

PALAEONTOLOGICAL IMPACT ASSESSMENT OF THE PROPOSED FICKSBURG RAW WATER PIPELINE



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EXECUTIVE SUMMARY

The Setsoto Local Municipality proposes the improvement and construction of a new 600mm Raw Water Pipeline from Meulspruit dam to the Ficksburg Water Treatment Plant. Due to Section 35 of the National Heritage Resources Act, a palaeontological impact assessment is required to detect the presence of fossil material at the proposed development site.

The development area in Ficksburg is underlain by Late Triassic to Early Jurassic sediments belonging to the upper part of the Karoo Supergroup, namely the Stormberg Group. Although the palaeontological sensitivity is rated high, the development area is largely an area which already has been disturbed by human activities and **no steep river gulleys or sharp outcrops is present**. The lack of appropriate exposure at the proposed site indicates that the impact on palaeontological material is **negligible and regarded as insignificant**.

It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

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1. INTRODUCTION

NSVT Consultants was appointed as the independent Environmental Assessment Practitioners (EAP) by the Setsoto Local Municipality. The Municipality proposes the improvement and construction of a new 600mm Raw Water Pipeline from Meulspruit dam to the Ficksburg Water Treatment Plant (Fig. 1). The pipeline will be designed to supply the future 24 hours daily Peak requirement in an 18 hour period and thus allow 6 hours per day for pump maintenance. The pipeline will also be designed to enlarge the water flow between the Meulspruit Dam and Ficksburg Water Treatment Plant. The total supply capacity of the new pipeline will be 27.1MI/day.

As the pipeline route crosses the R26 at four different positions, pipe jacking will be required. The excavation of land and pipe jacking will involve substantial excavations into the superficial sediment cover as well as locally into the underlying bedrock. These excavations will modify the existing topography and may disturb damage or destroy scientific valuable fossil heritage exposed at the surface or buried below ground. Palaeontological material is unique and non-renewable and is protected by the National Heritage Resources Act (Act No. 25 of 1999, section 35, see Appendix 1). A Palaeontological Impact Assessment of the proposed development is therefore necessary to certify that palaeontological material is either removed, or is not present.



Figure 1. Location of the construction of the Raw Pipeline from the Meulspruit Dam to the Ficksburg Water Treatment Plant (outlined in blue), Setsoso Local Municipality, Free State as indicated by a satellite image (Modified from Google 2015, Map provided by NSVT Consultants).

1.1.Objective

The objective is to conduct a Phase I, Palaeontological Impact Assessment and determine the impact on potential palaeontological material at this site.

When a palaeontological desktop study is conducted, the potentially fossiliferous rocks (i.e. groups, formations, members, etc) represented within the study area are determined from geological maps. The known fossil heritage within each rock unit is collected from published scientific literature; Fossil sensitivity map; consultations with professional colleagues, previous palaeontological impact studies in the same region and the databases of various institutions may be consulted. This data is then used to assess the palaeontological sensitivity of each rock unit of the development area. The likely impact of the proposed development on local fossil heritage is subsequently established on the basis of

- the palaeontological sensitivity of the rocks concerned and
- the nature and scale of the development itself(extent of new bedrock excavated)

When rocks of moderate to high palaeontological sensitivity are present within the development area, a field-based assessment by a professional palaeontologist is necessary. Based on this desktop data as well as a field examination of representative exposures of all major sedimentary rock present, the impact significance of the planned development is considered with recommendations for any further studies or mitigation.

2. BACKGROUND TO THE GEOLOGICAL AND PALAEOLOGICAL HISTORY

The Main Karoo Basin covers more than 50 % of the surface of South Africa. The Karoo Supergroup strata are between 310 and 182 million years old and span the Upper Carboniferous to Middle Jurassic Periods. During this period the basin developed from an inland sea flooded by a melting ice cap, to a giant lake (Ecca Lake) fed by seasonal meandering (and periodically braided) rivers. The lake progressively shrank as it filled with sediment and the basin's rate of subsidence stabilised.

The development area in Ficksburg is underlain by Late Triassic to Early Jurassic sediments belonging to the upper part of the Karoo Supergroup, Stormberg Group (Johnson, *et al.* 2006). The latter is composed of a thick sequence of continental clastic rocks which is generally divided into the Molteno, Elliot and Clarence Formations. The development area is underlain by two of these Formations namely the Late Triassic sediments of the Molteno and the Late Triassic to Early Jurassic "red beds" of the Elliot Formation.

The Triassic Molteno Formation is a shallow lacustrine deposit which ranges in thickness from 15 to 300 m. This formation consists of alternating medium-to coarse-grained sandstones and grey mudrocks. These sandstones are rich in quartz, giving the sandstones a "sparkling" appearance. Well preserved plant and insect fossils with sporadic coal deposits are present in this Formation. The Molteno Formation is very diverse in vascular plants, ferns (e.g. *Dicroidium* flora), horsetails, Gymnosperms and silicified woods. Insect biota, dinosaur track ways and rare fish are also present although animal fossils are very scarce in this Formation. The *Dicroidium* assemblage is an extinct genus of fork-leaved seed ferns that were dispersed over Gondwana. Invertebrate fossils are restricted to trace fossils.

The Molteno Formation is overlain by the Elliot Formation (15 to 250 m thick) and comprises of red mudstones and siltstones (Johnson, *et al.*, 2006). The Elliot Formation is internationally renowned for the abundance of early dinosaur remains; most notably *Massospondylus* as well as well fossilized dinosaur eggs. Early dinosaur fauna include

prosauro pods, sauropods, ornithisians and tetrapod track ways. Well preserved amphibians, turtles and crocodilians have also been recovered, while cynodont therapsids are also known from this Formation. Other fossil elements include phyllopod crustaceans (conchostracans or “clams shrimps”), root casts and possible termitaria.

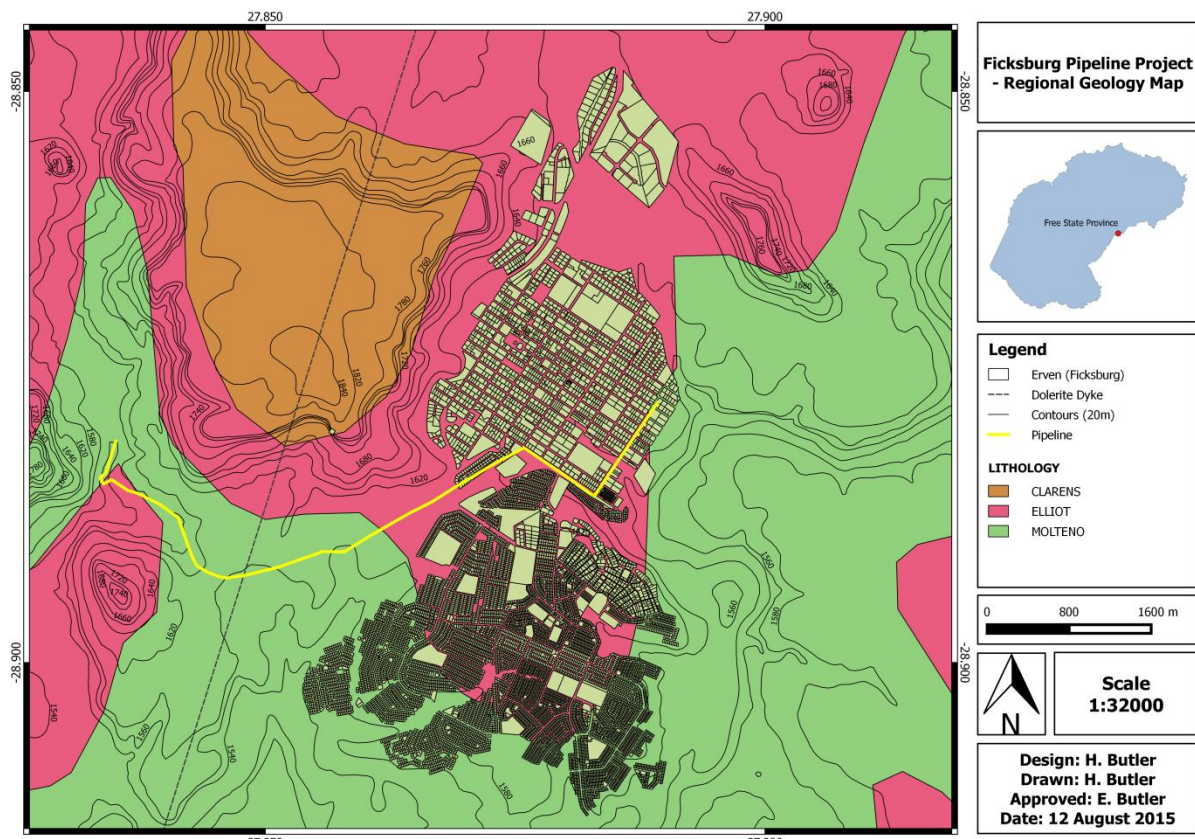


Figure 3. The surface geology of the development area in Ficksburg, Setsoto Local Municipality, Free State (bordered in yellow). The development area is underlain by Late Triassic to Early Jurassic sediments belonging to the upper part of the Karoo Supergroup. (Modified from Geological map (1: 250 000) Winburg 2826, Council for Geoscience, Pretoria).

3. GEOGRAPHICAL LOCATION OF THE SITE

The proposed development area originates at the Meulspruit dam to the south west of the town. The pipeline meanders and runs north of the R26 and crosses the R26 outside town from where it runs along De Villiers Street to the intersection with Visser Street. From Visser Street it crosses to Bosch Street and from there to Brand Street. The pipeline then again crosses the R26 to the Ficksburg Water Treatment Plant (Fig 4).



Figure 4. Location of the proposed Raw Water Pipeline from the Meulspruit Dam to the Ficksburg Water Treatment Plant (outlined in orange), Setsoso Local Municipality, Free State as indicated by a satellite image (Modified from Google 2015).

3.1. Site visit



Figure 5. Meulspruit Dam wall and adjacent area.



Figure 6. Proposed development areas along the sidewalks of Brand- and Bosch Street, Ficksburg, Free State.



Figure 7. Proposed development areas along the sidewalks of Visser- and De Villiers Streets, Ficksburg, Free State.

4. METHODS

A Palaeontological Impact Assessment was conducted to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed areas of development. The author's experience, aerial photos (using Google, 2015), topographical and geological maps and other reports from the same were used to assess the proposed area of development.

4.1 Assumptions and Limitations

The accuracy and reliability of desktop Palaeontological Impact Assessments as components of heritage impact assessments are normally limited by the following restrictions:

- Old fossil databases that have not been kept up-to-date or are not computerized. These databases do not always include relevant locality or geological information. South Africa has a limited number of professional palaeontologists that carry out fieldwork and most development study areas have never been surveyed by a palaeontologist.
- The accuracy of geological maps where information may be based solely on aerial photographs and small areas of significant geology have been ignored. The sheet explanations for geological maps are inadequate and little to no attention is paid to palaeontological material.
- Impact studies and other reports (*e.g.* of commercial mining companies) - is not readily available for desktop studies.

Large areas of South Africa have not been studied palaeontologically. Fossil data collected from different areas but in similar Assemblage Zones might however provide insight on possible occurrence of fossils in an unexplored area. Desktop studies of this nature therefore usually assume the presence of unexposed fossil heritage within study areas of similar geological formations. Where considerable exposures of bedrocks or potentially fossiliferous superficial sediments are present in the study area, the reliability of a palaeontological impact assessment may be significantly improved through field assessment by a professional palaeontologist.

5. FINDINGS AND RECOMMENDATIONS

The proposed development area consists largely of disturbed areas in the town of Ficksburg (see photographs of sidewalks). The only area where fossils might be present is on the outskirts of the town along the R26 road and at the Meulspruit Dam. In these areas the **absence of potentially fossiliferous gulleys** and **appropriate exposures** suggest that fossils are absent from this site. The impact on paleontological material is **negligible and regarded as insignificant**. It is therefore recommended that no further palaeontological heritage studies, ground truthing and/or specialist mitigation are required for the commencement of this development, pending the discovery or exposure of any fossil remains during the construction phase.

Should fossil remains be discovered during any phase of construction, either on the surface or exposed by fresh excavations, the ECO responsible for these developments should be alerted. Such discoveries ought to be protected (preferably *in situ*) and the ECO should alert SAHRA (South African Heritage Research Agency) so that appropriate mitigation (*e.g.* recording, sampling or collection) can be taken by a professional paleontologist.

The specialist involved would require a collection permit from SAHRA. Fossil material must be curated in an approved collection (*e.g.* museum or university collection) and all fieldwork and reports should meet the minimum standards for palaeontological impact studies developed by SAHRA.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Elize Butler has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working at the National Museum for the past 22 years and currently holds the position of Collection Manager of the Karoo Vertebrate Collection of the Palaeontology Department at the National Museum in Bloemfontein. Her current research interests comprise of Permo-Triassic vertebrate palaeobiology, with a special focus on gorgonopsians at the End-Permian Mass Extinction.

Declaration of Independence

I, Elize Butler, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed project, application or appeal in respect of which I was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise my objectivity in this work.

Sincerely

A handwritten signature in black ink, appearing to read 'Elize Butler'.

Mrs. Elize Butler

Appendix 1. Section 25 of the National Heritage Resources Act 1999.

Heritage resources

The various categories of heritage resources are recognised as part of the National Estate in Section 3 of The National Heritage Resources Act. This include among others:

- geological sites of scientific or cultural importance;
- palaeontological sites;
- palaeontological objects and material, meteorites and rare geological specimens.

According to Section 25 of the National Heritage Resources Act 1999, dealing with archaeology, palaeontology and meteorites:

- The protection of archaeological and palaeontological sites and material and meteorites is the responsibility of a provincial heritage resources authority.
- All archaeological objects, palaeontological material and meteorites are the property of the State.
- Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.
- No person may, without a permit issued by the responsible heritage resources authority—
 - destroy, damage, excavate, alter, deface or otherwise disturb any archaeological or palaeontological site or any meteorite;
 - destroy, damage, excavate, remove from its original position, collect or own any archaeological or palaeontological material or object or any meteorite;
 - trade in, sell for private gain, export or attempt to export from the Republic any category of archaeological or palaeontological material or object, or any meteorite; or

- bring onto or use at an archaeological or palaeontological site any excavation equipment or any equipment which assist in the detection or recovery of metals or archaeological and palaeontological material or objects, or use such equipment for the recovery of meteorites.
- When the responsible heritage resources authority has reasonable cause to believe that any activity or development which will destroy, damage or alter any archaeological or palaeontological site is under way, and where no application for a permit has been submitted and no heritage resources management procedure in terms of section 38 has been followed, it may—
 - serve on the owner or occupier of the site or on the person undertaking such development an order for the development to cease immediately for such period as is specified in the order;
 - carry out an investigation for the purpose of obtaining information on whether or not an archaeological or palaeontological site exists and whether mitigation is necessary.