

**SURVEY OF THE PROPOSED SIBAYA WATER
PIPELINE UPGRADE, VERULAM, KWAZULU-NATAL**

FOR TONGAAT HULETT DEVELOPMENT

DATE: 11 APRIL 2016

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INTRODUCTION

The development of the 850 ha Sibaya Precinct includes the potential development of residential, commercial, conservation and resort developments. The Sibaya Precinct is situated between the coast and N2 Freeway with the M4 bisecting the site. The Sibaya Precinct is strategically located along KwaZulu-Natal's north coast within the Province's Primary Corridor and a few minutes away from King Shaka International Airport (KSIA) and the Dube TradePort. It is also located in the centre of two of Durban's primary tourism nodes of Umhlanga and Umdloti.

From a development perspective, the Sibaya Precinct has been conceptualised with five (5) major nodes, two to the east and three to the west of the M4. Each node has a distinctive and specific role within the Sibaya Precinct and within the broader region. The phasing and implementation of the nodes are grouped into clusters as follows:

- Node 4;
- Nodes 2 & 3; and
- Nodes 1 & 5.

A significant amount of infrastructure has already been invested with the development of the Casino including new bulk water, electricity and sewer systems as well as two new accesses off regional routes. However there is still a quantum of infrastructure that is required to service the development including a bulk water main.

With regards to water provision and infrastructure, the recently upgraded 25 M. Waterloo Reservoir to the west of the Sibaya Precinct currently supplies water to Umdloti and the Sibaya Casino via a 250 mm water main. The existing 250 mm water main that currently supplies the Sibaya Casino and Umdloti, however, has insufficient capacity to cater for the additional flow generated by Nodes 1 &

5. Therefore it is proposed that this pipe be augmented with a larger main (700mm) which is the subject of this EIA application.

Part of the new pipeline will occur besides the existing pipeline.

Figures 1 – 3 show the location of the proposed pipeline. Figure 4 shows some of the pipeline routes.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

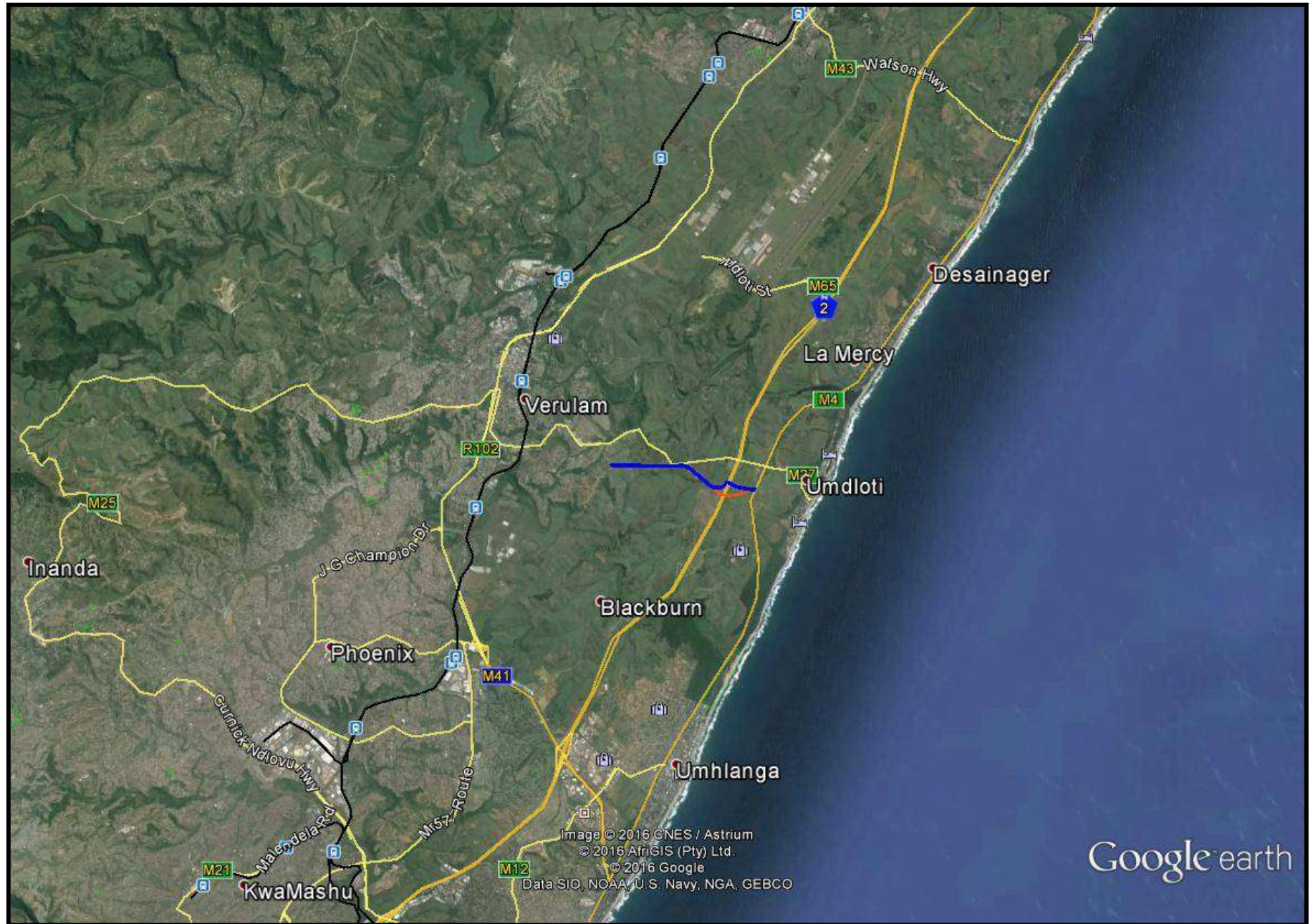


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA

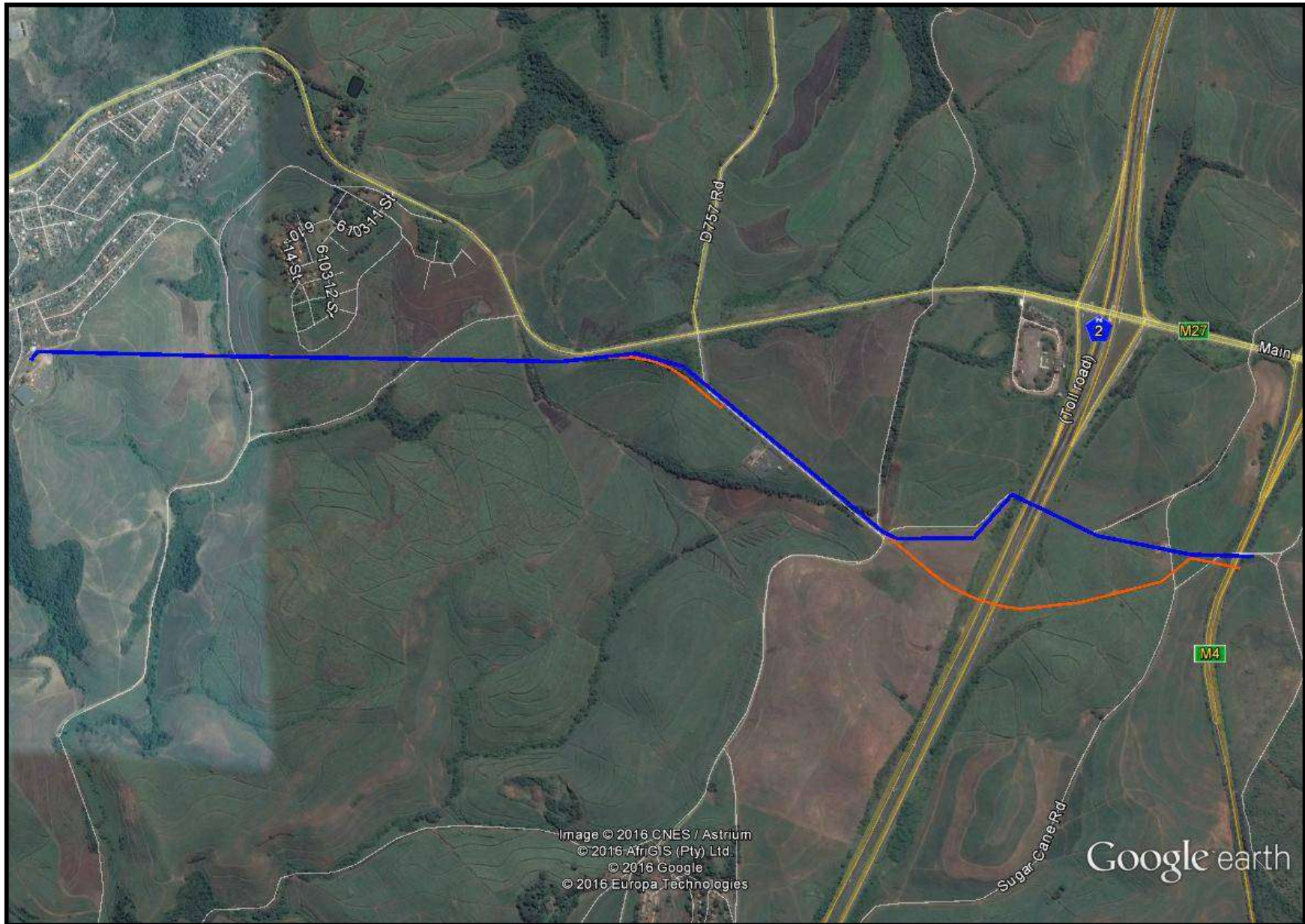


FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA

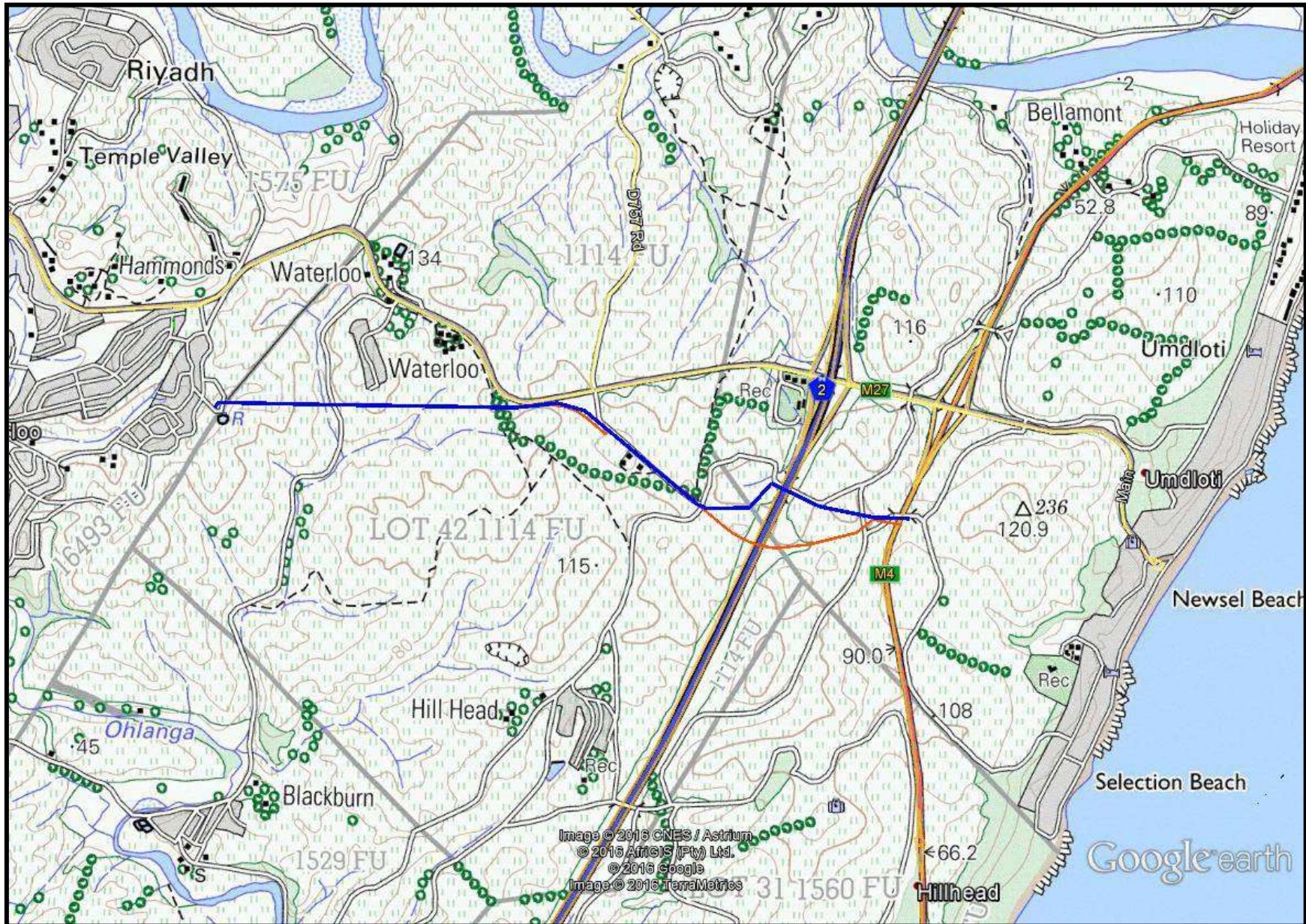


FIG. 4: SCENIC VIEWS OF THE PIPELINE ROUTE



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 quick 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.

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

- 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. 5). These sites include all types of Stone Age and Iron Age sites. Most of the sites were surveyed as part of the isiBaya Casino site and road interchange (Anderson 1997, 2003a-c). One of these sites was excavated and had human remains.

No national monuments, battlefields, or historical cemeteries are known to occur in the study area.

The deeds office indicates that the land was first surveyed in 1848 when the area was referred to as Victoria County (fig. 6).

The 1937 aerial photographs indicate that the area was under sugar cane cultivation, and probably was already in the late 19th century (fig. 7). No buildings or houses are noted in the footprint.

The 1969 map (fig. 8) indicates that the land is still under sugar cane cultivation. Of interest is the occurrence of a tarred road that runs adjacent to the new proposed line route.

TABLE 1: LOCATION OF RECORDED SITES

NAME	LATITUDE	LONGITUDE	DESCRIPTION
2931CA 169	-29.670000000	31.100833333	LIA/HP
2931CA 090	-29.669444444	31.098055556	LSA
2931CA 009	-29.669444444	31.097222222	LIA
Sibay01	-29.665224000	31.089875000	MSA/EIA/LIA/HP
Sibay02	-29.668949000	31.095748000	HP? Shell midden
Sibay03	-29.670015000	31.096130000	LIA/HP
Sibay04a	-29.668704000	31.102672000	Midden LIA/HP
Sibay04b	-29.668369000	31.102827000	Midden LIA/HP

FIG. 5: LOCATION OF KNOWN HERITAGE SITES NEAR THE STUDY AREA

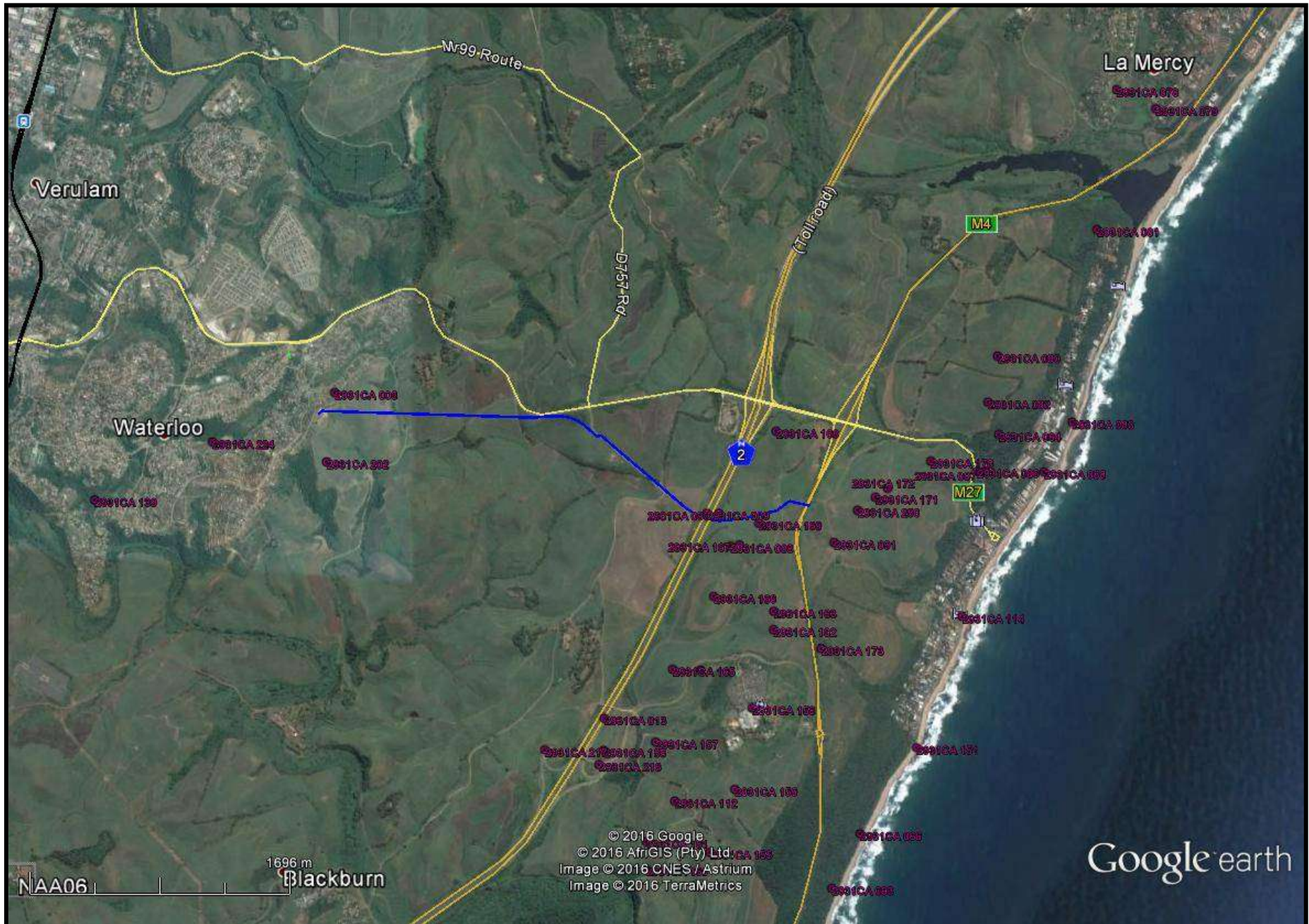


FIG. 6: ORIGINAL SURVEYOR GENERAL MAP (1848)

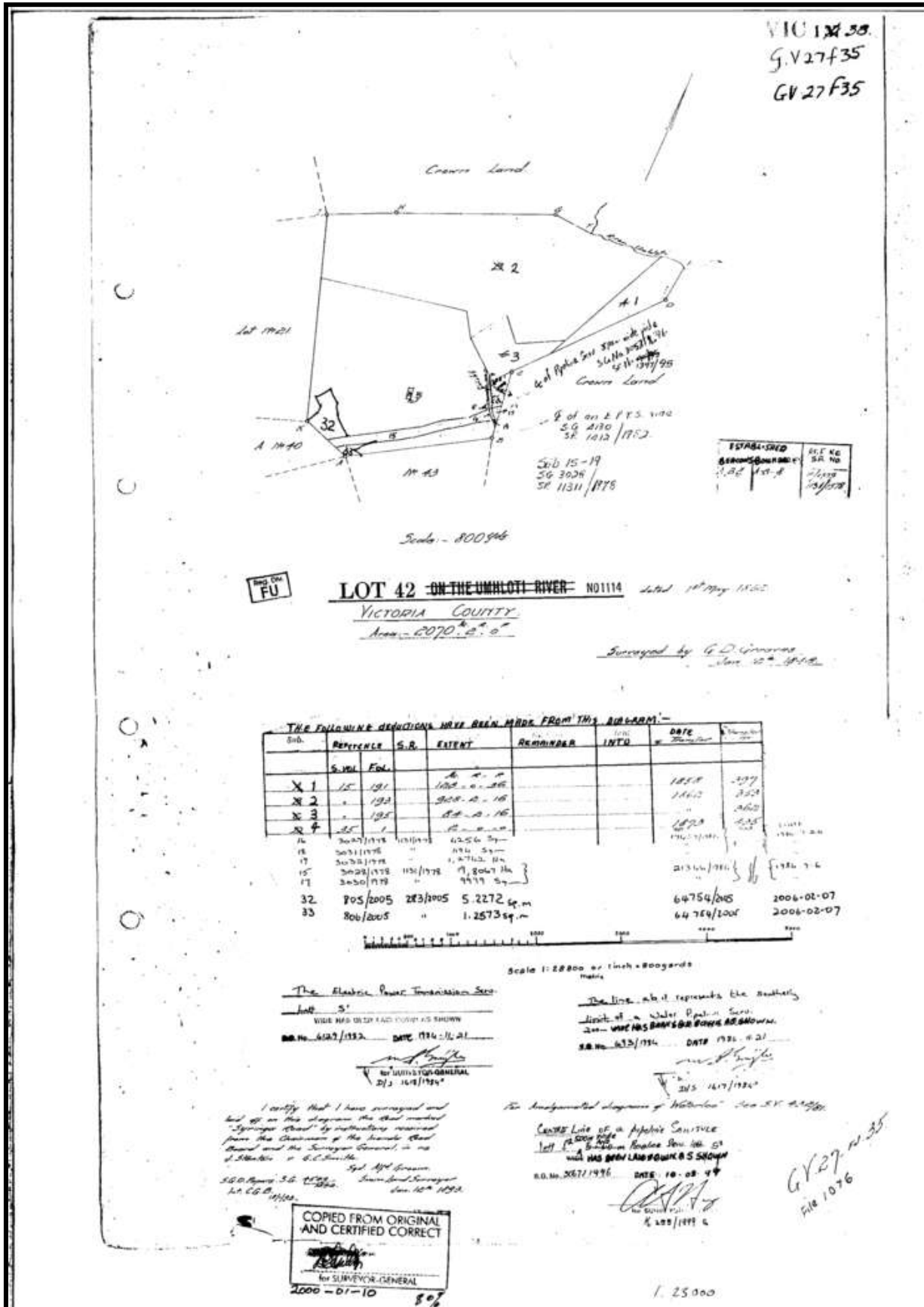


FIG. 7: STUDY AREA IN 1937



FIG. 8: STUDY AREA IN 1969

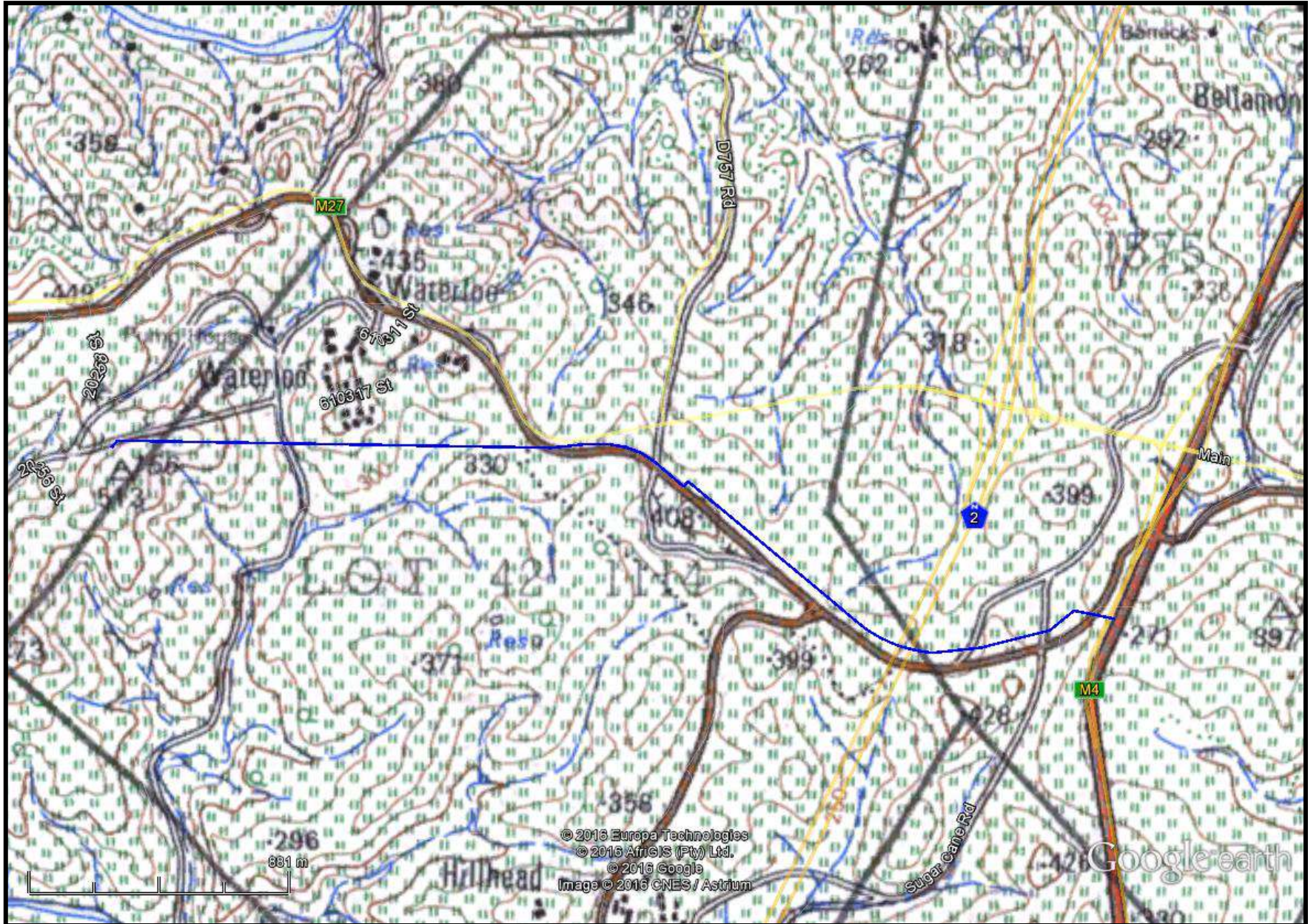
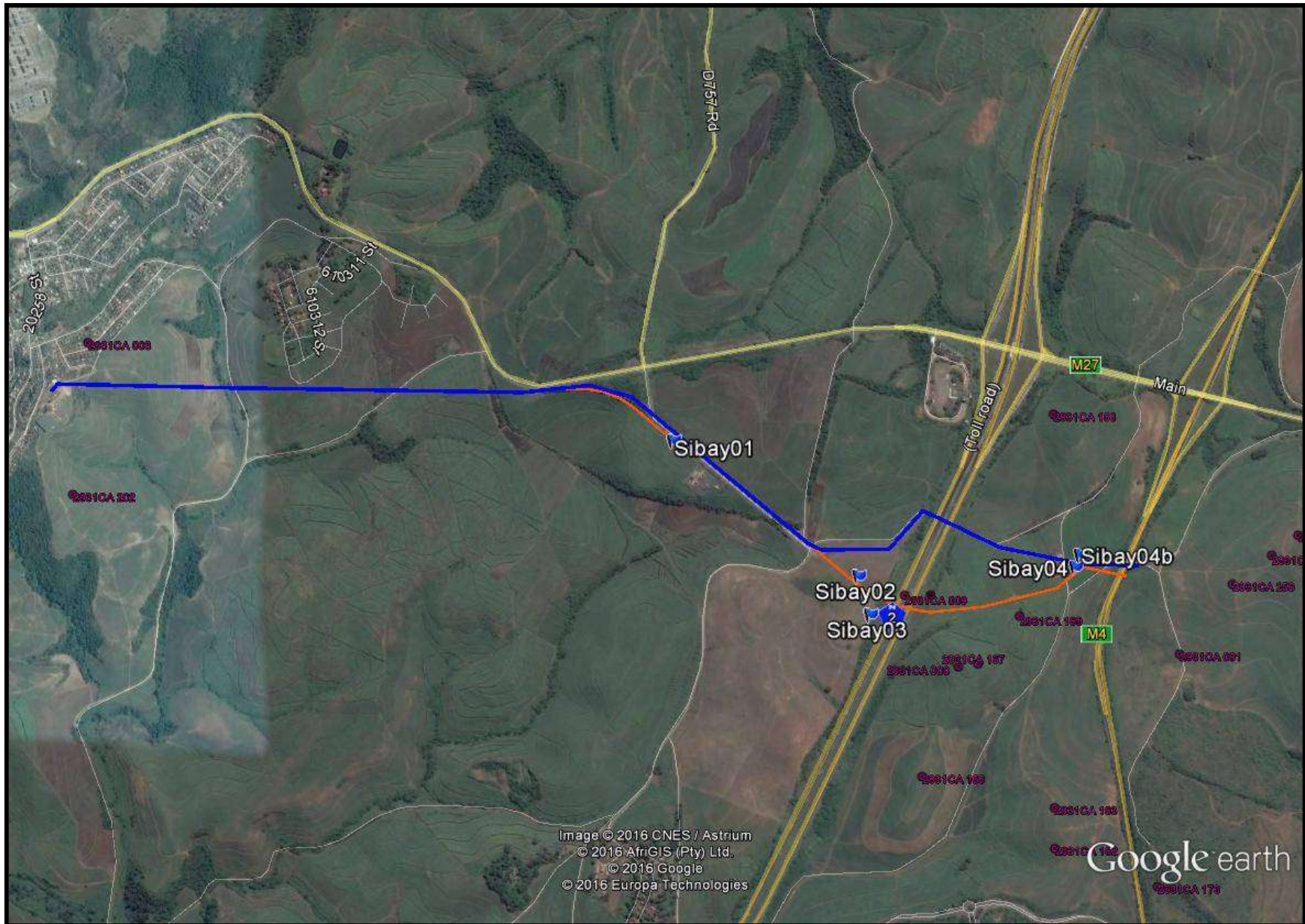


FIG. 9: RECORDED SITES IN THE STUDY AREA



FIELD SURVEY

The field survey was undertaken in March 2016. Four sites were recorded and three previously recorded sites were revisited. Two of the four sites form part of the previously recorded sites. The location of the sites is given in Table 1.

2931CA 009

2931CA 009 is a Late Iron Age site recorded by O. Davies in 1977. He describes the site as : “1 lightly rolled piece of Glycimeris, ?used as spoon. Probably belonging to a later occupation: broken and whole large *Perna perna*, *Fissurella [sic] natalensis*, *Patella longicosta*, both well preserved, no oyster seen; [Pottery is adiagnostic] .” He mentions some stone chunks on the surface. The site was subsequently partially destroyed by the N2.

The site SIBAY002 forms the western part of the site. It consists of a wide variety of pottery shards, upper and lower grinding stones. There is a partially intact shell midden on the western edge of the site that has been exposed by sugar cane cultivation (fig. 10).

Significance: The site is of low significance.

Mitigation: The site would need to be monitored during excavations of the pipeline if it was to be affected. It would be better if the pipeline was placed in the older road. The existing track is on the edge of the older road, and the older road would have already destroyed that part of the site. No mitigation nor permits would thus be required.

SAHRA Rating: 3C

FIG 10: ARTEFACTS AND VIEW OF 2930CA 009



2931CA 090

2931CA 090 was recorded by O. Davies in 1950s. The site consisted of an Early Stone Age hand-axe, some Middle Stone Age tools, indeterminate pottery, and a shell midden. This site might be the eastern part of 2931CA 009, or material from 2931CA 169.

Significance: The site is of low significance

Mitigation: It would be better if the pipeline was placed in the older road. The existing track is on the edge of the older road, and the older road would have already destroyed that part of the site. No mitigation nor permits would thus be required.

SAHRA Rating: 3C

2931CA 169

2931CA 169 was recorded by C. Sievers in 1997, and revisited in 2005. The site is noted for being a Late Iron Age site that probably post dates 1650 ACE. The site was noted for a variety of pottery sherds, grinding stones and some shell (fig. . The site has been bisected by an older tarred road that has since been removed. This site was also recorded as SIBAY003 during the field survey, but has been subsumed into this site.

Significance: The site does not appear to have deposit, however there is a lot of pottery on the sides of the road. Human skeletal remains are highly likely to occur at the site.

Mitigation: The site would need to be monitored during excavations of the pipeline if it was to be affected. It would be better if the pipeline was placed in the older road. The existing track is on the edge of the older road, and the older road would have already destroyed that part of the site. No mitigation nor permits would thus be required.

SAHRA Rating: 3C

FIG. 11: 2930CA 169 ARTEFACTS AND VIEW



SIBAY01

SIBAY01 is located on the top of a hill near the substation. Only the edge of the site could be surveyed due to dense vegetation, however the site would extend across the entire hill, i.e. on both sides of the road. The site consists of both Early and Late Iron Age artefacts (fig. 12). One decorated sherd dates to the Ntshekane Phase of the Early Iron Age. The Late Iron Age pottery tends to be thin walled and undecorated. One MSA flake was also noted.

Significance: The site is of low significance.

Mitigation: No mitigation is required. If the pipeline uses the existing pipeline footprint then it will not require a permit.

SAHRA Rating: 3C

FIG. 12: ARTEFACTS FROM SIBAY01



SIBAY03

SIBAY03 is located on a small hill to the south of 2931CA 009 (SIBAY02). The site is on a small hill ~50m in diameter and it might have been linked to SIBAY02 before the road was built (fig. 13). The site consists of a few thin-walled pottery sherds and grinding stone fragments. The pottery probably dates to the LIA.

Significance: The site is of low significance.

Mitigation: No mitigation is required.

SAHRA Rating: 3C

FIG. 13: VIEW OF SIBAY03



SIBAY04

SIBAY04 is located on the eastern side of the pipeline. The site overlooks the old road that has been taken apart and converted into farmland and the M4 (fig. 14). The site is ~50m in diameter and has been extensively ploughed. The site consists of thin-walled pottery and fragments of a shell midden. The shell in the midden is mostly *Perna perna*. The site probably dates to the LIA.

Significance: The site is of low significance.

Mitigation: The site would need to be monitored during excavations of the pipeline if it was to be affected. It would be better if the pipeline was placed in the older road. The existing track is on the edge of the older road, and the older road would have already destroyed that part of the site. No mitigation nor permits would thus be required.

SAHRA Rating: 3C

FIG. 14: VIEW OF SIBAY04



PALAEONTOLOGICAL IMPACT ASSESSMENT

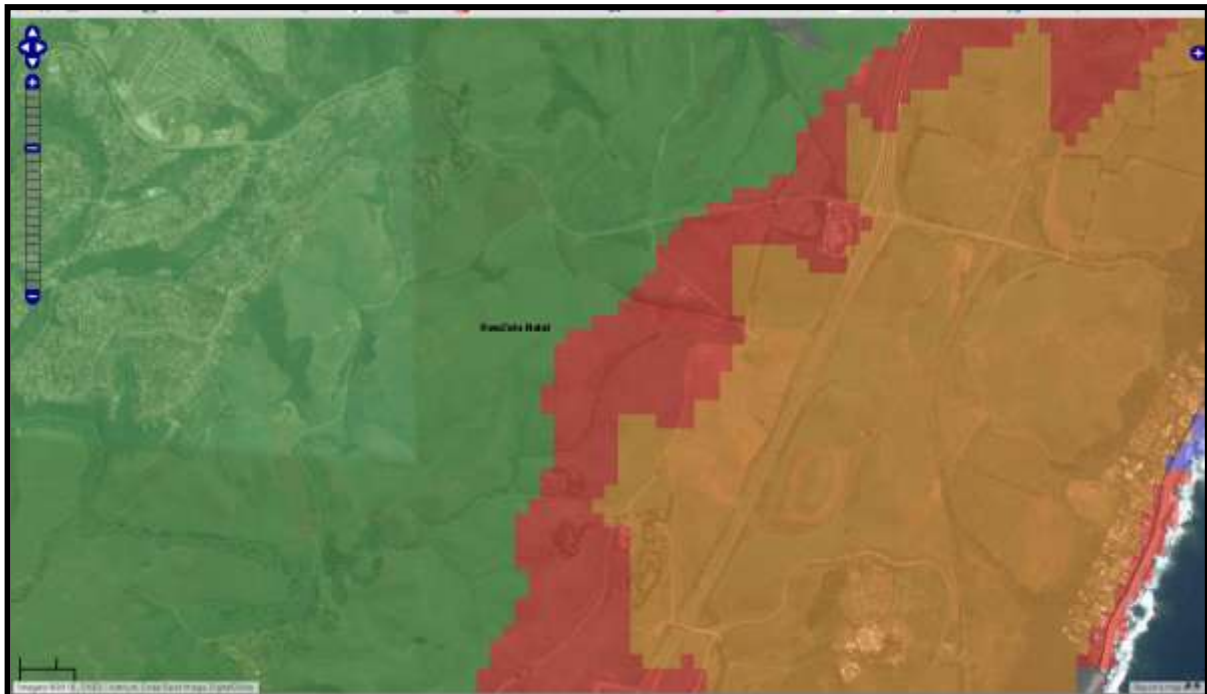
A desktop study was undertaken by Dr Gideon Groenewald for the pipeline (see Appendix A). The PIA notes that “the study area is underlain by sedimentary rocks of the Permian-aged Pietermaritzburg and Vryheid Formations of the Ecca Group and Quaternary aged dune sand of the Berea Formation, Maputuland Group. Trace fossils are known from the Pietermaritzburg Formation, where fossils are associated with the bedding planes of shales exposed during excavation of trenches or foundations deeper than 1.5m. A Moderate Palaeontological sensitivity is allocated to these rocks. Very rich assemblage of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation and a Very High Palaeontological sensitivity is allocated to areas underlain by this Formation. Interpretation of the Google images and information gathered from experience indicates that these areas are underlain by deeply weathered soil, mostly cultivated for sugar cane farming.”

Mitigation:

1. The EAP and ECO of the project must be informed of the fact that significant trace fossils have been described from the upper Pietermaritzburg Formation, highly significant fossils from the Vryheid Formation and significant fossils from the Berea Formation underlying the Sibaya Precinct pipeline route. Chance recording of fossils from these rocks will contribute uniquely to our understanding of the palaeo-environments of these regions.
2. All sections of the development that are allocated a Very High to High Palaeontological sensitivity and where trenching or excavation for infrastructure will be deeper than 1.5m must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified 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 during the initial stages of excavation.

3. PIA mitigation is required in those area where trenching will expose previously undisturbed deposits. Thus, no mitigation will be required if the old pipeline is removed and replaced if the trenches do not exceed 1.5m in depth.

FIG. 15: PALAEOLOGICAL SENSITIVITY OF THE AREA



COLOUR	SENSITIVITY	REQUIRED ACTION
RED	VERY HIGH	field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	desktop study is required and based on the outcome of the desktop study, a field assessment is likely
GREEN	MODERATE	desktop study is required
BLUE	LOW	no palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	no palaeontological studies are required
WHITE/CLEAR	UNKNOWN	these areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

MANAGEMENT PLAN

The archaeological sites tend to be of low significance; however, human remains may still occur underneath the topsoil. If any human remains are noted, then Amafa KZN and the SAPS need to be informed immediately. That specific area should be cordoned off with a 20m buffer until further investigations have occurred.

If the new pipeline occurs in the old road (see Fig. 8), then no further mitigation is required as this road has already destroyed any archaeological material. However, if the pipeline runs adjacent to the old road it will impact on the recorded archaeological sites. Some of these sites will require monitoring and/or salvage excavations during construction. The client will also require a permit from Amafa KZN to destroy these sites. This could cause delays to construction and I would suggest the old road route is chosen.

The sites requiring monitoring during construction, if they are to be affected, would be:

- 2931AC 009
- 2931AC 169
- SIBAY004

The palaeontological study indicated the area ranges from medium to very high palaeontological sensitivity. Any trenches that are more than 1.5m deep will require a palaeontologist on site to assess the deposits. The client will need to apply for a permit to destroy potential palaeontological deposits.

The client needs to apply for a permit timeously as it can take anywhere from 1 – 12 months to be issued.

The client needs to indicate the final route for approval and comment.

CONCLUSION

A heritage survey was undertaken for the proposed Sibaya bulk water pipeline. The pipeline is to service the proposed development nodes that are planned for the area. Parts of the pipeline route had already been surveyed in the 1990s and several archaeological sites were recorded. This survey recorded further archaeological sites.

If the pipeline affects any of the archaeological sites, then permits will be required from Amafa KZN as well as on-site monitoring during construction. However if the new pipeline route follows the old tarred road that has been demolished, then no further mitigation and permits will be required for the archaeological sites.

The palaeontological desktop report noted that the area has moderate to very high palaeontological sensitivity. Any trenching deeper than 1.5m below the surface will require a Phase 1 Palaeontological Survey with on-site monitoring. Permits from Amafa KZN might be required. This permit differs from the archaeological permits.

REFERENCES

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Anderson, G. 2003a. Archaeological Excavations At The Proposed Casino Site. Natal Museum, ICRM.

Anderson, G. 2003b. Archaeological Excavations Of The Cas6 Skeleton . Natal Museum, ICRM.

Anderson, G. 2003c. Archaeological Excavations At Casr1. Natal Museum, ICRM.

APPENDIX A
PALAEONTOLOGICAL DESKTOP STUDY

**DESKTOP PALAEOLOGICAL
ASSESSMENT FOR THE PROPOSED
SIBAYA PRECINCT PIPELINE PROJECT,
ETHEKWINI METROPOLITAN
MUNICIPALITY, KWAZULU-NATAL
PROVINCE.**

**FOR
Umlando**

DATE: 09 April 2016

By

**Gideon Groenewald
Cell: 078 713 6377**

EXECUTIVE SUMMARY

Gideon Groenewald undertook a desktop survey, assessing the potential palaeontological impact of the proposed construction of a 700mm mains water supply line at the proposed Sibaya Precinct, Ethekewini Metropolitan 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 sedimentary rocks of the Permian-aged Pietermaritzburg and Vryheid Formations of the Ecca Group and Quaternary aged dune sand of the Berea Formation, Mputuland Group. Trace fossils are known from the Pietermaritzburg Formation, where fossils are associated with the bedding planes of shales exposed during excavation of trenches or foundations deeper than 1.5m. A Moderate Palaeontological sensitivity is allocated to these rocks. Very rich assemblage of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation and a Very High Palaeontological sensitivity is allocated to areas underlain by this Formation. Interpretation of the Google images and information gathered from experience indicates that these areas are underlain by deeply weathered soil, mostly cultivated for sugar cane farming. A phase 1 PIA is therefore recommended during excavations of infrastructure deeper than 1.5m during the initial phases of the construction. Although also sparsely recorded, plant fossils from the Berea Formation can provide significant information on the palaeo-environments in this region during the Quaternary times and if fossils are found they should be recorded. Although a High palaeontological sensitivity is allocated to the areas underlain by the Berea Formation, a Phase 1 PIA is also recommended only during excavation of infrastructure that exceeds a depth of 1.5m.

Recommendations:

1. The EAP and ECO of the project must be informed of the fact that significant trace fossils have been described from the upper Pietermaritzburg Formation, highly significant fossils from the Vryheid Formation and significant fossils from the Berea Formation underlying the Sibaya Precinct pipeline route. Chance recording of fossils from these rocks will contribute uniquely to our understanding of the palaeo-environments of these regions.
2. All sections of the development that are allocated a Very High to High Palaeontological sensitivity and where trenching or excavation for infrastructure will be deeper than 1.5m must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified 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 during the initial stages of excavation.
3. These recommendations must form part of the EMP for the project.

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INTRODUCTION

Gideon Groenewald undertook a desktop survey, assessing the potential palaeontological impact of the proposed construction of a 700mm mains water supply line at the proposed Sibaya Precinct, Ethekewini Metropolitan Municipality, KwaZulu-Natal Province (Figure 1).

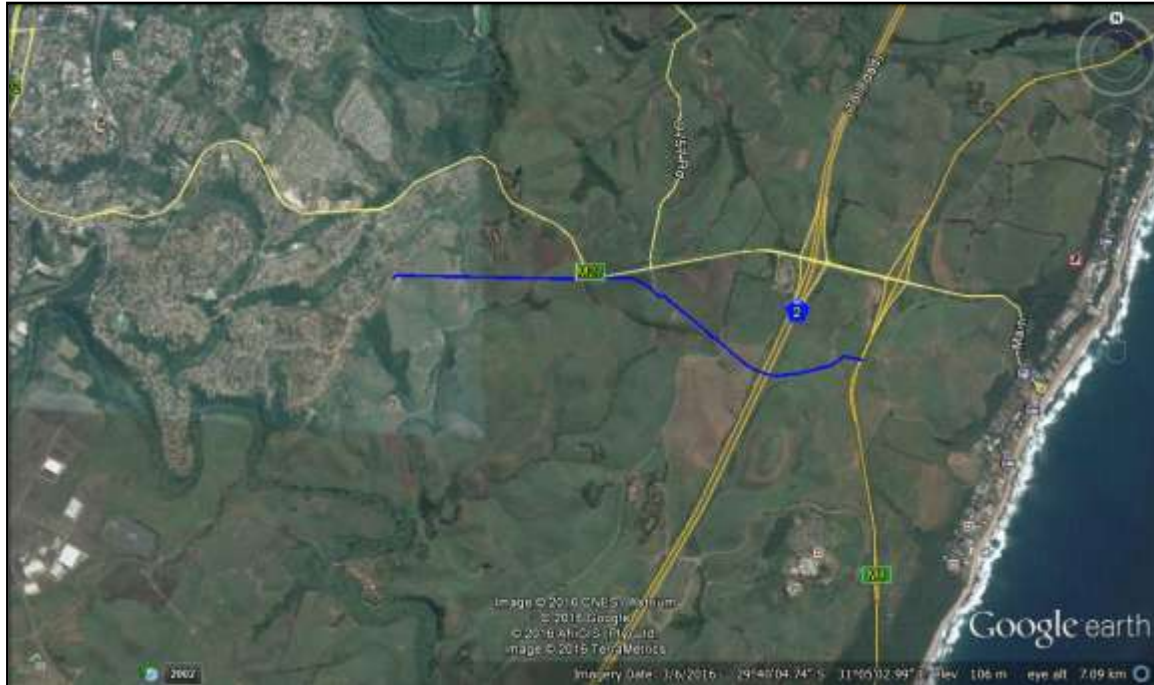


Figure 1 Locality of the proposed route of the new pipeline in blue

The development of the 850 ha Sibaya Precinct includes the potential development of residential, commercial, conservation and resort developments. The Sibaya Precinct is situated between the coast and N2 Freeway with the M4 bisecting the site. The Sibaya Precinct is strategically located along KwaZulu-Natal's north coast within the Province's Primary Corridor and a few minutes away from King Shaka International Airport (KSIA) and the Dube TradePort. It is also located in the centre of two of Durban's primary tourism nodes of Umhlanga and Umdloti.

With regards to water provision and infrastrucutre, the recently upgraded 25 Ml. Waterloo Reservoir to the west of the Sibaya Precinct currently supplies water to Umdloti and the Sibaya Casino via a 250 mm water main. The existing 250 mm water main that currently supplies the Sibaya Casino and Umdloti, however, has insufficient capacity to cater for the additional flow generated by Nodes 1 & 5. Therefore it is proposed that this pipe be augmented with a larger main (700mm) which is the subject of this EIA application.

**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 bedrock excavation envisaged. The different sensitivity classes used are explained in Table 1 below.

Table 1 Palaeontological sensitivity analysis outcome classification

PALAEONTOLOGICAL SIGNIFICANCE/VULNERABILITY OF ROCK UNITS	
The following colour scheme is proposed for the indication of palaeontological sensitivity classes. This classification of sensitivity is adapted from that of Almond et al (2008, 2009) (Groenewald et al.,2014).	
RED	Very High Palaeontological sensitivity/vulnerability. Development will most likely have a very significant impact on the Palaeontological Heritage of the region. Very high possibility that significant fossil assemblages will be present in all outcrops of the unit. Appointment of professional palaeontologist, desktop survey, phase I Palaeontological Impact Assessment (PIA) (field survey and recording of fossils) and phase II PIA (rescue of fossils during construction) as well as application for collection and destruction permit compulsory.
ORANGE	High Palaeontological sensitivity/vulnerability. High possibility that significant fossil assemblages will be present in most of the outcrop areas of the unit. Fossils most likely to occur in associated sediments or underlying units, for example in the areas underlain by Transvaal Supergroup dolomite where Cenozoic cave deposits are likely to occur. Appointment of professional palaeontologist, desktop survey and phase I Palaeontological Impact Assessment (field survey and collection of fossils) compulsory. Early application for collection permit recommended. Highly likely that a Phase II PIA will be applicable during the construction phase of projects.
GREEN	Moderate Palaeontological sensitivity/vulnerability. High possibility that fossils will be present in the outcrop areas of the unit or in associated sediments that underlie the unit. For example areas underlain by the Gordonia Formation or undifferentiated soils and alluvium. Fossils described in the literature are visible with the naked eye and development can have a significant impact on the Palaeontological Heritage of the area. Recording of fossils will contribute significantly to the present knowledge of the development of life in the geological record of the region. Appointment of a professional palaeontologist, desktop survey and phase I PIA (ground proofing of desktop survey) recommended.

<p>BLUE</p>	<p>Low Palaeontological sensitivity/vulnerability. Low possibility that fossils that are described in the literature will be visible to the naked eye or be recognized as fossils by untrained persons. Fossils of for example small domal Stromatolites as well as micro-bacteria are associated with these rock units. Fossils of micro-bacteria are extremely important for our understanding of the development of Life, but are only visible under large magnification. Recording of the fossils will contribute significantly to the present knowledge and understanding of the development of Life in the region. Where geological units are allocated a blue colour of significance, and the geological unit is surrounded by highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a blue colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in larger alluvium deposits. Collection of a representative sample of potential fossiliferous material is recommended.</p>
<p>GREY</p>	<p>Very Low Palaeontological sensitivity/vulnerability. Very low possibility that significant fossils will be present in the bedrock of these geological units. The rock units are associated with intrusive igneous activities and no life would have been possible during emplacement of the rocks. It is however essential to note that the geological units mapped out on the geological maps are invariably overlain by Cenozoic aged sediments that might contain significant fossil assemblages and archaeological material. Examples of significant finds occur in areas underlain by granite, just to the west of Hoedspruit in the Limpopo Province, where significant assemblages of fossils and clay-pot fragments are associated with large termite mounds. Where geological units are allocated a grey colour of significance, and the geological unit is surrounded by very high and highly significant geological units (red or orange coloured units), a palaeontologist must be appointed to do a desktop survey and to make professional recommendations on the impact of development on significant palaeontological finds that might occur in the unit that is allocated a grey colour. An example of this scenario will be where the scale of mapping on the 1:250 000 scale maps excludes small outcrops of highly significant sedimentary rock units occurring in dolerite sill outcrops. It is important that the report should also refer to archaeological reports and possible descriptions of palaeontological finds in Cenozoic aged surface deposits.</p>

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 Permian aged rocks of the Pietermaritzburg and Vryheid Formations of the Ecca Group, Karoo Supergroup and Quaternary aged sand and calcretes of the Berea Formation of the Maputuland Group (Figure 2).

Ecca Group

Pietermaritzburg Formation (Pp)

As Gondwana, a large continent that existed during the Permian, moved north towards toward the equator, thick clay and silt beds were laid down in a large sea that occupied the Karoo Basin in South Africa, leading to the deposition of the Ecca Group. These sediments, deposited in deep water, now form the shales of the Pietermaritzburg Formation of the Ecca Group in KZN. The shales are easily weathered and often present slope stability problems (Johnson et al, 2009).

Vryheid Formation (Pv)

The Permian aged Vryheid Formation is a thick sequence of sedimentary rocks consisting mainly of coarse-grained sandstone and interbedded black shale.

These sandstones and shales were deposited along ancient sandy shorelines behind which lay vast swamplands. Burial of vegetation in the swamps

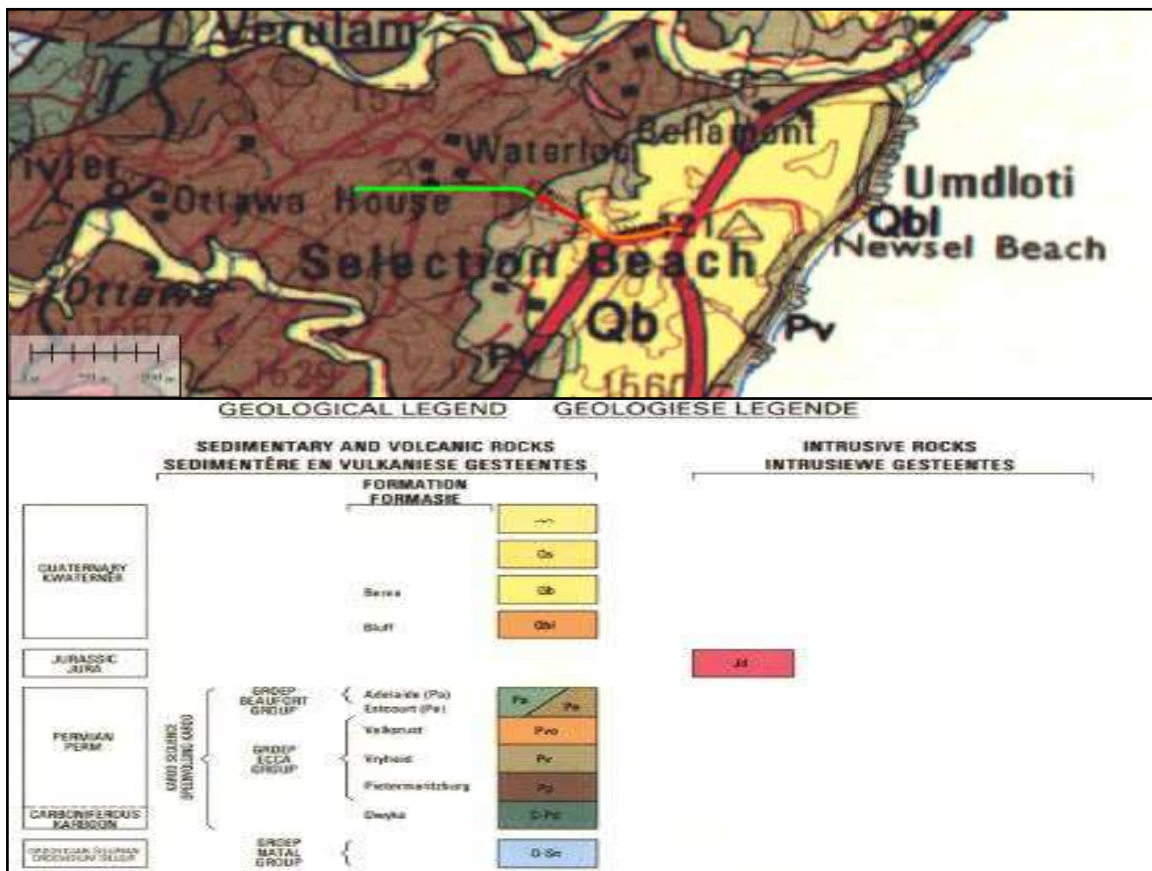


Figure 2 Geology of the area underlying the route of the Sibaya Pipeline

eventually formed coal which is mined at various localities in the outcrop areas of the formation in South Africa (McCarthy and Rubidge, 2005; Johnson et al, 2009).

Maputuland Group

Berea Formation (Qb)

In the study area the Berea Formation overlies the Vryheid and other older geological formations. The Berea Formation consists of red, orange and yellow Aeolian sand, in the form of dune cordons along the coast of KwaZulu-Natal, also known as the “Berea Red Sand”. The Berea Formation is interpreted as the weathering product of the Bluff Formation, which is not mapped as such in the study area (Wolmarans and Du Preez, 1986; Johnson et al, 2009).

PALAEONTOLOGY

Ecca Group

Pietermaritzburg Formation (Pp)

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

Vryheid Formation (Pv)

The Vryheid Formation is well-known for the occurrence of coal beds that resulted from the accumulation of plant material over long periods of time. Plant fossils described by Bamford (2011) from the Vryheid Formation are; *Azaniodendron fertile*, *Cyclodendron leslii*, *Sphenophyllum hammanskraalensis*, *Annularia* sp., *Raniganjia* sp., *Asterotheca* spp., *Liknometalon enigmata*, *Glossopteris* > 20 species, *Hirsutum* 4 spp., *Scutum* 4 spp., *Ottokaria* 3 spp., *Estcourtia* sp., *Arberia* 4 spp., *Lidgettonia* sp., *Noeggerathiopsis* sp. and *Podocarpidites* sp.

According to Bamford (2011) "Little data have been published on these potentially fossiliferous deposits. Around the coal mines there is most likely to be good material and yet in other areas the exposures may be too poor to be of interest. When they do occur fossil plants are usually abundant and it would not be feasible to preserve and maintain all the sites, however, in the interests of heritage and science such sites should be well recorded, sampled and the fossils kept in a suitable institution.

Although no vertebrate fossils have been recorded from the Vryheid Formation, invertebrate trace fossils have been described in some detail by Mason and Christie (1985). It should be noted, however, that the aquatic reptile, *Mesosaurus*, which is the earliest known reptile from the Karoo Basin, as well as fish (*Palaeoniscus capensis*), have been recorded in equivalent-aged strata in the Whitehill Formation in the southern part of the basin (MacRae, 1999; Modesto, 2006). Indications are that the Whitehill Formation in the main basin might be correlated with the mid-Vryheid Formation. If this assumption proves correct, there is a possibility that *Mesosaurus* could be found in the Vryheid Formation.

The late Carboniferous to early Jurassic Karoo Supergroup of South Africa includes economically important coal deposits within the Vryheid Formation of Natal. The Karoo sediments are almost entirely lacking in body fossils but ichnofossils (trace fossils) are locally abundant. Modern sedimentological and

ichnofaunal studies suggest that the north-eastern part of the Karoo basin was marine. In KwaZulu-Natal a shallow basin margin accommodated a prograding fluviodeltaic complex forming a broad sandy platform on which coal-bearing sediments were deposited. Ichnofossils include U-burrows (formerly *Corophioides*) which are assigned to ichnogenus *Diplocraterion* (Mason and Christie, 1985).

Maputuland Group

Berea Formation (Qb)

No significant vertebrate fossils have been recorded from the Quaternary aged Berea Formation (Wolmarans and Du Preez, 1986). Petrified wood, mainly flattened *Syzigium* logs, have been described from the Formation and recording of these plant fossils will contribute significantly to our understanding of the palaeo-environments of this region during the Quaternary (Mac Rae, 1999; Groenewald, 2012).

DISCUSSION

The predicted palaeontological impact of the development is based on the initial mapping assessment and literature reviews. No significant body fossils are known from the Pietermaritzburg Formation but some well-defined trace fossils have been recorded. Very significant fossils has been recorded from the Vryheid Formation and the recording of plant and trace fossils from this part of the Karoo Basin will contribute significantly to our understanding of the palaeo-environments that existed during the Permian times in this part of KwaZulu-Natal. The Berea Formation might contain important remains of plants that will in turn share light on the Palaeo-environments of the Quaternary in this part of the Province.

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 un-weathered bedrock excavation (deeper than 1.5m 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 significant outcrops on site, and that trenching of up to 2m depth, will in fact expose 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 area underlain by rocks of the Pietermaritzburg Formation, a Very High Palaeontological sensitivity in areas underlain by Vryheid Formation sediments and a High Palaeontological sensitivity in areas underlain by sand of the Berea Formation.

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

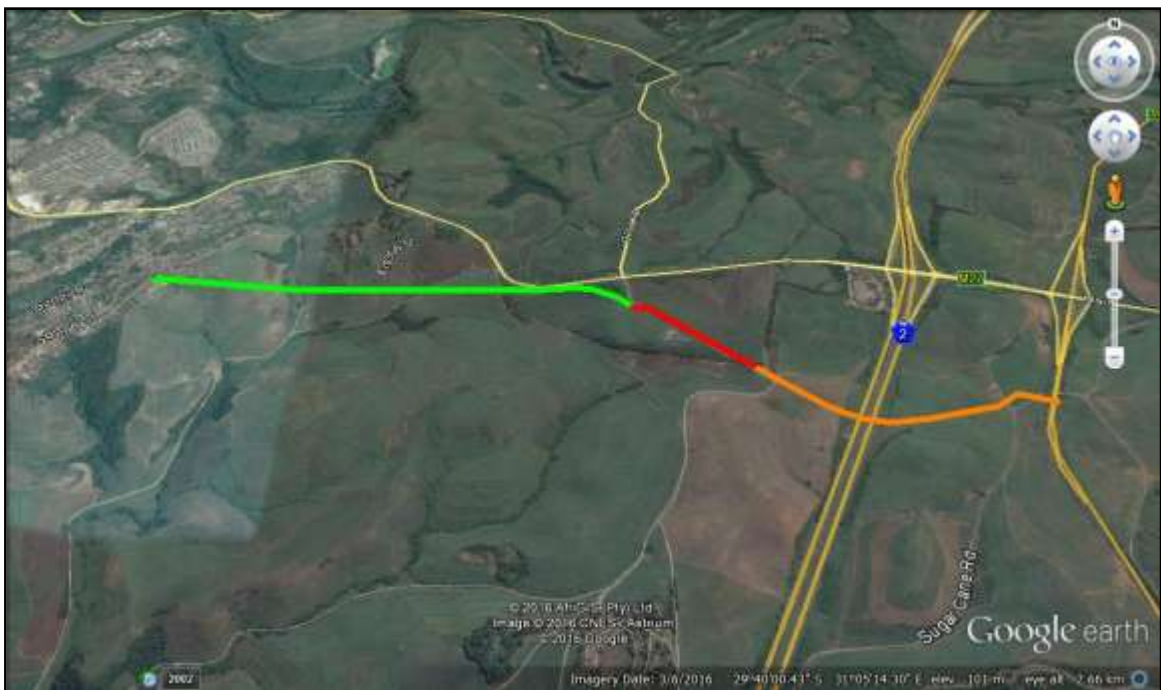


Figure 3 Palaeosensitivity of the Route for the 700mm pipeline at Sibaya Project

CONCLUSION AND RECOMMENDATIONS

The study area is underlain by sedimentary rocks of the Permian-aged Pietermaritzburg and Vryheid Formations of the Ecca Group and Quaternary aged dune sand of the Berea Formation, Maputuland Group. Trace fossils are known from the Pietermaritzburg Formation, where fossils are associated with the bedding planes of shales exposed during excavation of trenches or foundations deeper than 1.5m. A Moderate Palaeontological sensitivity is allocated to these rocks. Very rich assemblage of plant fossils, coal beds and significant trace fossils have been described from the Vryheid Formation and a Very High Palaeontological sensitivity is allocated to areas underlain by this Formation. Interpretation of the Google images and information gathered from

experience indicates that these areas are underlain by deeply weathered soil, mostly cultivated for sugar cane farming. A phase 1 PIA is therefore recommended during excavations of infrastructure deeper than 1.5m during the initial phases of the construction. Although also sparsely recorded, plant fossils from the Berea Formation can provide significant information on the palaeo-environments in this region during the Quaternary times and if fossils are found they should be recorded. Although a High palaeontological sensitivity is allocated to the areas underlain by the Berea Formation, a Phase 1 PIA is also recommended only during excavation of infrastructure that exceeds a depth of 1.5m.

Recommendations:

4. The EAP and ECO of the project must be informed of the fact that significant trace fossils have been described from the upper Pietermaritzburg Formation, highly significant fossils from the Vryheid Formation and significant fossils from the Berea Formation underlying the Sibaya Precinct pipeline route. Chance recording of fossils from these rocks will contribute uniquely to our understanding of the palaeo-environments of these regions.
5. All sections of the development that are allocated a Very High to High Palaeontological sensitivity and where trenching or excavation for infrastructure will be deeper than 1.5m, must be identified during geotechnical surveys. Where the trenches and excavations will reach this depth, a suitably qualified 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 during the initial stages of excavation.
6. These recommendations must form part of the EMP for the project.

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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 palaeo-ecological 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.



Dr Gideon Groenewald
Geologist