Report for proposed residential development

Steve Tshwete Local Municipality, Nkangala District Municipality, Mpumalanga Province

Farm: Portion 52 Rondebosch 403 JS

Fourie, H. Dr heidicindy@yahoo.com

Palaeontological Desktop Impact Assessment: Protocol for finds

Commissioned by: Clean Stream Environmental Services

P.O. Box 647, Witbank, 1035

013 697 5021

2015/02/03

Ref: DARDLEA 17/2/3 N-404

B. Executive summary

Outline of the development project: Clean Stream Environmental Services has appointed Dr H. Fourie, a palaeontologist, to undertake a Desktop Paleontological Impact Assessment with protocol of the suitability of–

The applicant Ivy Jewel 35 (Pty) Ltd proposes to develop a residential area on Portion 52 of the farm Rondebosch 403 JS, Steve Tshwete Local Municipality, Nkangala District Municipality, Middelburg, Mpumalanga Province. A new residential area, a school, community facility, churches and businesses are planned. Three parks (public open spaces) will also be provided as well as internal roads.

This project includes one Alternative.
Alternative 1: A roughly rectangular 48.4292 ha property (i.e. old Towers Hotel establishment) located adjacent to the Middelburg-Belfast (R104) provincial road on the outskirts of Middelburg. The coordinates for the centre of the site is 25˚ 46'24.90"S and 29˚30'40.59"E.

The **National Heritage Resources Act 25 of 1999** requires that all heritage resources, that is, all places or objects of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance are protected. The Republic of South Africa (RSA) has a remarkably rich fossil record that stretches back in time for some 3.5 billion years and must be protected for its scientific value. Fossil heritage of national and international significance is found within all provinces of the RSA. South Africa's unique and non-renewable palaeontological heritage is protected in terms of the National Heritage Resources Act. According to this act, palaeontological resources may not be excavated, damaged, destroyed or otherwise impacted by any development without prior assessment and without a permit from the relevant heritage resources authority.

The main aim of the assessment process is to document resources in the development area and identify both the negative and positive impacts that the development brings to the receiving environment. The PIA therefore identifies palaeontological resources in the area to be developed and makes recommendations for protection or mitigation of these resources.

This report prescribes to the Heritage Impact Assessment of Section 38 of the National Heritage Resources Act 25 of 1999.

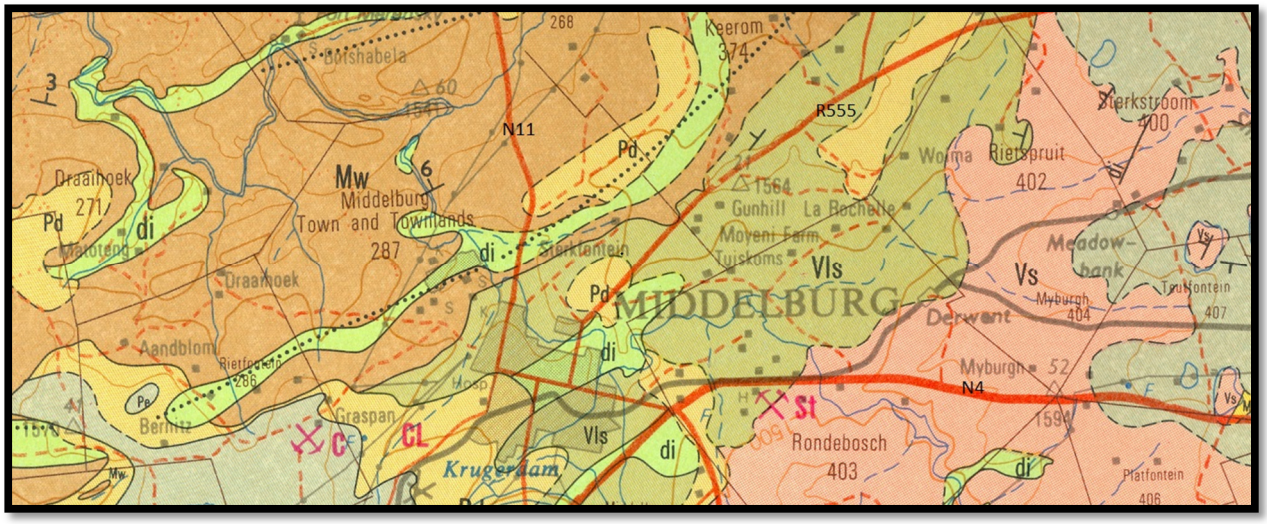
For this study, resources such as geological maps, scientific literature, institutional fossil collections, satellite images, aerial maps and topographical maps were used. It provides an assessment of the observed or inferred palaeontological heritage within the study area, with recommendations (if any) for further specialist palaeontological input where this is considered necessary.

A Palaeontological Impact Assessment is generally warranted where rock units of LOW to VERY HIGH palaeontological sensitivity are concerned, levels of bedrock exposure within the study area are adequate; large scale projects with high potential heritage impact are planned; and where the distribution and nature of fossil remains in the proposed area is unknown. The specialist will inform whether further monitoring and mitigation are necessary.

Types and ranges of heritage resources as outlined in Section 3 of the National Heritage Resources Act, 1999 (No 25 of 1999):
(i) (i) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens.
Section 38, 1(b) requires the details of the construction of a bridge or similar structure exceeding 50m in length.

It is proposed to comment and recommend on the impact of the development on fossil heritage, and if mitigation or conservation is necessary.

Outline of the geology and the palaeontology:
The geology was obtained from the Geological Map of the Republic of South Africa, 1:100 000 (Visser 1984) and 2528 Pretoria, 1:250 000 (Walraven 1978).



Legend to Map and short explanation
Pd – Tillite, shale (light brown). Dwyka Group, Karoo Supergroup. Permian.
Vls – Shale, sandstone, conglomerate, volcanic rocks (khaki). Loskop Formation, Transvaal Supergroup. Vaalian.
Vs – Volcanic rocks (orange). Selonsrivier Formation, Rooiberg Group, Transvaal Supergroup.
Di – (green) Diabase (from Vaalian to Mokolian in age).
…… - Lineament (possible dyke).
---f-- - Fault.
H - Rondebosch development (next to St on old N4, now R 104)

Mining activities:
St – Aggregate.

Summary of findings: The desktop palaeontological impact assessment was undertaken during December 2014 and January 2015, it was Summer, and the following is reported:
As this is a desktop study the date and season have no influence on the outcome. The formations present are mainly the Transvaal Supergroup (Vls, Vs) and the Dwyka Group (Pd) of the Karoo Supergroup. The development will take place over three formations (Pd, Vls, Di).

The Dwyka Group (Pd) is the lowermost unit of the Karoo Supergroup overlain by the Ecca Group and underlain by the Witteberg Group, Bokkeveld or Table Mountain Groups and various other groups. It ranges in age from Late Carboniferous to early Permian. Clastic rocks containing diamictite, varved shale, conglomerate, pebbly sandstone and mudrock are present. The rocks display features reflecting a glacial and glacially-related origin. Fossils are present (Kent 1980, Visser *et al.* 1990).

The Transvaal Supergroup is Vaalian in age (2600 – 2100 Ma). The Transvaal Supergroup comprises of clastic, volcanic and chemical sedimentary rocks. Quartzitic sandstones, mudstones and shale together with a prominent volcanic unit, minor conglomerate, chemical and volcanic members are present in the Pretoria Group. The Pretoria Group is known for stromatolitic fossils in some of the other formations. It is usually not more than 500 m thick and is well developed with an age of 2224 ± 21 Ma old.

The Loskop Formation consists of a thick succession of finely layered siltstone, mudstone, feldspathic sandstone and shale. Volcanic rocks and conglomerates also occur (2528 sheet information). This formation rests on the Selons River Formation and is overlain by the Wilge River Formation. Its age is probably between 2 100 – 2 200 my (Visser 1989). The Rooiberg Group is a 2500-6000m thick succession of feldspathic quartzites, arkoses and shales, with interbedded volcanics and felsites. It consists of two formations, the lower Damwal and the upper Selons River (Vs), restricted in its distribution (Kent 1980, Snyman 1996). The Selons River Formation has either a sandstone or a quartzite at its base and mainly consists of red riolite (Visser 1989). A diabase plate is also present.

Fossils in South Africa mainly occur in rocks of sedimentary nature and not in rocks from igneous or metamorphic nature. Therefore, if there is the presence of Karoo Supergroup strata the palaeontological sensitivity is generally LOW to VERY HIGH, but here locally MODERATE for the Loskop Formation and LOW for the Rooiberg and Dwyka Groups (SG 2.2 SAHRA APMHOB 2012).

Recommendation: The impact of the development on fossil heritage is MODERATE and LOW and therefore mitigation or conservation measures are not necessary for this development. A Phase 1 Palaeontological Assessment is not recommended. The topsoil, subsoil, overburden, inter-burden and bedrock may not need to be surveyed for fossiliferous outcrops, but care must be taken during the digging not to dig into underlying Pretoria Group formations such as Time Ball Hill. Protocol is attached due to the LOW sensitivity of the Rooiberg and Dwyka Groups and the possible presence of fossils (Appendix 2).

This project includes one Alternative:
Alternative 1: A roughly rectangular 48.4292 ha property (i.e. old Towers Hotel establishment) located adjacent to the Middelburg-Belfast (R104) provincial road on the outskirts of Middelburg. The coordinates for the centre of the site is 25˚ 46'24.90"S and 29˚30'40.59"E.

Concerns/threats:

1. Threats are earth moving equipment / machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of the fossils by development, vehicle traffic and human disturbance.
2. No consultation with parties was necessary, the SAHRA comments are included.

Stakeholders: Developer – Ivy Jewel 35 (Pty) Ltd., P.O. Box 4753, Middelburg, 1050, Tel. 013 282 0238.
Environmental – Clean Stream Environmental Services, P.O. Box 647, Witbank, 1035. Tel. 013 697 5021.
Landowner – Ivy Jewel 35 (Pty) Ltd.

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D. Background information on the project

Report This report is part of the environmental impact assessment process under the NEMA (National Environmental Management Act 107 of 1998) [as amended].

Outline of development

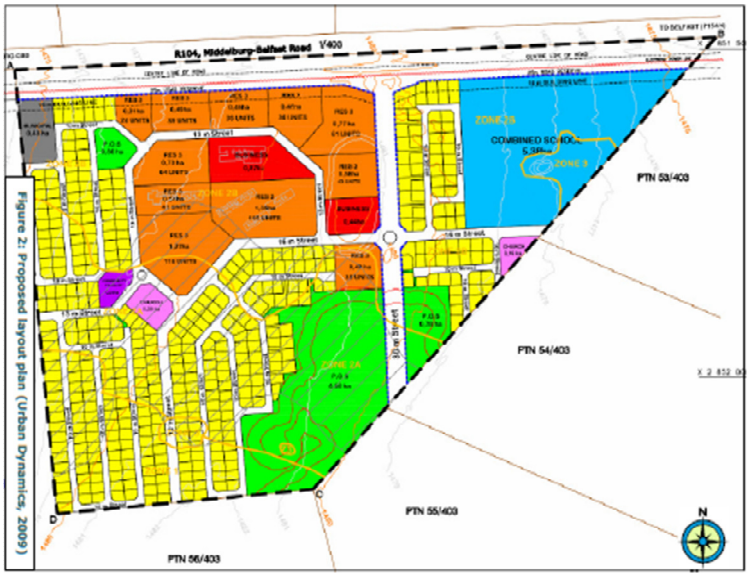
This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase, if the palaeontological sensitivity is VERY HIGH or LOW, it may be necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA) and follow protocol.

The extension possibilities of Middelburg are restricted due to mining activities and topographical factors. According to Urban Dynamics Inc. (2009), the future direction of development would be to the northern, north eastern and eastern side of Middelburg. The proposed site is to the eastern side of Middelburg and ideally located for development. The site is earmarked for residential development, it is an extension of the existing Hlalamnandi and Nasaret (BID document).

The main industrial area of Middelburg is located in close proximity of the site, which would give people the opportunity to reside closer to the workplace (BID document).

The following infrastructure is anticipated:
1. Buildings and associated structures.
2. Internal roads.

Figure: Proposed layout plan for the residential development (Figure 2, Clean Stream Environmental Services).



All of the infrastructure needed is already present such as a main road close by (R 104). Water, electricity, sewage and waste disposal may also be present nearby.

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Topographic Map (Provided by Clean Stream Environmental Services).

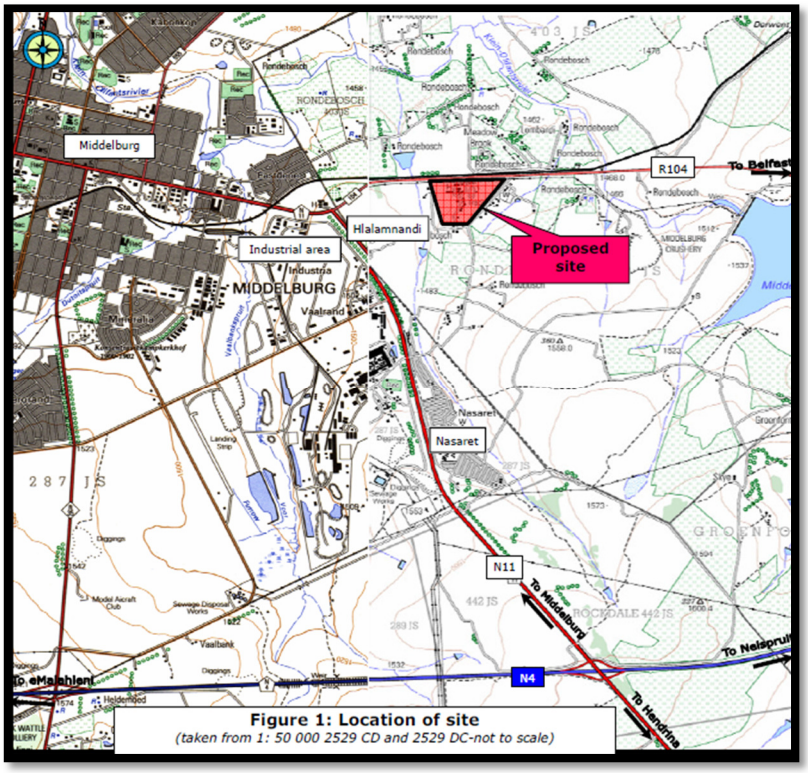
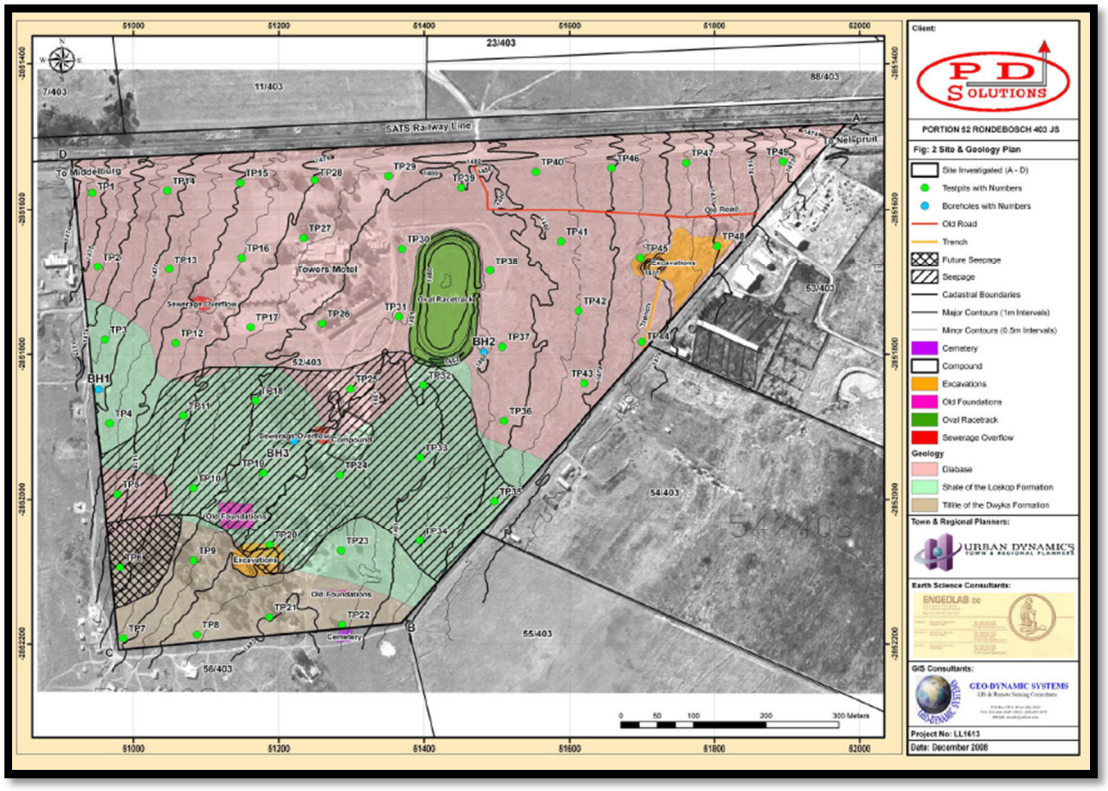


Figure 1: Location of site
(taken from 1: 50 000 2529 CD and 2529 DC-not to scale)

Rezoning/ and or subdivision of land: From Agriculture to residential and business.
Name of developer and consultant: Ivy Jewel 35 (Pty) Ltd and Clean Stream Environmental Services.
Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a desktop palaeontological impact assessment to ascertain if any palaeontological sensitive material is present in the development area. This study will advise on the impact on fossil heritage mitigation or conservation necessary, if any.
Dr Fourie obtained a Ph.D from the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand. Her undergraduate degree is in Geology and Zoology. She specialises in vertebrate morphology and function concentrating on the Therapsid Therocephalia. For the past nine years she carried out field work in the Eastern Cape Province and Mpumalanga Province. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 20 years.
Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act no: 25 of 1999. An electronic copy of this report must be supplied to SAHRA/PHRA.

E. Description of property or affected environment
Location and depth:
Ivy Jewel 35 (Pty) Ltd proposes the feasibility of the development of a residential area on Portion 52 of the farm Rondebosch 403 JS, Steve Tshwete Local Municipality, Nkangala District Municipality, Mpumalanga Province. The depth of structures / buildings / roads is determined by the foundations, footings and channels. In this instance buildings and structures will be erected.

Proposed site and geology plan superimposed on google.earth (Provided by Clean Stream Environmental Services).



F. Description of the Geological Setting

Description of the rock units:

The development is taking place in an area covered by mostly the Transvaal Supergroup sediments (Appendix 1).

The Transvaal Supergroup fills an east-west elongated basin in the south-central part of the old Transvaal (now North – West, Gauteng and Mpumalanga) as far south as Potchefstroom. It is Vaalian in age, approximately 2600 Ma to 2100 Ma. A maximum thickness of the Transvaal Supergroup reaches 2000 m in the north-eastern section. An east-west elongated basin is filled with clastic, volcanic and chemical sedimentary rocks. Three groups based on lithological differences have been established: they are the Rooiberg, Chuniespoort, and Pretoria Groups as well as other smaller groups (Kent 1980). It is the Bushveld Complex that is responsible for the tilting of the Transvaal sediments and the heat of its intrusion having created andalusite crystals (Norman and Whitfield 2006). This Supergroup is underlain by the Ventersdorp, Witwatersrand and Pongola Supergroups, and the Dominion Group.

The Loskop Formation (Vls) follows more or less concordantly on the Rooiberg Group without any trace of a regional unconformity. The Formation is separated from the overlying Waterberg sediments by a prominent regional unconformity and consists of a thick succession of finely layered siltstone, mudstone, feldspathic sandstone and shale. Volcanic rocks and conglomerates also occur (2528 sheet information). This formation rests on the Selons River Formation and is overlain by the Wilge River Formation. Its age is probably between 2 100 – 2 200 my (Visser 1989).

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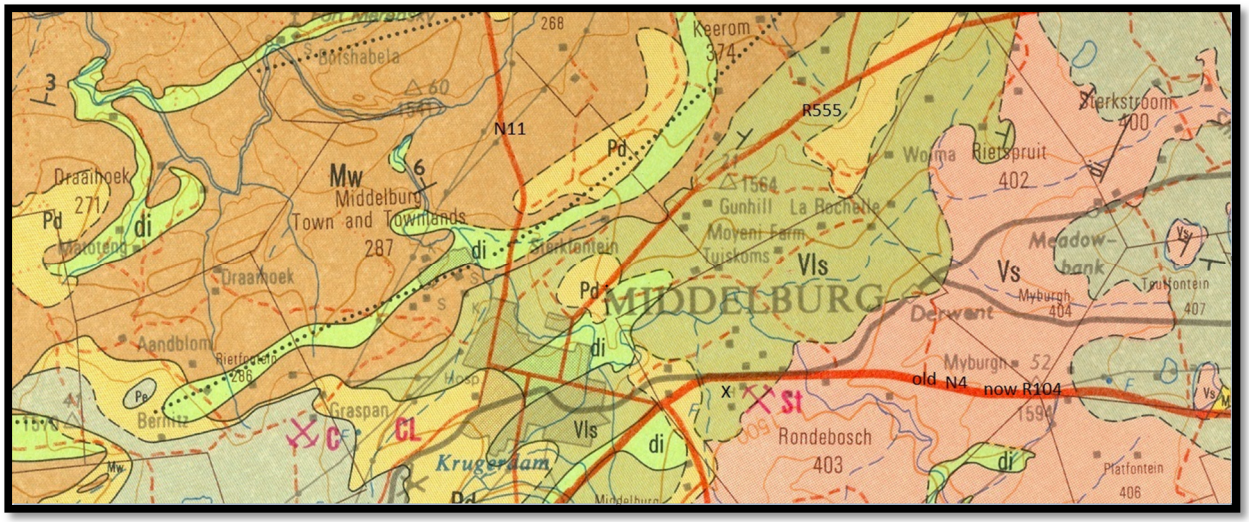
Thickness varies between 100-800 m (Visser *et al.* 1990). As Gondwana drifted northward the first sediments to be deposited would have been the Dwyka. As the glaciers melted they left striations on the surface also vast quantities of mud and large fragments of rock which formed the characteristic, poorly sorted Dwyka tillite (McCarthy and Rubidge 2005). Visser *et al.* (1990) proposed two subdivisions for the Dwyka Group in the main Karoo basin, the Elandsvlei and Mbizane Formations. In the far north, the Tshidzi and Wellington Formations also form part of the Dwyka Group.

Vaalian to post-Mokolian diabase (di) intrusions occur throughout the area in the form of plates, sills and dykes. These plates are common in the Transvaal Supergroup (Visser 1989). It is typically fine-grained, green-grey with plagioclase and pyroxenes (Visser 1989).



Legend to Map and short explanation (Walraven 1978)
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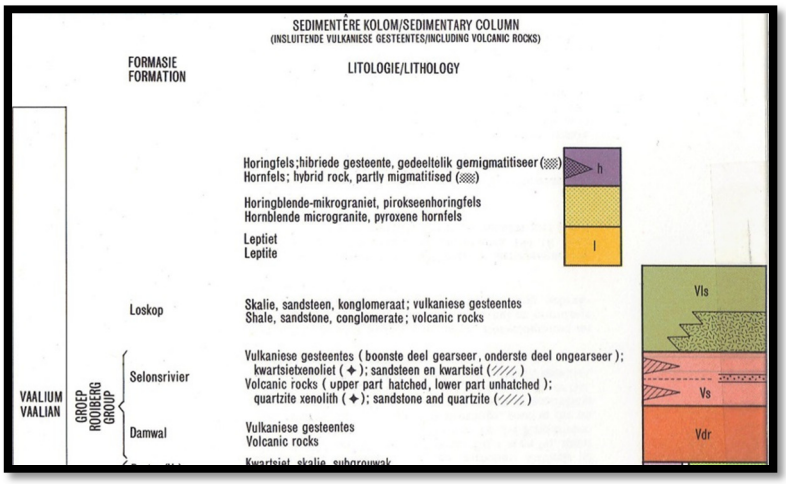
X – Rondebosch

Lithostratigraphic column of the Transvaal Supergroup (Walraven 1978)



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G. Background to Palaeontology of the area

Summary: When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a desktop and or field scoping (survey) study by a professional palaeontologist is usually warranted. The main purpose of a field scoping (survey) study would be to identify any areas within the development footprint where specialist palaeontological mitigation during the construction phase may be required (SG 2.2 SAHRA AMPHOB 2012).

Spores and acritarchs have been reported from the interglacial mudrocks, also spores, pollen and plant remains in the interbedded mudrocks of the Dwyka Group as well as the diamictite itself, while anthropod trackways and fish trails are present in places on bedding planes (Visser *et al.* 1990).

Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock unit	Significance/vulnerability	Recommended action
Dwyka Group	Low	No palaeontological studies are required, however a protocol for finds is required.
Loskop Formation	Moderate	Desktop study is required
Rooiberg Group	Low	No palaeontological studies are required, however a protocol for finds is required.

Databases and collections: Ditsong: National Museum of Natural History.

Impact: MODERATE and LOW. There may be significant fossil resources (LOW) that may be impacted by the development.

H. Description of the Methodology

The desktop palaeontological impact assessment scope was undertaken during December 2014 and January 2015.

Assumptions and Limitations:-

The accuracy and reliability of the report may be limited by the following constraints:

1. Most development areas have never been surveyed by a palaeontologist or geophysicist.
2. Variable accuracy of geological maps and associated information.
3. Poor locality information on sheet explanations for geological maps.
4. Lack of published data.
5. Lack of rocky outcrops.
6. A site visit was not conducted.
7. Insufficient data from developer and exact lay-out plan for all structures.

I. Description of significant fossil occurrences (Heritage value)

All Karoo Supergroup geological formations are ranked LOW to VERY HIGH, but here the impact is potentially MODERATE for the Loskop Formation and LOW for the Dwyka and Rooiberg Groups.

J. Recommendation

a. There is no objection to the development, and it is not necessary to request a Phase 1 Palaeontological Impact Assessment to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is MODERATE and LOW. A Phase 2 Palaeontological Mitigation will only be required if the Phase 1 Palaeontological Assessment finds fossiliferous outcrops. A Protocol for finds is attached (Appendix 2) due to the LOW palaeontological sensitivity.

b. This project will benefit the economy, the growth of the community and social development in general.

c. Preferred choice: Alternative 1 as the palaeontological sensitivity is MODERATE and LOW. Protocol for finds is attached and significant fossil resources may be impacted by the development (Appendix 2).

d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling, or blasting SAHRA/PRHA must be notified. All construction activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures.

Sampling and collecting:

Wherefore a permit may be needed from the South African Heritage Resources Agency (SAHRA).

a. Objections: None.
b. Conditions of development: See Recommendation.
c. Areas that may need a permit: None.
d. Permits for mitigation - needed from SAHRA / PHRA: None.

K. Conclusions

a. All the land involved in the development was assessed and none of the property is unsuitable for development.
b. All information needed for the Desktop Palaeontological Impact Assessment scope was provided by Clean Stream Environmental Services.
c. Areas that would involve mitigation and may need a permit from the South African Heritage Resources Agency are discussed.
d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting, SAHRA must be notified. All development activities must be stopped and a palaeontologist should be called in to determine proper mitigation measures. Especially shallow caves.
e. Condition in which development may proceed: It is further suggested that Occupational, Health and Safety Act is adhered to for safety and security reasons.

L. Bibliography

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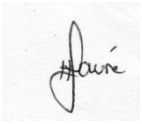
Declaration

I, Heidi Fourie, declare that I am an independent consultant and have no business, financial, personal or other interest in the proposed development project for which I was appointed to do a palaeontological scope. There are no circumstances that compromise the objectivity of me performing such work.

Heidi Fourie accepts no liability, and the client, by receiving this document, indemnifies Heidi Fourie against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by the use of the information contained in this document.

This report may not be altered in any way and any parts drawn from this report must make reference to this report.



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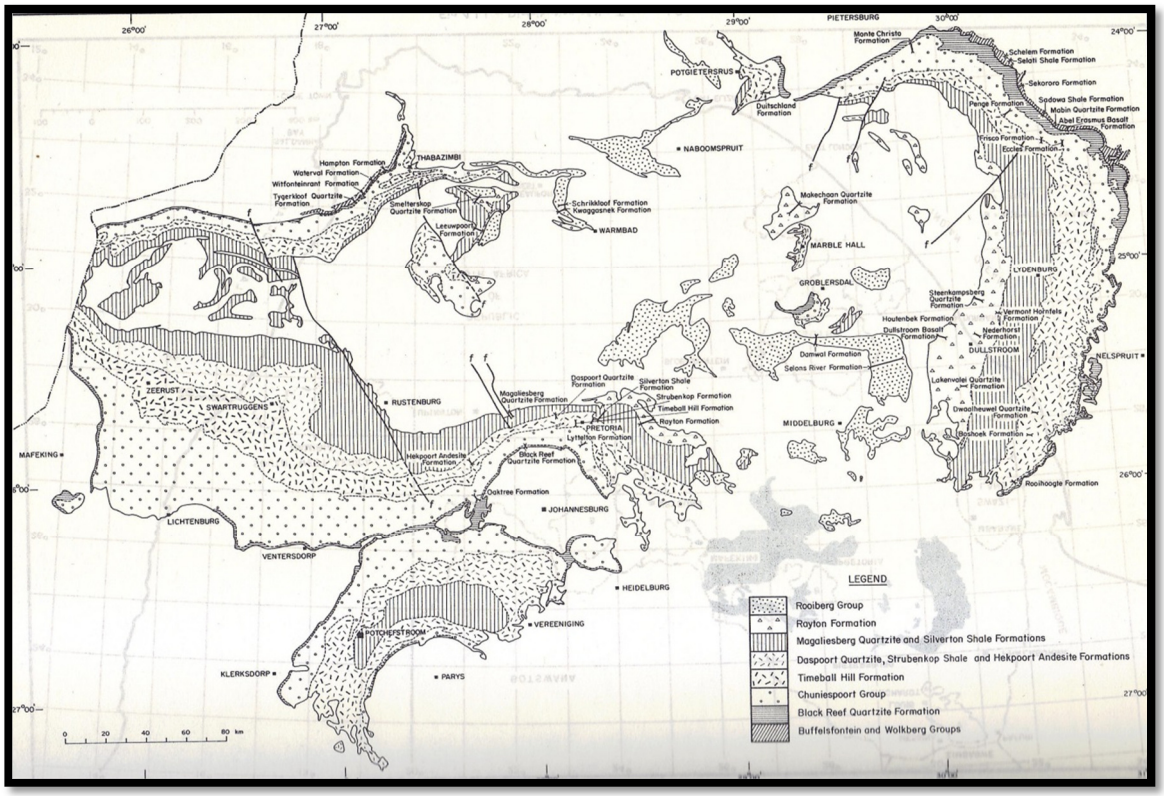
Heidi Fourie
2015/02/03

Appendix 1:

Map of the Transvaal Supergroup (Kent 1980)



Appendix 2:

Protocol for finds

This section covers the recommended protocol for a Phase 2 Mitigation process as well as for reports where the Palaeontological Sensitivity is LOW; this process guides the palaeontologist / palaeobotanist on site and should not be attempted by the layman / developer.

The developer must survey the areas affected by the development and then indicate on plan where the construction / development / mining will take place. Trenches have to be dug to ascertain how deep the sediments are above the bedrock (can be a few hundred metres). This will give the depth of the topsoil, subsoil, and overburden, if need be trenches should be dug deeper to expose the interburden.

Mitigation will involve recording, rescue and judicious sampling of the fossil material present in the layers sandwiched between the geological / coal layers. It must include information on number of taxa, fossil abundance, preservational style, and taphonomy. This can only be done during excavations. In order for this to happen, in case of coal mining operations, the process will have to be closely scrutinised by a professional palaeontologist / palaeobotanist to ensure that only the coal layers are mined (in case of coal mines) and the interlayers (siltstone and mudstone) are surveyed for fossils or representative sampling of fossils are taking place.

The palaeontological impact assessment process presents an opportunity for identification, access and possibly salvage of fossils and add to the few good plant and other fossil localities. Mitigation can provide valuable onsite research that can benefit both the community and the palaeontological fraternity.

A Phase 2 study is very often the last opportunity we will ever have to record the fossil heritage within the development area. Fossils excavated will be stored at a National Repository.

A Phase 2 Palaeontological Impact Assessment: Mitigation will include (SAHRA) -

1. Recommendations for the future of the site.
2. Description and purpose of work done (including number of people and their responsibilities).

3. A written assessment of the work done, fossils excavated, not removed or collected and observed.
4. Conclusion reached regarding the fossil material.
5. A detailed site plan and map.
6. Possible declaration as a heritage site or Site Management Plan.
7. Stakeholders.
8. Detailed report including the Desktop and Phase 1 study information.
9. Annual interim or progress Phase 2 permit reports as well as the final report.
10. Methodology used.

Mitigation involves planning the protection of significant fossil sites, rock units or other palaeontological resources and/or excavation, recording and sampling of fossil heritage that might be lost during development, together with pertinent geological data. The mitigation may take place before and / or during the construction phase of development. The specialist will require a Phase 2 mitigation permit from the relevant Heritage Resources Authority before a Phase 2 may be implemented.

The Mitigation is done in order to rescue representative fossil material from the study area to allow and record the nature of each locality and establish its age before it is destroyed and to make samples accessible for future research. It also interprets the evidence recovered to allow for education of the public and promotion of palaeontological heritage.

Should further fossil material be discovered during the course of the development (*e. g.* during bedrock excavations), this must be safeguarded, where feasible *in situ,* and reported to a palaeontologist or to the Heritage Resources authority. In situations where the area is considered palaeontologically sensitive (*e. g.* Karoo Supergroup Formations, ancient marine deposits in the interior or along the coast) the palaeontologist might need to monitor all newly excavated bedrock. The developer needs to give the palaeontologist sufficient time to assess and document the finds and, if necessary, to rescue a representative sample.

When a Phase 2 palaeontological impact study is recommended, permission for the development to proceed can be given only once the heritage resources authority has received and approved a Phase 2 report and is satisfied that (a) the palaeontological resources under threat have been adequately recorded and sampled, and (b) adequate development on fossil heritage, including, where necessary, *in situ* conservation of heritage of high significance. Careful planning, including early consultation with a palaeontologist and heritage management authorities, can minimise the impact of palaeontological surveys on development projects by selecting options that cause the least amount of inconvenience and delay.

Three types of permits are available; Mitigation, Destruction and Interpretation. The specialist will apply for the permit at the beginning of the process (SAHRA 2012).

The Palaeontological Society of South Africa (PSSA) does not have guidelines on excavating or collecting, but the following is suggested:

1. The developer needs to clearly stake or peg-out (survey) the areas affected by the mining / construction / development operations and dig representative trenches and if possible supply geological borehole data.
2. Fossils likely to occur are for example the fossil plants from the Vryheid Formation, these are present in the grey shale (if the Vryheid Formation is absent, then skip this point).
3. When clearing topsoil, subsoil or overburden and hard rock (outcrop) is found, the contractor needs to stop all work.
4. A Palaeontologist / Palaeobotanist (contact SAHRIS for list) must then inspect the affected areas and trenches for fossiliferous outcrops / layers. The contractor / developer may be asked to move structures, and put the development on hold.
5. If the Palaeontologist / Palaeobotanist is satisfied that no fossils will be destroyed or have removed fossils, development and removing of the topsoil can continue.
6. After this process the same Palaeontologist / Palaeobotanist will have to inspect and offer advice through the Phase 2 Mitigation Process. Bedrock excavations for footings may expose, damage or destroy previously buried fossil material and must be inspected.
7. When permission for the development is granted, the next layer can be removed, if this is part of a fossiliferous layer, then with the removal of each layer of sediment, the Palaeontologist / Palaeobotanist must do an investigation (a minimum of once every two weeks).

8. At this stage the Palaeontologist / Palaeobotanist in consultation with the developer / mining company must ensure that a further working protocol and schedule is in place. Onsite training should take place, followed by an annual visit by the Palaeontologist / Palaeobotanist.

Fossil excavation if necessary during Phase 2:

1. Photography of fossil / fossil layer and surrounding strata.
2. Once a fossil has been identified as such, the task of extraction begins.
3. It usually entails the taking of a GPS reading and recording lithostratigraphic, biostratigraphic, date, collector and locality information.
4. Using Paraloid (B-72) as an adhesive and protective glue, parts of the fossil can be kept together (not necessarily applicable to plant fossils).
5. Slowly chipping away of matrix surrounding the fossil using a geological pick, brushes and chisels.
6. Once the full extent of the fossil / fossils is visible, it can be covered with a plaster jacket (not necessarily applicable to plant fossils).
7. Chipping away sides to loosen underside.
8. Splitting of the rock containing palaeobotanical material will reveal any fossils sandwiched between the layers.

SAHRA does have the following documents in place:
Guidelines to Palaeontological Permiting policy.
Minimum Standards: Palaeontological Component of Heritage Impact Assessment reports.
Guidelines for Field Reports.

Appendix 3: Table listing points in Appendix 6 of the Act and position in Report.

Section	Point in Act	Heading
B	1(c)	Outline of development project
	1(d)	Summary of findings
	1(g)	Concerns/threats:
	1(n)i	"
	1(n)ii	"
	1(o)	"
	1(p)	"
D	1(h)	Figures
	1(a)i	Terms of reference
G	1(e)	Description of Methodology
	1(i)	Assumptions and Limitations
I	1(f)	Heritage value
J	1(j)	Recommendation
	1(l)	"
	1(m)	Sampling and collecting
	1(k)	"
Declaration	1(b)	Declaration
Appendix 2	1(k)	Protocol for finds
	1(m)	"
	1(q)	"