PALAEONTOLOGICAL IMPACT ASSESSMENT (PIA) for the proposed Senqu Rural Water Supply (Project no 1304), near Sterkspruit in the village of Masekeleng, in the Joe Gqabi District Municipality, Eastern Cape Province.

FOR

EZENDALO Environmental Consultants

DATE: 18 September 2021

By

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EXECUTIVE SUMMARY

EZENDALO Environmental Consultants are independent environmental consultants that have been appointed by NGCE Infrastructure Development and Project Management (on behalf of Joe Gqabi District Municipality) to ensure that the proposed project, Senqu Rural Water Supply (Project no 1304), near Sterkspruit and specifically in the village of Masekeleng, in the Joe Gqabi District Municipality, Eastern Cape Province, follows the applicable environmental process.

NGCE appointed a service provider to conduct an environmental impact assessment for the Senqu Rural Water Supply Scheme Project. Therefor Ezendalo Environmental Consultants are hereby requested to undertake the EIA on behalf of the municipality to the Eastern Cape Department of Economic Development, Environmental Affairs and Tourism (DEDEAT).

Dr Gideon Groenewald was appointed by Ezendalo Environmental Consultants to do a Phase 1 site inspection to confirm the sensitivity of the area for palaeontological heritage.

This report forms part of the Environmental Impact Assessment (EIA) for the proposed development of the Senqu Rural Water Supply Scheme Project no. 1304 and complies with the requirements for the South African National Heritage Resource Act No. 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment (PIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the proposed Senqu Rural Water Project.

The development site applicable to the application for the proposed Senqu Rural Water Supply (Project no 1304), near Sterkspruit and specifically in the village of Masekeleng, in the Joe Gqabi District Municipality, Eastern Cape Province, is underlain by Triassic aged sandstone and mudstones with a very high to high palaeontological sensitivity. No significant fossils are expected from the Jurassic aged dolerite sill areas.

Significant fossils are expected in areas where deep excavations are planned for trenching in areas indicated in red and orange on the palaeontological sensitivity map. It is important that a suitably qualified palaeontologist be appointed to visit the site of the development during the first week of excavations in these areas. If any fossils are exposed during the lifetime of the project, the finds must be reported as soon as possible to the relevant authority (ECPHRA) for collection and safe keeping of palaeontological heritage.

In areas underlain by the Molteno and Elliot Formations, the field investigation confirmed the potential for the presence of fossils (Table 2), and if fossils are recorded by the ECO, it will be imperative that a suitably qualified palaeontological specialist be appointed to do a Phase 2 PIA and to upgrade the "Chance Find Protocol" document. The CFP document must then be included as part of the EMPr of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a high and very high palaeontological sensitivity is allocated to the part of study area underlain by Karoo Supergroup sedimentary rocks and a low sensitivity over the rest of the site underlain by dolerite.
- No further mitigation for palaeontological heritage is recommended for this project, unless excavation of deeper than 1.5m exposes fossils.
- Recommendations contained in this Phase 1 PIA must be approved by ECPHRA and SAHRA for inclusion in the EMPr of the project.

TABLE OF CONTENT

TABLE OF FIGURES

LIST OF TABLES

INTRODUCTION

EZENDALO Environmental Consultants are independent environmental consultants that have been appointed by NGCE Infrastructure Development and Project Management (on behalf of Joe Gqabi District Municipality) to ensure that the proposed project, Senqu Rural Water Supply (Project no 1304), near Sterkspruit and specifically in the village of Masekeleng, in the Joe Gqabi District Municipality, Eastern Cape Province, follows the applicable environmental process.

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Legal Requirements

This report forms part of the Environmental Impact Assessment for the proposed development of the Senqu Rural Water Supply Scheme Project no. 1304 and complies with the requirements for the South African National Heritage Resource Act No. 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Palaeontological Impact Assessment is required to assess any potential impacts to palaeontological heritage within the development footprint of the proposed Senqu Rural Water Project.

Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage Resources Act, and which therefore fall under its protection, include:

- geological sites of scientific or cultural importance;
- objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens; and
- objects with the potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage.

Aims and Methodology

A Phase 1 site investigation is often the only opportunity to record the fossil heritage within the development footprint. These records are very important to understand the past and form an important part of South Africa's National Estate.

Following the "*SAHRA APM Guidelines: Minimum Standards for the Archaeological & Palaeontological Components of Impact Assessment Reports*" the aims of the Palaeontological Impact Assessment are:

- to identify exposed and subsurface rock formations that are considered to be palaeontologically significant;
- to assess the level of palaeontological significance of these formations;
- to comment on the impact of the development on these exposed and/or potential fossil resources and
- to make recommendations as to how the developer should conserve or mitigate damage to these resources.

Prior to a field investigation, a preliminary assessment (desktop study) of the topography and geology of the study area was made, using appropriate 1:250 000 geological information (3026 Aliwal North) in conjunction with Google Earth. Potential fossiliferous rock units (groups, formations etc) are identified within the study area and the known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

Priority palaeontological areas are identified within the development footprint to focus the field investigator's time and resources. The aim of the desktop survey is to document any exposed fossil material and to assess the palaeontological potential of the region in terms of the type and extent of rock outcrop in the area.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the minimal extent of fresh bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008, 2009) (Groenewald et al., 2014).	
RED	Very high palaeontological sensitivity/ vulnerability. Development will most likely have a very significant impact on the palaeontological heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, Phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and Phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High palaeontological sensitivity/ vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and Phase I palaeontological impact assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate palaeontological sensitivity/ vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example, areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the palaeontological heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and Phase I PIA (ground proofing of desktop survey) recommended.
BLUE	Low palaeontological sensitivity/ vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured

	units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in larger alluvium deposits. At least one site visit by a competent palaeontologist is compulsory. Collection of a representative sample of potential fossiliferous material is recommended.
GREY	Very low palaeontological sensitivity/ vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during intrusion of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits. At least one site visit by a suitably qualified palaeontologist is recommended.

Rocks with very low to high palaeontological sensitivity are present within the development footprint and palaeontological mitigation measures are incorporated into the Environmental Management Plan (EMP) for this project. Due to the fact that the 1:250 000 scale vector maps obtained from the Council for Geoscience indicates the rock unit underlying the area applicable to this report as being the Stormberg Group of the Karoo Supergroup, lead to an initial assessment that very distinctive fossils will be present. Field work during this survey as well as literature surveys have indicated that the rock units that will be exposed most of the time is the potential fossiliferous Molteno and Elliot Formations, well-known rock sequences of the Karoo Supergroup that contains highly significant palaeontological heritage.

Scope and Limitations of the Phase 1 Investigation

The scope of a Phase 1 Investigation includes:

- an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units;
- a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports;
- data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged); where feasible, location and examination of any fossil collections from the study area (e.g. museums); and
- an on-site investigation to assess the identified palaeontological sensitive areas within the development footprint/ study area, including a formal palaeontological collection if fossils are of collectable quality. The investigation focuses on the bedrock exposure where excavations would most probably require palaeontological monitoring.

The results of the field investigation are used to predict the potential of buried fossil heritage within the development footprint. In some investigations, (as in this study), this involves the examination of similar accessible bedrock exposures, such as road cuttings and quarries, along roads that run parallel to or across the development footprint.

Locality and Proposed Development

NGCE has been assigned a task to assess the existing water scheme and compile a report on the quick wins that are required to operate the scheme of Masekeleng. The villages that will be benefiting from this scheme are as follows:

• Masekeleng
• Upper Masekeleng (RDP houses new)
• Lower Masekeleng (RDP houses new/ Greenfields)

In terms of the impact on palaeontological heritage, the important activities are:

Installing pipelines that form part of the water conveyance scheme:
• 3 Borehole pump stations
• 3 Electrical connection points
• 6km of 100mm to 80mm steel rising mains
• 2.5km of 110mm to 75mm uPVC reticulation pipes
• 6km of 63mm to 32mm HDPe reticulation pipes
• 30 Standpipes

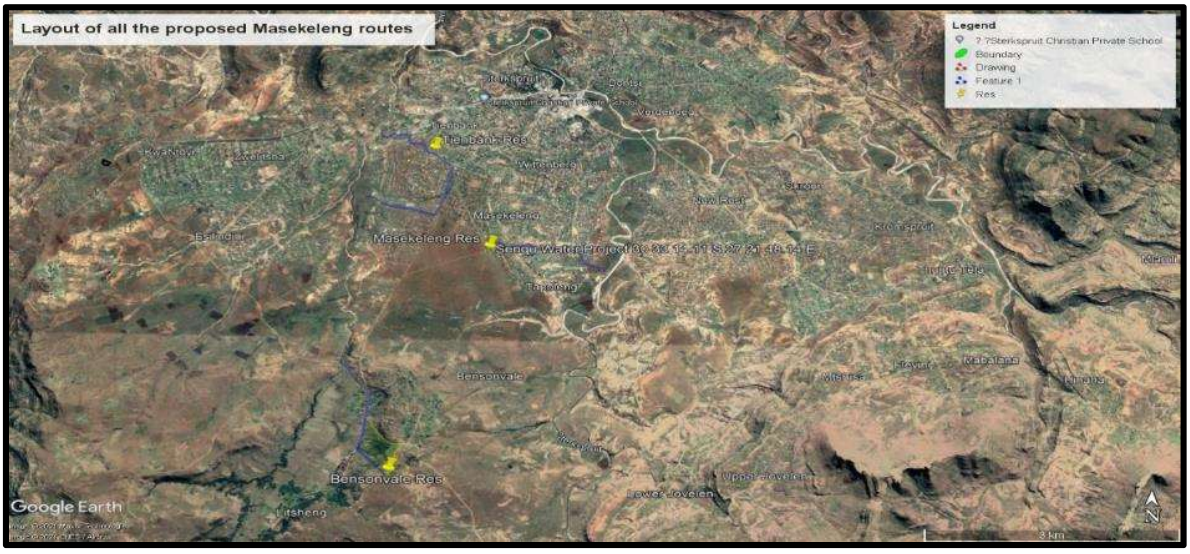


Figure 1 Locality of the pipeline routes in blue lines

GEOLOGY

The study area is underlain by alternating mudrock and sandstone of the Late Triassic Molteno and Elliot Formations (Figure 2)

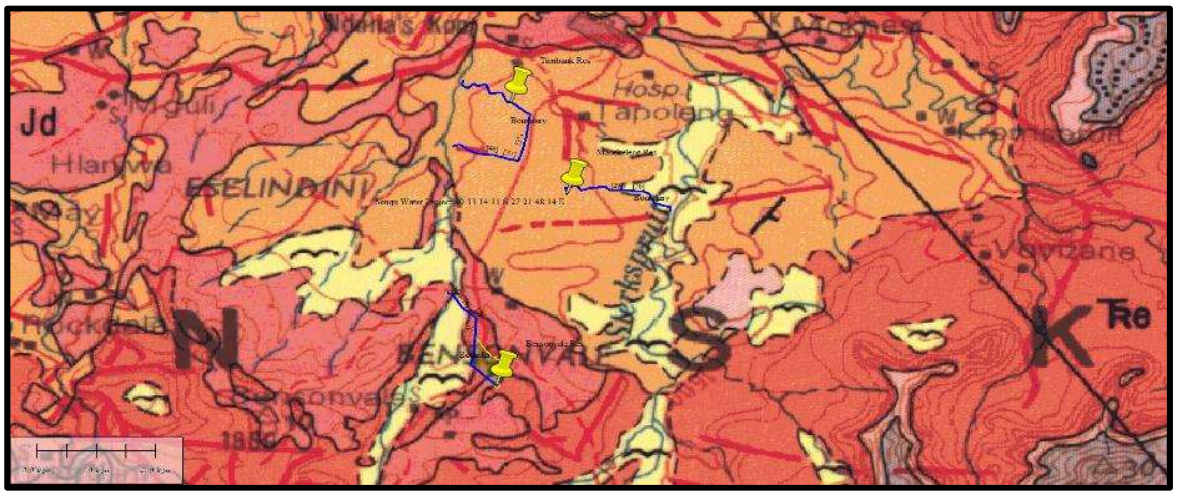


Figure 2 Geology of the study area. Rocks underlying the project area includes the Burgersdorp, Molteno, Elliot and Clarens Formations

The thickness of these 200 million year old sedimentary rocks is approximately 500m and is commonly associated with vertebrate fossils such as dinosaur bones and trace fossils such as footprint impressions. The Elliot Formation is overlain by the sandstone and siltstone horizons of the Clarens Formation which outcrop approximately 1.5km to the east. Outcrops of the Drakensberg Group are located approximately 1km to the west of the study area and consist of basalt resulting from 150 million year old lava flows (Johnson et al., 2006).

Karoo Supergroup

Stormberg Group

Molteno Formation (Trm)

The Molteno Formation comprises a sequence of coarse-grained glistening sandstone and subordinate khaki-colored mudstone that represent a Triassic aged braided river fluvial deposit with extensive sandstone beds that weathers into deep Hutton and Clovelly Form soils with a very high erosion potential.

Elliot Formation (Tre)

The Elliot Formation is predominantly a sequence of red colored mudstone, siltstone and subordinate sandstone layers. The formation represents a period of distal fluvial and lacustrine deposition in the Triassic aged Karoo Basin of South Africa.

Clarens Formation (Trc)

The Clarens Formation is a dominantly creamy colored aeolian sandstone deposit and is interpreted as the remains of an extensive Triassic aged desert deposit that covered most of the Southern African Karoo Basin (Johnson et al, 2009).

Drakensberg Group (Jd)

The Jurassic aged Drakensberg Group comprises a sequence of volcanic rocks, dominated by layers of basaltic lava and intrusive dolerite sills and dykes that leave typical features in the landscape.

Colluvial sedimentation

Resent deposits of deep colluvial and alluviual sediments cover extensive areas and river valleys in the region (Groenewald, 1978). The Tertiary aged deposits are known to contain local pockets of river and wetland deposits that contain conglomerates of recent age.

Palaeontology

The Karoo Supergroup is well-known for a very rich history of palaeontological remains (Smith et al 2020) and the Stormberg Group is particularly rich in the remains of plant and animal remains (Bordy et al, 2020).

Molteno Formation (Trm)

The Molteno Formation is particularly rich in the remains of plants of the *Dicroiidium* Assemblage (Anderson and Anderson, 1984). The list of plant fossils is extensive and a concise summary is presented in Appendix 1.

Dicroiidium Assemblages

The most common fossils found in the Molteno Formation are significantly well-preserved plant remains of the *Dicroiidium* fern from the Triassic whilst dinosaur tracks are also known from this formation.

Elliot Formation (Tre)

The Elliot Formation is particularly well-known for the remains of dinosaurs and prominent vertebrate fossils (including tracks of dinosaurs) that have recently been recorded from the study area and bordering parts of the Kingdom of Lesotho (Bordy et al, 2020).

Clarens Formation (Trc)

The Clarens Formation is well-known for significant remains of vertebrate fossils as well as tracks of dinosaurs and although difficult to recognize in the field, these remains form a very important part of the palaeontological heritage of South Africa (Groenewald et al, 2014).

Drakensberg Group (Jd)

The Jurassic aged volcanic deposits of the Drakensberg Group can contain significant fossil remains, but outcrops in the study area are very limited and it is unlikely that fossils will be discovered during the lifetime of this project.

Intrusive igneous rocks (dolerite) will not contain any fossils and these outcrops are allocated a very low significance for palaeontological heritage (Table 1).

Colluvial sedimentation

Large parts of the study area are underlain by colluvial material and these deposits are known to contain some significant Tertiary aged fossils.

PRELIMINARY ASSESSMENT RESULTS

The palaeontological sensitivity was predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself. The palaeontological sensitivity was predicted as very low to very highly significant, due to the potential abundance of Triassic aged fossils in the Stormberg Group.

Dolerite will not contain any significant fossil remains.

FIELD INVESTIGATIONS

Dr Gideon Groenewald, experienced fieldworker, visited the site of the proposed Senqu Rural Bulk Water Project on Wednesday 15th September 2021.

The topography of the area is undulating, albeit falling in a rugged river valley with dolerite batholiths and thick dolerite sills dominating the higher ground. The general landscape is dominated by extensive, deeply weathered middle slopes and limited foot slopes ending in a well-defined, albeit limited, valley floors, of the local streams and the main rivers of the area. The study area comprises a linear construction and development site that cuts the topography and follows the contours where the proposed pipeline constructions will cut the hills. The area is extensively grazed and developed in a rural environment and in many cases deep erosion dongas have developed in the landscape.

Field investigation confirmed that excavations for the new developments will expose sandstone and sandy mudstone of the Molteno Formation, whilst most of the areas underlain by the Dolerite will expose deep clay-loam soil deposits.

Detailed observations were recorded in the area that will be developed and observations were recorded photographically at GPS points (Figures 3, 4 & 5).

The ECO must be vigilant in areas where deep excavations are still planned for construction of the pipeline. This is important in all areas underlain by the Molteno and Elliot Formations. No fossils are expected in areas underlain by dolerite and no fossils were observed during this field investigation.

Photographic recordings of geological information and fossils occurring in the outcrops are presented in Table 2 below. These photographic recordings (see Figures 3, 4 & 5) might be the only records of palaeontological heritage for this project. Due to very deep weathering of the sedimentary rocks the author expects that the chance find of well-preserved fossils in this environment is not very high.

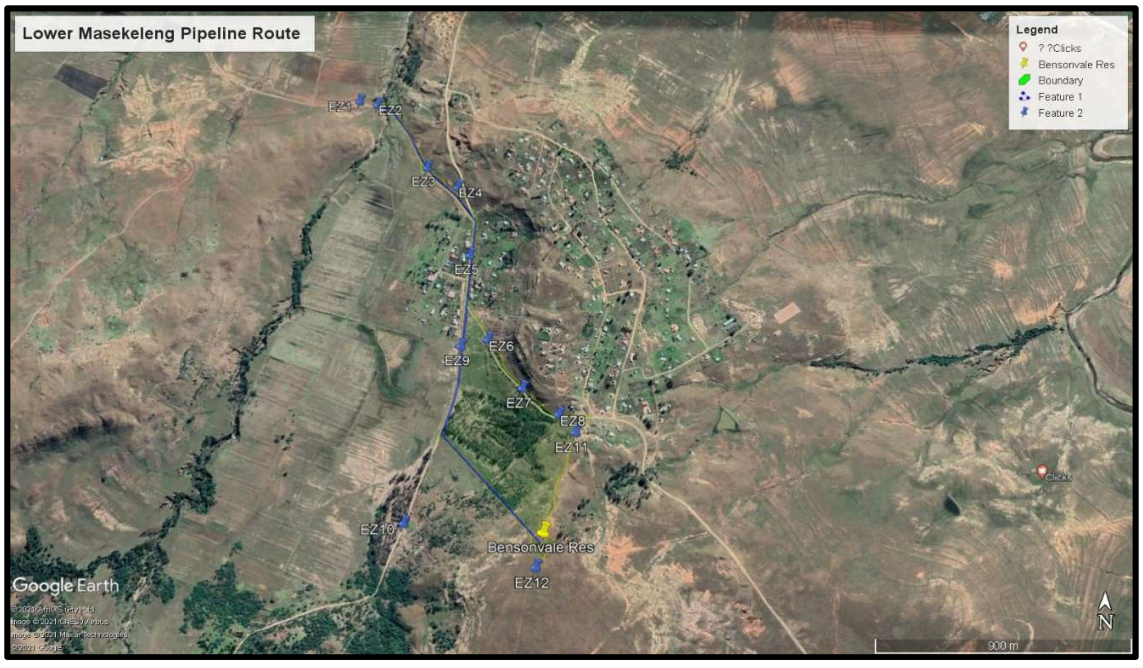


Figure 3 Localities of photographic recordings EZ1 to EZ12. See Table 2

Figure 4 Localities of photographic recordings EZ13 to EZ24. See Table 2

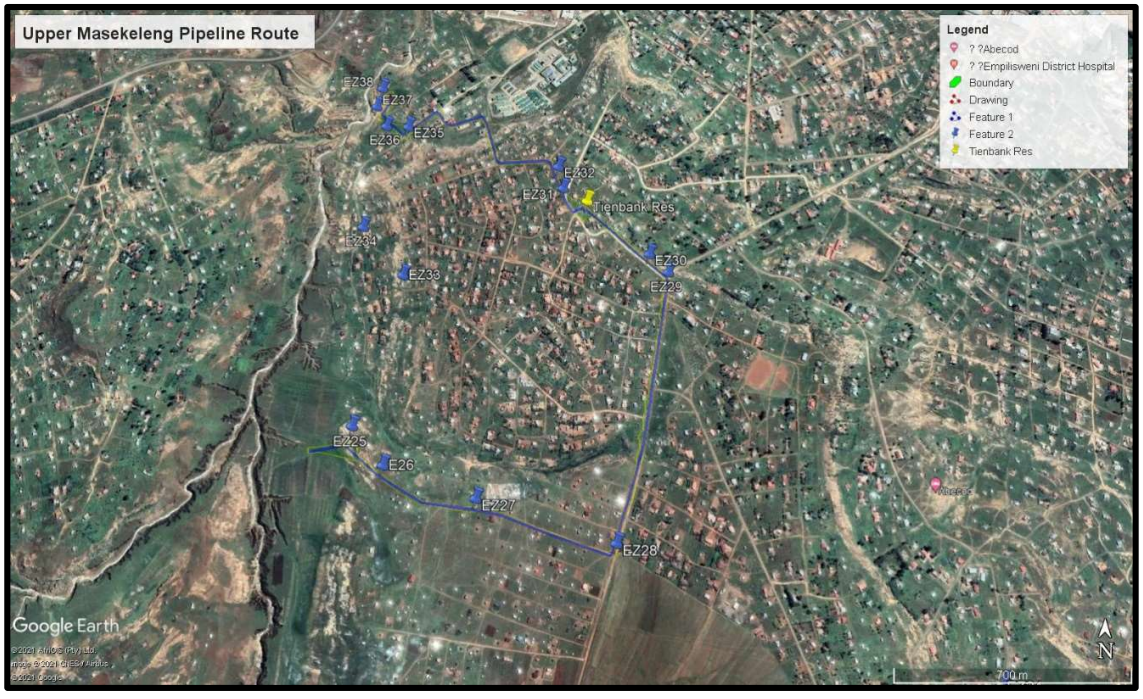


Figure 5 Localities of photographic recordings EZ25 to EZ38. See Table 2

Table 2 Photographic recordings along the routes of the pipelines

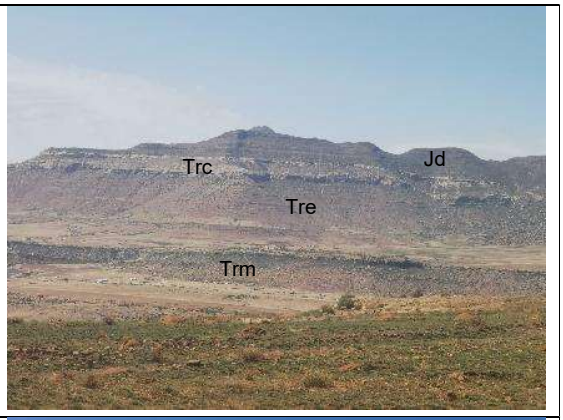
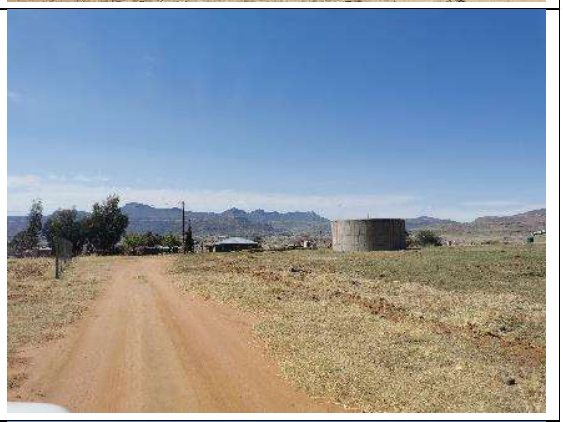
Photo	(GPS station) Coordinates	Comments	Photographic Record
EZ1	30.570989°S 27.344494°E	Main exposure of dolerite intruded into red mudstone of the Molteno Formation.	
EZ1	30.570989°S 27.344494°E	Main exposure of dolerite intruded into red mudstone of the Molteno Formation.	
EZ2	30.571120°S 27.345258°E	Deeply weathered dolerite in river floor areas with deep alluvial fill. No fossils expected.	

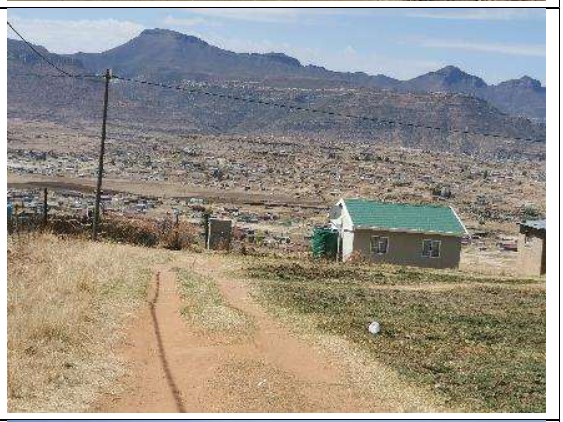
EZ3	30.573623°S 27.347519°E	Deeply weathered dolerite and deeply weathered mudstone of the Elliot Formation covered in dolerite scree.	
EZ4	30.574369°S 27.348827°E	Deeply weathered dolerite and deeply weathered mudstone of the Elliot Formation covered in dolerite scree.	
EZ5	30.573623°S 27.347519°E	No outcrop along parts of the pipeline route. No fossils observed	
EZ6	30.580120°S 27.350400°E	Very deeply weathered mudstone of the Elliot Formation in the road cuttings. No fossils observed.	

EZ6	30.580120°S 27.350400°E	Very deeply weathered mudstone of the Elliot Formation in the road cuttings. No fossils observed.	
EZ7	30.581837°S 27.351850°E	Sandstone outcrops in the Elliot Formation. No fossils observed	
EZ7	30.581837°S 27.351850°E	Deeply weathered dolerite underlies large parts of the study area. No fossils expected, no fossils observed	
EZ7	30.581837°S 27.351850°E	Deeply weathered shale and minor sandstone of the Elliot Formation. No fossils observed	

EZ8	30.582725°S 27.353298°E	Deeply weathered shale and minor sandstone of the Elliot Formation. No fossils observed	
EZ8	30.582725°S 27.353298°E	Sub-outcrop of dolerite on deeply weathered mudstone of the Elliot Formation.	
EZ9	30.580382°S 27.349354° E	This section of the planned trenches is underlain by deep soils of the Molteno Formation. No outcrops and no fossils observed	
EZ10	30.586597°S 27.347592°E	Weathering of mudstone and sandstone is extensive with very few outcrops. Fossils will only be observed in deep (>1.5m) excavations for the pipeline	

EZ10	30.586597°S 27.347592°E	Most of the high ground in this project is underlain by deeply weathered mudstone and deep colluvial material in which fossils might be found during excavation. No fossils observed	
EZ10	30.586597°S 27.347592°E	Most of the high ground in this project is underlain by deeply weathered dolerite with no fossils expected and no fossils observed	
EZ11	30.583340°S 27.353961°E	Most of the high ground in this project is underlain by deeply weathered dolerite with no fossils expected and no fossils observed	
EZ12	30.587916°S 27.352631°E	Deep soils on deeply weathered green-grey mudstone of the Molteno Formation. Fossils of the *Dicroiidium* Assemblage Zone expected in these rocks. No fossils were observed during the field visit.	

EZ12	30.587916°S 27.352631°E	Sequence of rocks building the high mountains in the study area includes the Molteno (Trm), Elliot (Tre) and Clarens (Trc) Formations. The top of the sequence is formed by the Drakensberg Group (Jd)	
EZ11	30.583340°S 27.353961°E	Deeply weathered khaki coloured mudstone of the Elliot Formation. No fossils observed.	
EZ13	30.553786° S 27.362829° E	Deeply weathered sandstone of the Molteno Formation underlying the Senqu Project area. No fossils expected, no fossils observed.	
EZ14	30.552813°S 27.363087°E	Deeply weathered sandstone of the Molteno Formation underlying the Senqu Project area. No fossils expected, no fossils observed	

EZ15	30.552361°S 27.364930°E	Deeply weathered sandstone of the Molteno Formation underlying the Senqu Project area. No fossils expected, no fossils observed	
EZ16	30.553303°S 27.365455°E	Deeply weathered sandstone of the Molteno Formation underlying the Senqu Project area. No fossils expected, no fossils observed	
EZ17	30.554909°S 27.367902°E	Prominent sandstone outcrop of the Molteno Formation. No fossils observed.	
EZ17	30.554909°S 27.367902°E	Prominent sandstone outcrop of the Molteno Formation overgrown with woody vegetation along the route of the proposed pipeline. No fossils observed.	

EZ18	30.552738°S 27.367951°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ19	30.553767°S 27.375721°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ20	30.554936°S 27.376402°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ21	30.556066°S 27.378583°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	

EZ21	30.556066°S 27.378583°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ22	30.556797°S 27.378801°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ22	30.556797°S 27.378801°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ22	30.556797°S 27.378801°E	General view of the sub-outcrop of the Molteno Formation with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	

EZ23	30.553254°S 27.372839°E	General view of the sub-outcrop of the Molteno and Elliot Formations with deeply weathered mudstone and potential for vertebrate fossils high if excavation exceeds 1.5m. No fossils observed.	
EZ24	30.551180°S 27.368099°E	Deeply weathered mudstone of the Elliot Formation with colluvium cover. Potential for fossils is high but none were observed during this field inspection.	
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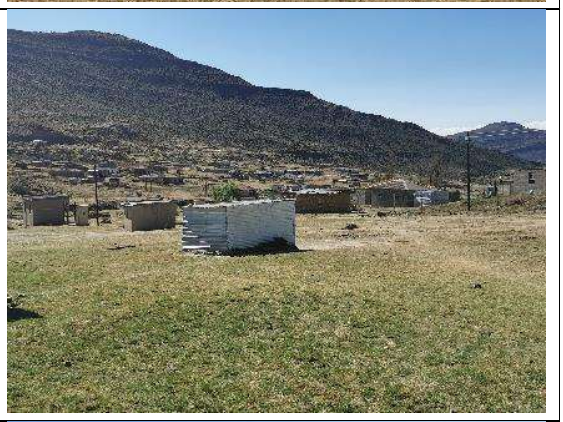
EZ25	30.545141°S 27.347322°E	Valley floor filled with deep alluvial sand. No fossils observed. Potential for fossil finds high where excavation exceeds 1,5m.	
EZ25	30.545141°S 27.347322°E	Sub-outcrop of Molteno Formation sandstone with cover of deep sandy, Clovelly form soil. No fossils observed.	
EZ25	30.545141°S 27.347322°E	Outcrop of sandstone of the Molteno Formation. No fossils observed.	
EZ26	30.546226°S 27.348440°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	

EZ27	30.547073°S 27.351504°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	
EZ28	30.548182°S 27.356045°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	
EZ29	30.540241°S 27.357682°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	
EZ30	30.539684°S 27.357022°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	

EZ31	30.537605°S 27.353970°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	
EZ32	30.536885°S 27.353779°E	Sub-outcrop of sandstone of the Molteno Formation. Deep sandy soils. No fossils observed.	
EZ33	30.540556°S 27.348576°E	Outcrops of glistening sandstone of the Molteno Formation. No fossils observed.	
EZ33	30.540556°S 27.348576°E	Valley floor filled with deep alluvial sand. Tertiary fossils expected but none were observed during this investigation.	

EZ34	30.539053°S 27.347049°E	Sub-outcrop of sandstone of the Molteno Formation. No fossils observed during this investigation.	
EZ35	30.535656°S 27.348318°E	Sub-outcrop of dolerite and mudstone of the Molteno Formation. No fossils observed during this investigation.	
EZ35	30.535656°S 27.348318°E	Sub-outcrop of the Molteno Formation. Shallow sandy soil on sandstone of the Molteno Formation. No fossils observed.	
EZ36	30.535651°S 27.347540°E	Very deep sandy alluvium filling the valley floor and river valley. No fossils observed	

EZ37	30.534979°S 27.347120°E	Outcrops of khaki coloured mudstone and sandstone of the Molteno Formation. Plant fossils of the *Dicroiidium* Assemblage expected – no fossils were observed during this investigation	
EZ38	30.534335°S 27.347267°E	Outcrops of khaki coloured mudstone and sandstone of the Molteno Formation. Plant fossils of the *Dicroiidium* Assemblage expected – no fossils were observed during this investigation	
E38	30.534335°S 27.347267°E	Outcrops of khaki coloured mudstone and sandstone of the Molteno Formation. Plant fossils of the *Dicroiidium* Assemblage expected – no fossils were observed during this investigation	
E38	30.534335°S 27.347267°E	Outcrops of khaki coloured mudstone and sandstone of the Molteno Formation. Plant fossils of the *Dicroiidium* Assemblage expected – no fossils were observed during this investigation	

PALAEONTOLOGICAL IMPACT AND MITIGATION

The predicted palaeontological impact (Figure 6) of the development is based on the initial mapping assessment and literature reviews, as well as information gathered during the field investigation (Table 2).

The field investigation confirms that the study area is underlain by rocks that range from the very low sensitive dolerite intrusive igneous rocks to the very highly sensitive red coloured mudstone of the Molteno and Elliot Formations of the Stormberg Group, Karoo Supergroup of South Africa.

The excavations for the construction of the infrastructure for the proposed developments can expose some sediments of very highly sensitive geological formations and some sites revealed evidence of very highly significant remains of fossils. A significant part of the excavation project will cut into rocks of the Molteno Formation of the Stormberg Group that has a high sensitivity for palaeontological heritage and the ECO must be on the lookout for vertebrate, plant as well as trace fossils. The entire project cut very important areas underlain by the very highly sensitive Molteno and Elliot Formations (Table 2).

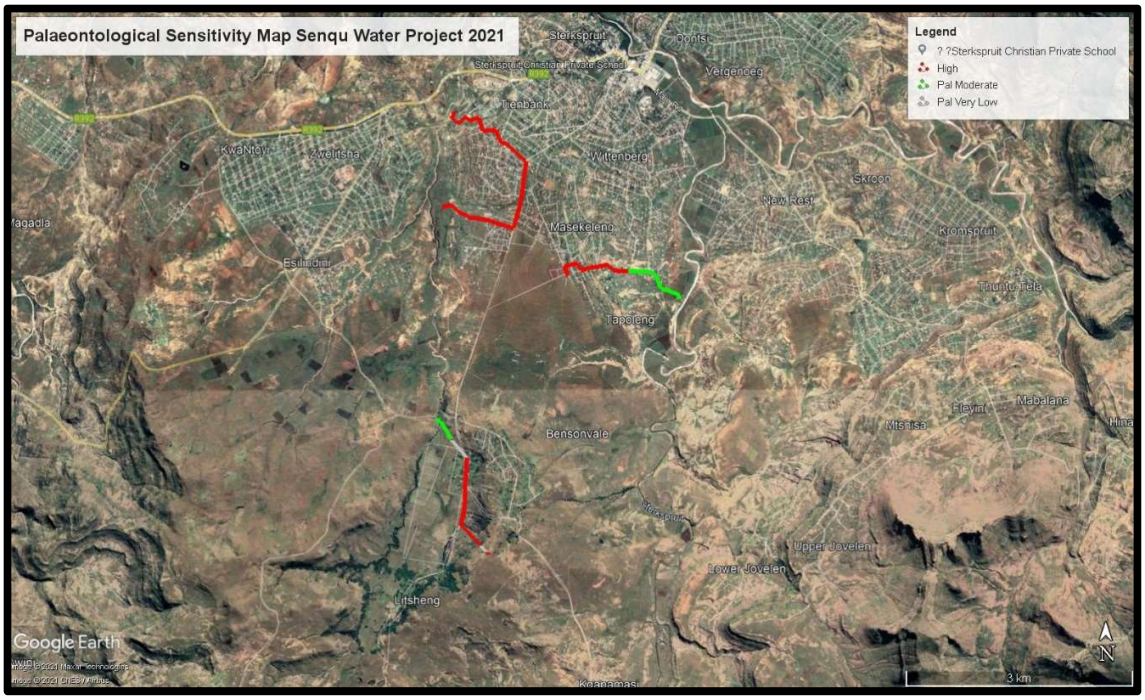


Figure 6 Palaeontological sensitivity map for the study area. Red indicates very highly sensitive and green indicates moderate sensitivity for palaeontological heritage

The construction team must be aware of the sensitivity of the area and the very high potential of exposing significant fossils. If any fossils are exposed, the palaeontologist must be informed and the procedures set out in the "Chance Find Protocol" (CFP) attached to this report, must be followed.

CONCLUSIONS

The development site applicable to the application for the proposed Senqu Rural Water Supply (Project no 1304), near Sterkspruit and specifically in the village of Masekeleng, in the Joe Gqabi District Municipality, Eastern Cape Province, is underlain by Triassic aged sandstone and mudstones with a very high to high palaeontological sensitivity. No significant fossils are expected from the Jurassic aged dolerite sill areas.

Significant fossils are expected in areas where deep excavations are planned for trenching in areas indicated in red and orange on the palaeontological sensitivity map. It is important that a suitably qualified palaeontologist be appointed to visit the site of the development during the first week of excavations in these areas. If any fossils are exposed during the lifetime of the project, the finds must be reported as soon as possible to the relevant authority (ECPHRA) for collection and safe keeping of palaeontological heritage.

In areas underlain by the Molteno and Elliot Formations, the field investigation confirmed the potential for the presence of fossils (Table 2), and if fossils are recorded by the ECO, it will be imperative that a suitably qualified palaeontological specialist be appointed to do a Phase 2 PIA and to upgrade the "Chance Find Protocol" document. The CFP document must then be included as part of the EMPr of this project, to record all unexpected fossils associated with the geological formations on site.

It is recommended that:

- The EAP and ECO must be informed of the fact that a high and very high palaeontological sensitivity is allocated to the part of study area underlain by Karoo Supergroup sedimentary rocks and a low sensitivity over the rest of the site underlain by dolerite.
- No further mitigation for palaeontological heritage is recommended for this project, unless excavation of deeper than 1.5m exposes fossils.
- Recommendations contained in this Phase 1 PIA must be approved by ECPHRA and SAHRA for inclusion in the EMPr of the project.

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QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

Dr Gideon Groenewald has a PhD in Geology from the University of Port Elizabeth (Nelson Mandela Metropolitan University) (1996) and the National Diploma in Nature Conservation from Technicon RSA (the University of South Africa) (1989). He specialises in research on South African Permian and Triassic sedimentology and macrofossils with an interest in biostratigraphy, and palaeo-ecological aspects. He has extensive experience in the locating of fossil material in the Karoo Supergroup and has more than 20 years of experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the southern, western, eastern and north-eastern parts of the country. His publication record includes multiple articles in internationally recognized journals. Dr Groenewald is accredited by the Palaeontological Society of Southern Africa (society member for 25 years).

DECLARATION OF INDEPENDENCE

I, Gideon Groenewald, declare that I am an independent specialist consultant and have no financial, personal or other interest in the proposed development, nor the developers or any of their subsidiaries, apart from fair remuneration for work performed in the delivery of palaeontological heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

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