



PGS HERITAGE

**PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED NIGEL GAS
TRANSMISSION PIPELINE PROJECT IN THE NIGEL AREA OF THE EKURHULENI
METROPOLITAN MUNICIPALITY, GAUTENG PROVINCE**

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Declaration of Independence

I, Elize Butler, declare that –

General declaration:

- I act as the independent palaeontological specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favorable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting palaeontological impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in section 38 of the NHRA when preparing the application and any report relating to the application;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favorable to the applicant or not
- All the particulars furnished by me in this form are true and correct;
- I will perform all other obligations as expected a palaeontological specialist in terms of the Act and the constitutions of my affiliated professional bodies; and
- I realize that a false declaration is an offense in terms of regulation 71 of the Regulations and is punishable in terms of section 24F of the NEMA.

Disclosure of Vested Interest

I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

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ACKNOWLEDGMENT OF RECEIPT

Report Title	PALAEONTOLOGICAL FIELD ASSESSMENT FOR THE PROPOSED NIGEL GAS TRANSMISSION PIPELINE PROJECT IN THE NIGEL AREA OF THE EKURHULENI METROPOLITAN MUNICIPALITY, GAUTENG PROVINCE		
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The heritage impact assessment report has been compiled taking into account the National Environmental Management Act 1998 (NEMA) and Environmental Impact Regulations 2014 as amended, requirements for specialist reports, Appendix 6, as indicated in the table below.

NEMA Regs (2014) - Appendix 6	Relevant section in report
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Page ii of Report – Contact details and company and Appendix A
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page ii
c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 4 – Objective
(cA) an indication of the quality and age of base data used for the specialist report;	Section 5 – Geological and Palaeontological history
(B) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 10 and 11
d) the date, duration and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 9- Site visit
e) a description of the methodology adopted in preparing the report or carrying out the specialized process inclusive of equipment and modeling used;	Section 7 Methodology
f) details of an assessment of the specifically identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 1 and 12
g) an identification of any areas to be avoided, including buffers;	Not identified, Section 12
h) a map superimposing the activity including the associated structures and infrastructure on the environmental	Section 5 – Geological and

NEMA Regs (2014) - Appendix 6	Relevant section in report
sensitivities of the site including areas to be avoided, including buffers;	Palaeontological history
i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 7.1 – Assumptions and Limitation
j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment or activities;	Section 12
k) any mitigation measures for inclusion in the EMPr;	Section 13
l) any conditions for inclusion in the environmental authorization;	N/A
m) any monitoring requirements for inclusion in the EMPr or environmental authorization;	N/A
n) a reasoned opinion- i. as to whether the proposed activity, activities or portions thereof should be authorized; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorized, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	Section 12
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable.
p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Not applicable.
q) any other information requested by the competent authority.	Not applicable.
2) Where a government notice <i>gazetted</i> by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	Section 3 compliance with SAHRA guidelines

EXECUTIVE SUMMARY

Banzai Environmental was appointed by PGS Heritage (Pty) Ltd to conduct the **Palaeontological Phase 1 Field Assessment** to assess the Palaeontology for the proposed Nigel gas transmission pipeline project in the Nigel area of the Ekurhuleni Metropolitan Municipality, Gauteng Province. The National Heritage Resources Act (No 25 of 1999, section 38) (NHRA), states that a Palaeontological Assessment is key to detect the presence of fossil material within the planned development footprint. In addition, SAHRA requested a Field Assessment of the current project. This study is thus in response to SAHRA's comment and aims to evaluate the effect of the construction on local palaeontological resources

The proposed **Nigel gas transmission pipeline project**, near Nigel **Gauteng Province** is underlain by Vryheid Formation of the Ecca Group (Karoo Supergroup) and the Dwyka Group of the Karoo Supergroup. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Vryheid Formation is Very High while the Ecca and Dwyka Groups have a moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website).

As part of the Heritage Impact Assessment (HIA) for this project an Archaeological Impact Assessment (AIA) was conducted by Kruger (2019). Furthermore, SAHRA requested a Field Assessment of the current project and thus this study is in response to SAHRA's comment.

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 August 2019. No visible evidence of fossiliferous outcrops was found. For this reason, an overall **low palaeontological sensitivity** is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of Nigel Project will be of a **low significance** in palaeontological terms. It is therefore considered that the proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the **construction of the development may be authorised in its whole extent**, as the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the **Chance Find Protocol** must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (if possible, *in situ*) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462

4509. Web: www.sahra.org.za) so that correct mitigation (e.g. recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

Impact Summary

Environmental parameter	Issues	Rating prior to mitigation	Average	Rating post mitigation	Average
Loss of fossil heritage	Destroy or permanently seal-in fossils at or below the ground surface that are then no longer available for scientific study	-56	Negative medium impact	-7	Negative low impact

The construction and operation of the Nigel gas transmission pipeline project is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources.

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TERMINOLOGY AND ABBREVIATIONS

Archaeological resources

This includes:

- material remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years including artifacts, human and hominid remains, and artificial features and structures;
- rock art is any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and which is older than 100 years, including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic as defined in the Maritimes Zones Act, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;
- features, structures, and artifacts associated with a military history which are older than 75 years and the site on which they are found.

Cultural significance

This means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance

Development

This means any physical intervention, excavation, or action, other than those caused by natural forces, which may in the opinion of the heritage authority in any way result in a change to the nature, appearance or physical nature of a place or influences its stability and future well-being, including:

- construction, alteration, demolition, removal or change in use of a place or a structure at a place;
- carrying out any works on or over or under a place;
- subdivision or consolidation of land comprising a place, including the structures or airspace of a place;
- constructing or putting up for display signs or boards;
- any change to the natural or existing condition or topography of land; and
- any removal or destruction of trees, or removal of vegetation or topsoil

Fossil

Mineralized bones of animals, shellfish, plants, and marine animals. A trace fossil is the track or footprint of a fossil animal that is preserved in stone or consolidated sediment.

Heritage

That which is inherited and forms part of the National Estate (historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999).

Heritage resources

This means any place or object of cultural significance and can include (but not limited to) as stated under Section 3 of the NHRA,

- places, buildings, structures, and equipment of cultural significance;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features of cultural significance;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds, and
- sites of significance relating to the history of slavery in South Africa;

Holocene

The most recent geological time period which commenced 10 000 years ago.

Palaeontology

Any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

Table 1: Abbreviations

Abbreviations	Description
ASAP	Association of South African Professional Archaeologists
BRMO	Black Rock Mining operations
CRM	Cultural Resource Management
DEA	Department of Environmental Affairs
DIA	Desktop Impact Assessment
EA	Environmental Authorisation
ECO	Environmental Control Officer
EIA practitioner	Environmental Impact Assessment Practitioner

Abbreviations	Description
EIA	Environmental Impact Assessment
ESA	Early Stone Age
GPS	Global Positioning System
HIA	Heritage Impact Assessment
I&AP	Interested & Affected Party
LSA	Late Stone Age
LIA	Late Iron Age
MSA	Middle Stone Age
MIA	Middle Iron Age
NEMA	National Environmental Management Act
NHRA	National Heritage Resources Act
PIA	Palaeontological Impact Assessment
PHRA	Provincial Heritage Resources Authority
PSSA	Palaeontological Society of South Africa
SADC	Southern African Development Community
SAHRA	South African Heritage Resources Agency
UCD1	Universal Coal Development 1

1 INTRODUCTION

Savannah Environmental (Pty) Ltd was appointed to conduct an Environmental Basic Assessment (BA) process for the Gas Transmission Pipeline Project in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Energy Group (Pty) Ltd. ('ENGP' hereafter) propose the development of a 10km gas pipeline within the Nigel area, to provide gas reticulation services to the Consol glass factory, under the Special Purpose Vehicle (SPV) of Phambili Gas (Pty) Ltd ('Phambili' hereafter). Should the project proceed, the pipeline will be connected to the nearby Sasol line, the gas decompressed and piped through to the Nigel Consol Glass facility, for use in their ongoing smelting operations (Figure 1-6) ¹.

1.1 Background to the project

The project entails the proposed development of a Nigel gas transmission pipeline measuring 10km and 0.25m routing from the Consol Glass factory in Nigel to the Farm Grootfontein 165 Portion 44, located 8km to the north of the factory. For the pipeline, a trench of 0.5m wide and approximately 1.5-2.5m deep will be excavated within road reserves throughout the proposed alignment.

The entire length of the pipeline will be constructed within the road reserves of the various roads along which the proposed development corridor is routed, which exhibit a wide variety of land uses adjacent to the development corridor. These included power line servitudes for Eskom 400kV lines transmission lines, agriculture in the form of maize and soya beans plantations mainly, but including large number of cattle being grazed within the road reserves, urban homesteads where the pipeline routed near the Dunnottar town (a small portion of the proposed pipeline), the Nigel cemetery, and some industrial complexes including notably the AfriSam cement factory complex, a Coca-Cola bottling plant, a waste transfer station (municipal owned) and one restaurant and accommodation site. While not occurring immediately adjacent to the road, a railroad is located close by the M63 along which the pipeline will route, along the Nigel-Dunnottar road¹.

2 QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

The author (Elize Butler) has an MSc in Palaeontology from the University of the Free State, Bloemfontein, South Africa. She has been working in Palaeontology for more than twenty-four years. She has extensive experience in locating, collecting and curating fossils, including exploration field trips in search of new localities in the Karoo Basin. She has been a member of the Palaeontological Society of South Africa for 13 years. She has been conducting PIAs since 2014.

¹Information provided by Savannah



Figure 1: Google Earth Image (2019) of the proposed Nigel gas transmission pipeline (indicated in red) in the Ekurhuleni Metropolitan Municipality, Gauteng Province.



Figure 2: Aerial image of the of the proposed Nigel gas transmission pipeline layout in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Map provided by Exigo.

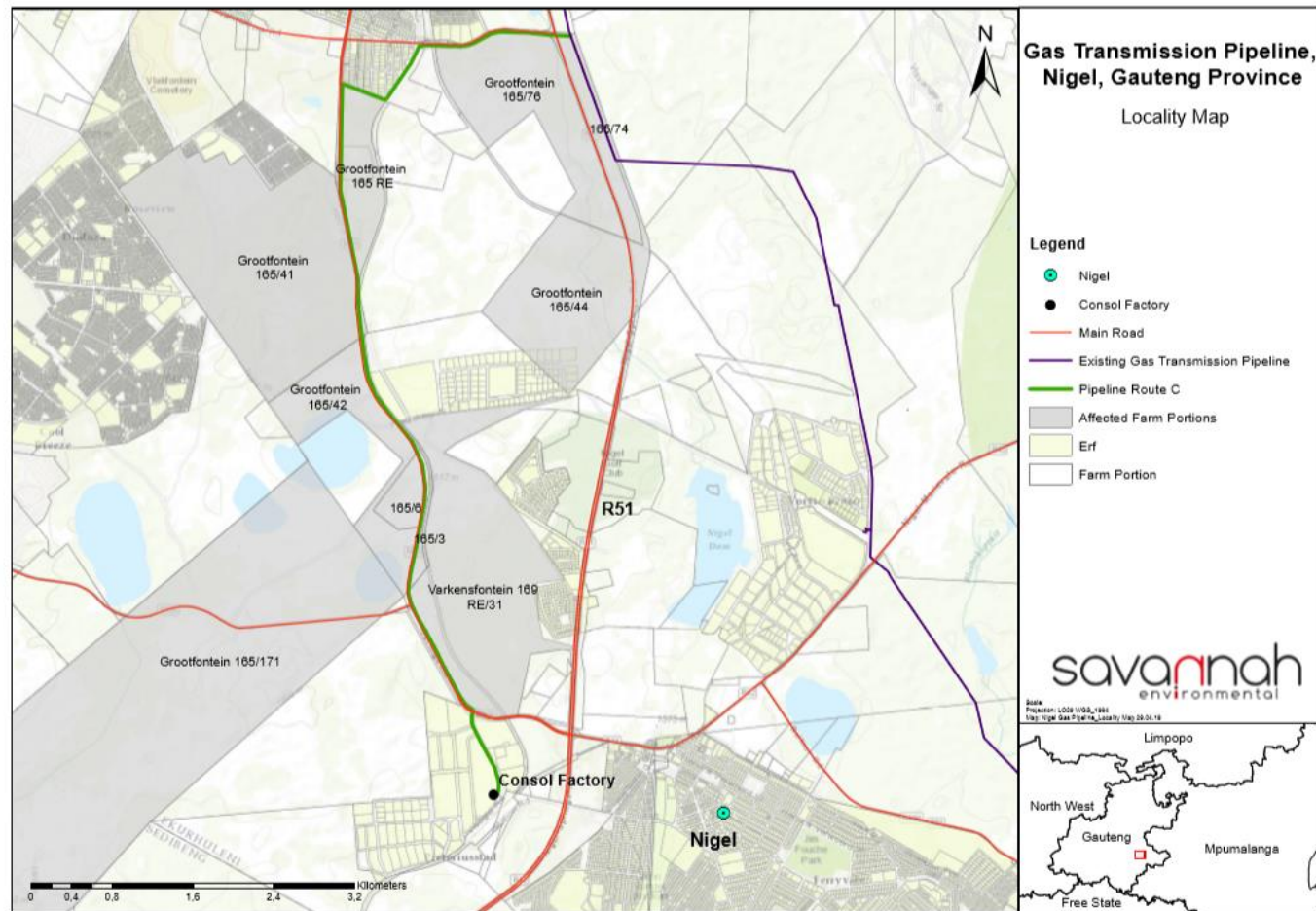


Figure 3: Locality map of the proposed Nigel gas transmission pipeline layout in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Map provided by Savannah.

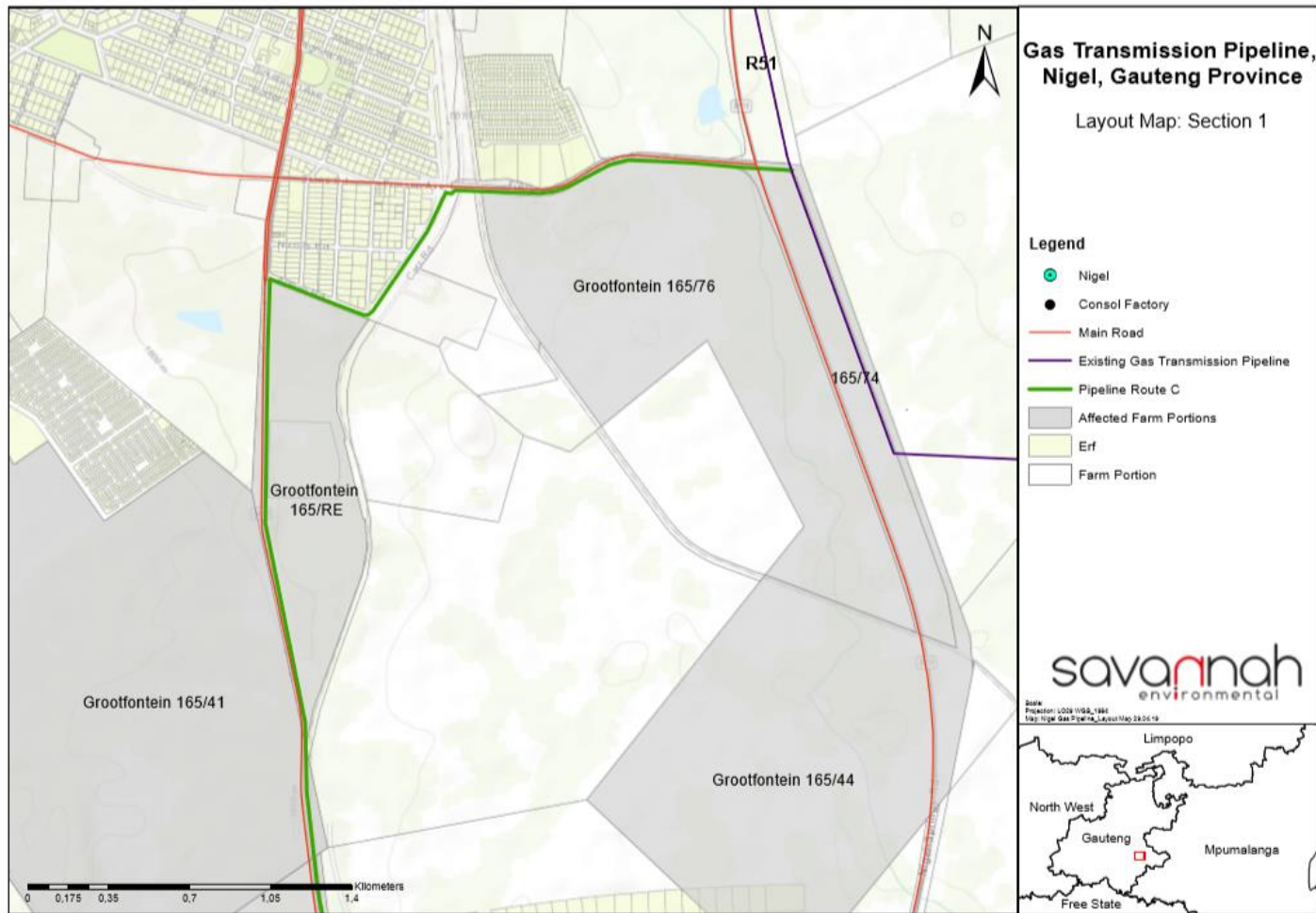


Figure 4: Layout Map: Section 1 of the of the proposed Nigel gas transmission pipeline layout in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Map provided by Savannah.

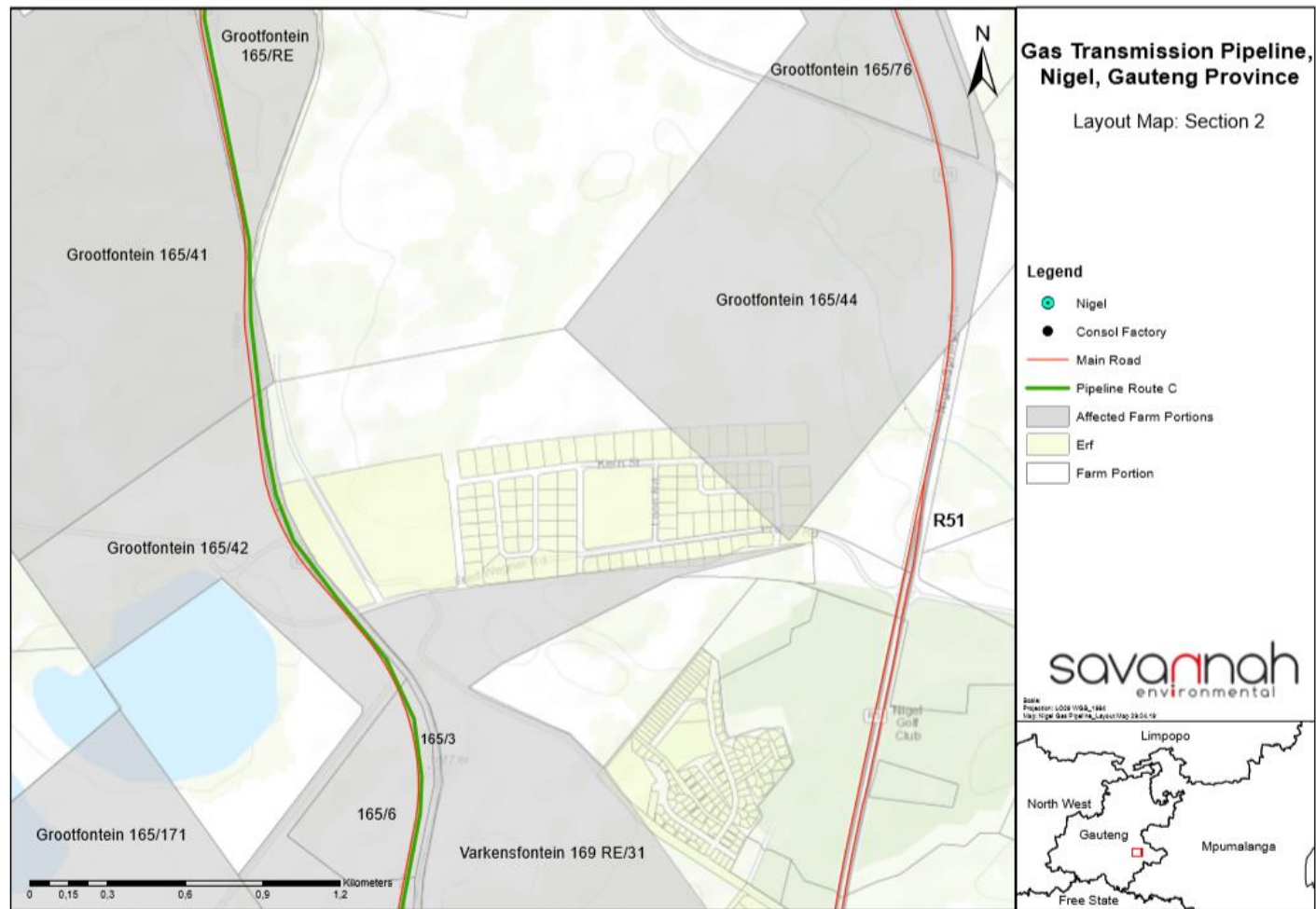


Figure 5: Layout Map: Section 2 of the of the proposed Nigel gas transmission pipeline layout in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Map provided by Savannah.

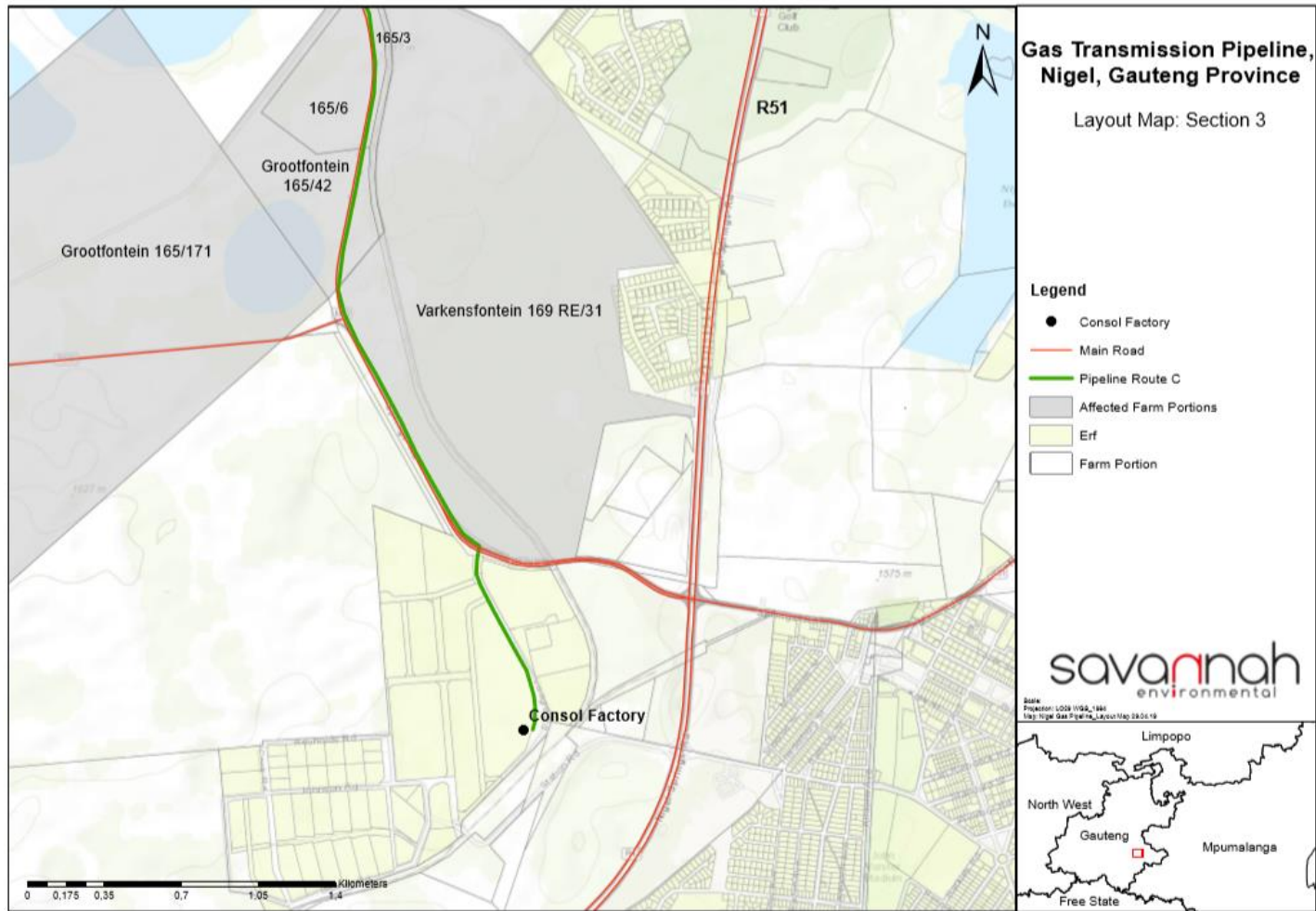


Figure 6: Layout Map: Section 3 of the of the proposed Nigel gas transmission pipeline layout in the Ekurhuleni Metropolitan Municipality, Gauteng Province. Map provided by Savannah.

3 LEGISLATION

3.1 National Heritage Resources Act (25 of 1999)

Cultural Heritage in South Africa, includes all heritage resources, is protected by the National Heritage Resources Act (Act 25 of 1999) (NHRA). Heritage resources as defined in Section 3 of the Act include “**all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens**”.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA. Palaeontological resources may not be unearthed, broken moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

This Palaeontological Assessment forms part of the existing Heritage Impact Assessment (HIA) and adheres to the conditions of the Act. According to **Section 38 (1)**, an HIA is required to assess any potential impacts to palaeontological heritage within the development footprint where:

- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length;
- the construction of a bridge or similar structure exceeding 50 m in length;
- any development or other activity which will change the character of a site—
- (exceeding 5 000 m² in extent; or
- involving three or more existing erven or subdivisions thereof; or
- involving three or more erven or divisions thereof which have been consolidated within the past five years; or
- the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority
- the re-zoning of a site exceeding 10 000 m² in extent;
- or any other category of development provided for in regulations by SAHRA or a Provincial heritage resources authority.

4 OBJECTIVE

The objective of a Palaeontological Assessment is to determine the impact of the development on potential palaeontological material at the site.

According to the “SAHRA APM Guidelines: Minimum Standards for the Archaeological and Palaeontological Components of Impact Assessment Reports” the aims of the PIA are: 1) to **identify** the palaeontological status of the exposed as well as rock formations just below the surface

in the development footprint 2) to estimate the **palaeontological importance** of the formations 3) to determine the **impact** on fossil heritage; and 4) to recommend how the developer ought to protect or mitigate damage to fossil heritage.

The terms of reference of a Palaeontological Field Assessment are as follows:

General Requirements:

- Adherence to the content requirements for specialist reports in accordance with Appendix 6 of the EIA Regulations 2014, as amended;
- Adherence to all applicable best practice recommendations, appropriate legislation and authority requirements;
- Submit a comprehensive overview of all appropriate legislation, guidelines;
- Description of the proposed project and provide information regarding the developer and consultant who commissioned the study,
- Description and location of the proposed development and provide geological and topographical maps
- Provide Palaeontological and geological history of the affected area.
- Identification sensitive areas to be avoided (providing shapefiles/kmls) in the proposed development;
- Evaluation of the significance of the planned development during the Pre-construction, Construction, Operation, Decommissioning Phases and Cumulative impacts. Potential impacts should be rated in terms of the direct, indirect and cumulative:
 - a. **Direct impacts** are impacts that are caused directly by the activity and generally occur at the same time and at the place of the activity.
 - b. **Indirect impacts** of an activity are indirect or induced changes that may occur as a result of the activity.
 - c. **Cumulative impacts** are impacts that result from the incremental impact of the proposed activity on a common resource when added to the impacts of other past, present or reasonably foreseeable future activities.
- Recommend mitigation measures to minimise the impact of the proposed development; and
- Implications of specialist findings for the proposed development (such as permits, licenses etc).

5 GEOLOGICAL AND PALAEOLOGICAL HISTORY

The proposed Nigel Gas transmission pipeline Project is underlain by the Dwyka Group (Karoo Supergroup) as well as the Vryheid Formation of the Eccca Group of the Karoo Supergroup (Figure 7).

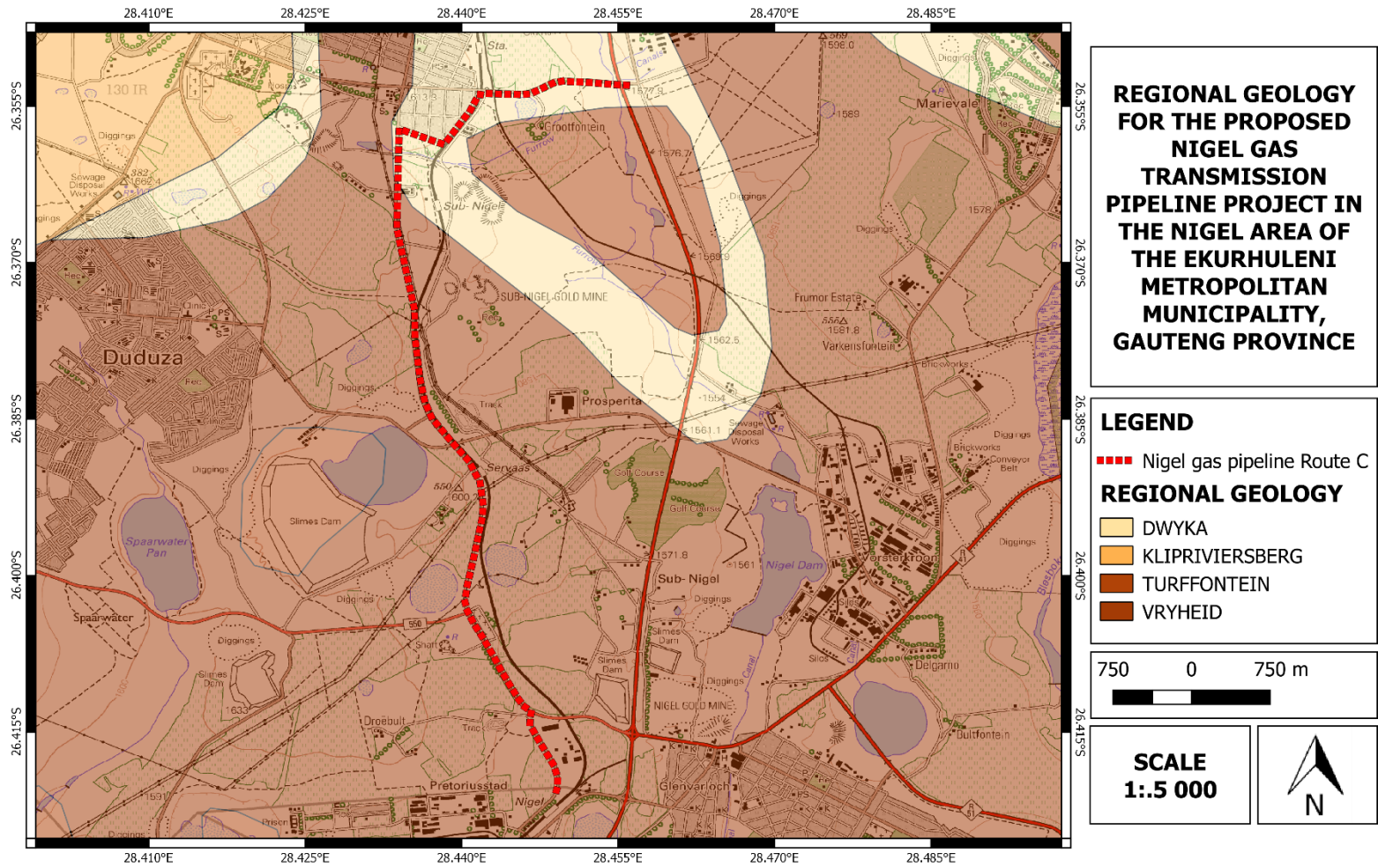


Figure 7: The surface geology of the proposed Nigel Gas transmission pipeline project is underlain by the Dwyka Group (Karoo Supergroup) as well as the Vryheid Formation, Ecca Group of the Karoo Supergroup. Map drawn QGIS Desktop 2.18. 28.

The Permo-Carboniferous Dwyka Group is the oldest deposit in the Karoo Supergroup and has a low palaeontological sensitivity. South Africa was covered by an ice sheet during the Dwyka. These deposits were thus deposited in a cold, glacially dominated environment. This Group consists mainly of gravelly sediments with subordinate varved shales and mudstones with scraped and faceted pebbles. The retreating glaciers deposited dark-grey tillite. The Dwyka is known for its rich assemblage of dropstones of various sizes. The Permo-Carboniferous Dwyka Group is known for its track ways also known as Ichnofacies that was formed by fish and arthropods. Fossilized faeces or coprolites have also been recovered. Body fossils consists of gastropods, invertebrates and marine fish, as well as fossil plants. A rich diversity of conifers, cordaitaleans, glossopterids, ginkgoaleans, pollens and spores have been described from this Group while ferns, horsetails and lycopods, are also found.

Table 2: *Ecca Group and Formations. (Modified from Johnson et al, 2006).*

Period	Supergroup	Group	Formation West of 24° E	Formation East of 24° E	Formation Free State / KwaZulu Natal
Permian	Karoo Supergroup	Ecca Group	Waterford Formation	Waterford Formation	Volksrust Formation
			Tierberg / Fort Brown Formation	Fort Brown Formation	
			Laingsburg / Rippon Formation	Rippon Formation	Vryheid Formation
			Collingham Formation	Collingham Formation	Pietermaritzburg Formation
			Whitehill Formation	Whitehill Formation	
			Prince Albert Formation	Prince Albert Formation	Mbizane Formation

This Group consists of the following Formations (DWA, 1998): The **Vryheid Formation** comprises mudrock, rhythmite, siltstone and fine- to coarse-grained sandstone (pebbly in places

The Vryheid Formation is known to contain a rich assemblage of Glossopteris flora which is the source vegetation for the Vryheid Formation. *Gymnospermous glossopterids* dominated the peat and non-peat accumulating of Permian wetlands after continental deglaciation took place (Falcon, 1986c, Greb et al., 2006).

Recent paleobotanical studies in the Vryburg Formation include that of Adenforff (2005), Bordy and Prefec (2008) and Prefec *et al.* (2008, 2009, 2010) and Prevec, (2011). Bamford (2011) described numerous plant fossils from this formation (e.g. *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia sp.*, *Raniganjia sp.*, *Asterotheca spp.*, *Liknopetalon enigmata*, *Hirsutum sp.*, *Scutum sp.*, *Ottokaria sp.*, *Estcourtia sp.*, *Arberia sp.*, *Lidgettonia sp.*, *Noeggerathiopsis sp.*, *Podocarpidites sp.* as well as more than 20 Glossopteris species.

In the past palynological studies have focused on the coal bearing successions of the Vryheid Formation and include articles by Aitken (1993, 1994, 1998), and Millsted (1994, 1999), while recent studies were conducted by Götz and Ruckwied (2014).

Bamford (2011) is of the opinion that only a small amount of data has been published on these potentially fossiliferous deposits and that most likely good material are present around coal mines and in other areas the exposures are poor and of little interest. When plant fossils do occur, they are usually abundant. According to Bamford it is not feasible to preserve all the sites but in the interests of science these sites ought to be well documented, researched and the collected fossils must be housed in an accredited institution.

To date no fossil vertebrates have been collected from the Vryheid formation. The occurrence of fossil insects is rare, while palynomorphs are diverse. Non-marine bivalves and fish scales have also been reported from this formation. Trace fossils are abundantly found but the diversity is low. The mesosaurid reptile, *Mesosaurus* has been found in the southern parts of the basin but may also be present in other areas of the Vryheid formation. Regardless of the rare occurrence of fossils in this biozone a single fossil may be scientifically importance as many fossil taxa are known from a solitary fossil.

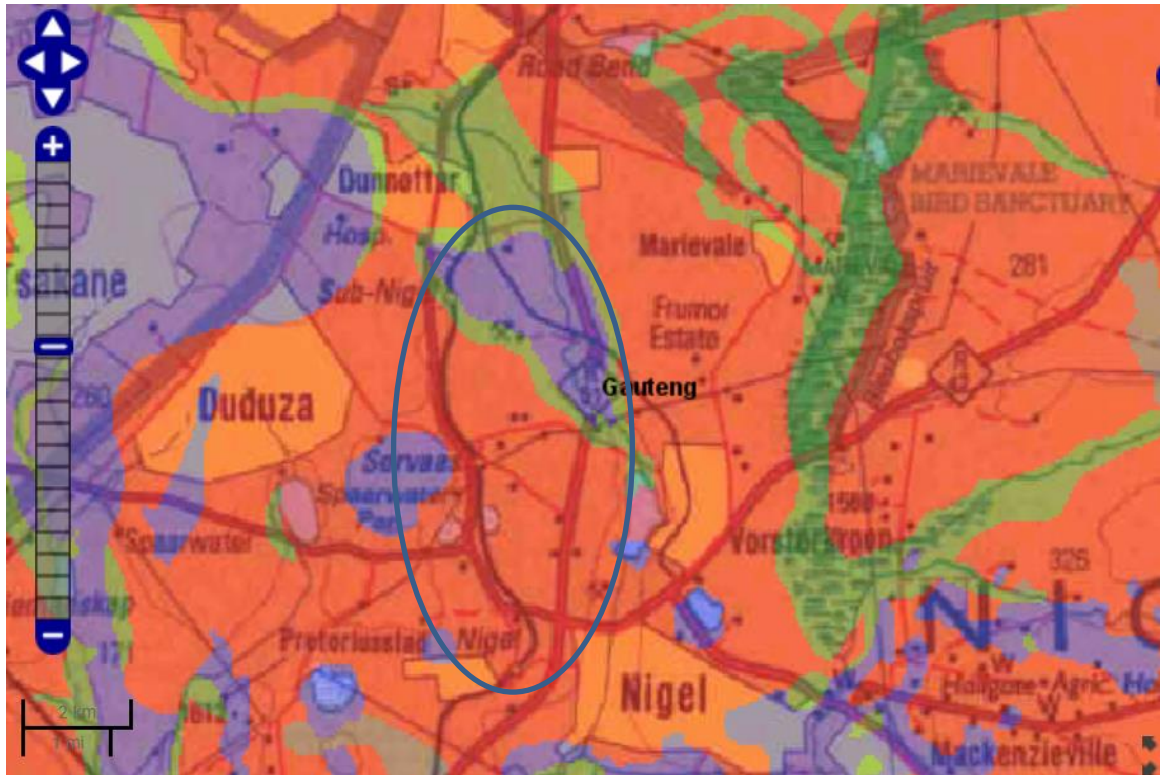


Figure 8: Extract of the 1 in 250 000 SAHRIS PalaeoMap map (Council of Geosciences). Approximate location of the proposed development is indicated in blue

Colour	Sensitivity	Required Action
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

According to the SAHRIS palaeosensitivity map (Figure 9) there is very high possibility of finding fossils in this area.

6 GEOGRAPHICAL LOCATION OF THE SITE

The project entails the proposed development of a 10km and 0.25m wide gas transmission pipeline routing from the Consol Glass factory in Nigel to the Farm Grootfontein 165 Portion 44, located 8km to the north of the factory.

The pipeline originates at the Consol Glass factory west of Nigel and follows the M63 road north towards Dunnottar where it follows Annan and Chaplan Avenues. It then routes east to the Farm Grootfontein 165 Portion 44 along the M45 road. For the pipeline, a trench of 0.5m wide and approximately 1.5-2.5m deep will be excavated and the impact footprint of the project will not exceed 10m where 5m on either side of the pipeline alignment might maximally be impacted (it was indicated that the typical affected area will be 2.5m on either side of the pipeline alignment). The pipeline construction will occur along and within road reserves throughout the proposed alignment¹.

Starting point: S26.42050° E28.44910° (Southern Nigel offset).

End Point 5302° E28.45662° (Northern Dunnottar offset).

¹Information provided by Savannah

7 METHODS

As part of the Palaeontological Assessment, a field-survey of the development footprint was conducted on the 17 August 2019 to assess the potential risk to palaeontological material (fossil and trace fossils) in the proposed footprint of the development. A physical field-survey was conducted on foot within the proposed development footprint. The results of the field-survey, the author's experience, aerial photos (using Google Earth, 2019), topographical and geological maps and other reports from the same area were used to assess the proposed development footprint. No consultations were undertaken for this Impact Assessment.

7.1 Assumptions and Limitations

The accuracy of desktop assessment is reduced by several factors which may include the following: the databases of institutions are not always up to date and relevant locality and geological information were not accurately documented in the past. Various remote areas of South Africa have not been assessed by palaeontologists and data is based on aerial photographs alone. Geological maps concentrate on the geology of an area and the sheet explanations were never intended to focus on palaeontological heritage.

Similar Assemblage Zones, but in different areas is used to provide information on the presence of fossil heritage in an unmapped area. Desktop studies of similar geological formations and

Assemblage Zones generally **assume** that exposed fossil heritage is present within the development area. The accuracy of the Palaeontological Impact Assessment is thus improved considerably by conducting a field-assessment.

8 ADDITIONAL INFORMATION CONSULTED

In compiling this report the following sources were consulted:

- The Palaeosensitivity Map from the SAHRIS website;
- 2628AD Topographical map;
- Geological map 1:100 000, Geology of the Republic of South Africa (Visser 1984) ;
- Geological Map 1: 250 000 2628 East Rand (Keyser, et al.,1986);
- A Google Earth map with polygons of the proposed development was obtained from Savannah; and
- One Nigel Impact Study report has been found on the internet and include Fourie, 2017. This report has been listed in the references.

9 SITE VISIT

The following photographs were taken during the site visit to the proposed Nigel gas transmission pipeline project in the Nigel area of the Ekurhuleni Metropolitan Municipality, Gauteng Province. No fossiliferous outcrop was identified during the site investigation. Dr H. Fourie is thanked for assisting with field work for this project.



Figure 9: Consol Factory
GPS coordinates S26° 25.304, E 28 26.903.



*Figure 10: Some scattered Ecca rocks at corner of M63
GPS coordinates S26 25.128, E 28 26.955*



Figure 11: Photo to the west to show road verge (705).

GPS coordinates S26 24.397, E28 26.525



Figure 12: Middle section of the pipeline route (706).

GPS coordinates S26 23.019, E28 26.178



*Figure 13: Crossing of Chaplan Avenue and Annan Avenue (709).
S26 21.305, E28 26.*



*Figure 14: End point in the north (710)
S26 21.190, E28 27.556*

10 ASSESSMENT METHODOLOGY

Direct, indirect and cumulative impacts of the impacts identified above will be assessed according to the following standard methodology:

- The nature which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The extent wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high).
- The duration wherein it will be indicated whether:
 - The lifetime of the impact will be of very short duration (0 - 1 years) – assigned a score of 1;
 - The lifetime of the impact will be of short duration (2 - 5 years) – assigned a score of 2;
 - Medium-term (5 - 15 years) – assigned a score of 3;
 - Long-term (> 15 years) – assigned a score of 4; or
 - Permanent – assigned a score of 5.
- The magnitude quantified on a scale from 0 - 10 where 0 is small and will have no effect on the environment, 2 is minor and will result in an impact on processes, 4 is low and will

cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease) and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.

- The probability of occurrence, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1 - 5 where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but of low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- The significance which shall be determined through a syntheses of the characteristics described above and can be assessed as low, medium or high; and
- The status, which is described as positive, negative or neutral.
- The degree to which the impact can be reversed.
- The degree to which the impact may cause irreplaceable loss of resources.
- The degree to which the impact can be mitigated.

The significance is calculated by combining the criteria in the following formula:

- $S = (E + D + M) \times P$
- S = Significance weighting
- E = Extent
- D = Duration
- M = Magnitude
- P = Probability

The significance weightings for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);
- 30 – 60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated); and
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

11 IMPACT ASSESSMENTS

An assessment of the impact significance of the proposed the proposed Nigel gas transmission pipeline project in the Nigel area of the Ekurhuleni Metropolitan Municipality, Gauteng Province is presented here:

11.1 Nature of the impact

The excavations and site clearance of the Nigel gas transmission pipeline project in Nigel 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 destroy and permanently seal-in fossils below the ground surface and will no longer be available for scientific research. According to the Geology of the project site there is a very high possibility of finding fossils.

11.2 Sensitive areas

The proposed Nigel Gas transmission pipeline Project is underlain by the Dwyka Group (moderate sensitivity) as well as the Vryheid Formation (very high palaeontological sensitivity) of the Ecca Group of the Karoo Supergroup. The site proposed for the Nigel gas transmission pipeline project will be constructed from the Consol Glass factory in Nigel to the Farm Grootfontein 165 Portion 44, and will be approximately 8km in extent.

During a site visit no fossils were detected in the proposed development footprint.

11.3 Geographical extent of impact

The impact on fossil palaeontological heritage will only occur in the construction phase when new excavations take place. The extent of potential impact is thus limited to the project site and therefore categorised as **local**.

11.4 Duration of impact

The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent**.

11.5 Potential significance of the impact

Should the project progress without due care to the possibility of fossils being present at the site the damage, and destruction of any affected fossils will be **permanent and irreversible**. Thus, any fossils occurring within the development area are potentially scientifically and culturally significant and any harmful impact on them would be of **high significance**.

11.6 Severity / benefit scale

The development of the proposed Nigel gas transmission pipeline project facilities is beneficial on not only a local level, but regional and national levels as well.

A potential **secondary advantage** of the construction of the project would be that the excavations may uncover fossils that would have remained unknown to science if construction did not take place.

11.7 Intensity

Probable significant impacts on palaeontological heritage during the construction phase are high, but the intensity of the impact on fossil heritage is rated as low.

11.8 Probability of the impact occurring

Since fossils were not detected during a field survey the probability of significant impacts on palaeontological heritage during the construction phase are low.

11.9 DAMAGE MITIGATION, REVERSAL AND POTENTIAL IRREVERSIBLE LOSS

11.9.1 Mitigation

If fossil material exists within the proposed development footprint any negative impact could be mitigated by describing and collecting well-preserved fossils. These actions should take place after vegetation clearance has taken place but *before* the ground is excavated for construction. Excavation of fossil heritage will require a permit from SAHRA and the material must be housed in a permitted institution.

11.9.2 Degree to which the impact can be mitigated

Recommended mitigation of the damage and destruction of fossil heritage within the proposed development area would involve the describing and collection of fossils in the development footprint. These actions would take place after initial vegetation clearance has taken place but *before* the ground is excavated for construction.

11.9.3 Degree of irreversible loss

Impacts on fossil heritage are generally irreversible. Scientifically, all well-documented records and palaeontological studies of any fossils exposed during construction would represent a positive impact. The possibility of a negative impact on the palaeontological heritage of the area can be reduced by the implementation of adequate damage mitigation procedures.

11.10 Degree to which the impact may cause irreplaceable loss of Resources

The proposed Nigel Gas transmission pipeline Project is underlain by the Dwyka Group (moderate sensitivity) as well as the Vryheid Formation (very high palaeontological sensitivity) of the Ecca Group of the Karoo Supergroup.

Table 3: Impact table of the construction phase of Nigel gas transmission pipeline project

Nature:		
	Without mitigation	With mitigation
Extent	Local (1)	Local (1)
Duration	Long term/permanent (5)	Long term/permanent (5)
Magnitude	High (8)	Moderate (1)
Probability	Highly probable (4)	Improbable (1)
Significance	Medium (56)	Low (7)
Status (positive or negative)	Negative	Neutral
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	-
Mitigation procedure		
<ul style="list-style-type: none"> • When a chance find is made the construction crew must instantly stop all work near the find. • The site must be secured by camping it off to protect it from any additional damage. • The finder of the fossil heritage must immediately report the find to his/her direct supervisor, according to the reporting protocols instituted by the development management. The supervisor must in turn report the find to his/her manager and the Environmental Officer (EO), resident engineer or site manager. The EO, resident engineer or site manager must report the find to the relevant Authorities and a relevant palaeontologist. • The developer/contractor must then appoint a relevant palaeontologist to investigate and access the chance find and site. • The palaeontologist must ensure that accurate records and documentation are kept. The documentation must start with the initial chance find report, including records of all actions taken, persons involved and contacted, comments received and findings. • These documents will be necessary to request authorizations and permits from the relevant Authorities to continue with the work on site. 		

- The reports and all other documents will be submitted to SAHRA by the palaeontologist.
- The report will include recommendations for additional specialist work if necessary, or request approval to continue with the development.
- When the necessary approvals have been issued, the development may carry on with the development.

The EO, resident engineer or site manager will close-off the chance find procedure and would be required to implement any requirements issued by the Authority and to add it to the operational management plan.

Residual Risk: *Loss of Fossil Heritage*

11.11 Summary of Impact Tables

The development footprint is completely underlain by the Vryheid Formation. The Palaeontological Sensitivity of this formation is rated Very High. The expected duration of the impact is assessed as potentially permanent to long term. In the absence of mitigation procedures (should fossil material be present within the affected area) the damage or destruction of any palaeontological materials will be **permanent**. Impacts on palaeontological heritage during the construction phase could potentially occur but are regarded as having a low possibility.

12 FINDINGS

The proposed Nigel gas transmission pipeline project, near Nigel Gauteng Province is underlain by Vryheid Formation of the Ecca Group (Karoo Supergroup) and the Dwyka Group of the Karoo Supergroup. According to the PalaeoMap of South African Heritage Resources Information System the Palaeontological Sensitivity of the Vryheid Formation is Very High while the Ecca and Dwyka Groups have a moderate Palaeontological Sensitivity (Almond and Pether 2008, SAHRIS website).

A site-specific field survey of the development footprint was conducted on foot and by motor vehicle on 17 August 2019. No visible evidence of fossiliferous outcrops was found. For this reason, an **overall low palaeontological sensitivity** is allocated to the development footprint. The scarcity of fossil heritage at the proposed development footprint indicates that the impact of Nigel Project will be of **a low significance** in palaeontological terms. It is therefore considered that the **proposed development is deemed appropriate and feasible and will not lead to detrimental impacts on the palaeontological resources of the area. Thus, the construction of the**

development may be authorised in its whole extent, as the development footprint is not considered sensitive in terms of palaeontological resources.

If fossil remains are discovered during any phase of construction, either on the surface or exposed by fresh excavations the Chance Find Protocol must be implemented by the ECO in charge of these developments. These discoveries ought to be protected (if possible in situ) and the ECO must report to SAHRA (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za) so that correct mitigation (e.g. recording and collection) can be carry out by a paleontologist.

Preceding any collection of fossil material, the specialist would need to apply for a collection permit from SAHRA. Fossil material must be curated in an accredited collection (museum or university collection), while all fieldwork and reports should meet the minimum standards for palaeontological impact studies suggested by SAHRA.

13 CHANCE FINDS PROTOCOL

A following procedure will only be followed in the event that fossils are uncovered during excavation.

13.1 Legislation

Cultural Heritage in South Africa (includes all heritage resources) is protected by the **National Heritage Resources Act (Act 25 of 1999) (NHRA)**. According to Section 3 of the Act, all Heritage resources include **“all objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens”**.

Palaeontological heritage is unique and non-renewable and is protected by the NHRA and are the property of the State. It is thus the responsibility of the State to manage and conserve fossils on behalf of the citizens of South Africa. Palaeontological resources may not be excavated, broken, moved, or destroyed by any development without prior assessment and without a permit from the relevant heritage resources authority as per section 35 of the NHRA.

13.2 Background

A fossil is the naturally preserved remains (or traces) of plants or animals embedded in rock. These plants and animals lived in the geologic past millions of years ago. Fossils are extremely rare and irreplaceable. By studying fossils it is possible to determine the environmental conditions that existed in a specific geographical area millions of years ago.

13.3 Introduction

This informational document is intended for workmen and foremen on construction sites. It describes the actions to be taken when mining or construction activities accidentally uncovers fossil material.

It is the responsibility of the Environmental Officer (EO) of the project to train the workmen and foremen in the procedure to follow when a fossil is accidentally uncovered. In the absence of the EO, a member of the staff must be appointed to be

responsible for the proper implementation of the chance find protocol as not to compromise the conservation of fossil material.

13.4 Chance Find Procedure

- If a chance find is made the person responsible for the find must immediately **stop working** and all work must cease in the immediate vicinity of the find.
- The person who made the find must immediately **report** the find to his/her direct supervisor which in turn must report the find to his/her manager and the ECO or site manager. The ECO must report the find to the relevant Heritage Agency (South African Heritage Research Agency, SAHRA). (Contact details: SAHRA, 111 Harrington Street, Cape Town. PO Box 4637, Cape Town 8000, South Africa. Tel: 021 462 4502. Fax: +27 (0)21 462 4509. Web: www.sahra.org.za). The information to the Heritage Agency must include photographs of the find, from various angles, as well as the GPS co-ordinates.
- A preliminary report must be submitted to the Heritage Agency within **24 hours** of the find and must include the following: 1) date of the find; 2) a description of the discovery and a 3) description of the fossil and its context (depth and position of the fossil), GPS co-ordinates.
- Photographs (the more the better) of the discovery must be of high quality, in focus, accompanied by a scale. It is also important to have photographs of the vertical section (side) where the fossil was found.

Upon receipt of the preliminary report, the Heritage Agency will inform the EO/ECO (or site manager) whether a rescue excavation or rescue collection by a palaeontologist is necessary.

- The site must be secured to protect it from any further damage. **No attempt** should be made to remove material from their environment. The exposed finds must be stabilized and covered by a plastic sheet or sand bags. The Heritage agency will also be able to advise on the most suitable method of protection of the find.
- In the event that the fossil cannot be stabilized the fossil may be collected with extreme care by the ECO (site manager). Fossils finds must be stored in tissue paper and in an appropriate box while due care must be taken to remove all fossil material from the rescue site.
- Once Heritage Agency has issued the written authorization, the developer may continue with the development.

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Appendix A – Elize Butler CV

CURRICULUM VITAE

ELIZE BUTLER

PROFESSION: Palaeontologist
YEARS' EXPERIENCE: 26 years in Palaeontology

EDUCATION: B.Sc Botany and Zoology, 1988
University of the Orange Free State

B.Sc (Hons) Zoology, 1991
University of the Orange Free State

Management Course, 1991
University of the Orange Free State

M. Sc. *Cum laude* (Zoology), 2009
University of the Free State

Dissertation title: The postcranial skeleton of the Early Triassic non-mammalian Cynodont *Galesaurus planiceps*: implications for biology and lifestyle

Registered as a PhD fellow at the Zoology Department of the UFS

2013 to current

Dissertation title: A new gorgonopsian from the uppermost *Daptocephalus Assemblage Zone*, in the Karoo Basin of South Africa

MEMBERSHIP

Palaeontological Society of South Africa (PSSA) 2006-currently

EMPLOYMENT HISTORY

Part-time Laboratory assistant Department of Zoology & Entomology
University of the Free State Zoology
1989-1992

Part-time laboratory assistant Department of Virology
University of the Free State Zoology
1992

Research Assistant
National Museum, Bloemfontein 1993 –
1997

Principal Research Assistant
and Collection Manager
National Museum, Bloemfontein
1998–currently

TECHNICAL REPORTS

Butler, E. 2014. Palaeontological Impact Assessment for the proposed upgrade of existing water supply infrastructure at Noupoort, Northern Cape Province. 2014. Bloemfontein.

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