PALAEONTOLOGICAL IMPACT ASSESSMENT (PHASE 1) FOR THE PROPOSED ESTABLISHMENT OF A 2.3 MILLION m³ DAM AND CULTIVATION OF 102 ha OF LAND LOCATED ON PORTION 1 OF MEERSIG No. 15550, PORTION 1, 3 & 4 AND REM OF SMALDEEL No. 1390, AND PORTION 2, 3 & 10 OF LINDEQUES LAAGER No. 1039, LUSH VALLEY FARM AND PRAIRIE FARM, WITHIN THE OKHAHLAMBA LOCAL AND uTHUKELA DISTICT MUNICIPALITY, WINTERTON, KWAZULU-NATAL

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Declaration of Consultants independence

I, Gary Trower, am an independent consultant and have no business, financial, personal or other interest in the proposed development project in respect of which I was appointed to do a palaeontological assessment other than fair remuneration for work performed. There are no circumstances whatsoever that compromise the objectivity of this specialist performing such work.

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Introduction

In terms of the National Environmental Management Act 107 of 1998 and Section 38 (8) of the National Heritage Resources Act 25 of 1999 (sections 34-36), all aspects of heritage are protected. Proposed developments that are likely to impact on heritage resources (i.e. historical, archaeological, palaeontological & cosmological) require a desktop and/or field assessment to gauge the importance of such resources in order to ensure that such sites are not damaged or destroyed by developments which could endanger them. Identified heritage resources should be recorded through detailed documentation, mitigation measures applied if resources are threatened, or collection and/or a rescue excavation carried out if necessary.

The Applicant, Sable Hill Dam Educational Fund NPC, proposes to a build a 2.3 million m^3 dam on Portion 1 of Meersig No. 15550; Portion 1 & 4 and Rem of Smaldeel No. 1390; and Portion 2, 3 and 10 of Lindeques Laager No. 1039. These subdivisions occur on Lush Valley Farm, located on the northern banks of the Lindequespruit River, and Prairie Farm, located on the southern banks of the same river in an area situated four kilometres west of Winterton, KwaZulu-Natal. The dam is aimed at improving the water supply on these properties by acting as a storage reservoir for supplementary irrigation purposes and for use during the dry months. The surface area of the dam will be approximately 50 ha, with a maximum depth of 16m and a dam wall length of 380m and a height of 16m. The proposed cultivated fields will be irrigated by water piped from the new dam and the Applicant is proposing to plant these fields for foliage and grazing, with pastures comprising kikuyu and grass mixtures. This increased grazing capacity of the cultivated land will allow for 500 extra head of cattle on the property.

As part of the overall EIA process, a ground survey was conducted for a Phase 1 Palaeontological Impact Assessment in order to gauge whether any geological outcrops and

associated biostratigraphic fossil occurrences were present in the immediate vicinity of the dam and within a buffer zone surrounding the site footprint. According to the SAHRIS palaeo-sensitivity map summarised in Figure 5 (www.sahra.org.za/sahris/map/palaeo), the Beaufort bedrock located on the property is given the highest ranking of red (highly palaeo-sensitive), making it very likely that fossil material will be present in the area. In addition, the Quaternary alluvium associated with the Lindequespruit is given a palaeo-sensitivity rating of green (moderately sensitive).

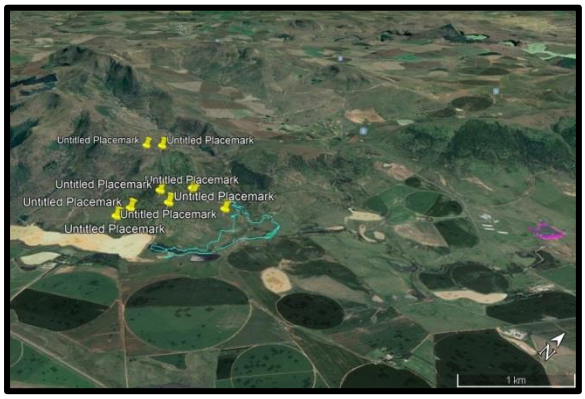
In terms of the National Environmental Management Act (NEMA, Act No. 107 of 1998) and the Environmental Impact Assessment Regulations of 2014 (amended 2017) published in Government Notices (GNR) 327 of 2017, the proposed project triggers the following Listed Activities which could have some relevance to heritage as such material is often preserved next to a water source:

1) GNR 327 (2014, amended 2017), Part 12 : *The development of – 1) dams or weirs, where the dam or weir, including infrastructure and water surface area, exceeds 100 square metres; or… where such development occurs - a) within a watercourse; ...c) if no development setback exists, within 32 metres of a watercourse, measured from the edge of the watercourse;…*
2) GNR 327 (2014, amended 2017), Part 19 : *The infilling or depositing of any material of more than 10 cubic metres into, or the dredging, excavation removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 10 cubic metres from a watercourse..*

In terms of Listed Water Use Activity, Section 21 of the National Water Act (Act No. 36 of 1998) the proposed project requires a Water Use License (WUL) from the Department of Water and Sanitation (DWS). Potential WUL activities which could have some relevance

heritage include Section 21 (i) - *Altering the bed, banks, course or characteristics of a watercourse.*

Figure 1: Satellite image showing the layout of the proposed project, with the blue outline showing the surface area of the dam and the five white circles showing the areas to be cultivated



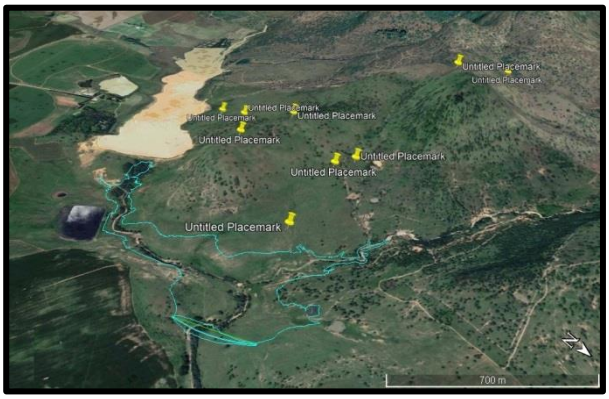


Figure 2 & 3: Satellite images showing the layout of the proposed project, as viewed from the south east (left) and from the north east (right). The yellow markers indicate the stone-walled features that occur within the area proposed for cultivation. The graves that were located occur close to the purple polygon (visible on the right hand side of Fig.2) but these were located several kilometres from the site footprint so are of no concern to this project.

Geology

Rocks of the Karoo Basin are rich repositories for palaeontological material, necessitating measures to minimize activities which may disturb or destroy fossils preserved in underlying beds. The geology in the area of the proposed development comprises of dolerite, Late Permian deposits of the Beaufort Group (more specifically the Adelaide Formation), and

lastly Quaternary alluvial deposits. The Adelaide Formation sedimentary package accumulated as channel and floodplain deposits within various drainage basins that flowed towards a giant inland sea and comprises of grey mudstone, dark grey shale which is carbonaceous in places, as well as siltsone and sandstone (Figure 4).

These sediments form an important component and subdivision of the stratigraphy of the Karoo Supergroup, an extensive inland basin that preserves a rich array of fossil plants, insects, fish, amphibians and terrestrial tetrapod fauna which existed through the Permian and Triassic of southern Gondwana (Rubidge 2005, Smith *et al*. 1993). The existence of several ecosystems in this palaeo-landscape means that an array of important fossil fauna which existed before the Permo-Triassic extinction event may be present within this geological unit, and this is also the reason why it has a palaeo-sensitivity rating of very high (red, Figure 5). The Quaternary deposits present within the study area comprise of fairly young alluvial sediments, which could contain archaeological material but the chances of palaeontological material being present are quite low.

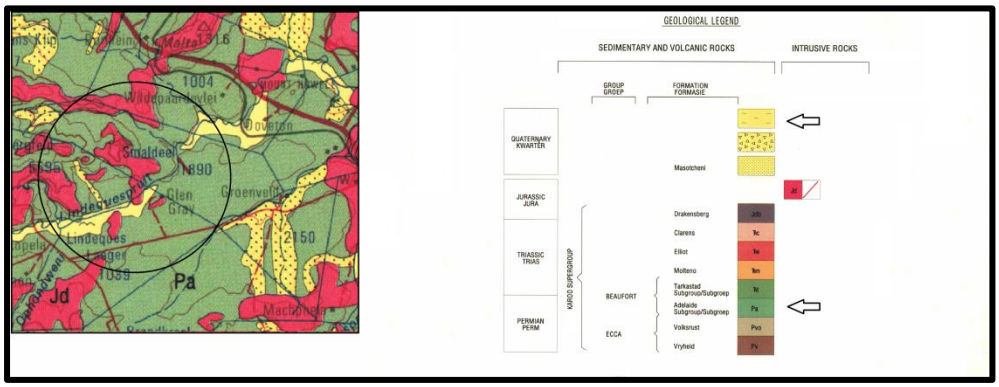


Figure 4: Map showing the geology of the region, with the site footprint located within the black circle and the black arrows in the legend indicating which geological units are relevant to this study. The site is located on Adelaide Formation bedrock of the Beaufort Group, a geological unit with a high palaeo-sensitivity. Other parts of the site footprint occur on Quaternary alluvial deposits which have a moderate palaeo-sensitivity. Modified from 2828 Harrismith, 1:250 000 Geological Series, Geological Survey, 1998

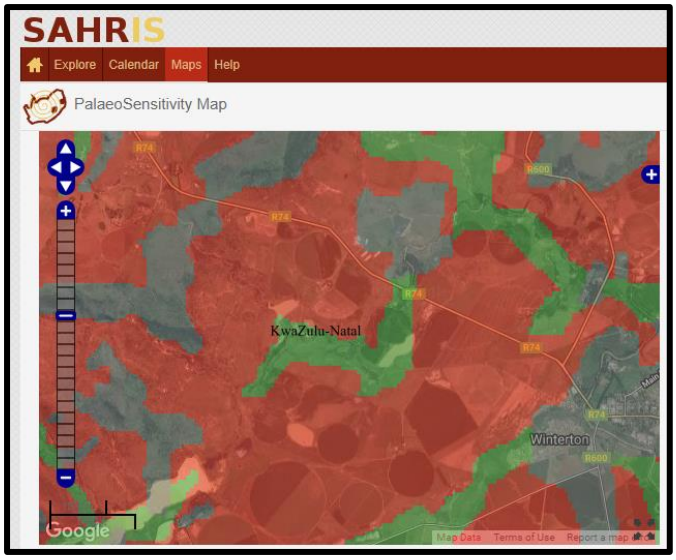


Figure 5: Map showing how the geology of the region translates into palaeo-sensitivity. The red represents the Adelaide Formation of the Beaufort Group, a rock type with a high sensitivity for possible fossil occurrences. The green represents Quaternary alluvium, a geological unit with a moderate palaeo-sensitivity rating. The grey areas represent dolerite outcrops which have a zero/insignificant palaeontology rating. Modified from the SAHRIS palaeo-sensitivity map, www.sahra.org.za/sahris/map/palaeo

Site observations

Before the ground survey commenced, an aerial survey of the study site was first carried out using Google Earth. The relevant geology map of the area (2828 Harrismith) and the SAHRIS palaeo-sensitivity map were both used in combination to gain an understanding of the underlying bedrock along the route, and how it is ranked in terms of possible fossil occurrences.

Only a few outcrops of rock were exposed at the surface at the proposed dam site, and within the buffer zone surrounding the dam site. Those that were visible looked promising (in terms of yielding fossiliferous material), but upon closer examination nothing palaeontological was observed (Figure 6). A low sandstone cliff was situated on the southern bank of the stream at the place where the proposed dam wall will be built and this outcrop of bedrock was surveyed but no visible fossils could be seen (Figure 7 & 9). As the rocks of this region are highly fossiliferous, it is probable that more fossil material is located within the broader landscape but was not observed due to its hidden or buried nature, or because they fell outside of the primary search area in the immediate vicinity of the dam.

Down by the stream the overbank deposits looked very young and were not stratified. The sediment appeared to be reworked material that had washed down fairly recently when the stream was in flood (Figure 10). It is therefore unlikely that the Quaternary alluvial deposits in the vicinity of the proposed dam will be fossil-bearing. Porcupines had several dens in the banks of the stream and the sediment that had been ejected during the digging of these holes was examined for archaeological or palaeontological material, but nothing was recorded and the soil appeared to be sterile. Some antelope teeth were observed outside one of these burrows but these were modern and showed no evidence of mineralization (Figure 11 & 12). Porcupines are known to collect bones and bring them back to their burrows, and a game camp was located adjacent to the site footprint so it is likely that these teeth were brought in from the neighbouring camp. Whilst walking around on the site footprint the occasional small fragment of petrified wood was observed, but these were out of context surface finds. In addition the odd piece of coloured glass and European ceramic were also observed, but their origin was unknown as there were no farmhouses anywhere in the near vicinity.

In the process of trying to reach the site some graves were located. They were semi-hidden amongst grass and were covered in rocks, and although located several kilometres from the site footprint they were documented and photographed to have on record (GPS coordinates 28 47 17.15 S 29 30 26.67 E, Figure 13 & 14). Whilst doing the initial satellite survey of the site footprint using Google Earth it was noted that some stone-walled features occur on a section of the land proposed for cultivation (Figure 18-23). Many of these features are overgrown with plants, making them difficult to see so their presence was revealed by sliding the time scale on Google Earth to previous years when the veld was drier and covered in less vegetation. They were predominantly circular in shape, although there were also linear features and some clustered features. Some of these were likely kraals whereas others likely represent the remnants of houses. These features are spread over quite a wide area and

probably represent a Late Iron Age settlement or historical Bantu village. Graves are likely to be present within these ruins so a thorough ground survey by a suitably qualified archaeologist will be necessary to assess the full extent of the occurrence if the plans to cultivate this area are to proceed.

Figure 6: Photograph showing some of the exposed mudstone located roughly 200m south west of the proposed dam wall. Although the rock type looked very promising for potential fossil occurrences, nothing could be seen within the small outcrops of exposed bedrock

Figure 7: At the location of the proposed dam wall, a low cliff formed the southern bank of the stream. This outcrop of rock was carefully surveyed but no palaeontological material could be located

Figure 8: Looking upstream from the position of the proposed dam wall reveals how the banks are covered in abundant riparian vegetation, of which more than 50ha will unfortunately be cleared and/or flooded

Figure 9: At the location of the proposed dam wall, a piece of red and white flagging tape had been stuck into an old termite mound just above the low cliff depicted in Fig.7 & 8

Figure 10: Upstream from the proposed dam wall, and within the area that will be submerged by the water, the overbank deposits did not look very old and appeared to be fairly young reworked deposits. No archaeological or fossil material was visible within this sediment. Several porcupine burrows were noted within the bank of the stream and the sand excavated from their burrowing activities was also examined for lithics and fossils but nothing was observed

Figure 11 & 12: Photographs showing the modern bovid tooth that was lying outside of the entrance to the porcupine burrow, possibly belonging to a wildebeest or hartebeest. The tooth was not mineralized and was either carried to the den by the porcupine from the neighbouring game camp (as porcupines are known bone collectors), or it was trapped within the overbank deposits and dug up as a result of the burrowing activities of the animal

Figure 13 & 14: In the process of trying to reach the proposed dam site, some graves were located. They were semi-hidden amongst the grass and were covered in rocks. However they were several kilometres from the proposed dam site and will not be affected by the project (GPS coordinates 28 47 17.15 S 29 30 26.67 E)

The two tables below summarize the palaeontological impact significance and the identified heritage resources at the site.

Assessing Impact Significance

Criteria	without mitigation	with mitigation
Extent/spatial scale of impact	local	local
Duration of impact	permanent	permanent
Intensity/severity of impact	low	low
Probability of impact	possible	possible
Consequence	low	low
Confidence	medium	medium
Significance	very low	very low
Reversibility	irreversible	
Loss of resource	low	
Mitigation potential	very low	

Identified heritage resources (NHRA status)

Formal protections	
National Heritage site (Section 27)	none
Provincial Heritage site (Section 27)	none
Provisional Protection (Section 29)	none
Place listed in heritage register (Section 30)	none
General protections	
Palaeontological site or material (Section 35)	none

Figure 15 & 16: Standing on the hill located to the south of the proposed site footprint, looking north (left) and north east (right). The area between the base of the hill and the patch of burnt veld in the distance will all be submerged

Figure 17: Standing on the hill located to the south of the site footprint, looking south west towards the area of the proposed cultivated fields where the stone-walled features were preserved

Figure 18 & 19: Satellite images showing some of the circular and linear stone-walled features situated very close to the location of the proposed cultivated fields. These features likely represent houses and kraals from a Late Iron Age or historical Bantu village (GPS coordinates 28º 49' 15.27" S 29º 27' 47.91" E, Fig.18 & 28º 49' 09" S 29º 27' 48.60" E, Fig.19)

Figure 20 & 21: Satellite images showing additional circular stone-walled features situated very close to the location of the proposed cultivated fields. On the left two circular structures are indicated with orange arrows and on the right a more complex layout is visible comprising of multiple units (GPS coordinates 28º 48' 29.34" S 29º 27' 01.16" E, Fig.20)

Figure 22 & 23: Satellite images showing more circular stone-walled features situated very close to the location of the proposed cultivated fields. There were several such occurrences, of which only a select few are depicted here (GPS coordinates 28º 48' 37.36" S 29º 28' 16.07" E, orange arrow in Fig.23)

Contingency plan for palaeontological discoveries: chance find protocol

Based on the work of Almond *et al*. (2009) and Groenewald *et al*. (2014) and summarised on the SAHRIS website (www.sahra.org.za/sahris/map/palaeo), if a development occurs within a red zone a desktop study is required, as well as a phase 1 Palaeontological Impact Assessment (PIA) comprising a field survey and recording of fossils. A phase 2 PIA is also required, which entails the rescue of fossil material during construction activities, as well as the compulsory application for a collection and destruction permit. If the development occurs in an orange zone, a desktop survey as well as a phase 1 PIA comprising of a field survey and collection of fossils is compulsory. A prior application for a collection permit is therefore recommended and a phase 2 PIA may be necessary during the construction phase of the project. If the development occurs in a green zone, a desktop survey as well as phase 1 PIA comprising a field survey is recommended. Lastly developments which occur in a blue or grey zone may require a desktop survey, based on the known heritage sites in the area as well as the nature of surrounding geological units.

The normal procedure for recovering palaeontological material would be to identify areas which show investigative potential through a concentration of fossils and whose recovery and preparation could address certain scientific questions. The process would then entail obtaining permission from the landowner/s and applying to SAHRA (South African Heritage Resources Agency) or another provincial heritage agency for a collection permit to excavate or remove blocks of bedrock for preparation in the lab. This is a slow and time-consuming process which requires the skills of a field archaeologist/palaeontologist to spot worthy material within geological/stratigraphic exposures, and skilled fossil excavators and/or preparators who can successfully recover fossils from sediment or slabs of bedrock.

But in the case of developments artefacts fossils may be exposed which were not being targeted as a part of a formal scientific investigation, which then requires intervention to ensure that such heritage resources are documented and evaluated, and possibly recovered. In this way, construction activities can provide an opportunity for scientists in that sediments or bedrock and other heritage related material will be exposed which otherwise would have gone unnoticed as it was hidden from view and would have been costly to excavate.

Heritage consultants such as palaeontologists are required to evaluate proposed development sites in the hope of recording and/or recovering important objects and artefacts before they are damaged or destroyed, but during the entire timeline of a project a PIA consultant is generally only on site for a few hours. Having a palaeontologist on site to examine every scoop of a back actor/JCB would be very costly and impractical, so additional site visits may be required for certain large-scale projects, or developments in highly sensitive areas. If fossils are unearthed during the rest of the project timeline when no palaeontologist is on site, they may be difficult for the on-site layman to identify as many geological formations superficially resemble palaeontological material. Pseudo-fossils and certain mineral deposits often form into a variety of shapes which may closely resemble plant and animal fossils, making it more difficult for laypersons to positively identify chance finds in the field.

It is not the responsibility of site workers to keep an eye out for heritage objects neither are they likely to have had the appropriate training on what to look for but they are on the ground witnessing and observing, which is a helpful tool when there is a flow of information from on-site staff to management and the protocol dictates that you convey when something unusual or out of the ordinary is observed during work operations. The probability of on-site foremen or construction workers operating heavy earth moving equipment and working to a strict time schedule spotting heritage objects amongst tons of bedrock or sediment is unlikely but nonetheless possible. In South Africa many important archaeological and

palaeontological discoveries have been made during construction projects, and companies can play their part by following the law and making the effort to report heritage resources which have been unearthed during digging operations. In so doing, developers can improve their public image and potentially contribute to a rare fossil or object reaching a museum or tertiary institution where it can studied and eventually displayed to the public as heritage belongs to the entire nation and should be preserved as best as possible.

If by chance fossils or any other heritage-related material were to be discovered which was not anticipated in this Phase 1 report, construction would need to cease immediately and a protocol should be followed whereby the relevant provincial or national heritage custodians in the relevant province would need to be informed. Developers would also need to acquire the services of a suitably qualified palaeontologist to rank the significance of the discoveries. If anything relevant is observed, mitigation measures may be necessary and an application for a collection permit may be required. A Phase 2 heritage study may be necessary so that scientists can be given the opportunity to record and/or recover fossil material if it is ranked as significant and likely to make a positive contribution to the field of science.

Assumptions and limitations

According to the amended 2017 EIA regulations, various assumptions and limitations need to be stated when reporting on proposed developments. The professional opinion given in this PIA report is based on the results of a field survey which was used to gauge the fossiliferous potential of the bedrock likely to be exposed during the proposed development. As a general rule, field observations are based on recording palaeontological material which is eroding out or visible on the surface. As many developments require a degree of digging down into the soil and/or underlying stratigraphy, fossils will only be exposed once they have been disturbed from their original positions. Therefore such objects would have been hidden from

the assessor during the fieldwork survey as they had not yet started eroding out from the stratigraphy they are preserved in.

In addition, the results reported herein are based upon a thorough field survey and careful scrutiny of the best available maps and data sets and all attempts were made to take a holistic, informed decision. Yet in spite of this, it is possible that fossils may be present somewhere along the route of the proposed development but are hidden from view due to their buried nature. Moreover, certain predictions about the likelihood of encountering fossils was based on all available evidence and may prove to be less or more likely than anticipated .

A key assumption for this report is that the kml/kmz file sent to the heritage specialist accurately conveys the layout and nature of the development, which is not always the case as plans are often revised or the site layout has not been accurately drawn in Google Earth. A further assumption is that the geological maps used in this assessment are accurate and up to date, which may not be the case as there is a continuous refinement and revision of the geological model through new scientific research, some which may still need to become incorporated into available maps. A further limitation with these large scale maps (1:250 000) is that smaller outcrops of fossiliferous bedrock may not be indicated within the represented geological model. In addition, several potentially fossiliferous outcrops may have been weathered and eroded over millennia, buried under younger deposits in the form of alluvial and colluvial sediments, or capped by topsoil. Palaeontologically-sensitive bedrock may have also been metamorphosed through its contact with intrusive lavas, damaging or destroying fossil specimens along the contact zone.

Lastly, it is assumed that the developers will respect the guidelines set out in the laws of South Africa with regards to good environmental management practices and policies, and will immediately halt all earth-moving equipment should any fossiliferous or heritage-related

material be discovered. It is also assumed that developers will practice integrity and embrace an unwavering mind-set with regards to respecting and protecting all aspects of heritage, including due consideration for the fact that such objects cannot simply be sacrificed to meet project deadlines.

Conclusion

If sandstone, mudstone or shale is locally quarried for use in the dam wall construction this material is very likely to contain fossil material, so it is suggested that the quarrying of fossiliferous bedrock be avoided. Dolerite occurs on the property and is non-fossiliferous (grey patches in Fig.5), so this rock type is recommended for quarrying if rock is required for dam wall construction. Alternatively, building rubble or soil is also suitable for this purpose, thereby avoiding the use of any potentially fossiliferous material.

During the ground survey of the property no fossil sites were recorded even though the area is highly palaeo-sensitive. As the rocks of this region are fossiliferous, it is probable that fossil material is located within the broader landscape but was not observed due to its hidden or buried nature, or because they fell outside of the primary search area in the immediate vicinity of the dam. In the area of the proposed cultivated fields, large portions of the site footprint occur on dolerite so this area is not a concern in terms of palaeontology. However whilst doing the initial site survey of this area using Google Earth, several stone-walled archaeological features were observed. Therefore a suitably qualified archaeologist would need to do a thorough site survey of this area and map out all stone-walled structures as graves are likely to be present in this area. Based on this survey the proposed cultivated area will likely need to be reduced in size so as to avoid this archaeological site. All graves will need to be located and mapped out as the area is overgrown with vegetation and even locating the large stone-walled features was a challenge as the site is so old.

In conclusion, the survey of the site footprint at the location of the proposed dam revealed no palaeontological material exposed at the surface but due to the fact that the foundation of the dam wall will be excavated to bedrock, a Phase 2 palaeontological impact assessment is recommended for the construction phase of the dam so that the site monitoring can evaluate any possible fossil material which may be unearthed. In preparation for embankment construction, loose rocks will be removed and the cleaning of the surfaces of the sound bedrock foundation with air and water jets which will provide a good opportunity to view any fossils which may be preserved within the rock. In addition, a ground survey will need to be conducted to assess the extent of the archaeological village observed in some portions of the proposed cultivation area.

If any palaeontological or any other heritage-related material were to be unearthed during current or planned future projects, land-owners and/or the developers they appoint are reminded that construction work should immediately cease. The chance-find protocol outlined above should be followed to ensure that developments comply with the law, and to ensure that accidentally unearthed rare objects stand a good chance of being recorded and/or relocated to a museum, university or other relevant tertiary institution.

References

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