

**HIA FOR THE PROPOSED MANDENI CEMETERY,
HLOMENDLINI, MANDENI LOCAL MUNICIPALITY**

**FOR K2M ENVIRONMENTAL
DATE: 18 JUNE 2023**

**By Gavin Anderson
Umlando: Archaeological Surveys and Heritage
Management
PO Box 10153, Meerensee, 3901
Phone: 035-7531785 Cell: 0836585362
umlando@gmail.com**



INDEMNITY AND CONDITIONS RELATING TO THIS REPORT

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. The report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken. Umlando reserves the right to modify aspects of the report including the recommendations if and when new information becomes available from ongoing research or further work in this field or pertaining to this investigation.

Although Umlando exercises due care and diligence in rendering services and preparing documents Umlando accepts no liability, and the client, by receiving this document, indemnifies Umlando against all actions, claims, demands, losses, liabilities, costs, damages and expenses arising from or in connection with services rendered, directly or indirectly by Umlando and by the use of the information contained in this document.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

COPYRIGHT

Copyright on all documents, drawings and records, whether manually or electronically produced, which form part of the submission and any subsequent report or project document, shall vest in Umlando.

The client, on acceptance of any submission by Umlando and on condition that the client pays to Umlando the full price for the work as agreed, shall be entitled to use for its own benefit:

- • The results of the project;
- • The technology described in any report; and
- • Recommendations delivered to the client.

Should the applicant wish to utilise any part of, or the entire report, for a project other than the subject project, permission must be obtained from Umlando to do so. This will ensure validation of the suitability and relevance of this report on an alternative project.

TABLE OF CONTENT

INTRODUCTION	5
KWAZULU NATAL AMAFA AND RESEARCH INSTITUTE, ACT 05, 2018,	10
METHOD	13
Defining significance.....	14
RESULTS	17
DESKTOP STUDY	17
FIELD SURVEY	23
MITIGATION.....	23
CONCLUSION.....	23
REFERENCES	24
EXPERIENCE OF THE HERITAGE CONSULTANT	25
DECLARATION OF INDEPENDENCE	25
APPENDIX A	26
DESKTOP PIA.....	26

TABLE OF FIGURES

FIG. 1 GENERAL LOCATION OF THE PROPOSED DEVELOPMENT	6
FIG. 2: AERIAL OVERVIEW OF THE PROPOSED DEVELOPMENT	7
FIG. 3: TOPOGRAPHICAL MAP OF THE PROPOSED DEVELOPMENT (2000)	8
FIG. 4: SCENIC VIEWS OF THE STUDY AREA	9
TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES	16
FIG. 5: LOCATION OF KNOWN HERITAGE SITES IN THE GENERAL AREA	18
FIG. 6: SURVEYOR GENERAL MAP OF 5C 8440 (1900)	19
FIG. 7: LOCATION OF THE STUDY AREA IN 1937	20
FIG. 8: 1968 TOPOGRAPHICAL MAP OF THE STUDY AREA	21
FIG. 9: PALAEOLOGICAL SENSITIVITY MAP	22

Abbreviations

EIA	Early Iron Age
ESA	Early Stone Age
HIA	Heritage Impact Assessment
HP	Historical Period
IIA	Indeterminate Iron Age
ISA	Indeterminate Stone Age
KZNARI	KwaZulu-Natal Amafa & Research Institute
LIA	Late Iron Age
LSA	Late Stone Age
MSA	Middle Stone Age
PIA	Palaeontological Impact Assessment
SAHRA	South African Heritage Resources Agency

INTRODUCTION

The Mandeni Local Municipality has proposed for the development of a cemetery in the Hlomendlini area. The project area, Lot 1490 Pardinagar, is located in Ward 4 of the Mandeni Local Municipality and is approximately 15.4 hectares in extent. The proposed development will entail the establishment of a cemetery (accommodating approximately 3600 adults graves and 3600 child graves) together with associated facilities such as a guard house, ablution facilities, access roads, parking facilities and a fence line.

Umlando was requested to undertake the Phase 1 HIA of the proposed development. Figures 1 – 4 show the location of the development.

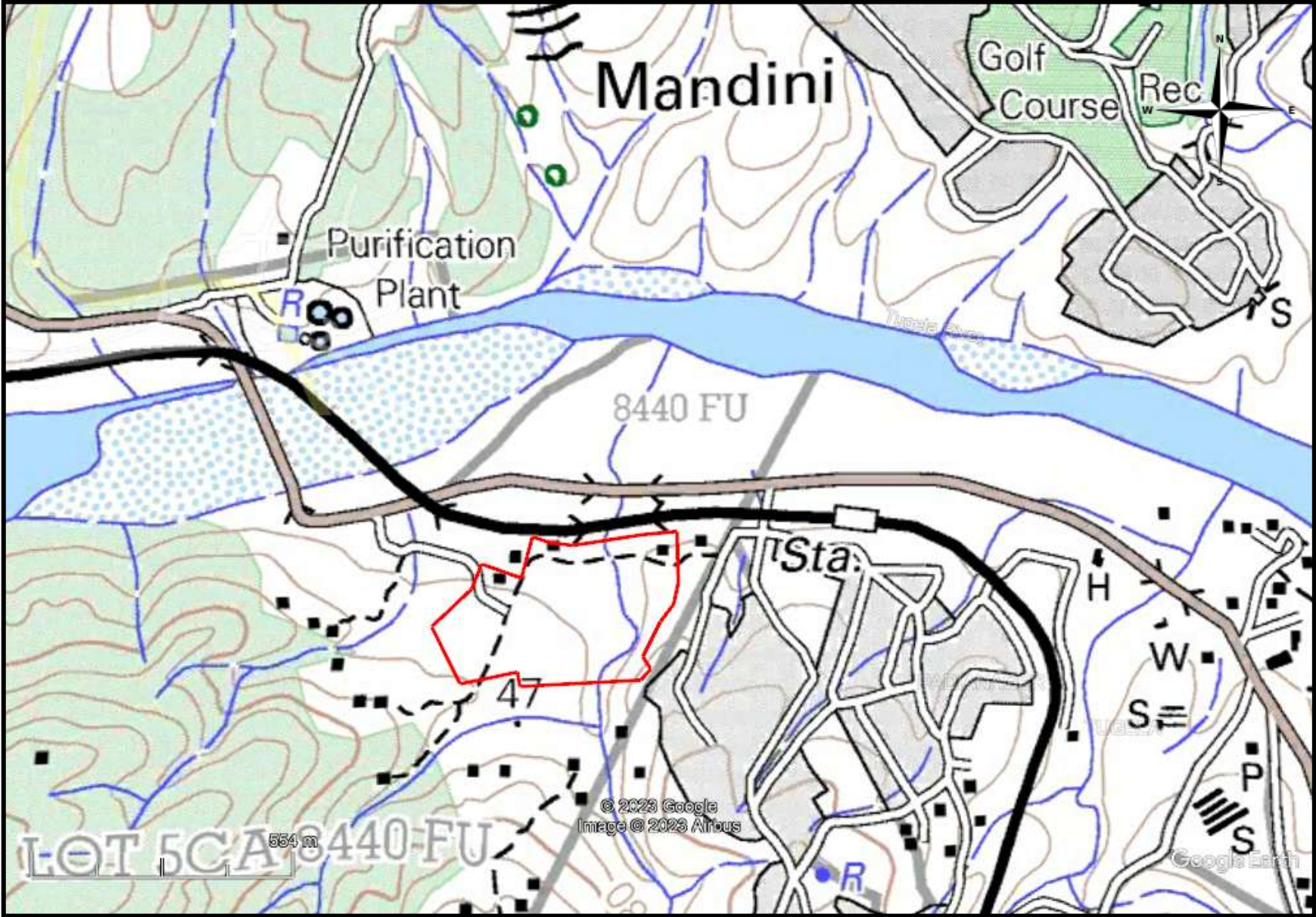
FIG. 1 GENERAL LOCATION OF THE PROPOSED DEVELOPMENT



FIG. 2: AERIAL OVERVIEW OF THE PROPOSED DEVELOPMENT



FIG. 3: TOPOGRAPHICAL MAP OF THE PROPOSED DEVELOPMENT (2000)¹



¹2931AB Tugela 2000

FIG. 4: SCENIC VIEWS OF THE STUDY AREA



KWAZULU NATAL AMAFA AND RESEARCH INSTITUTE, ACT 05, 2018,

The KwaZulu Natal Amafa And Research Institute, Act 05, 2018, Chapter 8 (pp 29 – 32) defines heritage resources.

“General protection: Structures.

37.(1)(a) 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 Institute having been obtained on written application to the Council.

(b) Where the Institute does not grant approval, the Institute must consider special protection in terms of sections 38, 39, 40, 41 and 43 of Chapter 9.

The Institute may, by notice in the *Gazette*, exempt—

(a) A defined geographical area; or

(b) defined categories of sites within a defined geographical area, from the provisions of subsection where the Institute 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.

(3) 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.

38. No person may damage, alter, exhume, or remove from its original position

(a) the grave of a victim of conflict;

(b) a cemetery made up of such graves; or

(c) any part of a cemetery containing such graves, without the prior written approval of the Institute having been obtained on written application to the Council.

General protection: Informal and private burial grounds

39.(1) or burial ground older than 60 years, or deemed to be of heritage significance by a heritage authority -

- (a) not otherwise protected by this Act; and
- (b) 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 Institute having been obtained on written application to the Council.

The Institute may only issue written approval once the Institute is satisfied that—

- (a) the applicant has made a concerted effort to consult with communities and individuals who by tradition may have an interest in the grave; and
- (b) 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.—

40 (1) 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 Institute having been obtained on written application to the Council.

(2) 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 Institute without delay.

(3) The Institute 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 Institute to be inappropriate within 50 metres of a rock art site.

(4) 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 Institute having been obtained on written application to the Council.

(5) 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 Institute having been obtained on written application to the Council.

(6)(a) 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, vests in the Provincial Government and the Institute is regarded as the custodian on behalf of the Provincial Government.

(b) The Institute may establish and maintain a provincial repository or repositories for the safekeeping or display of —

- (i) archaeological objects;
- (ii) palaeontological material;
- (iii) ecofacts;
- (iv) objects related to battlefield sites;
- (v) material cultural artefacts; or
- (vi) meteorites,

(7) The Institute may, subject to such conditions as the Institute may determine, loan any object or material referred to in subsection (6) to a national or provincial museum or institution.

(8) No person may, without the prior written approval of the Institute having been obtained on written application to the Institute, trade in, export or attempt to export from the Province ~

- (a) any category of archaeological object;

- {b) any palaeontological material;
- (c) any ecofact;
- {d) any object which may reasonably be regarded as having been recovered from a battlefield site;
- (e) any material cultural artefact; or
- {f) any meteorite.

(9){a) A person or institution in possession of an object or material, referred to in paragraphs (a) ~{f) of subsection (8), must submit full particulars of such object or material, including such information as may be prescribed, to the Institute.

{b) An object or material referred to in paragraph (a) must, subject to paragraph (c) and the directives of the Institute, remain under the control of the person or institution submitting the particulars thereof.

{c) The ownership of any object or material referred to in paragraph (a) vests in the Provincial Government and the Institute is regarded as the custodian on behalf of the Provincial Government.”

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. This 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. Table 1 lists the grading system.

TABLE 1: SAHRA GRADINGS FOR HERITAGE SITES

SITE SIGNIFICANCE	FIELD RATING	GRADE	RECOMMENDED MITIGATION
High Significance	National Significance	Grade 1	Site conservation / Site development
High Significance	Provincial Significance	Grade 2	Site conservation / Site development
High Significance	Local Significance	Grade 3A / 3B	
High / Medium Significance	Generally Protected A		Site conservation or mitigation prior to development / destruction
Medium Significance	Generally Protected B		Site conservation or mitigation / test excavation / systematic sampling / monitoring prior to or during development / destruction
Low Significance	Generally Protected C		On-site sampling monitoring or no archaeological mitigation required prior to or during development / destruction

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. There are no known heritage surveys in or near the study area.

The general area has had few heritage surveys (fig. 5). Many of these recordings are from KZN Museum surveys in the 1950s to 1970s. These surveys recorded ESA, MSA and LSA sites in a secondary context. There are EIA and LIA sites to the east, as well as Historical Period sites. In addition to these, there are Anglo-Zulu War graves 1km from the study area. The general area appears to be mainly Stone Age sites in a secondary context.

The Farm 5C 8440 was first surveyed in 1900 (fig. 6). No buildings are visible on the SG map.

The 1937 aerial photograph indicates that there are no settlements within the study area. The 1937 aerial photograph indicates that this is all under agricultural land (fig. 7). No buildings occur within the study area.

The 1968 1:50 000 topographical map indicates that there are not structures within the study area (fig. 8).

In summary, the desktop study indicates that there only Stone Age scatters within the study area and these are of low significance...

FIG. 5: LOCATION OF KNOWN HERITAGE SITES IN THE GENERAL AREA

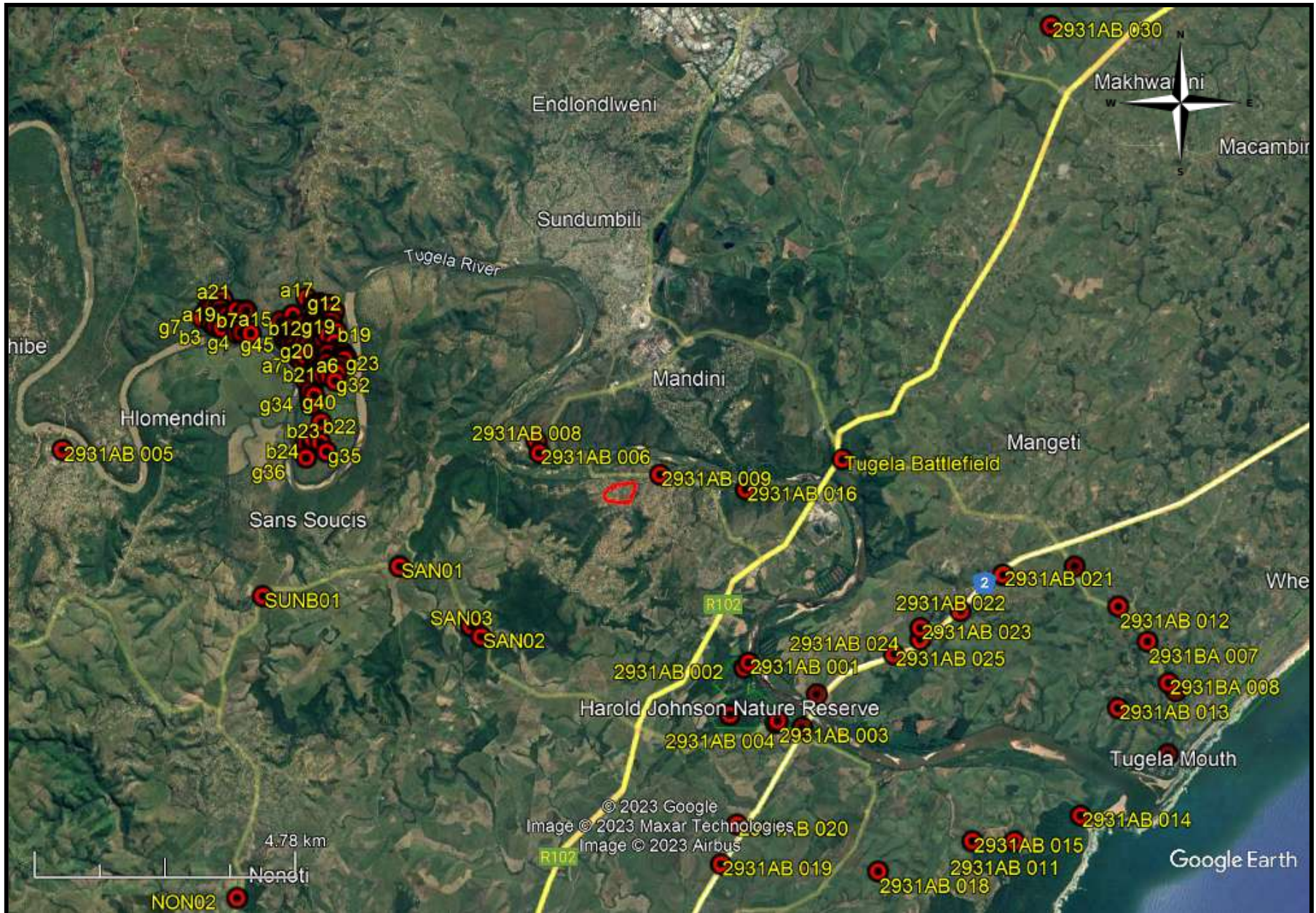
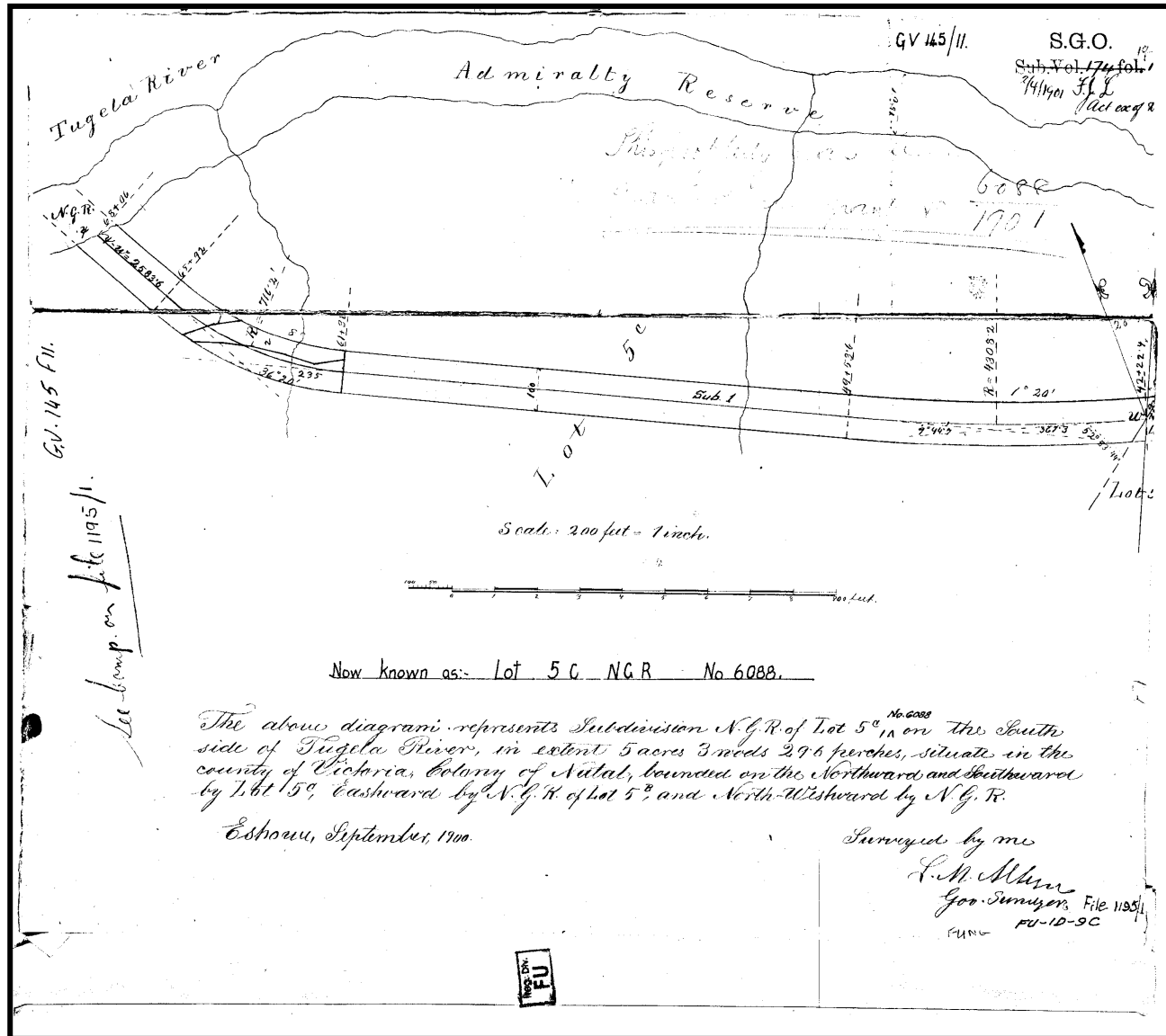


FIG. 6: SURVEYOR GENERAL MAP OF 5C 8440 (1900)²



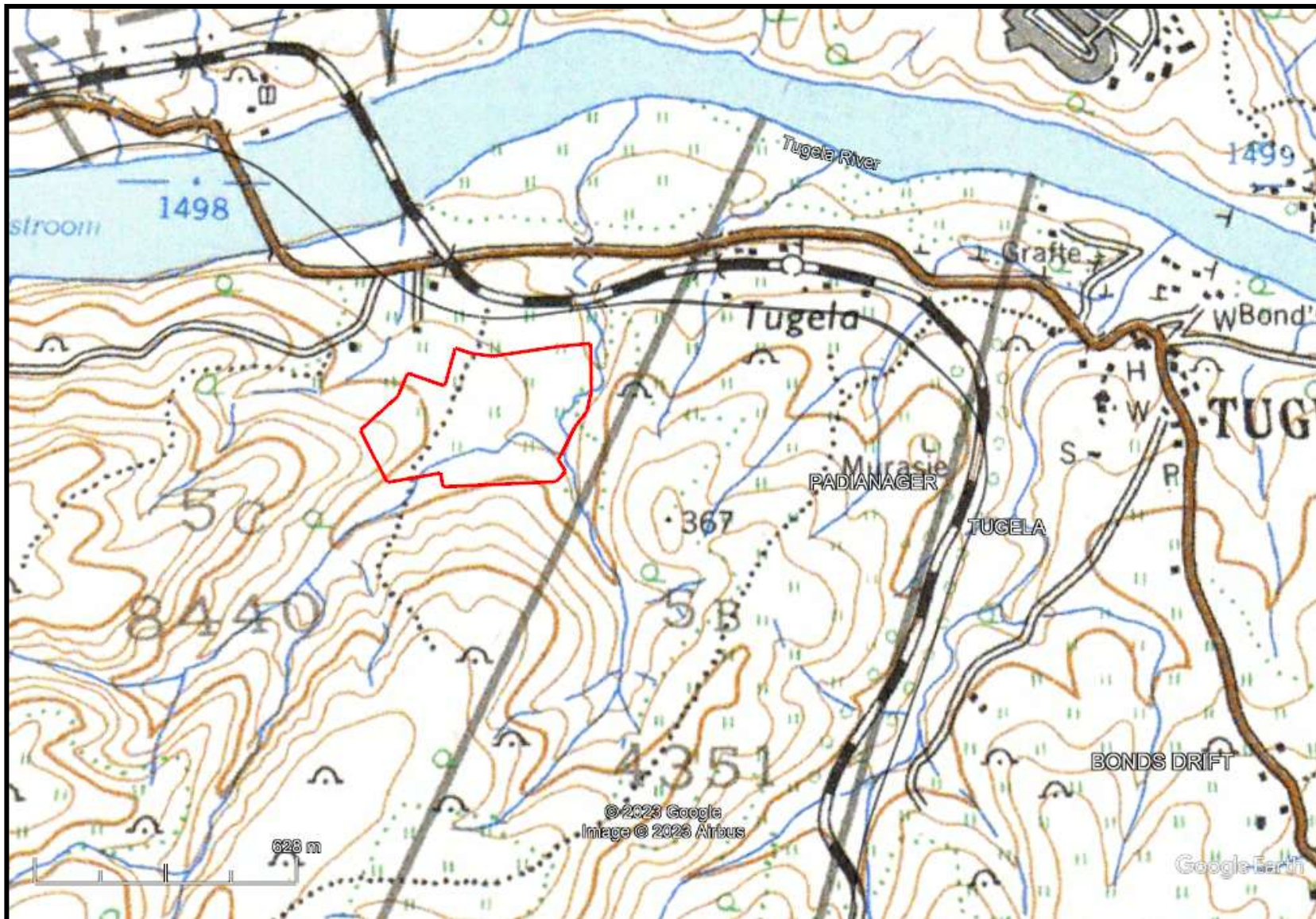
²GV145/11

FIG. 7: LOCATION OF THE STUDY AREA IN 1937³



³ 117C_052_03161

FIG. 8: 1968 TOPOGRAPHICAL MAP OF THE STUDY AREA⁴



⁴ 2931AB 1968 Tugela

PALAEONTOLOGICAL SENSITIVITY

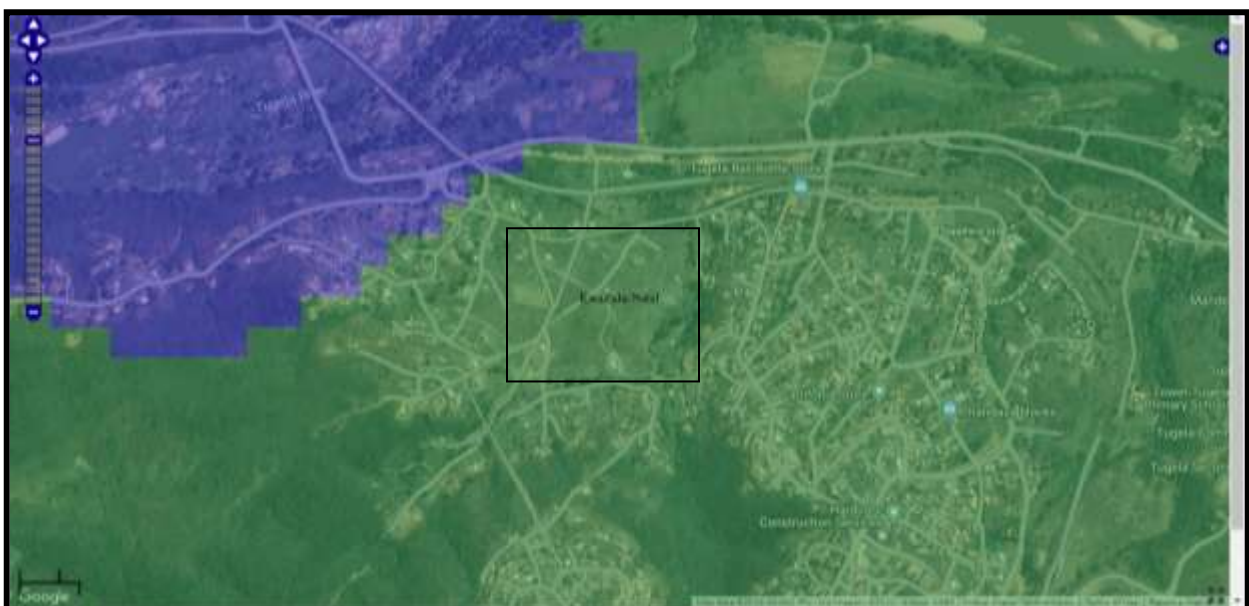
The area is mostly in an area of moderate palaeontological sensitivity (fig. 9). Dr Alan Smith undertook a desktop study of the proposed housing area. He states:

“The Dwyka Group comprises two formations, the Elandsvlei and the Mbizane Formations. In this region, it most likely comprises only the Elandsvlei Formation. The Mbizane Formation area of occurrence is generally north of Mandeni... but may be encountered.

Occasional trace fossils (no palaeontological value) have been found. No body fossils have been recorded from this lithology.

The chance of fossils being found in the Ulundi City development site is **Low**, but not **Zero**. A “**Chance Find Protocol**” has been included to cover this eventuality. No further palaeontological work is required, unless triggered by the “**Chance Find Protocol**” in which a suitably qualified palaeontologist must be consulted. The “Chance Find Protocol” must form part of the Environmental Management Programme (EMPr) for the site.”

FIG. 9: PALAEONTOLOGICAL SENSITIVITY MAP



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.

FIELD SURVEY

A field survey was undertaken on the 19 June 2023. Ground visibility was mostly good in most areas. The land is on a gentle gradient of. Some areas have been totally exposed allowing for a good representation of the general area. There are numerous existing houses within the cemetery footprint.

The soil is relatively shallow and appears to be unsuitable for Iron Age farmers.

No artefacts or heritage features were noted within the study area.

MITIGATION

No further heritage mitigation is required.

A Chance Find Protocol is required for the palaeontology.

CONCLUSION

A heritage survey was undertaken for the proposed Mandeni cemetery. The desktop and field survey noted that the area was of low heritage significance.

The chances of finding significant fossiliferous material is low. However, a Chance Find Protocol was initiated and needs to form part of the EMPr.

REFERENCES

Maps:

2931AB Tugela1968, 2000

117C_052_03161

Database

KZN Museum

SAHRA

Umlando

EXPERIENCE OF THE HERITAGE CONSULTANT

Gavin Anderson has a M. Phil (in archaeology and social psychology) degree from the University of Cape Town. Gavin has been working as a professional archaeologist and heritage impact assessor since 1995. He joined the Association of Professional Archaeologists of Southern Africa in 1998 when it was formed. Gavin is rated as a Principle Investigator with expertise status in Rock Art, Stone Age and Iron Age studies. In addition to this, he was worked on both West and East Coast shell middens, Anglo-Boer War sites, and Historical Period sites.

DECLARATION OF INDEPENDENCE

I, Gavin Anderson, 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 heritage assessment services. There are no circumstances that compromise the objectivity of my performing such work.

A handwritten signature in black ink, appearing to read 'G. Anderson', with a horizontal line underneath.

Gavin Anderson
Archaeologist/Heritage Impact Assessor

**APPENDIX A
DESKTOP PIA**

**PROPOSED MANDENI CEMETERY
DEVELOPMENT WITHIN MANDENI LOCAL
MUNICIPALITY, KWAZULU-NATAL:
DESKTOP PALEONTOLOGICAL
INVESTIGATION**

FOR

**UMLANDO: Archaeological Surveys & Heritage Management
PO Box 102532, Meerensee, KwaZulu-Natal 3901
phone (035)7531785 fax: 0865445631
cell: 0836585362 / 0723481327
Email:umlando@gmail.com**

by

**Dr Alan Smith
Alan Smith Consulting
29 Browns Grove, Sherwood, Durban, 4091, South Africa
Telephone: 031 208 6896
mailto:asconsulting@telkomsa.net**

19 June, 2023

Declaration of Independence

This report has been compiled by Dr Alan Smith (Pr. Sc. Nat.) of Alan Smith Consulting, Durban. The views expressed in this report are entirely those of the author, if not then the source has been duly acknowledged. No other interest was displayed during the decision making process for the Project.

Specialist: Dr Alan Smith

Signature:



EXECUTIVE SUMMARY

Alan Smith Consulting was appointed by **UMLANDO: Archaeological Surveys & Heritage Management** to conduct a Desk-Top field assessment of the potential impacts to **Palaeontology Resources** that might occur through the activities of the proposed Development of the Mandeni Cemetery, Mandeni Local Municipality, KwaZulu-Natal.

Section 38 of the National Resources Act No 25 of 1999 (Heritage Resources Management), requires a Palaeontological Impact Assessment (PIA) to assess any potential impacts to palaeontological heritage.

The chances of encountering fossils are **Low, but Not Zero**; consequently a “*Chance Find Protocol*” has been included.

ACRONYMS

BA:	Basic Assessment
EDTEA:	(Department of) Economic Development, Tourism and Environmental Affairs
HIA:	Heritage Impact Assessment
PIA;	Palaeontological Impact Assessment
SAHRA:	South African Heritage Resource Agency
SAHRIS:	South African Heritage Resources Information System

1. TERMS OF REFERENCE

Alan Smith Consulting was requested by **UMLANDO: Archaeological Surveys & Heritage Management** to provide a Desk-Top Palaeo Impact Assessment for a cemetery development within Mandeni Local Municipality, KwaZulu-Natal (Figure 1). This report is to meet the requirements of the National Environmental Management Act (Act 107 of 1998) [as amended] Environmental Impact Assessment (EIA) regulations, Appendix 6.



Figure 1: Location of the proposed Cemetery development within Mandeni (image background from GoogleEarth).

2. SCOPE AND PURPOSE OF REPORT

A Palaeontological Impact Assessment (PIA) is a means of identifying any significant palaeontological material before development begins, so that these can be managed in such a way as to allow the development to proceed (if appropriate) without undue impacts to the fragile heritage of South Africa. This Desk-Top investigation fulfills the requirements of the heritage authorities (SAHRA), such that a comment can be issued by them for consideration by the competent authority (EDTEA), who will review the Basic Assessment (BA) and grant or refuse authorisation. The PIA report will outline any management and/or mitigation requirements that will need to be complied with from a heritage point of view and that should be included in the conditions of authorisation, should this be granted.

3. METHODOLOGY

Geological maps, a literature review and personal experience (see Section 9) were used in this desk-top PIA research.

4. GEOLOGY

The Dwyka Group (*C-Pd: Greenish*) and possibly Karoo Dolerite may be present on this site (Figure 2).



Figure 2: Approximate area of the proposed Mandeni Cemetery Development. Extract from the Durban 2930 Geological Map. According to this geological map, this development will be entirely on the Dwyka Group; however dolerite dykes may also be present.

Dwyka Group

The Dwyka Group is a lithified glacial deposit which accumulated in the southern African region of the Gondwana Supercontinent during the global Late Palaeozoic Glaciation (Visser, 1990), otherwise known locally as the Dwyka Glaciation. This global glaciation began at 327 Ma (million years) and ended about 260 Ma (Fielding et al., 2008). In the Southern African region, glaciation commenced later at the end of the Carboniferous (~305 to 307 Ma [Visser, 1997; Bangert et al., 1999; Césari, 2005]), and ended during the early Permian (~290 Ma [Wopnfer, 2002; Catuneanu, 2004a; 2004b] or ~284 Ma [Herbert and Compton, 2007]). During this time the Gondwana Supercontinent moved from the South Polar region, northwards into lower latitudes, forcing a final ice-sheet collapse (Visser, 1992).

The Dwyka Group comprises two formations, the Elandsvlei and the Mbizane Formations. In this region it most likely comprises only the Elandsvlei Formation. The Mbizane Formation area of occurrence is generally north of Mandeni (Figure 3) but may be encountered. An example of a more southerly occurrence is located in Durban (Dunlevey and Smith, 2012).

The Elandsvlei Formation comprises massive debrites, whereas the Mbizane Formation is characterized by siltstones, sandstones and massive debrites. This glacial sediment, ranging from boulders to silt, was freed by melting ice sheets retreating across the Karoo Sea. The Elandsvlei was deposited within the Karoo Sea, whereas the Mbizane Formation was deposited at the Karoo Sea's edge (von Brunn & Visser, 1999).

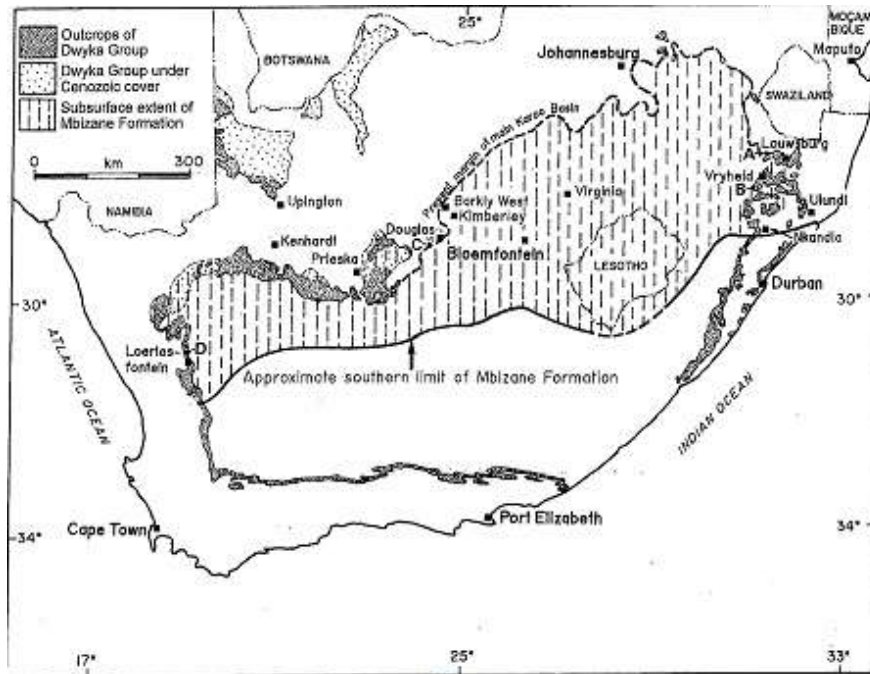


Figure 3: Region covered by the Dwyka Group in South Africa. The Elandsvlei Formation is dark speckled and the Mbizane Formation vertically dashed pattern (Visser, 1999).

Karoo Dolerite

Within this area the Karoo Dolerite may be represented by dolerite dykes (vertical sheets) or thin sills (sub-horizontal sheets). This dolerite is part of the Karoo Large Igneous Province (LIP), which consists of a sequence of lavas up to 4.5 km thick, which was deposited about 184 Ma (million years ago). This igneous deposit was extruded as a “Continental Flood Basalt”, a process that has never been witnessed by mankind. This process takes place by fissure eruption. This event triggered the break-up of the Gondwana supercontinent (Hastie et al., 2014).

5. PALAEOLOGY

The colour coding used in the Sahrís Palaeosensitivity Map is shown in Table 1 below.

Table 1: Summary of SAHRIS categories

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

The Dwyka Group is coded green (Table 1; Figure 4). Occasional trace fossils (no palaeontological value) have been found. No body fossils have been recorded from this lithology.



Figure 4: Palaeosensitivity of the proposed Mandeni Cemetery Development area. Approximate area is boxed. Extract from Sahrís Palaeosensitivity Map). Location is coded green.

Karoo Dolerite

This is an intrusive igneous rock and by definition is not fossiliferous.

6. SUMMARY

The chance of fossils being found in the Ulundi City development site is **Low**, but not **Zero**. A “**Chance Find Protocol**” has been included to cover this eventuality. No further palaeontological work is required, unless triggered by the “**Chance Find Protocol**” in which a suitably qualified palaeontologist must be consulted. The “**Chance Find Protocol**” must form part of the Environmental Management Programme (EMPr) for the site.

7. CHANCE FIND PROTOCOL

This Chance Find Protocol must be included in the site EMPr.

If any fossils are found, a Palaeontologist must be notified immediately by the ECO and/or EAP and a site visit must be arranged at the earliest possible time with the Palaeontologist.

In the case of the ECO or the Site Manager becoming aware of suspicious looking palaeo-material:

- The construction must be halted in that specific area and the Palaeontologist must be given enough time to reach the site and remove the material before excavation continues.
- Mitigation will involve the attempt to capture all rare fossils and systematic collection of all fossils discovered. This will take place in conjunction with descriptive, diagrammatic and photographic recording of exposures, also involving sediment samples and samples of both representative and unusual sedimentary or biogenic features. The fossils and contextual samples will be processed (sorted, sub-sampled, labeled, and boxed) and documentation consolidated, to create an archive collection from the excavated sites for future researchers.

Functional responsibilities of the Developer

1. At full cost to the project, and guided by the appointed Palaeontological Specialist, ensure that a representative archive of palaeontological samples and other records is assembled to characterize the palaeontological occurrences affected by the excavation operation.
2. Provide field aid, if necessary, in the supply of materials, labour and machinery to excavate, load and transport sampled material from the excavation areas to the sorting areas, removal of overburden if necessary, and the return of discarded material to the disposal areas.
3. Facilitate systematic recording of the stratigraphic and palaeo-environmental features in exposures in the fossil-bearing excavations, by described and measured geological sections, and by providing aid in the surveying of positions where significant fossils are found.

4. Provide safe storage for fossil material found routinely during excavation operations by construction personnel. In this context, isolated fossil finds in disturbed material qualify as “normal” fossil finds.
5. Provide covered, dry storage for samples and facilities for a work area for sorting, labeling and boxing/bagging samples.
6. Costs of basic curation and storage until collected. Documentary record of palaeontological occurrences must be done.
7. The contractor will, in collaboration with the Palaeontologist, make the excavation plan available to the appointed specialist, in which appropriate information regarding plans for excavations and work schedules must be indicated on the plan of the excavation sites. This must be done in conjunction with the appointed specialist.
8. Initially, all known specific palaeontological information will be indicated on the plan. This will be updated throughout the excavation period.
9. Locations of samples and measured sections are to be pegged, and routinely and accurately surveyed. Sample locations, measured sections, etc., must be recorded three-dimensionally if any “significant fossils” are recorded during the time of excavation.

8. REFERENCES

Bangert, B., Stollhofen, H., Lorenz, V. and Armstrong, R., 1999. The geochronology and significance of ash-fall tuffs in the glaciogenic Carboniferous-Permian Dwyka Group of Namibia and South Africa. *Journal of African Earth Sciences*, 29, 33–49.

Catuneanu, O., 2004a. Basement control on flexural profiles and the distribution of foreland facies: the Dwyka Group of the Karoo Basin, South Africa. *Geology*, 32, 517–520.

Catuneanu, O., 2004b. Retroarc foreland systems – evolution through time. *Journal of African Earth Sciences*, 38, 225–242.

Césari, S.N., 2005. Palynological biozones and radiometric data at the Carboniferous-Permian boundary in western Gondwana. *Gondwana Research*, 11, 529–536.

Dunlevey, J.N. & Smith, A.M. (2012). Sedimentological evidence for an interglacial in the Permo-Carboniferous Dwyka Group, Coedmore Quarry, Durban, South Africa. *South African Journal of Geology*, 114, 159-166

Fielding, C.R., Frank, T.D., Birgenheier, L.P., Rygel, M.C., Jones, A.T. and Roberts, J., 2008. Stratigraphic record and facies associations of the late Paleozoic ice age in eastern Australia (New South Wales and Queensland). *Geological Society of America, Special Paper*, 441, 41–58.

Hastie, W.W.; Watkeys, M.K.; Aubourg, C. (2014). Magma flow in dyke swarms of the Karoo LIP: Implications for the mantle plume hypothesis. *Gondwana Research* 25 (2014) 736–755.

Herbert, C.T. and Compton, J.S., 2007. Depositional environment of the lower Permian Dwyka diamictite and Prince Albert shale inferred from the geochemistry of early diagenetic concretions, southwestern Karoo Basin South Africa. *Sedimentary Geology*, 194, 263–277.

Sahris Palaeosensitivity Map: <https://sahris.sahra.org.za/map/palaeo>

Visser, J.N.J., 1990. The age of the late Palaeozoic glaciogene deposits in southern Africa. *South African Journal of Geology*, 93, 366–375.

Visser, J.N.J., 1992. Deposition of the Early to Late Permian Whitehill Formation during a sea-level highstand in a juvenile foreland basin. *South African Journal of Geology*, 95, 181–193.

Wopfner, H., 2002. Tectonic and climatic events controlling deposition in the Tanzanian Karoo Basin. *Journal of African Earth Sciences*, 34, 167–177.

Von Brunn, V. and Visser, J.N.J., 1999. Lithostratigraphy of the Mbizane Formation (Dwyka Group). Lithostratigraphy Series No. 32, South African Committee for Stratigraphy, Council for Geoscience, 10pp.

9. **DETAILS OF SPECIALIST**

Dr Alan Smith

Private Consultant: *Alan Smith Consulting, 29 Brown's Grove, Sherwood, Durban, 4091*

&

Honorary Research Fellow: *Discipline of Geology, School of Agriculture, Earth and Environmental Sciences, University of KwaZulu-Natal, Durban.*

Role: Specialist Palaeontological Report production

Expertise of the specialist:

- PhD in Geology (University of KwaZulu-Natal), Pr. Sc. Nat., I.A.H.S.
- MSc in Geology (University of KwaZulu-Natal)
- MSc topic concerned the stromatolites of Etosha Pan (palaeontological subject)
- Expert in Vryheid Formation (Ecca Group) in northern KZN, this having been the subject of PhD.
- Scientific Research experience includes: Fluvial geomorphology, palaeoflood hydrology, Cretaceous deposits.
- Experience includes understanding Earth Surface Processes in both fluvial and coastal environments (modern & ancient).
- Alan has published in both national and international, peer-reviewed journals. He has published + 50 journal articles with +620 citations (detailed CV available on request).
- Alan is active on Stromatolite Research (9 refereed publications and one in review).
- Attended and presented scientific papers and posters at numerous international and local conferences (UK, Canada, South Africa) and is actively involved in research.

Selected recent palaeo-related work includes:

- Desktop PIA: Proposed middle income housing units on Portion 23 of Farm Lot H Weston 13026, Bruntville, Mpofana Local Municipality. Client: UMLANDO.
- Desktop PIA: Proposed ByPass Pipeline for Ulundi bulk water pipeline upgrade. Client: UMLANDO.
- Fieldwork PIA: Bhekuzulu Epangweni KZN water reticulation project, Cathkin Park. Client: Mike Webster, HSG Attorneys.
- Fieldwork PIA: Mpungoze water supply scheme, Empangeni. Client: Enviropro.
- Fieldwork PIA: Helpmekaar Dam. Client: Afzelia environmental consultants.

- Desktop PIA: Zuka valley, Ballito. Client: Mike Webster, HSG Attorneys.
- Mevamhlope proposed quarry palaeontology report. Client: Enviropro.
- Desktop PIA: Proposed Lovu Desalination site. Client: eThembeni Cultural Heritage.
- Desktop PIA: Tinley Manor phase 2 North & South banks: eThembeni Cultural Heritage
- Desktop PIA: Tongaat. Client: eThembeni Cultural Heritage.
- Palaeontological Assessment Reports (3) to Scatec Solar SA (Pty) Ltd on an Appraisal of Inferred Palaeontological Sensitivity for a Potential Photo Voltaic Park at (1) Farm Rooilyf near Groblershoop, N Cape; (2) Farm Riet Fountain No. Portions 1 and 6, 18km SE of De Aar, N Cape; and (3) Dreunberg, near Burgersdorp, Eastern Cape. Client: Sustainable Development Projects.