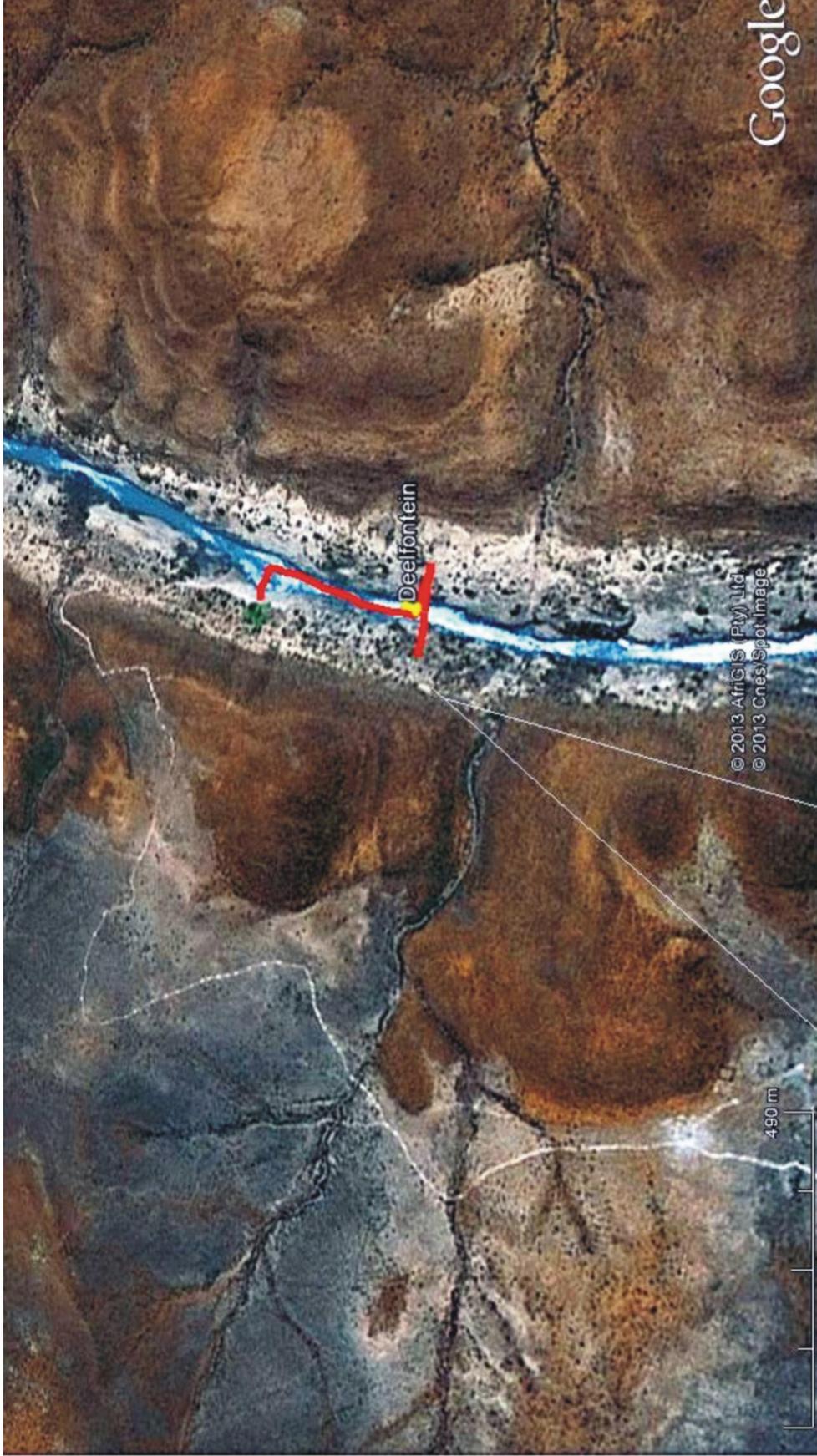


Figure 3. Aerial view of the proposed South Site falls between Portion 3 of Farm Eskdale No. 204 and Portion 1 of Farm Deelfontein No. 237.



Figure 4. Aerial view (Google Maps) of the proposed North and South hydroelectric sites, the two alternative sites and five power line options that were investigated during the survey.

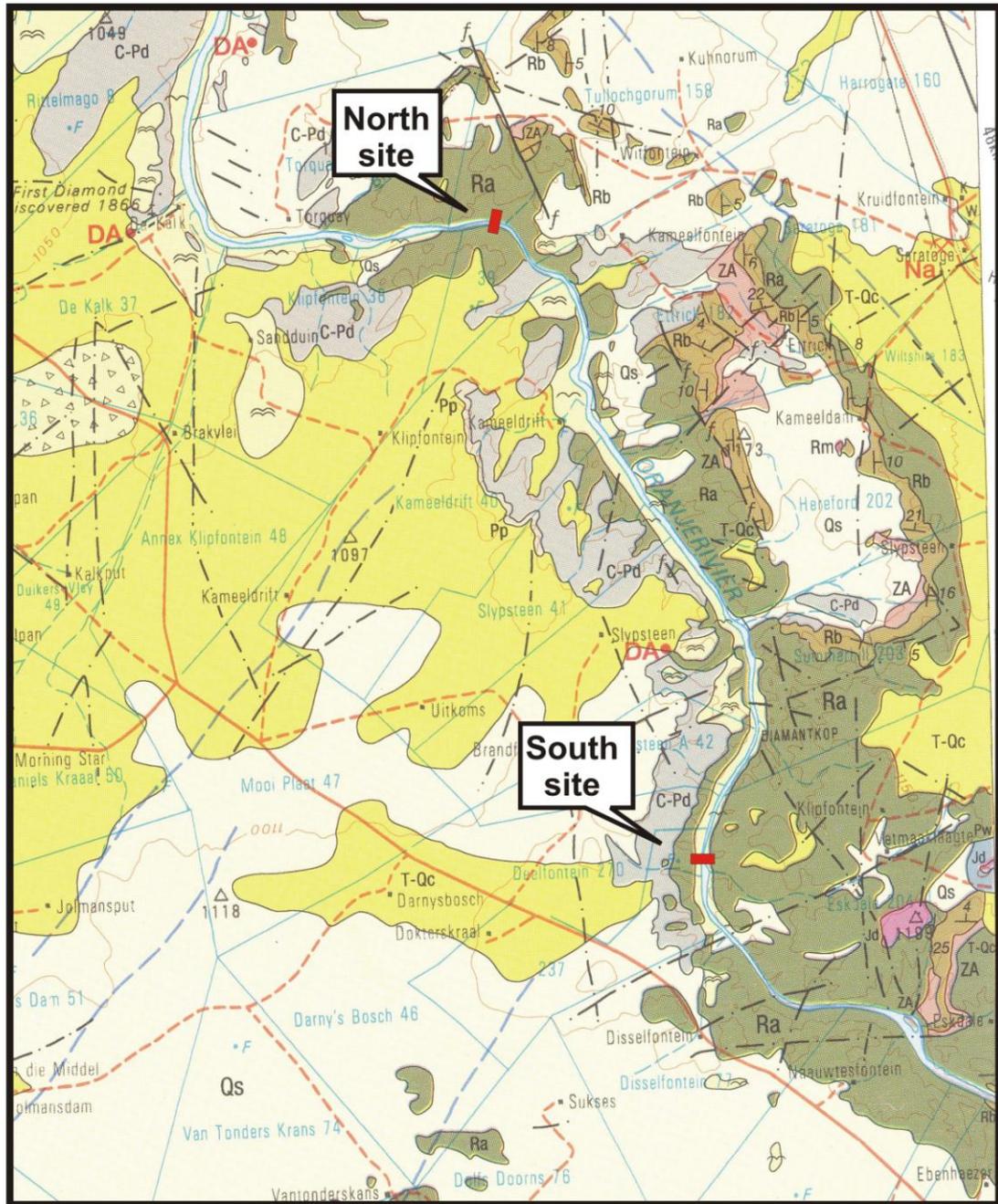


Figure 5. Portion of 1: 250 000 geological map 2922 Prieska (Council for Geoscience, Pretoria) showing approximate location of the proposed two hydroelectric scheme localities between Douglas and Hopetown. The study areas are underlain at depth by Precambrian lavas of the Allanridge Formation (Ventersdorp Group, *Ra*) as well as Dwyka tillites (Mbizane Formation, *C-Pd*) and basal Ecca mudrocks (Prince Albert Formation, *Pp*) of the Karoo Supergroup. The basement lavas and Karoo sediments are largely overlain by Late Cenozoic superficial deposits made up of cf. Plio-Pleistocene or older terrace gravels and/or aeolian sands (*T-Qc*, *Qs*).

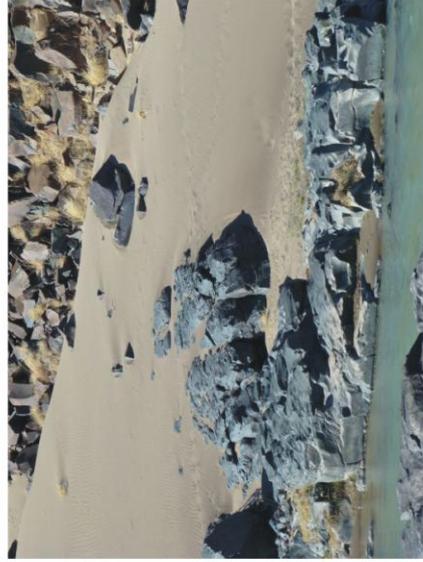


Figure 6. Looking west along the footprint of the proposed North Site weir (above). River incision into massive, well-jointed basement rocks (Allanridge Formation lavas, right).



Figure 7. Large, angular and blocky surface gravels overlying Allanridge Formation outcrop.



Figure 8. Calcretized Dwyka Group tillite outcrop.



Figure 9. Poorly sorted surface gravels consists of more variable clasts of quartzite, vein quartz and lava. The surface gravels are either embedded in, or covering red-brown Kalahari sands and calcrete fragments.





Figure 10 River incised Allanridge Formation lavas (basement rock) at the South Site.



Figure 11. Polymict surface gravels and aeolian Kalahari sands west of the South Site.