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HIA STUDY OF THE PRIORITY 2 SEWAGE PIPELINE AND PUMP STATIONS AT NJEKANE, ILEMBE DISTRICT MUNICIPALITY, KZN

FOR TRIPLO4 SUSTAINABLE SOLUTIONS DATE: 2 FEBRUARY 2015

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INTRODUCTION

"The locality is approximately 7km to the North West of the Mvoti Toll Plaza in the Njekane/Charlottedale area of Northern Kwa-Zulu Natal. The proposed project, falls within the KwaDukuza Local- and iLembe District Municipality.

The proposed construction of the Priority 2: Trunk Sewer Pipeline and Pump stations in the Njekane area forms part of the Regional Bulk sanitation Scheme which is an initiative of the iLembe District Municipality. The current housing developments are undergoing expansion due to the growth of the Njekane and surrounding communities, these housing developments currently do not have access to water borne sewage. The current housing developments are provided with pit latrines which are to be upgraded to water-borne sanitation as per iLembe Policy and water connection services. Thus the Priority 2 project is an initiative by the iLembe District Municipality to address the need for water borne sewage in the Njekane and surround areas.

The proposed construction of the Priority 2: Bulk sewer pipeline and pump stations in the Njekane area comprises of four lines that have a total length of approximately 6km. The lines have their own associated activities that vary in length, size and associated structures. The details of the lines are as follows:

• Line 1: Njekane pump station - Ethafeni

- The proposed gravity sewer line is approximately 1.85km in length with and internal diameter of approximately 200mm. The anticipated daily throughput capacity is approximately 350m³/d.

• Line 2: Njekane pump station – pump station 2 Charlottedale

- The proposed Rising main sewer line is approximately 1.8km in length with one Submersible pump station (5m*10m). The proposed sewer pipeline has internal diameters of approximately 400mm (300m) -500mm (1500m) as the

proposed pipeline does not have the same diameter throughout its entirety of its length. The anticipated daily throughput capacity is approximately 6918m³/d.

• Line 3: Pump station 2 charlotte sale -branch

- The proposed gravity sewer line is approximately 0.8km in length with and internal diameter of approximately 150mm. The anticipated daily throughput capacity is approximately 150m³/d.

• Line 4: Pump station 2 Charlotte dale-pump station 1 charlotte dale.

The proposed Rising main sewer line is approximately 1.5km in length with one Submersible pump station (5m*10m). The proposed sewer pipeline has internal diameters of approximately 400mm (1300m) -500mm (200m) as the proposed pipeline does not have the same diameter throughout its entirety of its length. The anticipated daily throughput capacity is approximately 6486m³/d" (Triplo4 BID 2014)

The study site is situated approximately 40 km to the north of Durban and 5km to the north of Ballito and Compensation at Shaka's Head. Figures 1 - 3 show the location of the pipeline.



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FIG. 1 GENERAL LOCATION OF THE STUDY AREA



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FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA



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FIG. 3: TOPOGRAPHICAL MAP OF THE STUDY AREA



KWAZULU-NATAL HERITAGE ACT NO. 4 OF 2008

"General protection: Structures.--

- No structure which is, or which may reasonably be expected to be older than 60 years, may be demolished, altered or added to without the prior written approval of the Council having been obtained on written application to the Council.
- Where the Council does not grant approval, the Council must consider special protection in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- The Council may, by notice in the *Gazette*, exempt—
- A defined geographical area; or
- defined categories of sites within a defined geographical area, from the provisions of subsection where the Council is satisfied that heritage resources falling in the defined geographical area or category have been identified and are adequately protected in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.
- A notice referred to in subsection (2) may, by notice in the *Gazette*, be amended or withdrawn by the Council.

General protection: Graves of victims of conflict.—No person may damage, alter, exhume, or remove from its original position—

- the grave of a victim of conflict;
- a cemetery made up of such graves; or
- any part of a cemetery containing such graves, without the prior written approval of the Council having been obtained on written application to the Council.
- General protection: Traditional burial places.—
- No grave—
- not otherwise protected by this Act; and
- not located in a formal cemetery managed or administered by a local authority, may be damaged, altered, exhumed, removed from its original position, or otherwise disturbed without the prior written approval of the Council having been obtained on written application to the Council.

The Council may only issue written approval once the Council is satisfied that-

- the applicant has made a concerted effort to consult with communities and individuals who by tradition may have an interest in the grave; and
- the applicant and the relevant communities or individuals have reached agreement regarding the grave.

General protection: Battlefield sites, archaeological sites, rock art sites, palaeontological sites, historic fortifications, meteorite or meteorite impact sites.—

- No person may destroy, damage, excavate, alter, write or draw upon, or otherwise disturb any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- Upon discovery of archaeological or palaeontological material or a meteorite by any person, all activity or operations in the general vicinity of such material or meteorite must cease forthwith and a person who made the discovery must submit a written report to the Council without delay.
- The Council may, after consultation with an owner or controlling authority, by way of written notice served on the owner or controlling authority, prohibit any activity considered by the Council to be inappropriate within 50 metres of a rock art site.
- No person may exhume, remove from its original position or otherwise disturb, damage, destroy, own or collect any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site without the prior written approval of the Council having been obtained on written application to the Council.
- No person may bring any equipment which assists in the detection of metals and archaeological and palaeontological objects and material, or excavation equipment onto any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, or meteorite impact site, or

use similar detection or excavation equipment for the recovery of meteorites, without the prior written approval of the Council having been obtained on written application to the Council.

 The ownership of any object or material associated with any battlefield site, archaeological site, rock art site, palaeontological site, historic fortification, meteorite or meteorite impact site, on discovery, vest in the Provincial Government and the Council is regarded as the custodian on behalf of the Provincial Government." (KZN Heritage Act of 2008)

METHOD

The method for Heritage assessment consists of several steps.

The first step forms part of the desktop assessment. Here we would consult the database that has been collated by Umlando. These databases contains archaeological site locations and basic information from several provinces (information from Umlando surveys and some colleagues), most of the national and provincial monuments and battlefields in Southern Africa (http://www.vuvuzela.com/googleearth/monuments.html) and cemeteries in southern Africa (information supplied by the Genealogical Society of Southern Africa). We use 1st and 2nd edition 1:50 000 topographical and 1937 aerial photographs where available, to assist in general location and dating of buildings and/or graves. The database is in Google Earth format and thus used as a guick reference when undertaking desktop studies. Where required we would consult with a local data recording centre, however these tend to be fragmented between different institutions and areas and thus difficult to access at times. We also consult with an historical architect, palaeontologist, and an historian where necessary.

The survey results will define the significance of each recorded site, as well as a management plan.

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All sites are grouped according to low, medium, and high significance for the purpose of this report. Sites of low significance have no diagnostic artefacts or features. Sites of medium significance have diagnostic artefacts or features and these sites tend to be sampled. Sampling includes the collection of artefacts for future analysis. All diagnostic pottery, such as rims, lips, and decorated sherds are sampled, while bone, stone, and shell are mostly noted. Sampling usually occurs on most sites. Sites of high significance are excavated and/or extensively sampled. Those sites that are extensively sampled have high research potential, yet poor preservation of features.

Defining significance

Heritage sites vary according to significance and several different criteria relate to each type of site. However, there are several criteria that allow for a general significance rating of archaeological sites.

These criteria are:

1. State of preservation of:

- 1.1. Organic remains:
- 1.1.1. Faunal
- 1.1.2. Botanical
- 1.2. Rock art
- 1.3. Walling
- 1.4. Presence of a cultural deposit
- 1.5. Features:
- 1.5.1. Ash Features
- 1.5.2. Graves
- 1.5.3. Middens
- 1.5.4. Cattle byres
- 1.5.5. Bedding and ash complexes



2. Spatial arrangements:

2.1. Internal housing arrangements

2.2. Intra-site settlement patterns

2.3. Inter-site settlement patterns

3. Features of the site:

3.1. Are there any unusual, unique or rare artefacts or images at the site?

3.2. Is it a type site?

3.3. Does the site have a very good example of a specific time period, feature, or artefact?

4. Research:

4.1. Providing information on current research projects

4.2. Salvaging information for potential future research projects

5. Inter- and intra-site variability

5.1. Can this particular site yield information regarding intra-site variability, i.e. spatial relationships between various features and artefacts?

5.2. Can this particular site yield information about a community's social relationships within itself, or between other communities?

6. Archaeological Experience:

6.1. The personal experience and expertise of the CRM practitioner should not be ignored. Experience can indicate sites that have potentially significant aspects, but need to be tested prior to any conclusions.

7. Educational:

7.1. Does the site have the potential to be used as an educational instrument?

7.2. Does the site have the potential to become a tourist attraction?

7.3. The educational value of a site can only be fully determined after initial test-pit excavations and/or full excavations.

8. Other Heritage Significance:

8.1. Palaeontological sites

8.2. Historical buildings

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- 8.3. Battlefields and general Anglo-Zulu and Anglo-Boer sites
- 8.4. Graves and/or community cemeteries
- 8.5. Living Heritage Sites

8.6. Cultural Landscapes, that includes old trees, hills, mountains, rivers, etc related to cultural or historical experiences.

The more a site can fulfill the above criteria, the more significant it becomes. Test-pit excavations are used to test the full potential of an archaeological deposit. This occurs in Phase 2. These test-pit excavations may require further excavations if the site is of significance (Phase 3). Sites may also be mapped and/or have artefacts sampled as a form of mitigation. Sampling normally occurs when the artefacts may be good examples of their type, but are not in a primary archaeological context. Mapping records the spatial relationship between features and artefacts.

RESULTS

DESKTOP STUDY

The desktop study consisted of analysing various maps for evidence of prior habitation in the study area, as well as for previous archaeological surveys. The archaeological database indicates that there are archaeological sites in the general area (fig. 4). These sites include all types of Stone Age and Iron Age sites. No sites occur in the study area. There is an Indeterminate Stone Age site ~600km from the western section of the pipeline (2931AD 002). More of this site would occur in the study area, as these sites tend to be spread over a large area. The site records for the site probably discuss an Early Stone Age or Middle Stone Age site. The other site (2930AD 052) ~620m to the west is an Early Stone Age site. These sites tend to be of low significance.

There are no Surveyor General maps online for this area.

The 1937 aerial photographs indicate that there are twenty-two (22) settlements within 50m of the pipeline (fig. 5). These settlements would have human graves. The pipeline also crosses the original railway at four areas.

The 1968 topographical map indicates that there are twelve (12) settlements within 50m of the pipeline route. Some of these occur in the same place as the 1937 map (fig. 6).

The recent aerial imagery (fig. 2) indicates that most of the sites identified on the desktop no longer exist. The settlements have been built over by other settlements. These settlements would have human graves associated with them. These graves would be subsurface by now, unless they were demarcated with a cairn or tombstone. Sixteen of these settlements have not been built over, and remnant would remain.

The pipeline crosses the railway line in four places. Even though the railway line is still in use, it might have historical connotations and would require some form of management plan.

Table 1 lists the locations of the sites. A buffer of 50m should be placed around all of these sites and noted as being sensitive for possible human remains.

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TABLE 1: LOCATION OF HERITAGE SITES FROM HISTORICAL MAPS

NAME	LATITUDE	LONGITUDE	DESCRIPTION	STILL EXISTS
a1	-29.383670213	31.264798318	Settlement	Yes
a2	-29.383950929	31.267009962	Settlement	No
a3	-29.383937438	31.267866707	Settlement	No
a4	-29.384081201	31.271708282	Railway	Yes
a5	-29.384072936	31.273562616	Railway	Yes
a6	-29.384365896	31.273805828	Settlement	Yes
a7	-29.387135680	31.274411175	Settlement	Yes
a8	-29.387759285	31.274475670	Settlement	Yes
a9	-29.389257917	31.276455060	Settlement	Yes?
a10	-29.387909476	31.275586243	Settlement	Yes
a11	-29.383976307	31.278994803	Settlement	Yes
a12	-29.383466503	31.280524723	Settlement	No
a13	-29.384423499	31.280841532	Settlement	No
a14	-29.384764358	31.281499471	Settlement	Yes
a15	-29.384699981	31.282025279	Settlement	No
a16	-29.384558022	31.282553349	Settlement	Yes?
a17	-29.384208795	31.282034035	Settlement	No
a18	-29.385354637	31.283196604	Settlement	Yes
a19	-29.385953090	31.283340816	Settlement	Yes
a20	-29.386335358	31.283680338	Settlement	Yes
a21	-29.390476356	31.281834970	Settlement	Yes?
a22	-29.393816206	31.285225338	Settlement	No
b1	-29.383495940	31.266765921	Settlement	Yes
b2	-29.383665720	31.268163744	Settlement	No
b3	-29.384257797	31.273484513	Railway	Yes
b4	-29.384027194	31.275701250	Railway	Yes
b5	-29.383978492	31.280972718	Railway	No
b6	-29.385694959	31.283131074	Settlement	Yes
b7	-29.387868862	31.283607873	Settlement	No
b8	-29.389533039	31.281593527	Settlement	No
b9	-29.390139627	31.281180895	Settlement	No
b10	-29.390768773	31.280897409	Settlement	Yes
b11	-29.393156920	31.284902795	Settlement	No



Palaeontological Impact Assessment

Although it can be assumed that most of the study area is covered soil or weathered rock, it is expected that excavations of the trenches for the pipelines will be deeper than 1.5 m, and it is likely that fresh bedrock will be exposed. A Moderate Palaeontological Sensitivity is therefore allocated to the development site and any observation of fossils must be reported to the ECO.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that mainly trace fossils have been described from the Dwyka and Pietermaritzburg Formations that underlies part of the development site.

2. All sections of the development where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by the ECO and if fossils are recorded, a professional Palaeontologist must be appointed to record and collect the fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment.

3. No further palaeontological assessments are recommended for this development.



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FIG. 4: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA



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FIG. 5: STUDY AREA IN 1937



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FIG. 6: STUDY AREA IN 1968



FIELD SURVEY

The field survey followed the line route. Most of the pipeline occurs just outside of the road reserve, and thus the main part of the pipeline is in already disturbed areas. Many of the sites noted in the desktop study no longer exist. This is due to road works and housing that is more recent. Most of the footprint area has been heavily disturbed by these infrastructures.

The railway has been fixed and replaced several times since the original railway. The route has also deviated in some areas. The pipeline will be pipe jacked underneath the railway and thus not effect the railway itself.

All sites recorded at the desktop level should be treated as sensitive areas with the possibility of human remains occurring. If any human remains are uncovered during construction, then this will need to be reported to Amafa KZN, SAPS, and the ECO. Sites that are not mentioned in the Field Survey section have been destroyed/damaged. Other parts of the line fall in small agricultural fields and small valleys that do not have heritage sites.

Table 2 lists the locations of these sites while figure 7 shows their location. Figure 8 shows part of the line route.

NAME	LATITUDE	LONGITUDE	DESCRIPTION
CHAR01	-29.383442	31.265808	Religious site

FIG. 7: LOCATION OF RECORDED HERITAGE SITE



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FIG. 8: VIEWS OF THE PIPELINE



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CHAR01

CHAOR01 is situated on Line 3. The site consists of a recent Shembe Circle. The pipeline will come within ~ 15 m of the circle itself and probably closer to the edge of the site

Significance: The site has religious significance.

Mitigation: The edge of the site itself needs to be shown by the religious leader(s) of the Shembe site. An agreement should be made regarding the distance of the pipeline footprint in relation to the religious site.

FIG. 9: SHEMBE FEATURE AT CHAR01





MANAGEMENT PLAN

The area has been disturbed by various infrastructures resulting in no intact heritage sites. The railway has been upgraded and serviced several times since its initial construction. There would thus be few original railway sections. Moreover, the pipeline will go underneath the railway and thus not damage it. No further mitigation is required.

One the Shembe site was noted during the survey. The religious leader(s) of this site would need to discuss the sensitive areas of the site in relation to the pipeline.

CONCLUSION

A desktop heritage survey was undertaken for the Priority 2 Sewage Pipeline. Several heritage sites were noted in the desktop study. These sites include built structures and human settlements. The area was also noted for having low palaeontological significance, and requiring at least a desktop study. The area has been heavily effected by various servitudes and constructions and none of the original heritage sites occur.

The community PPP should finalise the pipeline footprint in relation to the Shembe site.

No further mitigation is required.



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APPENDIX A PIA DESKTOP REPORT



DESKTOP PALAEONTOLOGICAL ASSESSMENT FOR THE PROPOSED PRIORITY 2 LINE 1-4, KWADUKUZA LOCAL MUNICIPALITY, ILEMBE DISTRICT MUNICIPALITY, KWAZULU-NATAL PROVINCE.

FOR

Umlando

DATE: 31 January2015

By

Gideon Groenewald Cell: 082 339 9202

<u>priority 2 HIA final</u>

<u>06/02/2015</u>

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed construction of the Priority 2 line 1-4 project near Thembeni Kwadukuza Local Municipality, Ilembe District Municipality, Kwazulu-Natal Province.

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 as well as the KwaZulu-Natal Heritage Act No 4 of 2008. In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.

The study area is underlain by Ordovician to Silurian aged rocks of the Natal Group, Carboniferous to Permian aged rocks of the Dwyka Formation, Permian aged rocks of the Pietermaritzburg Formation, Ecca Group, of the Karoo Supergroup and Quaternary aged alluvium.

The footprint of the proposed construction of Priority 2 line 1-4 project near Thembeni, Kwadukuza Local Municipality, Ilembe District Municipality, Kwazulu-Natal Province is underlain by Ordivician to Silurian aged quartzite of the Natal Group, Carboniferous to Permian aged tilite of the Dwyka Formation, Permian aged shale of the Pietermaritzburg Formation and Quaternary aged alluvium. No significant fossils have to date, been described from the Natal Group quartzites, shales of the Pietermaritzburg Formation or the alluvial deposits from this part of KwaZulu-Natal. Although rare, significant fossils have been however been described from the Dwyka Formation, with specific reference to trace fossils. Recording of fossils from the construction site will however, contribute significantly to our understanding of the palaeo-environments that existed during deposition of the formations.

Although it can be assumed that most of the study area is covered soil or weathered rock, it is expected that excavations of the trenches for the pipelines will be deeper than 1.5 m, and it is likely that fresh bedrock will be exposed. A Moderate Palaeontological Sensitivity is therefore allocated to the development site and any observation of fossils must be reported to the ECO.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that mainly trace fossils have been described from the Dwyka and Pietermaritzburg Formations that underlies part of the development site.

2. All sections of the development where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by the ECO and if fossils are recorded, a professional Palaeontologist must be appointed to record and collect the fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment.

3. No further palaeontological assessments are recommended for this development.

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INTRODUCTION

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed construction of the Priority 2 line 1-4 project near Thembeni Kwadukuza Local Municipality, Ilembe District Municipality, Kwazulu-Natal Province (figure 1).



Figure 1 Locality of the proposed Priority 2 line 1-4 Study Site

SOUTH AFRICAN NATIONAL HERITAGE RESOURCE ACT NO 25/1999 AND KWAZULU-NATAL HERITAGE ACT NO 4/2008

This Palaeontological Assessment forms part of the Heritage Impact Assessment (HIA) and complies with the requirements of the South African National Heritage Resource Act No 25 of 1999 as well as the KwaZulu-Natal Heritage Act No 4 of 2008.In accordance with Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), a HIA is required to assess any potential impacts to palaeontological heritage within the development footprint.



Categories of heritage resources recognised as part of the National Estate in Section 3 of the Heritage 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.

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 and Google Earth imagery. The known fossil heritage within each rock unit is inventoried from the published scientific literature, previous palaeontological impact studies in the same region and the author's field experience.

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 below.

Sensitivity	Description
Low Sensitivity	Areas where there is likely to be a negligible impact on the fossil heritage. 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

Table 1	Palaeontologic	al sensitivity	/ analysis	outcome	classification
	raiaeonitoiogit	ai sensitivity	/ апагузіз	outcome	classification

When rock units of moderate to high palaeontological sensitivity are present within the development footprint, a field-based assessment by a professional palaeontologist is usually warranted.

The key assumption for this desktop 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.

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).

GEOLOGY

The study area is underlain by Ordovician to Silurian aged rocks of the Natal Group, Carboniferous to Permian aged rocks of the Dwyka Formation, Permian aged rocks of the Pietermaritzburg Formation, Ecca Group, of the Karoo Supergroup and Quaternary aged alluvium(Figure 2).





Figure 2 Geology of the study area.

Natal Group (O-Sn)

The Ordovician to Silurian aged rocks of the Natal Group consists mostly of grey-coloured quartzites, indicating fluvial deposition of sand from the highlands in the northern part of QwaZulu-Natal (Johnson et al, 2006).



Dwyka Formation (C-Pd)

The Carboniferous to Permian aged Dwyka Formation consists mainly of poorly sorted tillites. The rocks overlying the Natal Group is a thick unit of tillite that was deposited in a glacial environment by retreating ice sheets about 300 million years ago.

At this time South Africa was part of the supercontinent Gondwana, which was situated near the South Pole and covered with ice. Rocks imbedded in the slowly moving ice sheets scoured and polished the underlying older rocks giving rise to glacial pavements. Striation directions indicate that ice flow was from north to south - valuable information when it comes to reconstructing Gondwana

Pietermaritzburg Formation (Pp)

The Permian aged Pietermaritzburg Formationis the lower most formation of the Ecca Group, which is part of the Karoo Supergroup. The Pietermaritzburg Formationis an assemblage of fine-grained sediments, consisting mainly of dark greymudstone and shale. The deposits represent Permian aged marine deposits in this part of Gondwanaland (Johnson et al, 2006). Basinal dark mudrocks with phosphatic / carbonate / sideritic concretions can be present.

Offshore shelf, but possibly also nearshore / lacustrine / lagoonal deposits.

Alluvium

Quaternary aged alluvium consists mostly of sandy to mud-rich sandy deposits along the major river and stream systems.

PALAEONTOLOGY

Natal Group (O-Sn)

Up to date, no fossils have been recorded from the Natal Group sediments. Trace fossils are common in equivalent groups of rock in South Africa and the recording of fossils from these rock units will be significant.

Dwyka Formation (C-Pd)

Trace fossils have been recorded from the fine-grained shales of the Dwyka Formation in KwaZulu-Natal (Linstrom, 1987; MacRae, 1999). All of the

following could potentially be found in KwaZulu-Natal. Trackways, produced mostly by fish and arthropods (invertebrates), have been recovered in shales from the uppermost Dwyka Formation. Other trace fossils include coprolites (fossilized faeces) of chondrichthyians (sharks, skates and rays).

Body fossils include aranaceous foraminifera and radiolarians (single-celled organisms), bryozoans, sponge spicules (internal support elements of sponges), primitive starfish, orthoceroid nautiloids (marine invertebrates similar to the living *Nautilus*), goniatite cephalopods (*Eoasinites* sp.), gastropods (marine snails such as *Peruvispiraviperdorfensis*), bivalves (*Nuculopsis* sp., *Phestia* sp., *Aphanaiahaibensis*, *Eurydesmamytiloides*), brachiopods (*Attenuatella* sp.) and palaeoniscoid fish such as *Namaichthysschroederi* and *Watsonichthys lotzi*.

Fossil plants have also been found, including lycopods (*Leptophloemaustrale*), moss, leaves and stems (possibly belonging to a protoglossopterid flora). Fossil spores and pollens (such as moss, fern and horsetail spores and primitive gymnosperm pollens) as well as fossilized wood probably belonging to primitive gymnosperms have also been recorded from Dwyka deposits (MacRae, 1999; McCarthy and Rubidge, 2005).

Pietermaritzburg Formation (Pp)

Fossils are generally absent from the Formation although trace fossils have been recorded from the upper layers of the Pietermaritzburg Formation by Linstrom (1987).

Alluvium

Up to date no significant fossils have been described from the alluvium deposits along the streams of this part of KwaZulu-Natal. Significant fossils have however been reported from similar deposits in other parts of South Africa and the recording of fossils from these sediments will be highly significant.

DISCUSSION

The predicted palaeontological impact of the development isbased on the initial mapping assessment and literature reviews. Although fossils are rarely recorded from the Dwyka and Pietermaritzburg Formations, the recording of fossils recording of trace fossils and other fossils from this part of the Karoo Basin will contribute significantly to our understanding of the palaeo-environments that existed during the Permian.

MANAGEMENT PLAN

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.

The palaeontological sensitivity of the development is related to the specific geology that underlies the development footprints. For the sake of this desktop survey it is assumed that there are no significant outcrops on site, but that trenching of up to 2m depth will in fact expose fresh bedrock of all the geological formations recorded in the desktop survey. Due to the fact that the recording of fossils will have a significant impact on our understanding of the palaeo-environments in this part of the basin, a Moderate Palaeontological sensitivity is allocated to the study site.



The palaeontological sensitivity of the study area is shown in Figure 3.

Figure 3. Palaeontological sensitivity of the routes of Priority 2 lines 1-4.

CONCLUSION AND RECOMMENDATIONS

The footprint of the proposed construction of Priority 2 line 1-4 project near Thembeni, Kwadukuza Local Municipality, Ilembe District Municipality, Kwazulu-Natal Provinceis underlain by Ordivician to Silurian aged quartzite of the Natal

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Group, Carboniferous to Permian aged tilite of the Dwyka Formation, Permian aged shale of the Pietermaritzburg Formation and Quaternary aged alluvium. No significant fossils have to date, been described from the Natal Group quartzites, shales of the Pietermaritzburg Formation or the alluvial deposits from this part of KwaZulu-Natal. Although rare, significant fossils have been however been described from the Dwyka Formation, with specific reference to trace fossils. Recording of fossils from the construction site will however, contribute significantly to our understanding of the palaeo-environments that existed during

deposition of the formations.

Although it can be assumed that most of the study area is covered soil or weathered rock, it is expected that excavations of the trenches for the pipelines will be deeper than 1.5 m, and it is likely that fresh bedrock will be exposed.A Moderate Palaeontological Sensitivity is therefore allocated to the development site and any observation of fossils must be reported to the ECO.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that mainly tracefossils have been described from the Dwyka and Pietermaritzburg Formations that underlies part of the development site.

2. All sections of the development where bedrock is exposed due to erosion or where geotechnical surveys indicate that bedrock will be exposed during excavation, must be inspected by the ECO and if fossils are recorded, a professional Palaeontologist must be appointed to record and collectthe fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment.

3. No further palaeontological assessments are recommended for this development.

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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).

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.

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Dr Gideon Groenewald Geologist

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