Palaeontological Impact Assessment for the proposed Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province

Scoping Study

For

Savannah Environmental

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 20 year PIA studies

Declaration of Independence

I, Marion Bamford, as the appointed specialist hereby declare that I:

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have no vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offence in terms of regulation 48 of GN No. R. 326.

Signature: …….

Table of Contents

List of Tables

List of Figures

1. Executive Summary

The desktop Palaeontological Impact Assessment has been completed for the proposed development of a new thermal plant utilising a Circulating Fluidised Bed (CFB) boiler within the Clayville Industrial Area, Gauteng Province, by Bellmall Energy Project 325 (Pty) Ltd. The project is to be known as the Clayville Thermal Plant.

The rocks in the area are of ancient lacustrine and volcanic origin (Witwatersrand Supergroup and the Pretoria Group) but at the surface are sedimentary rocks of the Vryheid Formation (Ecca Group, Early Permian). Although the area is highly disturbed from earlier industrial activity and fossils have not previously been reported from here, the Vryheid Formation rocks could potentially contain fossil plants of the *Glossopteris* flora, especially if there are deposits of refractory clays. Since there is a small chance that fossil plants could be discovered when excavations or construction commences a Chance Find protocol and monitoring programme have been added to the report and should be included the the Environmental Management Programme (EMPr). It is concluded that the project may continue as far as the paleontology is concerned because the significance is low. No further study is required for the EIA process.

2. Palaeontological Impact Assessment for the proposed CFB boiler within the Clayville Industrial Area, Gauteng Province

2.1 Background

Bellmall Energy Project 325 (Pty) Ltd proposes the development of a new thermal plant utilising a Circulating Fluidised Bed (CFB) boiler within the Clayville Industrial Area, Gauteng Province. The project is to be known as the Clayville Thermal Plant. The purpose of the thermal plant is to utilise waste from off-takers, Municipal waste, Refuse Derived Fuel (RDF) in combination with coal fines to produce steam to provide to multiple off-takers within the Clayville Industrial Area for use within various processes. The development of the thermal plant in the Clayville Industrial Area will provide the opportunity to utilise an already available resource such as waste, while providing steam to off-takers in the industrial area to use in various processes.

The intention is to utilise waste from Astral Foods, other production facilities within the Clayville Industrial area (referred to as off-takers), Municipal waste and Refuse Derived Fuel (RDF) (at a maximum of 30%) in combination with coal fines (at a maximum of 90%) as feedstock for the Circulating Fluidized Bed (CFB) boiler. The steam generation plant will have a capacity of up to 240 tons of steam per hour (an equivalent of up to 60 MWe).

Infrastructure associated with the thermal plant will include:

- CFB boiler,
- steam supply pipes from the central plant to the Astral site and to other off-takers,

- steam condensate return pipes to the central plant from various off-takers within the Clayville industrial area,
- an exhaust stack located adjacent to the central plant,
- a condenser at each off-taker's site,
- waste water treatment plant,
- holding tanks for the storage of water,
- silos for the storage of bottom ash and fly ash,
- feedstock holding and processing area, and
- maintenance building / office and control room.

The National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

This report complies with the requirements of the NEMA and Environmental Impact Assessment (EIA) regulations of 2014, as amended on 07 April 2017 (GNR 326). The table below provides a summary of the requirements, with cross references to the report sections where these requirements have been addressed.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014), as amended.

A specialist report prepared in terms of the Environmental Impact Regulations of 2014, as amended must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Prof Marion Bamford
The expertise of that person to compile a specialist report including a curriculum vitae	Palaeontologist (PhD Wits 1990) CV attached
A declaration that the person is independent in a form as may be specified by the competent authority	Page 2
An indication of the scope of, and the purpose for which, the report was prepared	Section 2.1, page 4
a) an indication of the quality and age of base data use for the specialist report	Page 6
b) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change	Page 10
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	n/a Seasons make no difference to fossils
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 3, page 6
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	See table 2
An identification of any areas to be avoided, including buffers	n/a
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	n/a
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6, page 12
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 5, p 11
Any mitigation measures for inclusion in the EMPr	Appendix B, p 15
Any conditions for inclusion in the environmental authorisation	Appendix B, p 15
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Appendix B, p 15

A reasoned opinion as to whether the proposed activity or portions thereof should be authorised and regarding the acceptability of the proposed activity or activities; and	Section 7, page 12
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 5, page 11
A description of any consultation process that was undertaken during the course of carrying out the study	Section 3 page 6
A summary and copies of any comments that were received during any consultation process	n/a (Section 3, p 6)
Any other information requested by the competent authority.	n/a

3. Methods and Terms of Reference

a) In order to determine the likelihood of fossils occurring in the affected area geological maps, literature, palaeontological databases and published and unpublished records will be consulted. These are mostly held at the Evolutionary Studies Institute (ESI), University of the Witwatersrand and are current.

b) If fossils are likely to occur then a site visit must be made by a qualified palaeontologist during the EIA phase to locate and assess the fossils and their importance. The specialist should have over 10 years of field experience.

c) Unique or rare fossils should either be collected (with the relevant South African Heritage Resources Agency (SAHRA) permit) and removed to a suitable storage and curation facility, for example a Museum or University palaeontology department or protected on site. The ESI is a recognizsed repository and has two full-time curators.

d) Common fossils can be sacrificed if they are of minimal or no scientific importance but a representative collection could be made if deemed necessary.

e) The published geological and palaeontological literature, unpublished records of fossil sites, catalogues and reports housed in the Evolutionary Studies Institute, University of the Witwatersrand, and SAHRA databases were consulted to determine if there are any records of fossils from the sites and the likelihood of any fossils occurring there.

3.1 Consultation Process:

No consultations were carried out during the desktop study.

Figure 1: Proposed site for the Clayville Thermal Plant (red and green lines), Olifantsfontein. Googlemap provided by Savannah Environmental.

4. Receiving Environment

4.1 Project location and geological setting

The location of the proposed Clayville Thermal Plant is in the Clayville Industrial area, Olifantsfontein, Gauteng Province and is in a highly industrialised urban area between Johannesburg and Pretoria (Figure 1). The underlying rocks are the gneisses of the Johannesburg Dome (Witwatersrand Supergroup), various formations of the Transvaal Supergroup and a small outlier of the Permian Vryheid Formation (Figure 2; Table 2).

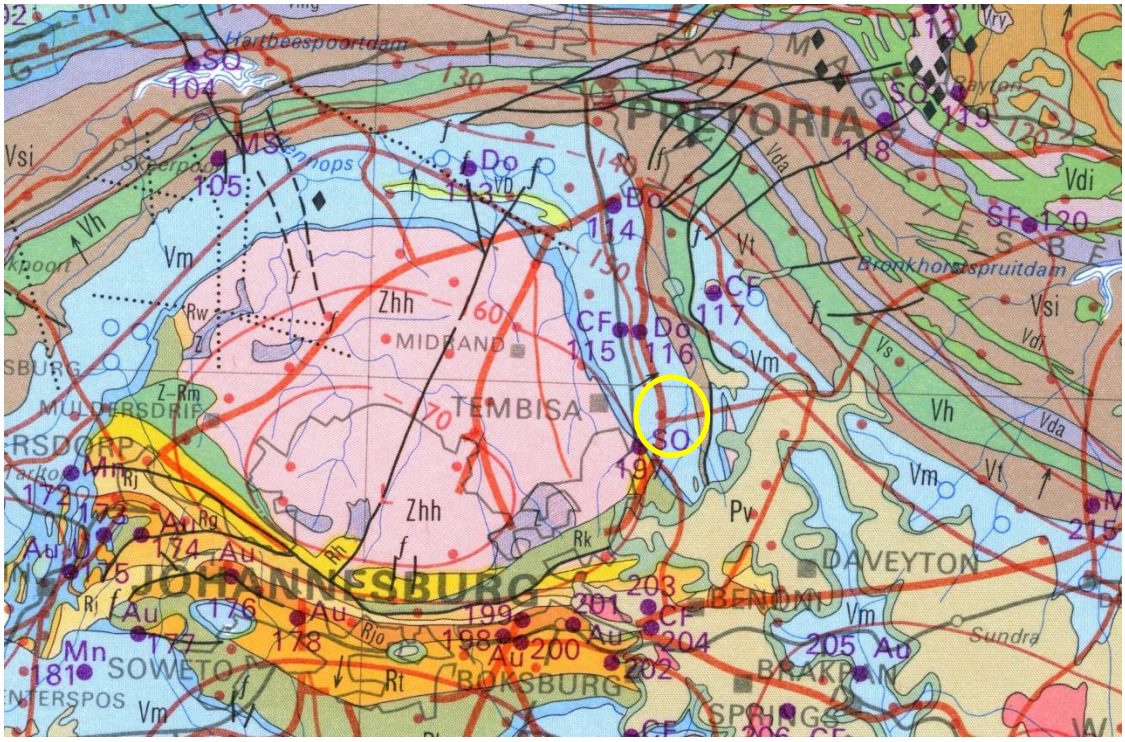


Figure 2: Geological map of the area around Clayville, Olifantsfontein for the proposed Clayville Thermal Plant. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Barbolini et al., 2016; Erikssen et al., 2006. Johnson et al., 2006; McCarthy, 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	**Group/Formation**	**Lithology**	**Approximate Age**
Jd	Jurassic dolerite dykes	Dolerite	Ca 180 Ma
Pv	Vryheid Fm, Ecca Group	Sandstone, shale, coal	Early Permian 296-269 Ma
C-Pd	Dwyka	Tillite, sandstone, mudstone, shale	Upper Carboniferous, Early Permian 295-290 Ma
Vsi	Silverton Fm, Pretoria Group	Basalt, tuff, shale	Ca 2150 Ma
Vhd	Dwaalheuvel, Strubenkop and Daspoort Fms; Pretoria Group	Andesite, sandstone, shale	
Vh	Hekpoort Fm, Pretoria Group	Basaltic andesite, pyroclastic rocks	2224 Ma
Vti	Timeball Hill and Rooihoogte Fm, Pretoria Group	Shale, quartzite, conglomerate, breccia, diamictite	Ca 2420 Ma
Vm	Malmani subgroup, Chuniespoort Group	Dolomite, chert	2642 – 2500 Ma
Vbr	Black Reef Fm	Quartzite,	>2642 Ma

Symbol	Group/Formation	Lithology	Approximate Age
		conglomerate, shale, basalt	
Vdi	Diabase	Diabase	
Rk	Klipriviersberg Group, Ventersdorp Supergroup	Mafic and felsic lavas, quartzites, shales conglomerates	Late Archaean >2700 Ma
Rw	Witwatersrand Supergroup (undifferentiated)	Quartzite, shale	Ca 2950 – 2750 Ma
Rt	Turfontein Subgroup, Central Rand Group, Witwatersrand SG	Conglomerate, quartzite	
Rjo	Johannesburg Subgroup, Central Rand group, Witwatersrand SG	Quartzite, conglomerate, shale	
Rg	Government Subgroup, West Rand Group, Witwatersrand SG	Quartzite, shale	
Rh	Hospital Hill, West Rand Group, Witwatersrand SG	Shale, quartzite	
Z, Zhh	Basement complex of the Johannesburg Dome	Gneiss, migmatite, granodiorite	3340 Ma

4.2 Geology

The oldest rocks in the area are the basement rocks (ultramafic rocks, gneiss, migmatite and granodiorite) of the Johannesburg Dome to the west of the project site. To the east, north and south are a variety of ancient rocks of the Witwatersrand Supergroup and the Pretoria Group, ranging in age from 3340 to 2150 Ma (million years). These rocks are all volcanic (produced by early volcanic activity, i.e, igneous rock that came up to the surface) or plutonic (igneous rock that solidified far below the earth's surface) in origin. To the south east is an outlier of the Karoo Supergroup sediments, namely sandstones, shales and coals of the Early Permian Ecca, Vryheid Formation.

4.3 Palaeontology
(Refer to Figure 3 for SAHRIS palaeosensitivity)

The Black Reef Formation and Malmani Subgroup contain banded ironstone and dolomites, which although were formed by the chemical activities of ancient algae, photosynthesis and oxygen production, are not known to have preserved fossil algae near Olifantsfontein.

Some formations within the ancient Pretoria Group represent marginal marine or lacustrine deposits with trace fossils of microbial mats and some ripple marks, for example the Daspoort and Magaliesberg Formations, (Erikssen et al., 2006), but not the particular Formations represented in the Olifantsfontein area.

The Dwyka Formation represents the receding glacial deposits from the Upper Carboniferous and Early Permian, a time period when land plants were abundant in the warmer regions to the far north of Brakpan. Rare Dwyka fossils (*Glossopteris* leaves, *Stigmaria* roots, lycopods and sphenophytes; Plumstead, 1969) have been reported from near Vereeniging, about 75-100km southwest of Olifantsfontein but nothing from this area. Likewise, no fossil plants of the *Glossopteris* flora have been reported from the Vryheid Formation around here. There is no coal mining in this region, probably because the coal seams are not economic or are severely altered by the intrusive dolerite dykes which are abundant to the south. All these rocks are too old for vertebrate body fossils. There is a possibility that there are refractory clays at the base of the Vryheid Formation, especially given the name of the area, similar to the ones recorded to the southwest and southeast of the Rand (Bredell, 1978). Although clay deposits are fairly common, they seldom preserve fossil plants, the exception being the Lawley brick quarry near Lenasia (Bredell, 1978, Anderson and Anderson, 1985).

Even though the project site is located within very high palaeontological sensitivity zone, the proposed site for the Clayville Thermal Plant is highly disturbed from previous and current industrial buildings, infrastructure and roads, so any surface fossils that may occur in the Vryheid Formation would be very weathered and unrecognizable. There is, however, a small chance that fossil plants could be found where new excavations for building foundations are made (Figure 3).

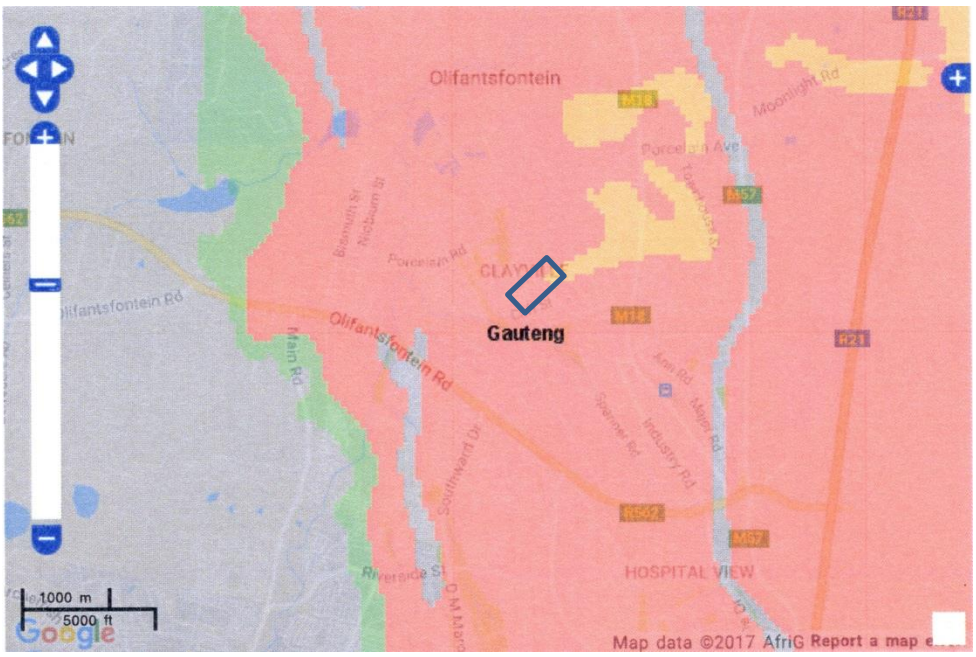


Figure 3: SAHRIS palaeosensitivity map. Clayville Thermal Plant site is shown within the blue rectangular outline. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

5. Impact assessment

Using the criteria listed in the amended 2014 EIA Regulations, GNR 326, the impact on the Palaeontology of the proposed development has been assessed (Tables 3-6) and found to be very low.

Table 3: Summary of the evaluation of Potential Impacts associated with the Construction of the Facility at the Scoping Phase

Impact: Destruction of fossils

Fossils could be destroyed by the clearing of the site and excavations unless care is taken to remove them before such activities occur.

Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
Loss of potential palaeontological heritage	Construction of the Clayville Thermal Plant will permanently modify the existing topography and may disturb damage, destroy or permanently seal-in fossils at or below the ground surface and which are then no longer available for scientific research or as cultural heritage.	Local	n/a Fossils can be removed from the site
Description of expected significance of impact	Even though the project site is located within very high palaeontological sensitivity zone, the proposed site for the Clayville Thermal Plant is highly disturbed from previous and current industrial buildings, infrastructure and roads, so any surface fossils that may occur in the Vryheid Formation would be very weathered and unrecognizable. Therefore the impact will be of low significance. There is, however, a small chance that fossil plants could be found where new excavations for building foundations are made.		
Gaps in knowledge and recommendations for further study.	Fossils are unlikely to be preserved on the site because surface fossils would have been weathered and the site is already very disturbed, but this is unknown until the ground is penetrated. Recommendation: Due to a lack of fossil heritage located within the project site no further study is required for the EIA phase. If any fossils are present and scientifically important (i.e. rare, or exceptionally well-preserved), fossils should be carefully removed (after a SAHRA permit has been obtained) and curated in a recognized facility		

Residual risk	None

There will be no impacts on the fossil heritage during the operation phase because there will be no further excavations.

Cumulative Impact: Destruction of fossils

Any surface fossils would have been destroyed by previous building operations; if any fossils occur below the standard depth for foundations they would not be affected by the proposed project. The overall cumulative impact of the project and other projects in the area are considered to be of low significance.

6. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the basement rocks, dolomites, sandstones, shales, coals, quartzites, basalts and volcanic rocks are typical for the country and do not contain any fossil material. The sediments of the Vryheid Formation could contain impression fossils of plants of the *Glossopteris* flora, however, they have yet to be recorded from the proposed Clayville Thermal Plant site.

Fossil databases are kept up to date but no recent studies have been done in this area recently as there are very few paleontologists in the country. The geological maps are updated frequently but he SAHRIS Palaeosensitivity map only indicates the POTENTIAL of finding fossils.

7. Conclusion and Recommendation

It is unlikely that any fossils occur in the surface areas of the proposed project as these areas are already highly disturbed by industrial buildings and infrastructure. Furthermore, no fossils have been recorded from this area. Nonetheless rocks of this type and age are potentially fossiliferous, as indicated in the SAHRIS palaeosensitivity map (Fig 4). As there is a chance find, a monitoring protocol is recommended (Appendix A) to be implemented.

As far as the palaeontology is concerned the proposed development of the Clayville Thermal Plant will not result in any detrimental impacts on fossil heritage. The project is considered to be acceptable from a palaeontology perspective and there is no reason why the project should not proceed. Any further palaeontological assessment would only be required after construction has commenced and if fossils are found by the geologist or environmental personnel. It is therefore recommended that no palaeontological impact assessment is required during the EIA phase of the project. It is furthermore recommended that the monitoring protocol be included in the EMPr.

8. References

Anderson, J.M., Anderson, H.M., 1985. Palaeoflora of Southern Africa: Prodromus of South African megafloras, Devonian to Lower Cretaceous. A.A. Balkema, Rotterdam. 423 pp.

Erikssen, P.G., Altermann, W., Hartzer, F.J., 2006. The Transvaal Supergroup and its pre-cursors. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 237-260.

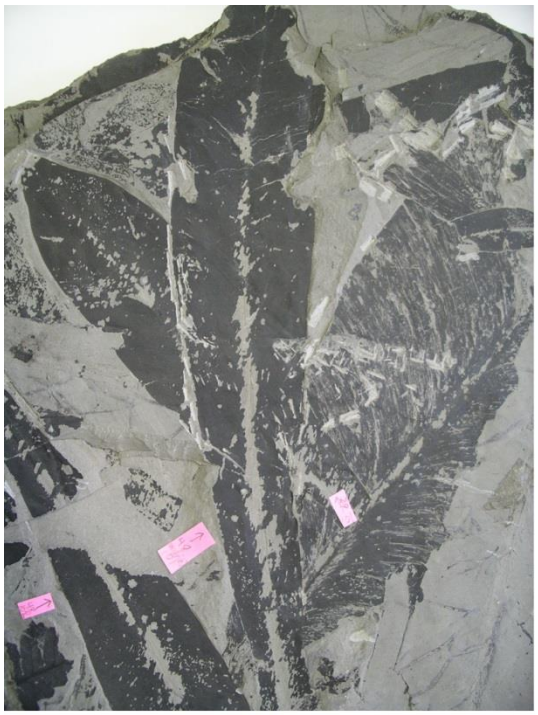
Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

McCarthy, T.S., 2006. The Witwatersrand Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 155-186.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Appendices A-C – next pages

Appendix A: example of fossils that could be found



Wide and narrow Glossopteris leaves

Narrow Glossopteris leaves

Lycopod stem with leaf abscission scars

Astertotheca (fern)

Hammanskraal fossil plants

Figure 5: Examples of fossil leaf impressions and compressions of the *Glossopteris* flora (Ecca Group) that could possibly be found.

Appendix B:

Monitoring Programme for Palaeontology – to commence once the excavations begin.

1. The following procedure is only required if fossils are seen on the surface and when construction commences.
2. When construction begins (for site leveling) the rocks must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (trace fossils, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the construction activities will not be interrupted.
3. Photographs of similar fossil plants must be provided to the developer to assist in recognizing the fossil plants in the shales and mudstones (for example see Figure 5). This information must be built into the EMPr's training and awareness plan and procedures.
4. Photographs of the presumed fossils should be sent to the palaeontologist for a preliminary assessment.
5. As and when required, the palaeontologist should visit the site to inspect the selected material that has been retrieved by the geologist before crushing, removal or disposal. The frequency of inspections should be determined by the amount of material put aside and the response of the palaeontologist on the photographs sent to him/her of the potential fossils.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, location GPS recorded, plus stratigraphy recorded, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits (should they be required).
7. A final report by the palaeontologist must be sent to SAHRA once the construction has been completed, if there are any fossils found.
8. If no fossils are found at completion of construction, then no further monitoring is required.

Appendix C:

Mitigation measures to be included in the Environmental Management Programme (EMP)

Objective: **Protection of fossil heritage.**	
Project Components	Excavation for foundations or all infrastructure that would penetrate below (more than standard depth of +/- 2-3m) the ground surface to any potential fossils.
Potential impact	Deep excavations would reveal fossils – if present – and potentially destroy them. Permanently seal-in fossils.
Activity/Risk source	Deep excavations for all project components
Mitigation: Target/Objective	No prior mitigation. Once the development has commenced and if fossils are found then the responsible person must collect and preserve a representative sample of fossils

Mitigation: action/control	**Responsibility**	**Timeframe**
Once excavations begin the responsible person must check the rocks and sediments for fossil plants (example of such plants in Figure 5) and photographs taken and sent to the palaeontologist.	Geologist, project manager or Environmental officer	Construction period
If the fossils are of scientific interest then a collecting permit must be obtained from SAHRA. Collection of a representative sample of fossils to be housed in a recognised institute. A report sent to SAHRA on completion of the collecting visit.	Palaeontologist	Construction period

Performance Indicator	There should be no disturbance outside of designated areas. Should any palaeontogical features be discovered, it should be immediately be reported to the relevant authority.
Monitoring	Environmental Officer/site manager/project manager should check that the rocks are being inspected. Appropriate permits obtained from SAHRA prior to the disturbance or destruction of heritage sites.