

**SURVEY OF THE PROPOSED SMALHOEK DAM,
LADYSMITH, KWAZULU-NATAL**

**FOR NATURE STAMP
DATE: 16 FEBRUARY 2016**

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INTRODUCTION

Green H Ranches propose to build a dam on the farm Smal hoek 1282 near Ladysmith, in the Okhahlamba Local Municipality within the uThukela District of KwaZulu-Natal. The client wishes to build an earthen dam for the purposes of stock-watering and irrigation on Dewdrop watercourse, 18km west of Ladysmith.

The specifications of the dam are as follows

- Dam wall height: 11.9m
- Length of wall: 197m
- Gross storage capacity: 759 585m³
- Area covered at full supply: 26.6 ha (or ~780m x 230m)
- Maximum full water supply depth: 10.2m

Parts of the full supply level land is eroded or within the flood level. Only parts of the southern half occur in a raised area.

Figures 1 – 3 show the location of the planned dam. Figure 4 shows a scenic view of the dam looking west.

FIG. 1 GENERAL LOCATION OF THE STUDY AREA

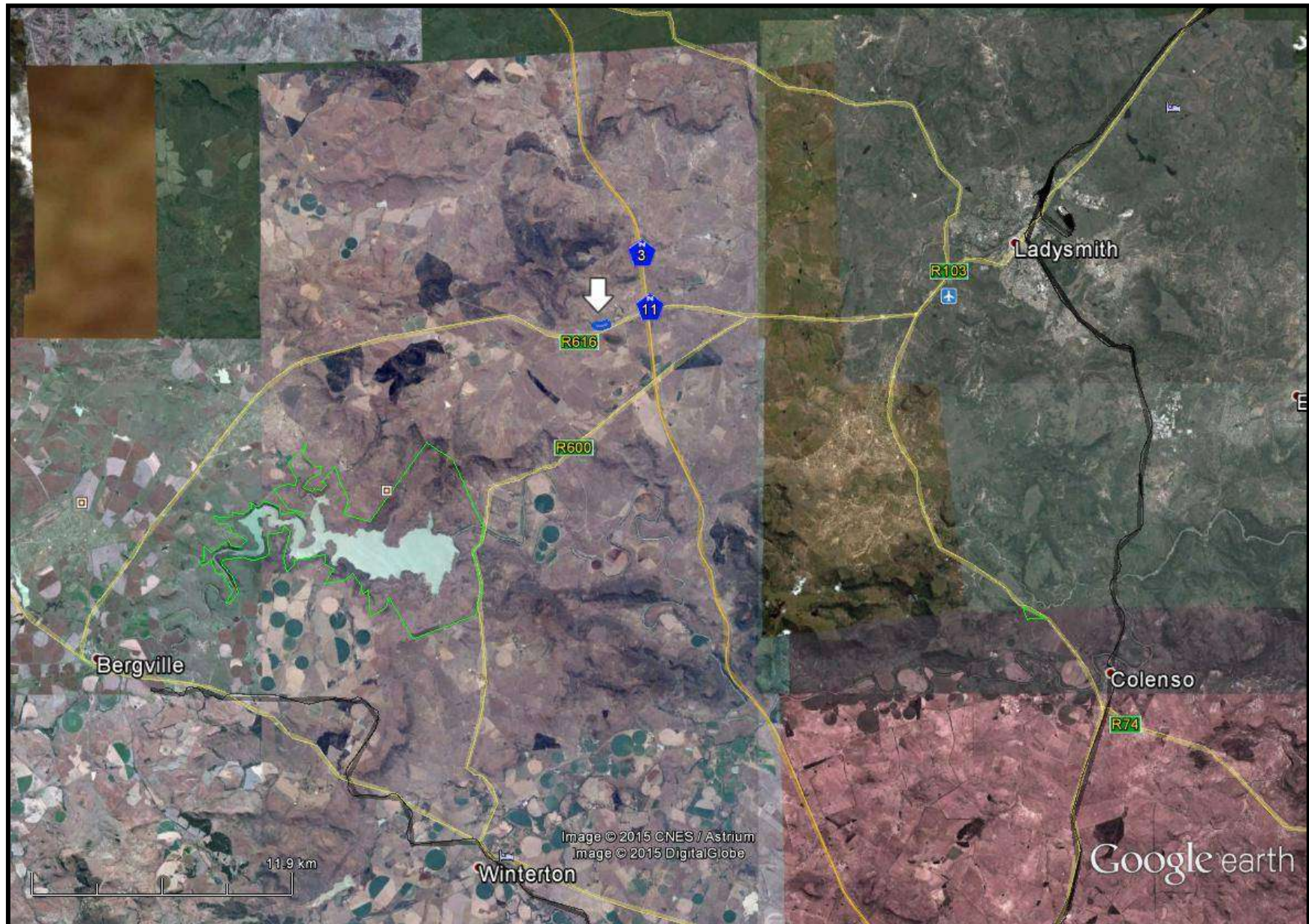


FIG. 2: AERIAL OVERVIEW OF THE STUDY AREA



FIG. 3: TOPOGRAPHICAL OVERVIEW OF THE STUDY AREA

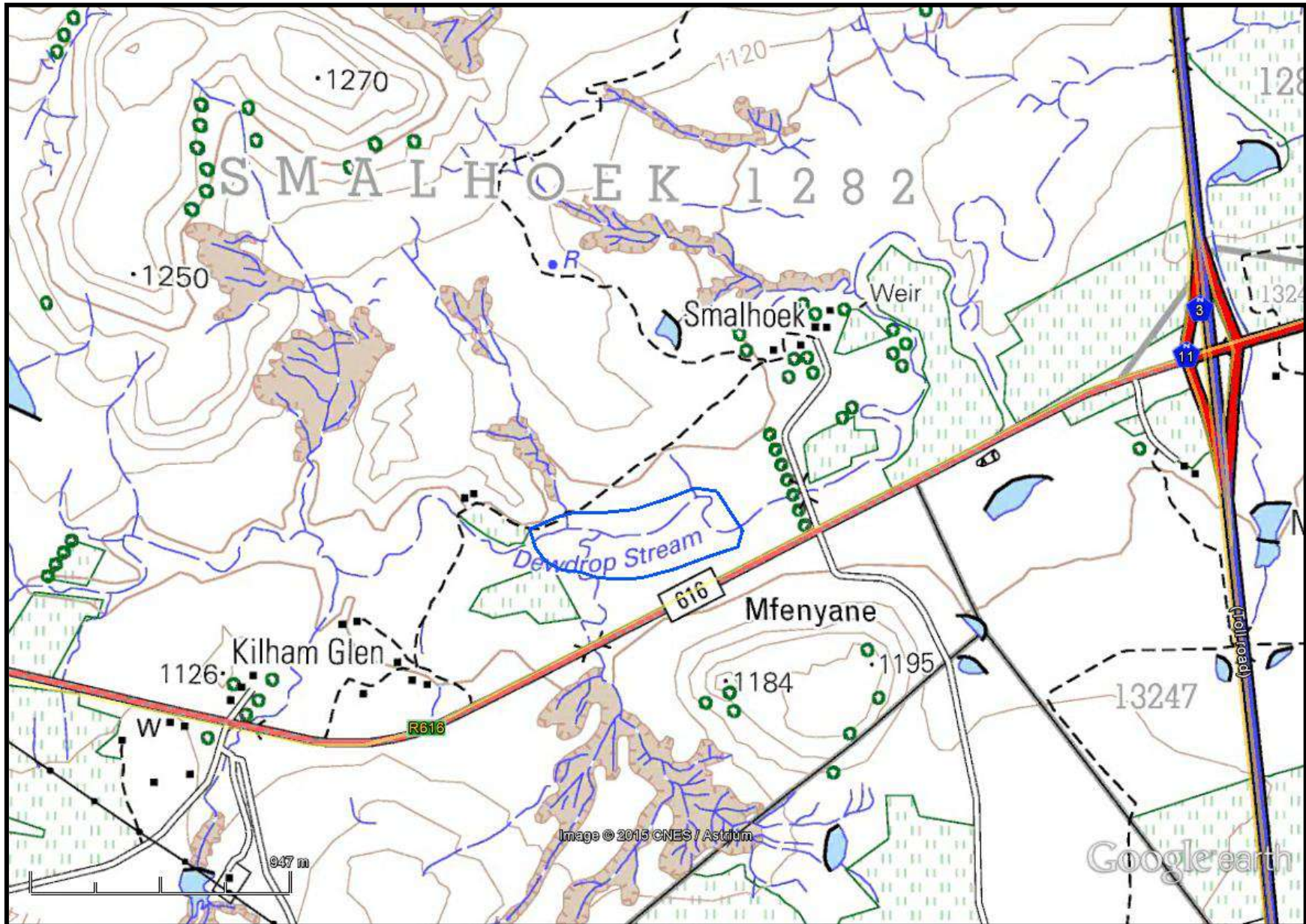


FIG. 4: SCENIC VIEW OF THE DAM AREA



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 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. No sites occur in the study area. No national monuments, battlefields, or historical cemeteries are known to occur in the study area. There are several historical buildings on the adjacent farm lands.

The 1937 aerial photographs indicate that there are stone walled features in the southwestern part of the dam, and that the rest of the area was used for crop planting purposes (fig. 6). The 1954 topographical map indicates that the area was no longer used for crops (fig. 7).

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

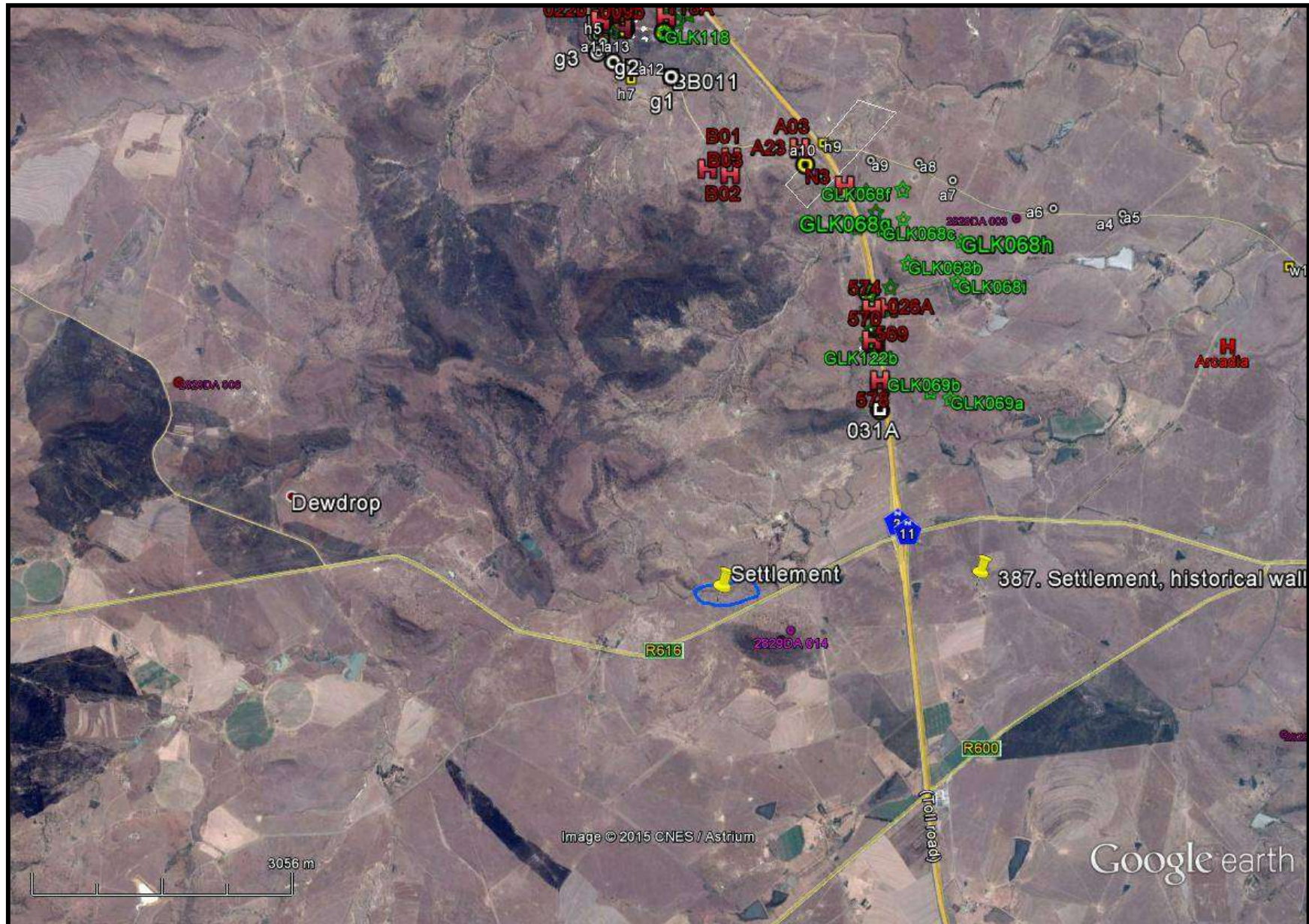
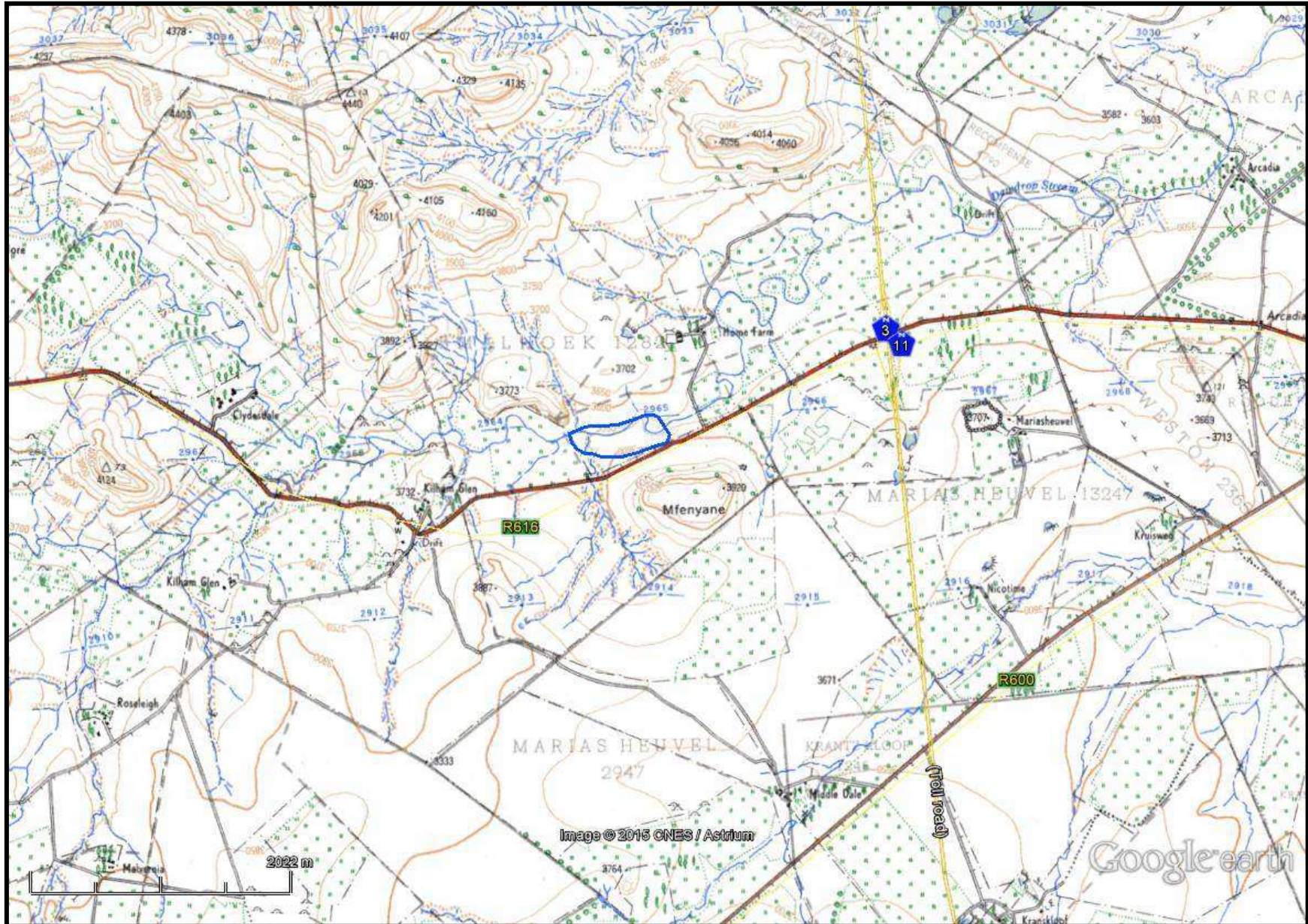


FIG. 6: STUDY AREA IN 1937



FIG. 7: STUDY AREA IN 1954



FIELD SURVEY

The field survey was undertaken in January 2016. Given the current lack of rain in the area, there was good archaeological visibility. One area was noted as having stone walled features from the desktop study. This area yielded a site called SMA01.

SMA01

SMA01 is located on a small hill overlooking the Dewdrop River and a small stream. The site consists of at least five large stone walled features (fig. 9), a house foundation and two graves (fig. 10). The stone walling is low and has a substantial build up of deposit on the outside of the features. The stone walling appears to be contemporaneous with each other. The house foundation occurs to the east of the walling.

The two graves occur to the north of the stone walled features and are in an approximate east-west orientation.

The site dates to the Late Iron Age. The low walling and high accumulation of natural deposit suggests the site could be part of the early Late Iron Age. However, only maize-related upper grinding stones were noted in the area. This suggests that the site post-dates 1550 ACE

There does not appear to be much of an archaeological deposit, nor were any pottery sherds noted on the southern side of the river. A few upper grinding stones were noted. The site is just above the flood line, and thus there would be poor preservation of organic remains.

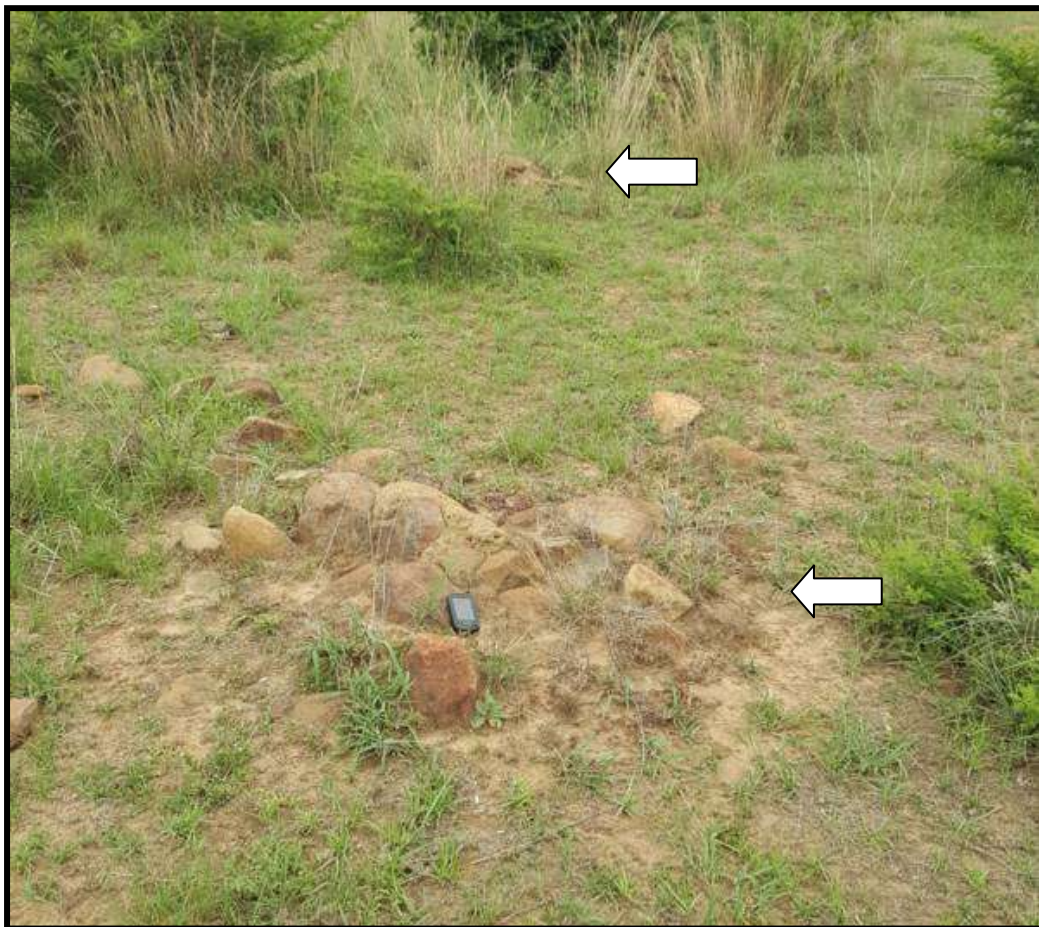
FIG. 8: LOCATION OF STONE WALLED FEATURES



FIG. 9: STONE WALLED BYRE AT SMA01



FIG. 10: GRAVES AT SMA01



Significance: The site is of low significance. The human remains in the graves have probably decomposed. There is no clear archaeological deposit at the site and the walling is standard Late Iron Age walling.

Mitigation: I suggest that basic mitigation occurs at the site. This will entail the following:

- All stone walling and related features are photographed and accurately mapped. This will be done using a Trimble navigation unit.
- The graves are tested for human remains. This will entail excavating half of the grave for potential human remains. If no human remains are found then a soil sample will be taken. If human remains are noted, then a complete excavation will be undertaken.

SAHRA Rating: 3C for the site in general, but 3A for the graves.

PALAEONTOLOGICAL IMPACT ASSESSMENT

A desktop PIA was undertaken by Dr Gideon Groenewald and is in Appendix B. The area is of high palaeontological significance due to the presence of the Normandien Formation (fig. 11). However, the occurrence of dolerite in the area, especially at the wall, could result in no fossils occurring. The lack of a geotechnical report makes it difficult to assess the exact location of the various rich palaeontological deposits.

“If Normandien mudstone or sandstone is present in [the] area of [the] dam wall excavation or in donga floor where [the] alluvium is not covering sediments - we need to look for and remove fossils. If fossils are present they will be either destroyed during excavation or for ever lost under water and ... silt that fills the dam basin....

If excavation[s] for [the] wall or for [the] material to build the wall expose Normandien Formation rocks we also need to remove fossils if there are any. Plant fossils will be too many to remove so we sample a representative number. Vertebrate fossils all need to be taken out as they contribute significantly to our present database on vertebrate biostratigraphy of the Karoo Basin.

If the engineers [they]... are excavating into dolerite for wall foundation and dam basin is all covered in deep alluvium they need to ensure that operators look out for Tertiary bones in alluvium. It [would be preferable for a palaeontologist] to come on site one day before they start excavation and one day after they have excavated say 50m of wall foundation trench - unless it is dolerite. The[y can then] assess if further site inspection is needed” (email to Umlando 16/02/2016).

Palaeontological Mitigation:

A palaeontologist will need to be on site before dam wall construction to determine if the Normandien Formation will be affected. If this Formation is affected, then the palaeontologist will need to reassess the area after 50m of construction. The alternative is to submit the geotechnical report, if it is undertaken, to the palaeontologist for a final review.

FIG. 11: PALAEOLOGICAL 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.

CONCLUSION

A heritage survey was undertaken for the proposed Smal Hoek dam on the Dewdrop River, Ladysmith. The proposed dam will cover an area that has been partially ploughed in the past, and now left for pasturage.

One archaeological site was recorded during the survey. The site dates to the Late Iron Age and will require further mitigation in the form of mapping and (partial) excavation of the skeletons.

The area is considered to have very high to moderate palaeontological significance. A palaeontological survey will need to be undertaken before construction begins, and possibly during construction as well.

Provide the management plans are adhered to there are no further objections to the proposed dam.

APPENDIX A
SITE RECORD FORM

UMLANDO ARCHAEOLOGICAL SITE RECORD FORM**SITE CATEGORY:**

Stone Age	ESA:		MSA		ESA		ISA	
Rock Art	Paintings		Engravings		Other			
Iron Age	EIA:		LIA	X	IAI			
Historical	Historical Period:		Recent Past (last 60 yrs):					

Recorder's Site No.: SAM01

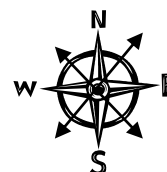
Official Name: Smal Hoek 1282

Local Name: Smalhoek

Map Sheet: 2829 DA Spionkop

GPS reading: S28.594940 E29.586046

Altitude: 1095m

**DIRECTIONS TO SITE: SKETCH OR DESCRIPTION**

From Ladysmith, travel west along the R616 towards Winterton. Travel for 1.8km after the N3 western interchange. Site is on the right/north of the road approx. 200m from the fence, and just above the river..

SITE DESCRIPTION:

Type of Site: Stone walling and graves

Merits conservation: Yes

Threats: Yes

What threats: Dam

RECORDING:

Digital pictures #: X

Tracings :

Drawings:

Recorder/Informant: Name: Gavin Anderson

Address: PO Box 102532, Meerensee, 3901

Date: 11 January 2016

Owner: H Green

References:

DESCRIPTION OF SITE AND ARTEFACTUAL CONTENT.

Diameter:

Length:

Width:

Depth

Height

SMA01 is located on a small hill overlooking the Dewdrop River and a small stream. The site consists of at least five large stone walled features, a house foundation and two graves. The stone walling is low and has a substantial build up of deposit on the outside of the features. The stone walling appears to be contemporaneous with each other. The house foundation occurs to the east of the walling. The two graves occur to the north of the stone walled features and are in an approximate east-west orientation. The dates to the Late Iron Age. The low walling and high accumulation of natural deposit suggests the site could be part of the early Late Iron Age.

However, only maize-related upper grinding stones were noted in the area. This suggests that the site post-dates 1550 ACE. There does not appear to be much of an archaeological deposit, nor were any pottery sherds noted on the southern side of the river. A few upper grinding stones were noted. The site is just above the floodline, and thus there would be poor preservation of organic remains.

**APPENDIX B
PIA REPORT**

**DESKTOP PALAEOLOGICAL
ASSESSMENT FOR THE PROPOSED
SMALHOEK DAM, EMNAMBITHI LOCAL
MUNICIPALITY, UTHUKELA DISTRICT
MUNICIPALITY, KWAZULU-NATAL
PROVINCE.**

**FOR
Umlando**

DATE: 30 JANUARY 2016

By

Gideon Groenewald

Cell: 078 713 6377

EXECUTIVE SUMMARY

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of the Smalhoek Dam, Emnambithi Local Municipality, Uthukela 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 Smalhoek Dam development site is underlain by sedimentary rocks of the Permian-aged Normandien Formation, Adelaide Subgroup and Quaternary Alluvium deposits. A Very High Palaeontological Sensitivity is allocated to rocks of the Adelaide Subgroup due to the rich assemblages of animal and plant fossils described from this unit. While no significant fossils have been described from the Alluvium deposits in this part of South Africa, significant fossils are known from similar deposits in other parts of the country and a Moderate Palaeontological Sensitivity is therefore allocated to these areas. The development is located along a river course and there are likely to be exposures of fossiliferous rocks that will be covered by the development and exposed during construction of the dam wall. A phase 1 PIA is therefore recommended during the initial phases of the construction.

Recommendations:

1. The EAP and ECO of the projects must be informed of the fact that significant fossils have been described from the Normandien Formation. The recording of fossils will contribute significantly to our understanding of the palaeo-environments of this region.

2. A suitably qualified Palaeontologist must be appointed to record and collect fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment during excavation of foundation for dam wall.
3. These recommendations must form part of the EMP for the project.

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INTRODUCTION

Gideon Groenewald was appointed to undertake a desktop survey, assessing the potential palaeontological impact of the proposed development of the Smalhoek Dam, Emnambithi Local Municipality, Uthukela District Municipality, KwaZulu-Natal Province (Figure 1).

The proposed dam will have the following specifications:

- Dam wall height: 11.9m
- Length of wall: 197m
- Gross storage capacity 759 585m³
- Area covered at full supply: 26.6 ha
- Maximum full water supply depth: 10.2m



Figure 1 Satellite image of the proposed development 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 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 predominantly by Quaternary-aged alluvium deposits with areas along the northern part underlain by Permian-aged rocks of the Adelaide Subgroup, Karoo Supergroup (Figure 2).



Adelaide Subgroup

The Adelaide Subgroup overlies the Volksrust Formation of the Ecca Group and the transition from deep water deposits of the Volksrust Formation to pro-deltaic and deltaic deposits of the Beaufort Group present fieldworkers with problems in mapping these units (e.g. Groenewald, 1984; Munitingh, 1997; Johnson et al, 2009).

The Permian aged Adelaide Subgroup comprises the lower part of the Beaufort Group along the Drakensberg Escarpment and on some 1:250 000 sheets is referred to as the Adelaide Formation. In most of the outcrop areas in KwaZulu-Natal the Adelaide Subgroup consists primarily of a lower deltaic facies, mostly referred to as the Estcourt Formation and an upper fluvial facies referred to as the Normandien Formation (Groenewald, 1984; Johnson et al 2009). Recently there is consensus to refer to the entire Adelaide Subgroup as the Normandien Formation.

The Normandien Formation represents the northward migration of deltaic environments, followed by fluvial environments into the Karoo Basin. The Formation consists of a sequence of interbedded deltaic to fluvial and lacustrine sandstones and mudstone (Groenewald, 1990; Johnson et al. 2009).

Alluvium

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

PALAEONTOLOGY

Adelaide Subgroup [Normandien Formation]

The Adelaide Subgroup (Normandien Formation) in this part of the Karoo Basin comprises the *Daptocephalus* (previously *Dicynodon*) Assemblage Zone as well as the overlying *Lystrosaurus* Assemblage Zone of the Karoo Supergroup

(van der Walt et al, 2010). It also contains abundant plant fossils of the *Glossopteris* Assemblage.

Alluvium

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 is based on the initial mapping assessment and literature reviews. While no significant fossils have been described to date from the alluvium deposits in this part of South Africa, any such finds would be highly significant. A variety of fossils have been described from the Permian to Triassic aged Adelaide Subgroup and includes plant fossils of the *Glossopteris* Assemblage and vertebrate fossils of the *Daptocephalus* and *Lystrosaurus* Assemblage Zones. Invertebrate fossils include several small trace fossils as well as casts of vertebrate burrows.

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. 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 footprint. The Smalhoek Dam development site is located along a river course and it is probable that Adelaide Subgroup rocks are exposed through erosion. The recording of fossils from the development site will have a significant impact on our understanding of the palaeo-environments in this part of Gondwanaland and a Very High Palaeontological Sensitivity is allocated to the sections underlain by rocks of the

Normandien Formation. A Moderate Palaeontological Sensitivity is allocated to areas underlain by Alluvium to ensure that new finds are properly recorded, since any such finds would be highly significant.

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

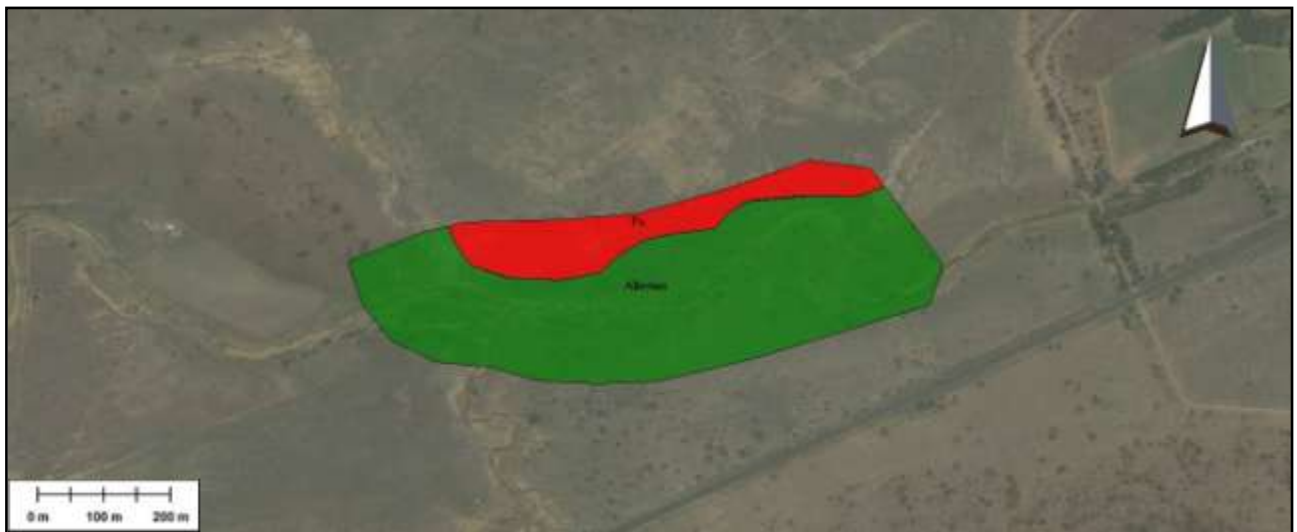


Figure 3 Palaeosensitivity of the proposed development sites. Colour coding is explained in Table 1

CONCLUSION AND RECOMMENDATIONS

The study area is underlain by sedimentary rocks of the Permian-aged Normandien Formation, Adelaide Subgroup and Quaternary Alluvium deposits. A Very High Palaeontological Sensitivity is allocated to rocks of the Adelaide Subgroup due to the rich assemblages of animal and plant fossils described from this unit. While no significant fossils have been described from the Alluvium deposits in this part of South Africa, significant fossils are known from similar deposits in other parts of the country and a Moderate Palaeontological Sensitivity is therefore allocated to these areas. The development is located along a river course and there are likely to be exposures of fossiliferous rocks that will be covered by the development and exposed during construction of the dam wall. A phase 1 PIA is therefore recommended during the initial phases of the construction.

Recommendations:

1. The EAP and ECO of the projects must be informed of the fact that significant fossils have been described from the Normandien Formation. The recording of fossils will contribute significantly to our understanding of the palaeoenvironments of this region.
2. A suitably qualified Palaeontologist must be appointed to record and collect fossils according to SAHRA and AMAFA specifications as part of a Phase 1 Palaeontological Impact Assessment during excavation of foundations for the dam wall.
3. 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.



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