

DESKTOP PALAEOLOGICAL SPECIALIST STUDY

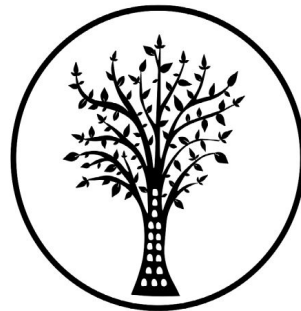
In terms of Section 38(8) of the NHRA

Proposed development of water pipelines near Noenieput, Northern Cape

Prepared by

Dr K. Chapelle

and



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In Association with

EnviroWorks Environmental Services

January 2020



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THE INDEPENDENT PERSON WHO COMPILED A SPECIALIST REPORT OR UNDERTOOK A SPECIALIST PROCESS

I, Dr Kimberley E. J. Chapelle, as the appointed independent specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2010 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2010 (specifically in terms of regulation 17 of GN No. R. 543) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- have ensured that the names of all interested and affected parties that participated in terms of the specialist input/study were recorded in the register of interested and affected parties who participated in the public participation process;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 71 of GN No. R. 543.

Signed:

Name: Dr Kimberley E. J. Chapelle

Date: 31/01/2020



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EXECUTIVE SUMMARY

The Kalahari- East Users Association proposes the construction of a portable water supply pipeline (approximately 25km) in Noenieput, Northern Cape Province. The connection point will be at Noenieput where the water supply pipeline that is currently under construction terminates. The water will flow from the connection point at Noenieput to Swartkopdam.

Although mainly traversing the Kalahari Group which has a sparse fossil record, the Swartkopdam route (west) is planned to cross a significant amount of Nama Group outcrop (Cambrian period Nababis Formation). Outcrops of this group are rare and poorly understood. There is a high probability of this outcrop yielding trace fossils (See table 1 for a summary of the area).

The Noenieput route (east) is planned to only traverse the Kalahari Group, Jurassic period intrusive Dykes and Dwyka Group outcrop. The latter seems to be exposed in association with the Jurassic igneous dolerites and there is therefore a high chance of localised but extensive metamorphism of the primary sedimentary structures, including any preserved ichnological record. Both the Dwyka and Kalahari Groups have a sparse and low diversity fossil record. In the southern part, the Noenieput route also passes close to Nababis exposures.

Based on the geology of the proposed development area as well as the current palaeontological record, it is anticipated that the impact of the development will HIGH for the Swartkopdam route (with chances of poorly known Cambrian trace fossils in the Nababis Formation) and LOW to MODERATE for the Noenieput route (with a low chance of fossil remains in the Dwyka Tillites and a high chance of these being metamorphosed).

Based on the geology and fossil record, there is very little chance of significant fossil finds being made in the loose Kalahari Group sediments. However, should the Swartkopdam (west) line be selected, it is recommended that a field scoping study be conducted around the southern section of the line to search for trace fossils before excavation commences (Nababis Formation exposure). See Appendix 1 for fossil examples.

Should the Noenieput (east) line be selected, there are no objections to the proposed development regarding potential impacts to significant palaeontological resources. Should important fossil material be found during excavations in the Dwyka Group exposures, the attached Fossil Finds Procedure must be implemented (Appendix 2). Should Nababis exposure be found, it is recommended that a field scoping study be done before excavations commence.



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Appendix 2: Chance Finds Procedure



1. INTRODUCTION

1.1 Background Information on Project

The Kalahari- East Users Association proposes the construction of a portable water supply pipeline (approximately 25km) in Noenieput, Northern Cape Province. The connection point will be at Noenieput where the water supply pipeline that is currently under construction terminates. The water will flow from the connection point at Noenieput to Swartkopdam. Connection points will be provided for small and commercial farmers along the pipeline route. The approximate usage per month is 0.9l/s at peak summer demand. The pipeline material is UPVC of various pipe classes and diameters. The pipeline shall be installed in a trench with at least 600mm cover above the pipe. At the two crossings of the Molopo River the pipe cover will be 1.2 meters. Noenieput is located approximately 160km northwest of Upington within the ZF Mgcau District Municipality in the Northern Cape Province.

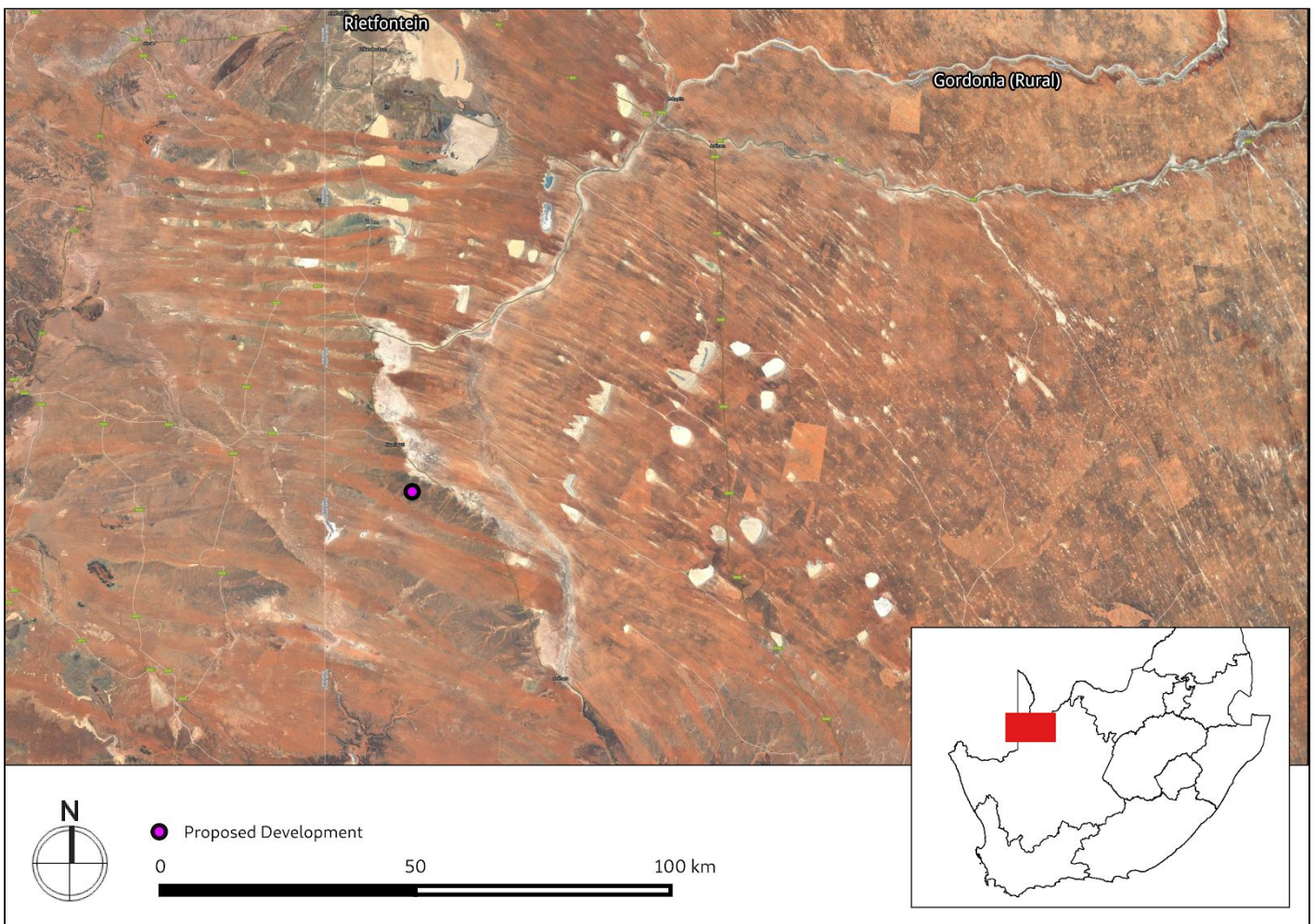


Figure 1: Google Earth© satellite image of the proposed development area



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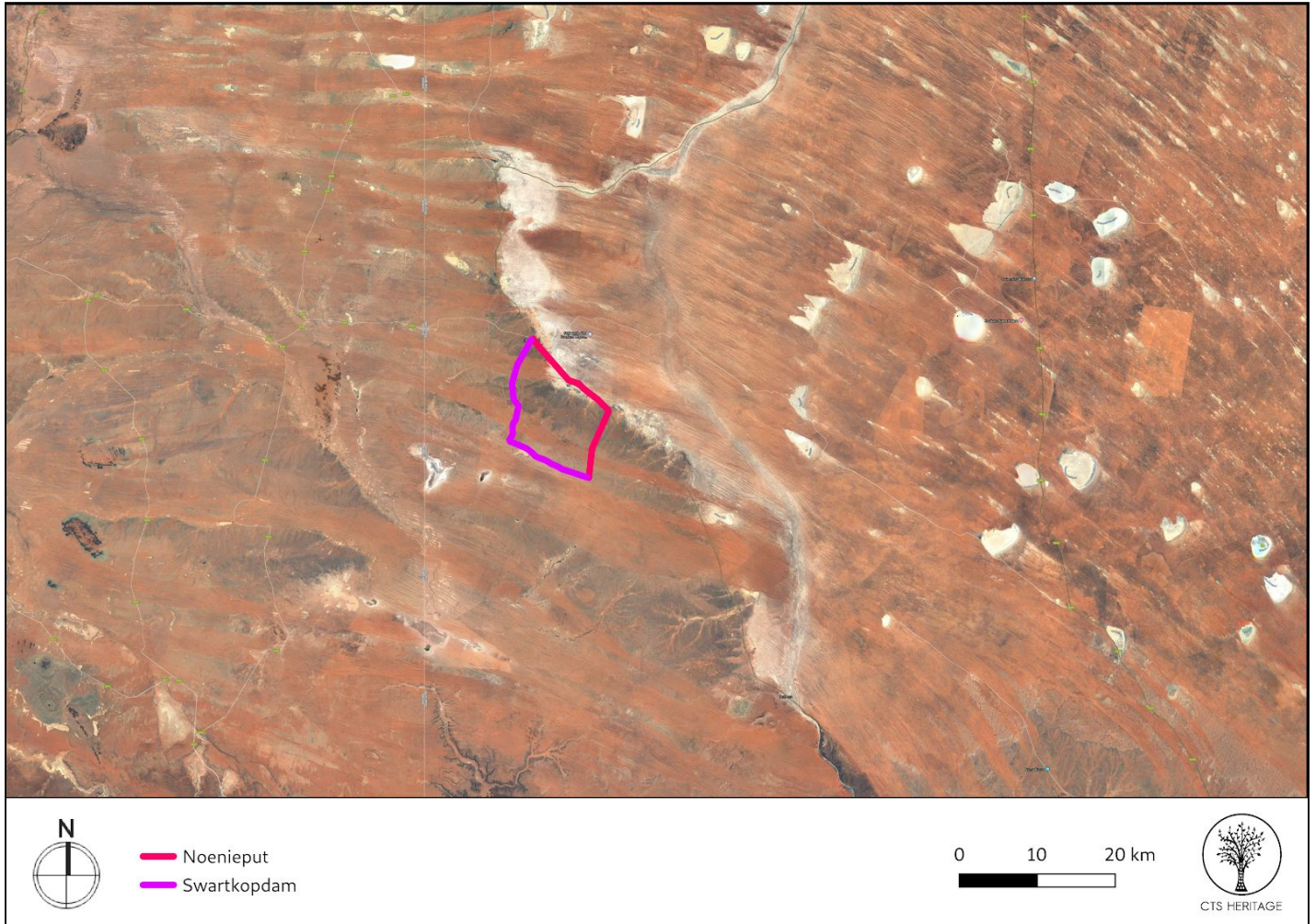


Figure 2: Google Earth© satellite image of the proposed pipelines

2. METHODOLOGY

2.1 Purpose of Palaeontological Study

Beaumont (2007) describes the superficial geology of the area as “Surface silts overlie Karoo shale in the inspected swale area, whereas subangular - subrounded exotic (often quartzite) clasts were seen to cover the abutting plains to the east. These could be Dwyka tillite vestiges and, if so, a nearby (but not visited) low outcrop of black rock, perhaps the source of the settlement name (Swartkopdam), may show smoothing or plucking as a result of ice action at that time, about 300 million years ago.” According to the SAHRIS Palaeosensitivity map (Figure 4), most of the area proposed for development is underlain by sediments of moderate palaeontological sensitivity. These sediments are primarily sands of the Gordonia Formation. Additionally, according to the SAHRIS Palaeosensitivity map, the eastern extent of the proposed Swartkopdam (west) alignment is likely to impact sediments of high palaeontological sensitivity of the Mokalanen Formation. Both the Gordonia Formation and the Mokalanen Formations form part of the Kalahari Group of sediments which are known to preserve palynomorphs, root casts (rhizomorphs) and burrows (eg termitaria), rare vertebrate remains (mammals, fish, ostrich egg shell *etc*), diatom-rich limestones, freshwater stromatolites, freshwater and terrestrial shells (gastropods, bivalves), ostracods and charophytes. As such, the proposed pipelines may negatively impact on significant palaeontological heritage.



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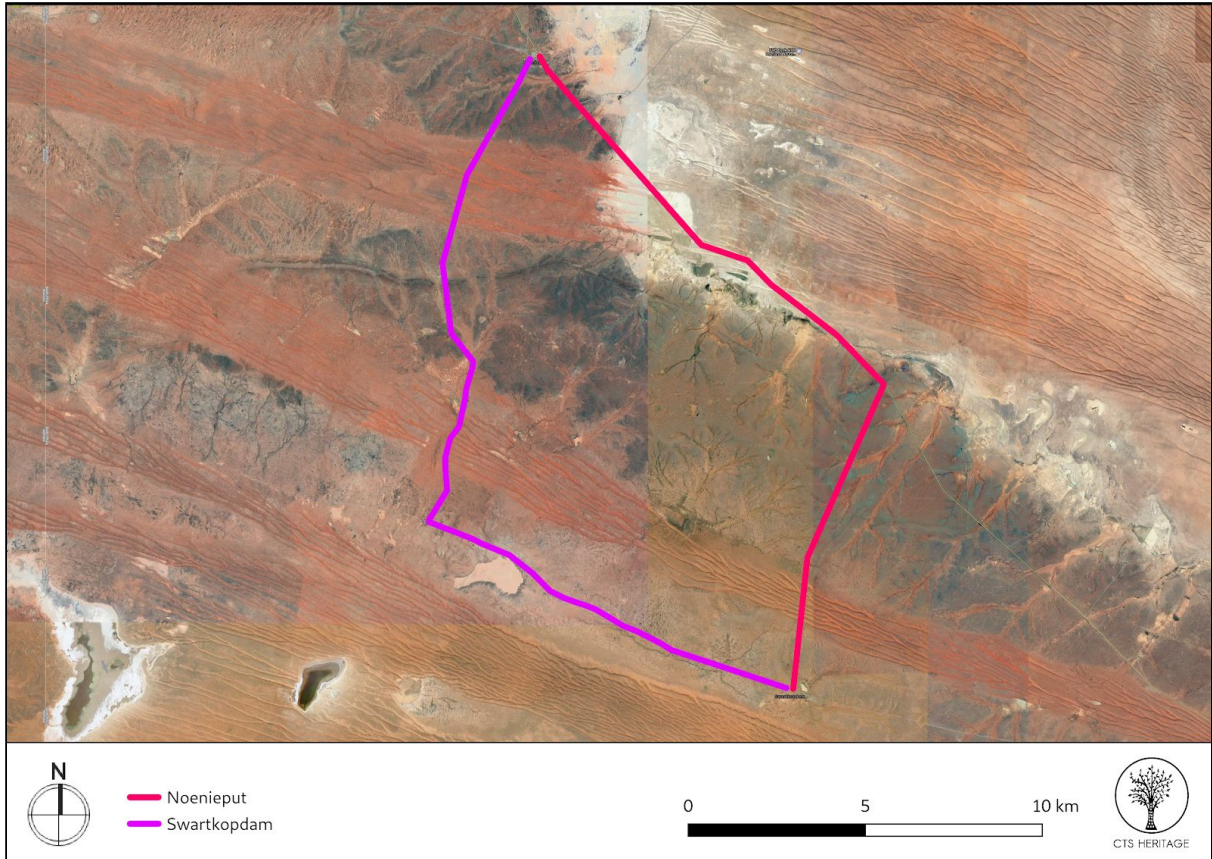


Figure 3: Google Earth© satellite image of the proposed pipelines

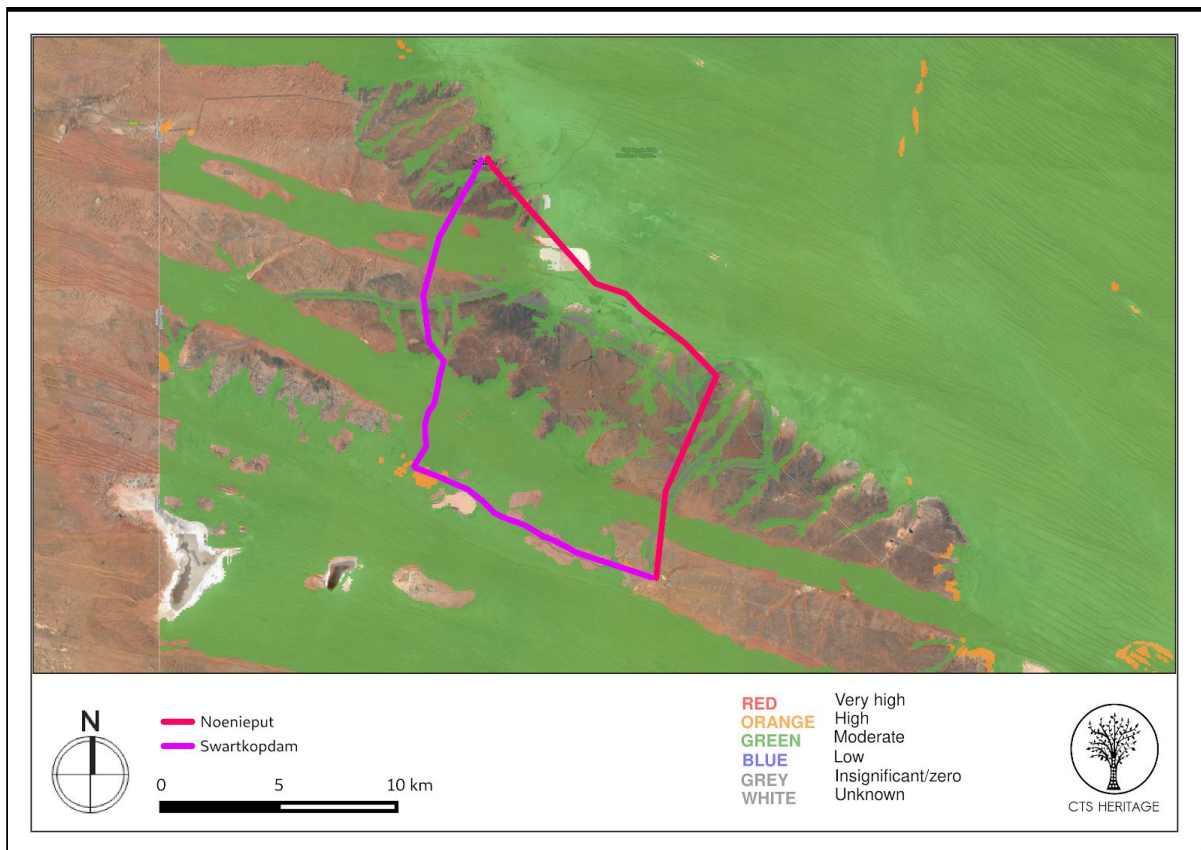


Figure 4: Palaeosensitivity Map. Indicating Unknown to Moderate to High fossil sensitivity underlying the study area.



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2.2 Study approach

This Desktop PIA report provides a record of the observed or inferred palaeontological heritage resources within the broader project study area. The identified resources have been assessed to evaluate their heritage significance in terms of the grading system outlined in Section 3 of the NHRA (Act 25 of 1999). Recommendations for specialist palaeontological mitigation are made where this is considered necessary. The report is based on a review of the relevant scientific literature, including previous palaeontological impact assessments in the broader study region published geological maps, project data, Google Earth satellite imagery and accompanying sheet explanations.

3. GEOLOGICAL CONTEXT OF THE STUDY AREA

The project proposes two alternative pipelines to run water from Noenieput to Swartkop Dam. The Noenieput (east) line is approximately 23km long and follows a main road for its northern section while the Swartkopdam (west) line is approximately 26km long and follows service roads for its entire length. The geological assemblages traversed by these pipelines are described below.

Swartkopdam route (west):

- The southern extent of the Swartkopdam route traverses approximately 7km of Nababis Formation outcrop (Red, brown, black and green cross-bedded sandstone and flagstone; clay pellet conglomerate; 'Nn' on Figure 5). This Formation is the second youngest of four formations forming the Fish River Subgroup, which in turn represents the upper subgroup of the larger Nama Group. The Nama Group extends 350 000 km² and outcrops over an area of approximately 125 000 km². It extends from the southern rim of the Damara orogen to the Vanrhynsdorp area in the northern Cape province). The Fish River Subgroup has a total thickness that ranges from 600 to 1000m increasing in thickness to the south and east. It is assigned to the Cambrian period (541mya to 485.4mya). It comprises red fine to medium-grained sandstones with frequent intercalations of red to purple shales. The Fish River Subgroup is divided into four formations, with the Nababis formation being the second highest one (under the Gross Aub Formation and overlying the Breckhorn Formation). The Nababis Fm is divided into the upper Haribes Member (a sandstone dominated unit, generally consisting of cross-bedded sandstones with minor shale intercalations, deposited under a fluvial regime in braided river systems) and the lower Zamnarib Member (cross-bedded fine- to medium-grained sandstones in its lower part and more typically an alternation of shales and fine-grained sandstones in the upper part; lower part formed partly by braided rivers, middle and upper part are shallow marine deposits). Several faults that cut through the outcrops make it difficult to ascertain the thickness of the Nababis Formation. The Zamnarib and Haribes members form a large part of the Fish River Subgroup and outcrop area, however, stratigraphically informative exposures are rare, particularly for the Zamnarib Member (Geyer, 2005).
- The South East corner of the line passes through the Mokalanen Formation (calcrete diatomaceous in places; 'T-Qm' on Figure 5) of the Kalahari Group. This Formation underlies the outcrop consisting of boulder gravel derived from Dwyka Tillite ('Qr' on Figure 5) that is found underneath the Gordonina Formation. The calcretes forming the Mokalanen Formation were deposited between the Pliocene and early Holocene (5.3mya-0mya). These comprise sandy limestones and overlying conglomerates with a calcareous matrix. The Mokalanen



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Formation was deposited under more arid conditions than the underlying fluvial Eden Formation (Johnson et al., 2006).

- The majority of the proposed pipeline passes through the Kalahari Group (including boulder gravel derived from Dwyka Tillites; 'Qr' on Figure 5), including the Gordonia Formation (Red sands, white sands and pan sediments; 'Qg' on Figure 5). The Kalahari Group represents the largest Cenozoic (66mya to 0mya) terrestrial sediment deposit in southern Africa. It extends uninterrupted from the Northern Cape to 2 degrees north of the equator, and possibly further south in the semi-arid Karoo. The Kalahari Group can reach up to 210m in thickness. The thickest part of the Kalahari overlies the Dwyka Group rocks that may have played a role in the deposition of Kalahari Group sediments (Johnson et al., 2006; Malherbe, 1984). The Gordonia (Qg) Formation (informally Kalahari sand) is part of the upper Kalahari Group. The former can reach up to 30m in thickness and comprises red aeolian sands, usually deposited on an underlying calcrete surface but can rest directly on pre Kalahari deposits. The sands, composed of round quartz grains, owe their red colour to a thin coating of haematite around the grains. The presence of white sand in river bottoms and bottomland areas is due to the lack of haematite. Linear dunes (formed as early as the Late Pliocene or Early Pleistocene, 2.6mya) make up a lot of the Gordonia Formation.

Noenieput route (east):

- At two locations, the pipeline crosses intrusive Jurassic dolerite dykes surrounded by Karoo Dwyka (Tillite; shale, brown grit and conglomerate; impure brown limestone and calcarenite; 'C-Pd' on Figure 5). The glacial Dwyka was deposited in a marine basin during the Late Carboniferous to Early Permian (320mya to 290mya). At this time, Southern Africa was located near the South Pole and was covered with glaciers and ice sheets. As these glaciers seasonally melted, they left behind mud and rock fragments that formed the poorly sorted Dwyka tillite. The Dwyka represents the oldest Karoo Supergroup deposits. The Dwyka Group comprises seven facies that were deposited under varying environmental conditions of glacial retreat and formation. In the north, these are called the Mbizane Formation, and in the south they are called the Elandsvlei Formation (Johnson et al., 2006; Visser et al., 1997).
- The majority of the proposed pipeline passes through the Kalahari Group, including the Gordonia Formation. See Swartkoppdam route geological context.

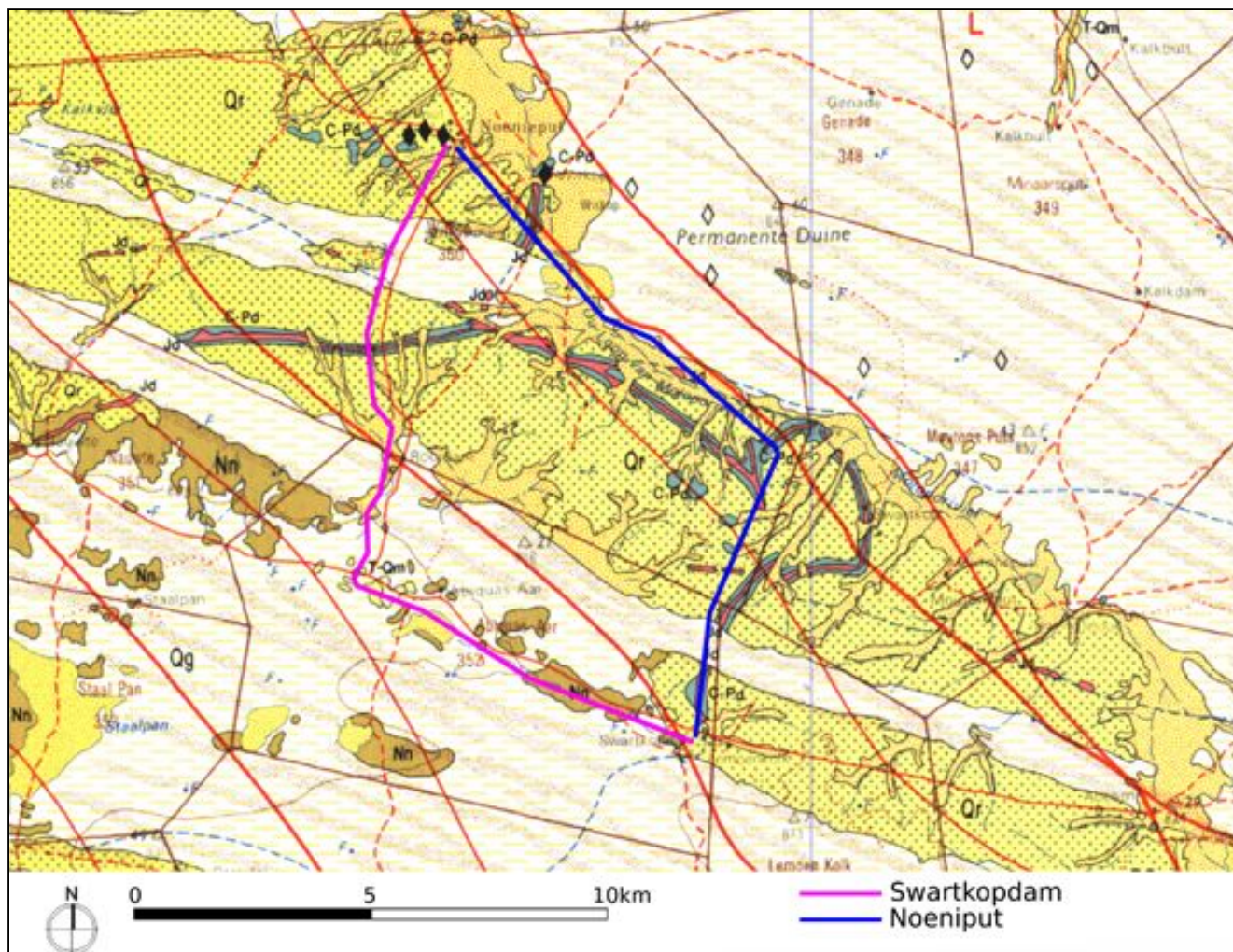
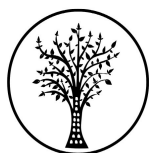


Figure 5: Geology Map. Indicating the underlying geology across the study area by overlaying the geology maps from the CGS series 2720 Noenieput.

4. PALAEOLOGICAL HERITAGE RESOURCES

4.1. Review of regional palaeontology

The Zamnarib unit of the Nababis member is known to contain trace fossils including *Skolithos*-type vertical tubes as well as *Trichophycus tripleurum* and *Helminthodichnites* (Crimes and Germs, 1982; Germs, 1972; Geyer, 2005; Geyer and Uchman, 1995).

Of the seven Dwyka facies, only one has yielded fossil plants (*Glossopteris*). These have only been recorded from one area (around Douglas, in the mudrock facies) (Anderson and AM, 1976). The same area has also yielded fossils of marine invertebrates, fish, and trace fossils made by arthropods and fish (Almond and Pether, 2008; Bangert et al., 2000).

The igneous intrusive origin of the Jurassic dolerite dykes makes it unlikely that they contain fossils.

Although present, the fossil record of the Kalahari Group is sporadic and not very diverse. Aeolian dunes are not likely to preserve fossil material, however, calcretisation of burrows (including termites) and root casts (rhizoliths) can occur.



Fossils that have been recorded include ostrich egg shells (*Struthio*), shells of land snails (e.g. *Trigonephrus*), bivalves and gastropods (e.g. *Corbula*, *Unio*) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms (microscopic algae within siliceous shells) and stromatolites (laminated microbial limestones). The Mokolanen clacretes have also yielded calcretised burrows (including termites), root casts (rhizoliths) as well as mammalian ichnofossils (Almond and Pether, 2008; Malherbe, 1984).

4.2. Summary of palaeontological resources identified in this area

Although mainly traversing the Kalahari Group which has a sparse fossil record, the Swartkopdam route is planned to cross a significant amount of Nama Group outcrop (Cambrian period Nababis Formation). Outcrops of this group are rare and poorly understood. There is a high probability of this outcrop yielding trace fossils (See table 1 for summary of area).

The Noeniput route is planned to only traverse the Kalahari Group, Jurassic period intrusive Dykes and Dwyka Group outcrop. The latter seems to be exposed in association with the Jurassic igneous dolerites and there is therefore a high chance of localised but extensive metamorphosis of the primary sedimentary structures, including any preserved ichnological record. Both the Dwyka and Kalahari Groups have a sparse and low diversity fossil record. In the southern part, the Noeniput route also passes close to Nababis exposures.

Table 1: Geology and fossil heritage of the Noeniput pipeline area, Northern Cape. Palaeontological sensitivity (Almond and Pether (2008) indicated by colour: Red - Very High, Orange - High, Green - Moderate, Blue - Low, Grey - Insignificant, Clear - Unknown)

Geological Unit	Age	Lithology	Symbol Fig. 5	Fossil Heritage	Mitigation
Kalahari Group	66mya to 0mya	Fluvial gravels, sands, lacustrine and pan Mudrocks, diatomites and diatomaceous Limestones, evaporites, consolidated to unconsolidated aeolian sands, pedocretes (especially calcrete)	Q9, Qr, T-Qm	Calcretised insect burrows (including termites) and root casts (rhizoliths), ostrich egg shells (<i>Struthio</i>), shells of land snails (e.g. <i>Trigonephrus</i>), bivalves and gastropods (e.g. <i>Corbula</i> , <i>Unio</i>) and snails, ostracods (seed shrimps), charophytes (stonewort algae), diatoms, stromatolites, Mammalian ichnofossils	No action required (any fossil finds to be reported by developer)
Gordonia Formation	2,6mya to 0mya				
Mokalanen Formation	5,3mya to 0mya				
Jurassic dolerite	200mya	Intrusive dolerite	Jd	None	No action
Dwyka Group	320mya to 290mya	Tillite, sandstone, mudstone, shale	C-Pd	Glossopteris, marine Invertebrates, fish, arthropods and fish trace fossils	No action required (any fossil finds to be reported by developer)
Nama Group, Fish River Subgroup, Nababis Formation	541mya to 485,4mya	Braided river and shallow marine, cross-bedded sandstones with minor shale intercalations; Cross-bedded fine- to medium-grained sandstones; alternation of shales and fine-Grained sandstones	Nn	Trace fossils including <i>Skolithos</i> -type vertical tubes, <i>Trichophycus tripleurum</i> and <i>Helminthodichnites</i> .	Field scoping study recommended before excavation takes place



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5. ASSESSMENT OF THE IMPACT OF THE DEVELOPMENT

Based on the geology of the proposed development area as well as the current palaeontological record, it is anticipated that the impact of the development will HIGH for the Swartkopdam route (with chances of poorly known Cambrian trace fossils in the Nababis Formation) and LOW to MODERATE for the Noeniput route (with a low chance of fossil remains in the Dwyka Tillites and a high chance of these being metamorphosed).

6. CONCLUSION AND RECOMMENDATIONS

Based on the geology and fossil record, there is very little chance of significant fossil finds being made in the loose Kalahari Group sediments. However, should the Swartkopdam (west) line be selected, it is recommended that a field scoping study be conducted around the southern section of the line to search for trace fossils before excavation commences (Nababis Formation exposure). See Appendix 1 for fossil examples.

Should the Noenieput (east) line be selected, there are no objections to the proposed development regarding potential impacts to significant palaeontological resources. Should important fossil material be found during excavations in the Dwyka Group exposures, the attached Fossil Finds Procedure must be implemented (Appendix 2). Should Nababis exposure be found, it is recommended that a field scoping study be done before excavations commence.



7. REFERENCES

Heritage Impact Assessments				
Nid	Report Type	Author/s	Date	Title
4110	HIA	Peter Beaumont	24/10/2007	Phase 1 Heritage Impact Assessment Report on a Proposed Waste Disposal Site at the Swartkopdam Settlement near Noenieput, North-West of Upington, in the Siyanda District Municipality of the Northern Cape Province
27178 7	HIA	Jonathan Kaplan	30/10/2013	Heritage Impact Assessment Report Proposed Low Income Housing Project Noenieput, Groot Mier Municipality, Northern Cape.

Other references used:

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Visser, J., B. Van Niekerk, and S. Van der Merwe. 1997. Sediment transport of the late Palaeozoic glacial Dwyka Group in the southwestern Karoo Basin. *South African Journal of Geology* 100:223-236.



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APPENDIX 1: Examples of Nababis Formation trace fossils.



From (Geyer, 2005): Surface of massive quartz-arenitic bed close to the top of the Haribes Member, showing slight load structures and tops of *Skolithos* tubes (right).



From (Geyer, 2005): Nababis Formation, Zamnarib Member. Trace fossil *Trichophycus tripleurum* Geyer & Uchman, 1995; holotype (PIW 94X45) in upper left corner with clear longitudinal tripartition.



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APPENDIX 2: Chance Fossil Finds Procedure