PALAEONTOLOGICAL DESKTOP ASSESSMENT FOR THE PROPOSED UPGRADEOF THE KING WILLIAM'S TOWN BULK REGIONAL SEWAGE SCHEME, BUFFALO CITY METROPOLITAN MUNICIPALITY, EASTERN CAPE

For:

HIA CONSULTANTS

DATE: 08 JUNE 2013

By

GIDEON GROENEWALD

EXECUTIVE SUMMARY

Gideon Groenewald was appointed by PSG Heritage and Grave Relocation Consultants to undertake a desktop survey, assessing the potential palaeontological impact of the proposed upgrading of the King William's Town bulk regional sewage scheme by the Buffalo City Municipality in the Eastern Cape.

This report forms part of the Environmental Impact Assessment and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the development footprint of the development.

Buffalo City Municipality (BCM) is developing proposals to upgrade the bulk regional sewage system in the King William's Town (KWT) area to cater for both current and future sanitation demands to 2030. The focus area for the upgrade incorporates KWT, Bhisho, Breidbach, Zwelitsha and immediately surrounding areas.

The regional scheme is to be implemented in a sequential phased approach, as funding becomes available, with each of the seven phases representing a standalone component of the total upgrading scheme.

The study area is mainly underlain by Permian to Triassic aged sedimentary rocks of the Karoo Supergroup. The Permian sedimentary rocks belong to the Balfour and Middleton Formations of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Jurassic aged dolerite sills and dykes also occur sporadically across the development area.

The Adelaide Subgroup contains vertebrate fossils of the *Cistecephalus* and *Dicynodon* Assemblage Zones. The anomodont reptile *Oudenodon baini* Owen is fairly common throughout the succession. Fossils from the *Lystrosaurus* Assemblage zone, including well-defined casts of vertebrate burrows, are well known from the red mudstone unit (Palingkloof Member) at the top of the sequence. Fragments of silicified wood occur throughout the Subgroup.

No fossils are expected from the Jurassic dolerites.

Recommendation:

- A palaeontological site inspection and Phase 1 Palaeontological Impact Assessment needs to be done by a qualified palaeontologist once the vegetation has been cleared during the early stages of construction in areas with a Moderate sensitivity rating for the occurrence of fossils.
- The EAP of the project team should be made aware of the possible occurrence of fossils. If any fossils are recorded during initial field visits, a trained palaeontologist must be notified to assess the finds.

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1. INTRODUCTION

1.1. Background

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This report forms part of the Environmental Impact Assessment and complies with the requirements of theSouth African National Heritage Resource Act No 25 of 1999. In accordance with Section 38 (Heritage Resources Management), a Heritage Impact Assessment (HIA) is required to assess any potential impacts to palaeontological heritage within the developmentfootprint of the development.

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

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

1.2. Aims and Methodology

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

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

In preparing a palaeontological desktop study the potential fossiliferous rock units (groups, formations etc.) represented within the study area are determined from geological maps.The known fossil heritage within each rock unit is inventoried from the published scientific literature and previous palaeontological impact studies in the same region.

The likely impact of the proposed development on local fossil heritage is determined on the basis of the palaeontological sensitivity of the rock units concerned and the nature and scale of the development itself, most notably the extent of fresh bedrock excavation envisaged.The different sensitivity classes used are explained in Table 1.1 below.

Table 1.1 Palaeontological Sensitivity Analysis Outcome Classification

Sensitivity	Description
Low Sensitivity	Areas where a negligible impact on the fossil heritage is likely. This category is reserved largely for areas underlain by igneous rocks. However, development in fossil bearing strata with shallow excavations or with deep soils or weathered bedrock can also form part of this category.
Moderate Sensitivity	Areas where fossil bearing rock units are present but fossil finds are localised or within thin or scattered sub-units. Pending the nature and scale of the proposed development the chances of finding fossils are moderate.A field-based assessment by a professional palaeontologist is usually warranted.
High Sensitivity	Areas where fossil bearing rock units are present with a very high possibility of finding fossils of a specific assemblage zone. Fossils will most probably be present in all outcrops and the chances of finding fossils during a field-based assessment by a professional palaeontologist are very high. Palaeontological mitigation measures need to be incorporated into the Environmental Management Plan

1.3. Scope and Limitations of the Desktop Study

The study will include: i) an analysis of the area's stratigraphy, age and depositional setting of fossil-bearing units; ii) a review of all relevant palaeontological and geological literature, including geological maps, and previous palaeontological impact reports; iii) data on the proposed development provided by the developer (e.g. location of footprint, depth and volume of bedrock excavation envisaged) and iv) where feasible, location and examination of any fossil collections from the study area (e.g. museums).

The key assumption for this scoping study is that the existing geological maps and datasets used to assess site sensitivity are correct and reliable. However, the geological maps used were not intended for fine scale planning work and are largely based on aerial photographs alone, without ground-truthing. There is also an inadequate database for fossil heritage for much of the RSA, due to the small number of professional palaeontologists carrying out fieldwork in RSA. Most development study areas have never been surveyed by a palaeontologist.

These factors may have a major influence on the assessment of the fossil heritage significance of a given development and without supporting field assessments may lead to either:

- an underestimation of the palaeontological significance of a given study area due to ignorance of significant recorded or unrecorded fossils preserved there, or
- an overestimation of the palaeontological sensitivity of a study area, for example when originally rich fossil assemblages inferred from geological maps have in fact been destroyed by weathering, or are buried beneath a thick mantle of unfossiliferous "drift" (soil, alluvium etc.).

2. DESCRIPTION OF THE PROPOSED DEVELOPMENT

Buffalo City Municipality (BCM) is developing proposals to upgrade the bulk regional sewage system in the King William's Town (KWT) area to cater for both current and future sanitation demands to 2030. The focus area for the upgrade incorporates KWT, Bhisho, Breidbach, Zwelitsha and immediately surrounding areas.

Collectively, the KWT Bulk Regional Sewage Scheme upgrade provides for: the transfer of sewerage flows from existing treatment works within the focus area which are operating over capacity to a central treatment works; for unlocking development in areas which are restricted by a lack of sewage treatment; and, providing bulk infrastructure for the reticulation of towns within the focus area. The Zwelitsha wastewater treatment works (WWTW) will be upgraded over time to form the central treatment works for the region. The regional scheme is to be implemented in a sequential phased approach, as funding becomes available, with each of the seven phases representing a standalone component of the total upgrading scheme (Figure 2.1). In short, the seven phases comprise the following major activities:

Phase 1 Connecting the Schornville WWTW in KWT to Zwelitsha WWTW via a bulk gravity sewer main – this is subject to a separate environmental authorisation process which commenced in October 2008.
Phase 2 Upgrading the treatment capacity of Zwelitsha WWTW from 9.1 to 17.5 mega litres (Mℓ) per day (Stage 1 upgrade).
Phase 3 Connecting Breidbach WWTW to the Zwelitsha WWTW via a bulk sewer main
Phase 4 Connecting Bhisho WWTW to the Zwelitsha WWTW via the Breidbach connection. Decommissioning the Bhisho WWTW.
Phase 5 Upgrading the treatment capacity of the Zwelitsha WWTW from 17.5 to 35 Mℓ per day (Stage 2 upgrade).
Phase 6 Decommissioning the Breidbach and Schornville WWTWs. Connecting Phakamisa to the Zwelitsha WWTW via the Zwelitsha pipe bridge.
Phase 7 Providing bulk infrastructure to enable the reticulation of KwaTshatshu, Ndevana and part of Phakamisa.

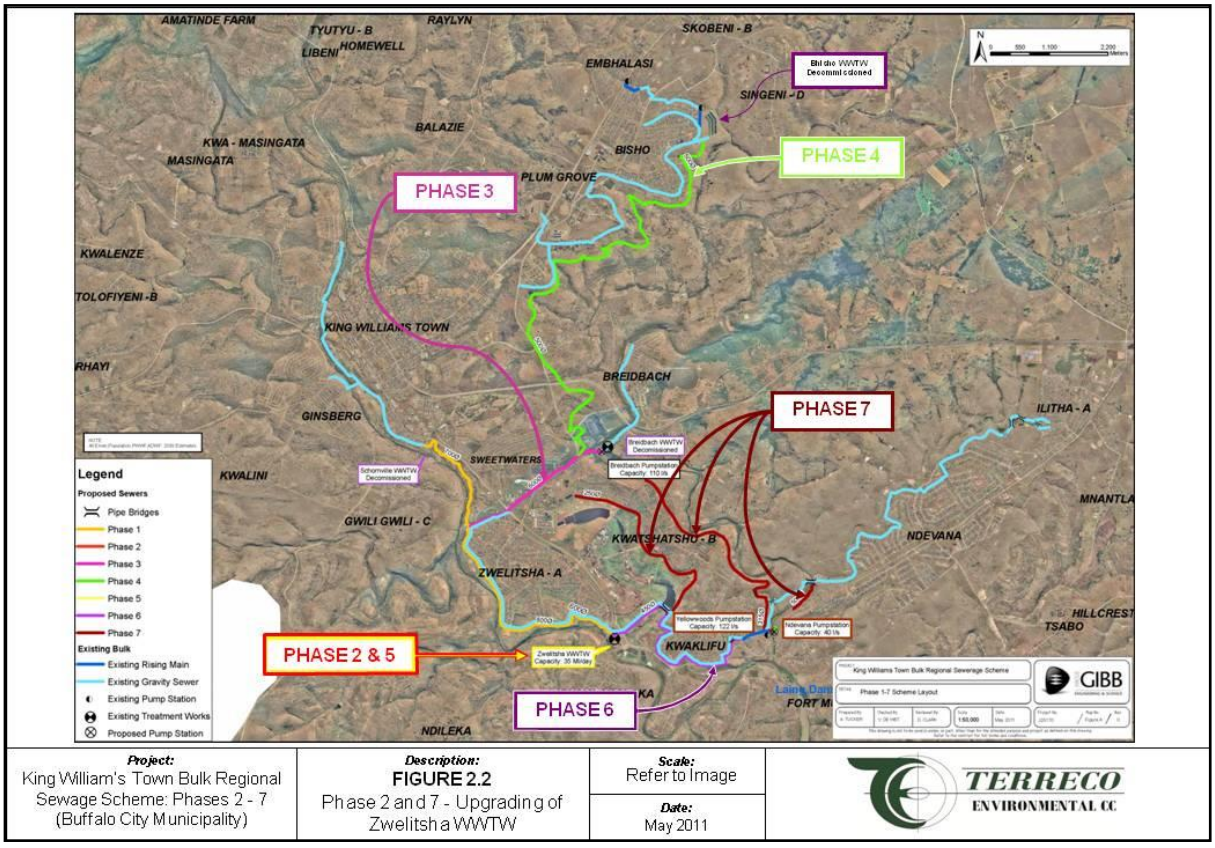

Figure 2.1 Map showing the 7 proposed phases of the project

3. GEOLOGY

The study area is mainly underlain by Permian to Triassic aged sedimentary rocks of the Karoo Supergroup (Figure 3.1). The Permian to Triassic sedimentary rocks belong to the Balfour and Middleton Formations of the Adelaide Subgroup, Beaufort Group, Karoo Supergroup. Jurassic aged dolerite sills and dykes also occur sporadically across the development area.

3.1. Middleton Formation (Pum)

The Middleton Formation consists mainly of grey and red mudstone, shale and sandstone and is interpreted as a mixed fluvial and lacustrine deposit with major meandering river systems (Johnson et al 2009). Mudstones are poorly stratified or massive.

3.2. Balfour Formation (Pub)

The Balfour Formation consists of grey mudstone, shale and sandstone in alternating layers. The Mudstone is poorly bedded or massive. Wave formed ripples are fairly common in the Balfour Formation (Johnson MR and Keyser AW, 1976). The upper part of the formation is known as the Triassic Palingkloof Member, consisting of a sequence of mainly red mudstone.

3.3. Jurassic Dolerite (Jd)

Dolerite is a very hard igneous rock that intruded the sedimentary layers and can occur either as sills or as dykes. Sills can be from a few meters to tens of meters thick.

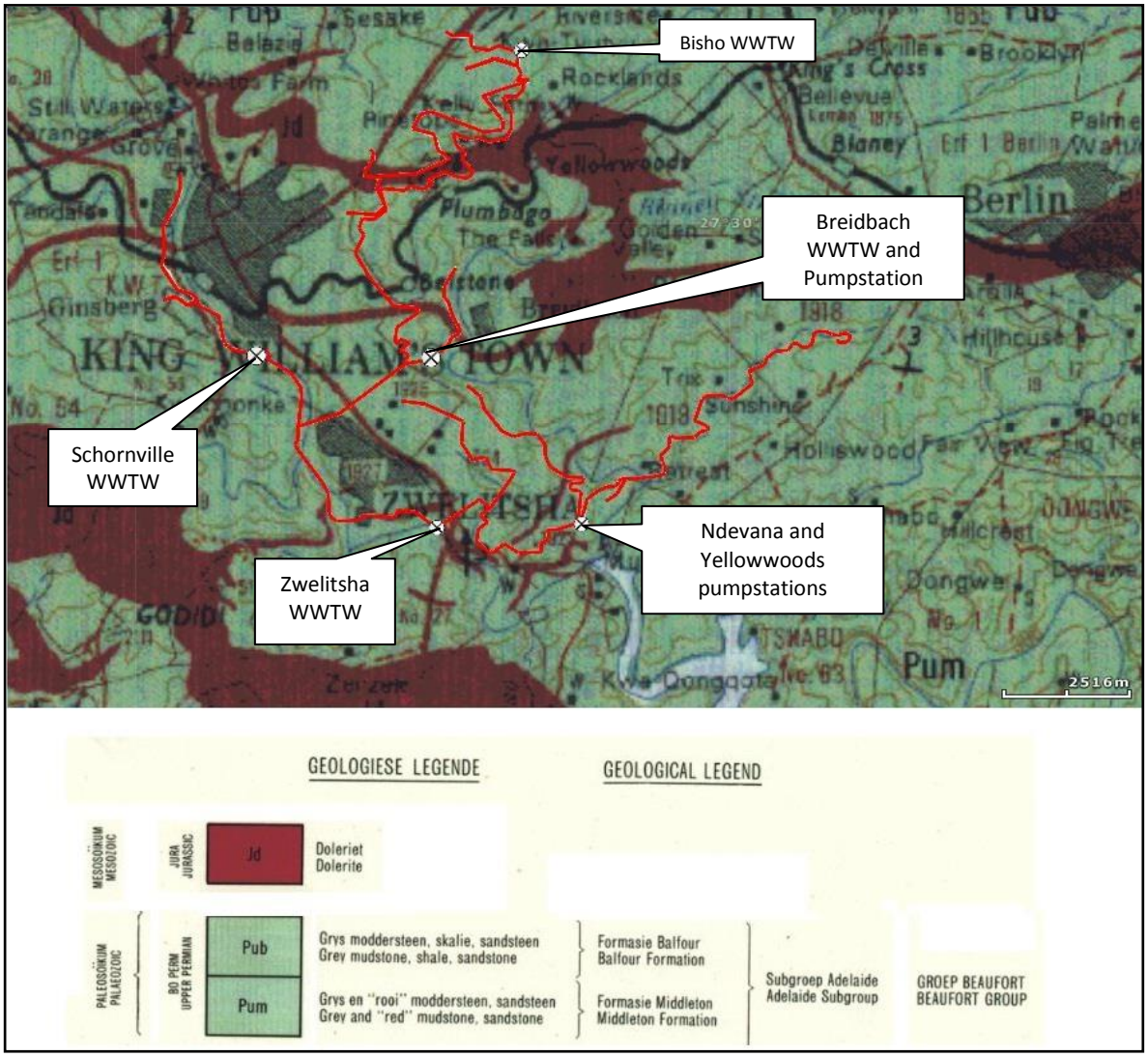

Figure 3.1 Geological map of the study area (3226 King Williams's Town)

4. PALAEONTOLOGY OF THE AREA

4.1. Adelaide Subgroup

This subgroup contains vertebrate fossils of the *Cistecephalus* and *Dicynodon* Assemblage Zones. The anomodont reptile *Oudenodon baini* Owen is fairly common throughout the succession. Fossils from the *Lystrosaurus* Assemblage zone is well known from the red mudstone unit at the top of the sequence. Fragments of silicified wood occur throughout the Subgroup (Johnson MR and Keyser AW, 1976).

4.1.1. Middleton Formation

Fossils of *Oudenodon Baini* Owen and *Pristerodon mackayi* Huxley are fairly common in this formation.

4.1.2. Balfour Formation

The lower part of this formation has yielded fossils of the *Cistacephalus* Zone such as *Aulacephalalodon baini* (Owen), *Pareiasaurus serridens* Owen and *Gorgonops torvus* Owen.

Fossils belonging to the *Dicynodon* Assemblage zone, namely *Daptocephalus leonoceps* (Owen) and *Whaitsia platyceps* Haughton, have been recorded by J.W. Kitching from this formation. The upper part of the formation, also known as the Palingkloof Member, yield fossils from the *Lystrosaurus* Assemblage zone, with well defined casts of vertebrate burrows.

4.2. Jurassic Dolerite

Due to the igneous nature of this rock, no fossils will be present.

5. PALAEONTOLOGICAL SENSITIVITY

The palaeontological sensitivity is predicted after identifying potentially fossiliferous rock units; ascertaining the fossil heritage from the literature and evaluating the nature and scale of the development itself.

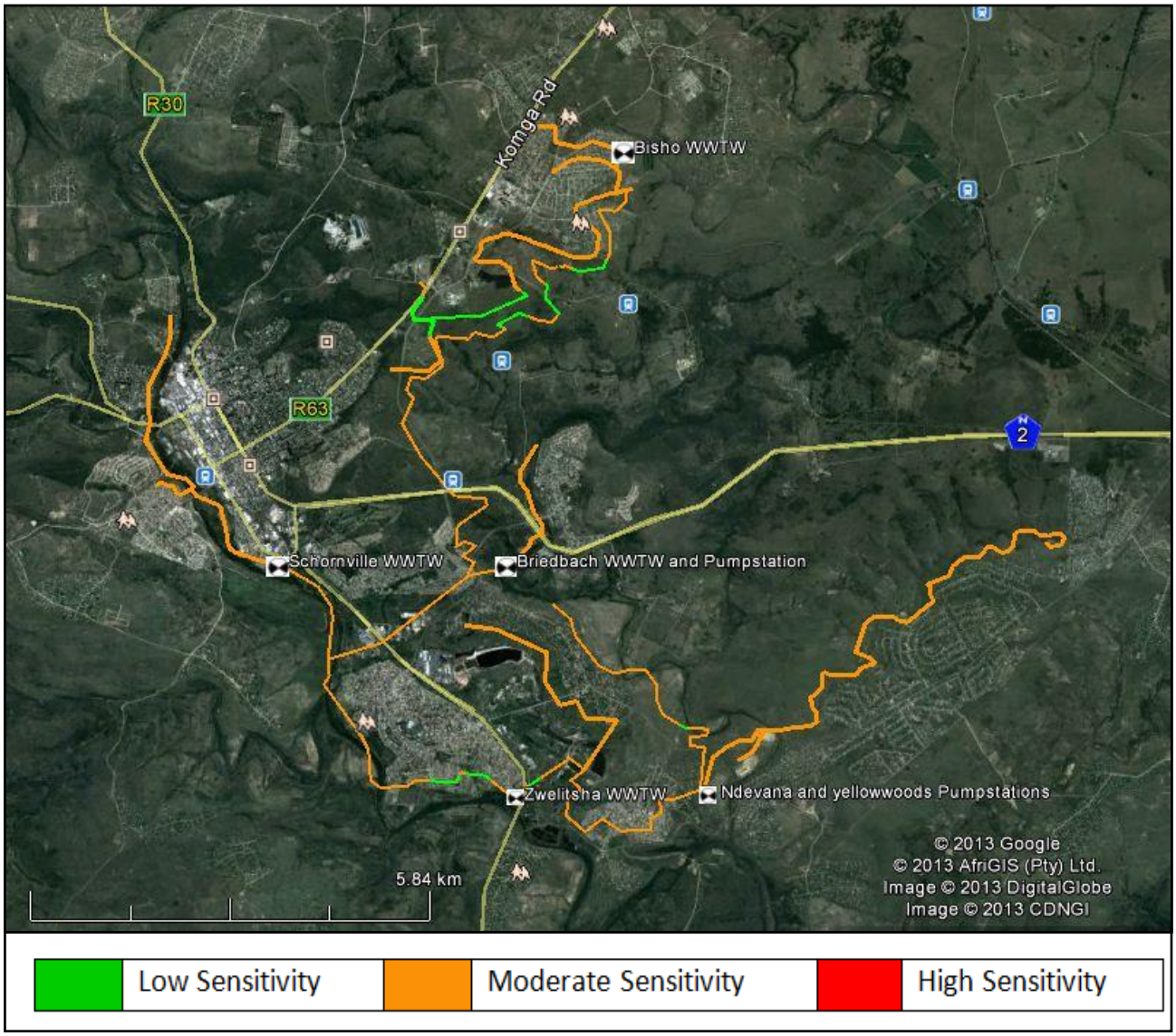

Figure 5.1 Image showing the Palaeosensitivity of the study area for phases 1-7 of the project

Rocks of the Adelaide Subgroup will have a moderate sensitivity as shown in Figure 5.1.

6. CONCLUSION AND RECOMMENDATIONS

The study area is mainly underlain by Permian to Triassic aged rocks of the Balfour and Middleton Formations of the Adelaid Subgroup, Beaufort Group. Jurasic aged Dolerite dykes and sills occur throughout the area.

Fragments of silicified wood occur throughout the Adelaide Subgroup.

Fossils of *Oudenodon Baini* Owen and *Pristerodon mackayi* Huxley are fairly common in the Middleton Formation.

Fossils of the *Cistacephalus* Zone such as *Aulacephalalodon baini* (Owen), *Pareiasaurus serridens* Owen and *Gorgonops torvus* Owen have been described from the lower part of the Balfour Formation and fossils belonging to the *Dicynodon* Assemblage zone, namely *Daptocephalus leonoceps* (Owen) and *Whaitsia platyceps* Haughton, have been recorded by J.W. Kitching from the upper part of this formation (Johnson MR and Keyser AW, 1976). Fossils from the *Lystrosaurus* Assemblage zone is well known from the Palingkloof Member which is a prominent red-coloured mudstone at the top of the Balfour Formation.

No fossils are expected from the Jurassic dolerites.

Recommendation:

- A palaeontological site inspection and Phase 1 Palaeontological Impact Assessment needs to be done by a qualified palaeontologist once the vegetation has been cleared during the early stages of construction in areas with a Moderate sensitivity rating for the occurrence of fossils (Figure 5.1).
- The EAP of the project team should be made aware of the possible occurrence of fossils. If any fossils are recorded during initial field visits, a trained palaeontologist must be notified to assess the finds.

7. REFERENCES

Johnson MR and Keyser AW. 1976. Explanatory Notes map sheet 3226 King William's Town, Geological Survey, Pretoria

Johnson MR, Anhausser CR and Thomas RJ. 2009. The Geology of South Africa. Geological Society of South Africa.

8. QUALIFICATIONS AND EXPERIENCE OF THE AUTHOR

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

9. DECLARATION OF INDEPENDENCE

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

Dr Gideon Groenewald
Geologist