

The proposed township establishment Blydeville ext 4 - mixed land use housing development  
Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality, North West Province

Farm: Portion 1 of Rietdraai 51 IP

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Palaeontological Impact Assessment: Desktop study

Facilitated by: THOLOANA

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## B. Executive summary

Outline of the development project: THOLOANA has facilitated the appointment of Dr H. Fourle, a palaeontologist, to undertake a Palaeontological Impact Assessment (PIA), Desktop Study of the suitability of the proposed township establishment Blydeville ext 4 - mixed land use housing development, with related infrastructure on Portion 1 of Rietdraai 51 IP in the Ditsobotla Local Municipality, Ngaka Modiri Molema District Municipality in the North West Province.

The applicant Ditsobotla Local Municipality, proposes to develop the property in to a mixed land use development consisting of a residential area with related infrastructure in Lichtenburg.

The Project includes two Alternatives (see google.earth image):

Alternative 1: An area roughly rectangular blocked in red between the Blydeville suburb to the west and Kalkwegway to the east. The area is approximately 59 hectares.

Alternative 2: No Go option is not viable.

The National Heritage Resources Act (Act No. 25 of 1999) (NHRA) 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.

"palaeontological" means 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 traces.

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 (Act 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.

This report adheres to the guidelines of Section 38 (1) of the National Heritage Resources Act (Act No. 25 of 1999).

Subject to the provisions of subsections (7), (8) and (9), any person who intends to undertake a development categorised as (a) the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300 m in length; (b) the construction of a bridge or similar structure exceeding 50 m in length; (c) any development or other activity which will change the character of a site (see Section 38); (d) the re-zoning of a site exceeding 10 000 m<sup>2</sup> in extent; (e) or any other category of development provided for in regulations by SAHRA or a PHRA authority.

This report aims to provide comment and recommendations on the potential impacts that the proposed development could have on the fossil heritage of the area and to state if any mitigation or conservation measures are necessary.

Outline of the geology and the palaeontology:

The geology was obtained from map 1:100 000, Geology of the Republic of South Africa (Visser 1984) and the 1:250 000 (2526) Geological Map Wes Rand (Keyser 1986).

Figure 3: The geology of the development area.



Legend to Map and short explanation.

Qc – Calcrete (yellow), Quaternary.

C-Pd – Diamictite, shale (green) Dwyka Group, Karoo Supergroup.

R-Vk – Breccia, conglomerate [::], greywacke, shale, limestone, tuff (brown), Kameeldoorns Formation, Platberg Group, Ventersdorp Supergroup.

—f— (black) Fault.

⊥ 30 - Strike and dip of bed.

B – Approximate position of development (in the middle of the Figure).

Mining Activities

LS – Limestone.

Summary of findings: The Palaeontological Impact Assessment: Desktop study was undertaken in July 2016 in the winter in dry and cold conditions, as this is a desktop study the season (Appendix 6 of Act, 1(d)) has no influence on the outcome, and the following is reported:

The Dwyka Group 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). 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.

Spores and acritarchs have been reported from the interglacial mudrocks of the Dwyka Group, also spores, pollen and plant remains in the interbedded mudrocks as well as the diamictite itself, while arthropod trackways and fish trails are present in places on bedding planes (Visser *et al.* 1990). Trace fossils and cyanobacterial mats are present in the Waterberg Group (Groenewald and Groenewald 2014).

The development is taking place on the Karoo Supergroup, Dwyka Group.

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 can generally be LOW to VERY HIGH, and here locally MODERATE for the Dwyka Group (SG 2.2 SAHRA APMHOB, 2012).

Recommendation:

The impact of the development on fossil heritage is MODERATE and therefore a field survey or further mitigation or conservation measures may not be necessary for this development (according to SAHRA protocol). A Phase 1 Palaeontological Impact Assessment and or mitigation may not be recommended. The overburden and inter-burden must be surveyed for fossils. Special care must be taken during the digging, drilling, blasting and excavating of foundations, trenches, channels and footings and removal of overburden not to intrude fossiliferous layers.

**Table 2:** Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Dwyka Group	Moderate	Desktop study is required

The Project includes two Alternatives (see google.earth image):

Alternative 1: An area roughly rectangular blocked in red between the Blydeville suburb to the west and Kalkwegway to the east. The area is approximately 59 hectares.

Alternative 2: No Go option is not viable.

Concerns/threats:

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

Stakeholders: Developer – Not yet known.

Environmental – THOLOANA, P.O. Box 1549, Honeydew, 2040, Tel. 011 057 1847.

Landowner – Ditsobotla Local Municipality.

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**D. Background information on the project**

Report

This report is part of the environmental impact assessment process under the National Environmental Management Act, as amended (Act No. 107 of 1998) (NEMA) and includes Appendix 6 (GN R38282 of 4 December 2014) of the Environmental Impact Assessment Regulations (see Appendix 2).

Outline of development

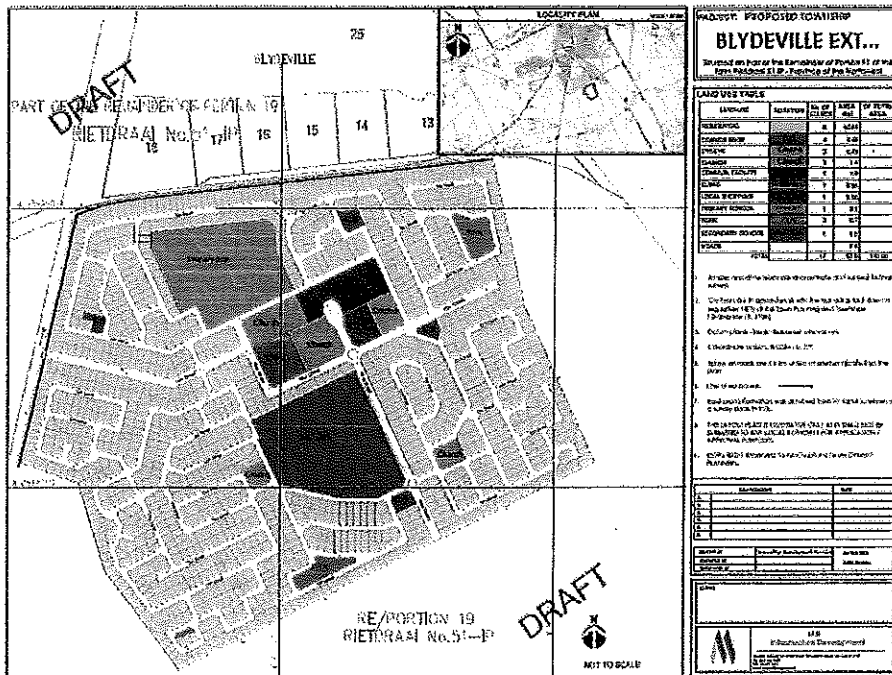
This report discusses and aims to provide the developer with information regarding the location of palaeontological material that will be impacted by the development. In the pre-construction phase it is necessary for the developer to apply for the relevant permit from the South African Heritage Resources Agency (SAHRA / PHRA).

The applicant Ditsobotla Local Municipality, proposes to develop the property in to a mixed land use development consisting of a residential area (1111 erven) with related infrastructure in Lichtenburg. The project will entail the following (Draft Scoping Report, THOLOANA):

1. Construction of internal roads and sidewalks,
2. Construction of draining and storm water systems,
3. Installation of electricity infrastructure,
4. Installation of potable water supply infrastructure and sanitation,
5. Construction of housing units,
6. Construction of primary and secondary schools,
7. Construction of a community facility,
8. Construction of a shopping complex,
9. Construction of a crèche,
10. Construction of a park,
11. Construction of a clinic, and
12. Construction of a church.

The North West Local Government has a mandate to take a more strategic approach to housing by developing high quality and well maintained accommodation. This will be profitable in the community of Lichtenburg in that it will give access to formal housing, basic services, secure tenure, and affordable mortgage finance. This will address the backlog of housing in the area (Draft Scoping Report, Tholoana).

Figure 1: Layout plan for the proposed development (Tholoana).



The Project includes two Alternatives (see google earth image):

Alternative 1: An area roughly rectangular blocked in red between the Blydeville suburb to the west and Kalkwegway to the east. The area is approximately 59 hectares.

Alternative 2: No Go option is not viable.

Rezoning/ and or subdivision of land: Yes, from Agricultural to Mixed land use.

Name of Developer and Consultant: North-West Department and Human Settlement and THOLOANA.

Terms of reference: Dr H. Fourie is a palaeontologist commissioned to do a 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 (now ESI), 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 ten years she carried out field work in the Eastern Cape, Limpopo, Mpumalanga, Gauteng and Free State Provinces. Dr Fourie has been employed at the Ditsong: National Museum of Natural History in Pretoria (formerly Transvaal Museum) for 22 years.

Legislative requirements: South African Heritage Resources Agency (SAHRA) for issue of permits if necessary. National Heritage Resources Act (Act No. 25 of 1999). An electronic copy of this report must be supplied to SAHRA.

### E. Description of property or affected environment

#### Location and depth:

Currently the farms are vacant, with the following surrounding land uses:

- Agricultural land uses,
- R503 and R 505 roads, and
- Informal and formal residential units.

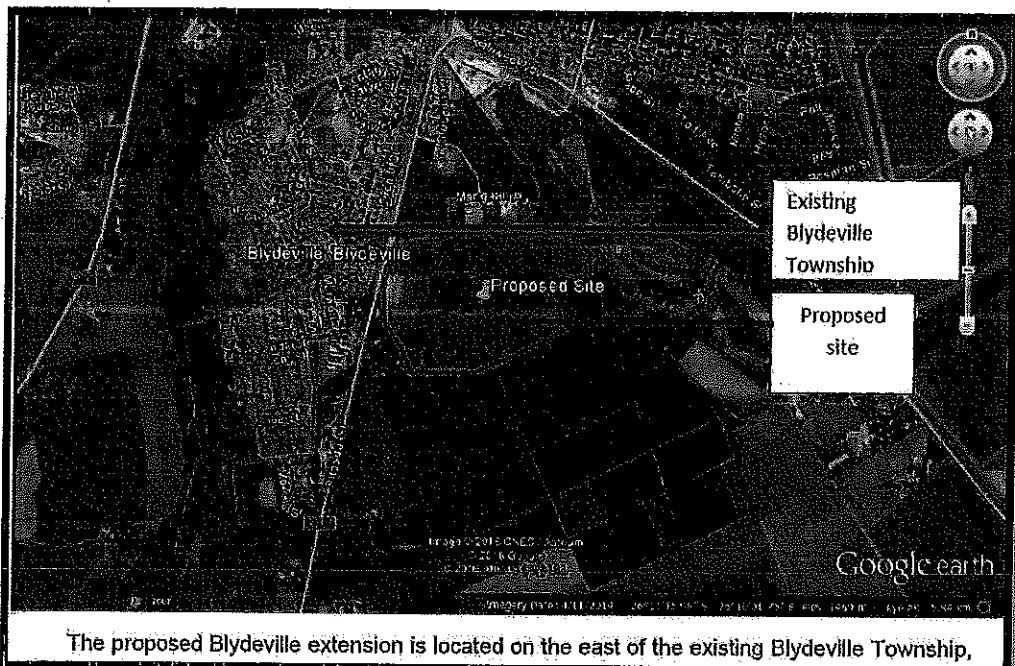
Depth is determined by the development and related infrastructure.

The Project includes two Alternatives (see google.earth image):

Alternative 1: An area roughly rectangular blocked in red between the Blydeville suburb to the west and Kalkwegway to the east. The area is approximately 59 hectares.

Alternative 2: No Go option is not viable.

Figure 2: Google.earth image showing location (Tholoana).



The proposed Blydeville extension is located on the east of the existing Blydeville Township,

The bulk of the site is underlain by the Karoo Supergroup and Ventersdorp Supergroup rocks.

#### F. Description of the Geological Setting

##### Description of the rock units:

The Dwyka Group is the lowermost unit of the Karoo Supergroup overlain by the Eccca Group and underlain by the Witteberg Group, Bokkeveld or Table Mountain Groups and various other groups (Visser 1989). 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). 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 Elandsvelei and Mbizane Formations. In the far north, the Tshidzi and Wellington Formations also form part of the Dwyka Group.

The Ventersdorp Supergroup consists mainly of andesitic lava, tuff and agglomerate. The Klipriviersberg Group and the Platberg Group are Randian in age, where the Rietgat Formation is Vaalian in age (Sheet information 2626 Wes Rand). The Ventersdorp Supergroup sits disconformably on the Witwatersrand Supergroup and is made up of the lower Klipriviersberg Group, the middle Platberg Group, and two formations (Bothaville and Allanridge). Together it can reach a maximum thickness of 4,260 m in some areas. The Klipriviersberg Group comprises the Edenville, Westonarea, Alberton and Orkney Formations. Several formations make up the Platberg Group, the Kameeldoorns, Makwassie, Rietgat, Bothaville and Allanridge (Kent 1980, Visser 1989). A volcanic event that started 2,714 million years ago is responsible for the Klipriviersberg Group of the Ventersdorp Supergroup, further eruptions of basalt and rhyolite formed the Platberg Group (McCarthy and Rubidge 2005). It is described as an elliptical basin named after the town of Ventersdorp. Sediments accumulated in fault-bounded troughs or grabens and gold can be present (Norman and Whitfield 2006).

The Platberg Group consists predominantly of Randian age and Vaalian age rocks. The Rietgat Formation sits concordantly on the Makwassie Formation consisting of green-grey amygdaloidal, porphyritic lava (Garfield Member), interlayered with shale, tuff, greywacke conglomerate, and impure lacustrine limestone with algal stromatolites (2626 Wes Rand sheet info, Kent 1980). This formation is at the top of the Platberg Group. Soils forming can be divided into three groups with the solid lavas creating excellent conditions for foundations, the residual soils and the tuffs are not ideal for foundations (Snyman 1996).

Figure 3: Geology of development area 2626 West Rand (Keyser 1986)



Qc – Calcrete (yellow), Quaternary.

C-Pd – Diamictite, shale (green) Dwyka Group, Karoo Supergroup.

R-Vk – Breccia, conglomerate [:], greywacke, shale, limestone, tuff (brown), Kameeldoorns Formation, Platberg Group, Ventersdorp Supergroup.

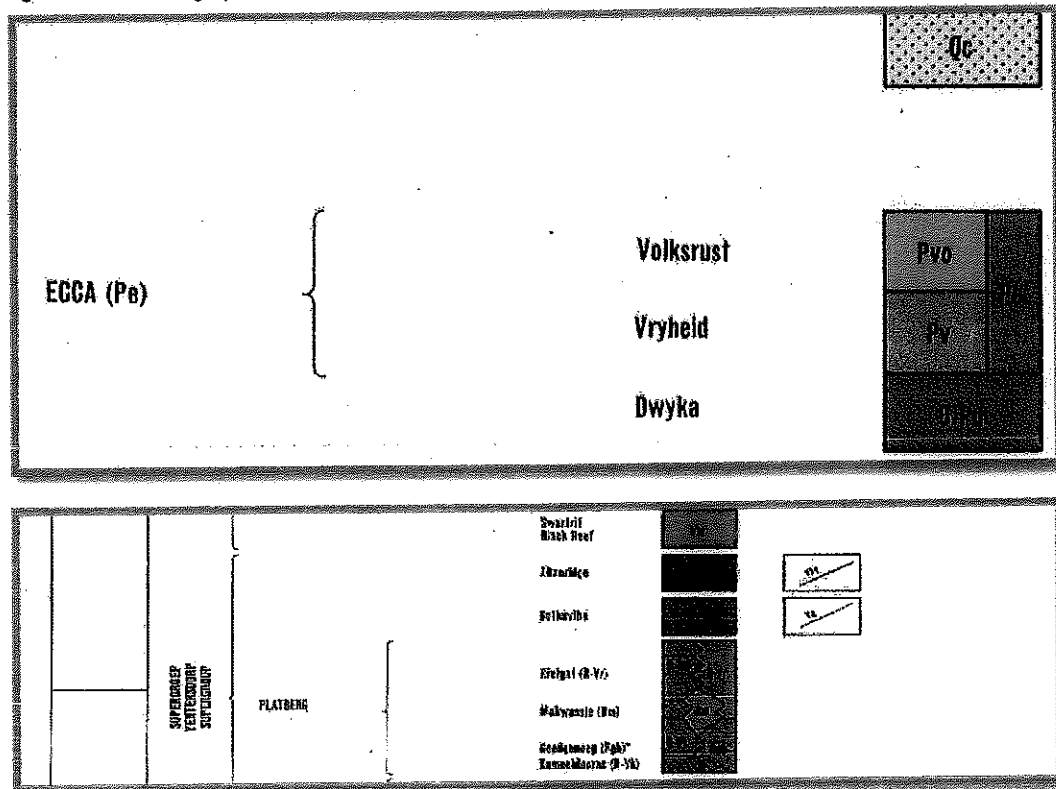
- f-- (black) Fault.
- ⊥ 30 - Strike and dip of bed.
- B - Approximate position of development (in the middle of the Figure).

The Project includes two Alternatives (see google.earth image):

Alternative 1: An area roughly rectangular-blocked-in-red-between-the-Blydeville-suburb-to-the-west-and-Kalkwegway-to-the-east. The area is approximately 59 hectares.

Alternative 2: No Go option is not viable.

Figure 4: Lithostratigraphic column of the geology of the site (Keyser 1986).



It is recommended to wait for the response from SAHRA on the Desktop Study (this report), and if a Phase 1: Field study is recommended then SAHRA protocol must be followed. Alternatives will not be feasible.

### G. Background to Palaeontology of the area

**Summary:** When rock units of moderate to very high palaeontological sensitivity are present within the development footprint, a desk top 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 of the Dwyka Group, also spores, pollen and plant remains in the interbedded mudrocks as well as the diamictite itself, while anthropod trackways and fish trails are present in places on bedding planes (Visser *et al.* 1990). Trace fossils and cyanobacterial mats are present in the Waterberg Group (Groenewald and Groenewald 2014).

Table 1: Taken from Palaeotechnical Report (Groenewald and Groenewald 2014).

Subgroup/sequence	Group	Formation	Fossil Heritage	Comment
Quaternary		(Qc)	Mammalian	Caves such as Wonderwerk and-Taung



Karoo Supergroup	Dwyka	(C-Pd)	Trace fossil assemblages, fossil plants, shelly invertebrates	
Ventersdorp Supergroup	Platberg	Kameeldooms (R-Vk)	Stromatolites.	Probably also contain microfossils. This may also apply to carbonaceous mudrocks.

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 Platberg Group, Ventersdorp Supergroup.

**Table 2:** Criteria used (Fossil Heritage Layer Browser/SAHRA):

Rock Unit	Significance/vulnerability	Recommended Action
Quaternary	High	Desktop study is required and based on the outcome of the desktop study, a field assessment is likely
Dwyka Group	Moderate	Desktop study is required
Platberg Group	Moderate	Desktop study is required

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

Impact: MODERATE for the Dwyka Group, Karoo Supergroup. There are significant fossil resources that may be impacted by the development and if destroyed are no longer available for scientific research or other public good.

#### H. Description of the Methodology

The palaeontological impact assessment desktop study was undertaken in July 2016. A literature survey is included and the study relied on literature, geological maps, google.maps and google.earth images.

Assumptions and Limitations (Appendix 6 of Act 1(i):-

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. Insufficient data from developer and exact lay-out plan for all structures.

#### A Phase 1 Palaeontological Impact Assessment: Field Study will include:

1. Recommendations for the future of the site.
2. Background information on the project.
3. Description of the property of affected environment with details of the study area.
4. Description of the geological setting and field observations.
5. Background to palaeontology of the area.
6. Field Rating.
7. Stating of Significance (Heritage Value).

#### A Phase 2 Palaeontological Impact Assessment: Mitigation will include:

1. Recommendations for the future of the site.
2. Description 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.
6. Possible declaration as a heritage site or Site Management Plan.

The National Heritage Resources Act No. 25 of 1999 further prescribes.

Act No. 25 of 1999. National Heritage Resources Act, 1999.

National Estate: 3 (2) (f) archaeological and palaeontological sites,

(i)(1) objects recovered from the soil or waters of South Africa, including archaeological and palaeontological objects and material, meteorites and rare geological specimens,

Heritage assessment criteria and grading: (a) Grade 1: Heritage resources with qualities so exceptional that they are of special national significance;

(b) Grade 11: Heritage resources which, although forming part of the national estate, can be considered to have special qualities which make them significant within the context of a province or a region; and (c) Grade 111: Other heritage resources worthy of conservation.

SAHRA is responsible for the identification and management of Grade 1 heritage resources.

Provincial Heritage Resources Authority (PHRA) identifies and manages Grade 11 heritage resources.

Local authorities identify and manage Grade 111 heritage resources.

No person may damage, deface, excavate, alter, remove from its original position, subdivide or change the planning status of a provincially protected place or object without a permit issued by a heritage resources authority or local authority responsible for the provincial protection.

Archaeology, palaeontology and meteorites: Section 35.

(2) Subject to the provisions of subsection (8) (a), all archaeological objects, palaeontological material and meteorites are the property of the State.

(3) Any person who discovers archaeological or palaeontological objects or material or a meteorite in the course of development or agricultural activity must immediately report the find to the responsible heritage resources authority, or to the nearest local authority offices or museum, which must immediately notify such heritage resources authority.

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).

#### **I. Description of significant fossil occurrences**

Details of the location and distribution of all significant fossil sites or key fossiliferous rock units are often difficult to determine due to thick topsoil, subsoil, overburden and alluvium. Depth of the overburden may vary a lot.

Stromatolites are significant indicators of palaeoenvironments and provide evidence of algal growth between 2640 and 2432 million years ago (Groenewald and Groenewald 2014).

The threats are:- earth moving equipment/machinery (front end loaders, excavators, graders, dozers) during construction, the sealing-in or destruction of fossils by development, vehicle traffic, and human disturbance. See Description of the Geological Setting (F)-above.

#### J. Recommendation

- a. There is no objection (see Recommendation B) to the development, it may not be necessary to request a Phase 1 Palaeontological Impact Assessment: Field study to determine whether the development will affect fossiliferous outcrops as the palaeontological sensitivity is MODERATE. A Phase 2 Palaeontological Mitigation may be required if the Phase 1 Palaeontological Assessment identifies a fossiliferous formation (for example breccia).
- b. This project may benefit the economy, the growth of the community and social development in general.
- c. Preferred choice: The impact on the palaeontological heritage is MODERATE. Care must be taken during the grading of roads, digging of foundations and removing topsoil, subsoil and overburden (see Executive Summary) or blasting of bedrock.
- d. The following should be conserved: if any palaeontological material is exposed during digging, excavating, drilling or blasting SAHRA 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 is needed from the South African Heritage Resources Agency (SAHRA / PHRA).

- a. Objections: Cautious. See heritage value and recommendation.
- b. Conditions of development: See Recommendation.
- c. Areas that may need a permit: Yes.
- d. Permits for mitigation: No. Only if mitigation is recommended.

#### K. Conclusions

- a. All the land involved in the development was assessed and none of the property is unsuitable for development (see Recommendation B).
- b. All information needed for the Desktop study was provided by the Consultant. All technical information was provided by THOLOANA.
- 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, for example, shallow caves.
- e. Condition in which development may proceed: It is further suggested that a Section 37(2) agreement of the Occupational, Health and Safety Act 85 of 1993 is signed with the relevant contractors to protect the environment and adjacent areas as well as for safety and security reasons.

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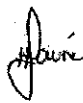
#### Declaration

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 assessment. There are no circumstances that compromise the objectivity of me performing such work.

I accept no liability, and the client, by receiving this document, indemnifies me 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.

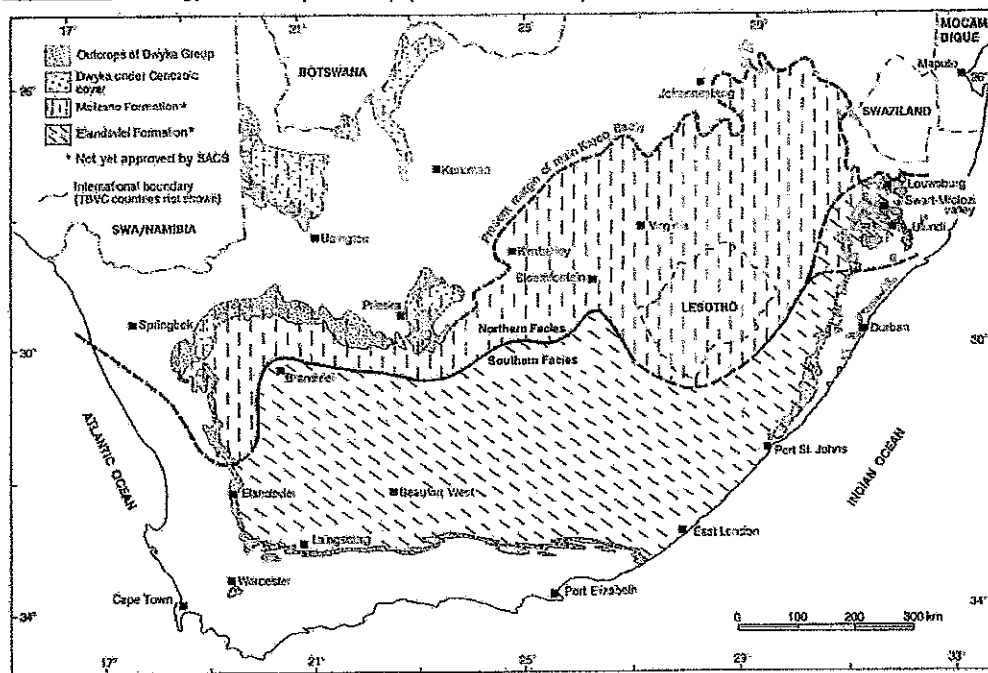
It may be possible that the desktop study may have missed palaeontological resources in the Project Area as the presence of outcrops are not known and may only be found once development commences.

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



Heidi Fourie  
2016/08/03

Appendix 1: Geology of the Dwyka Group (Visser *et al.* 1990).



Appendix 2:

Table 3: 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)	"
D	1(p)	"
	1(h)	Figures
H	1(a)i	Terms of reference
	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 1	1(k)	Protocol for finds
	1(m)	"
	1(q)	"