PHASE 1 PALAEONTOLOGICAL IMPACT ASSESSMENT FOR THE PROPOSED UPGRADING OF THE NATIONAL ROUTE 1 (N1) SECTION 16 BETWEEN WINDBURG STATION AND VENTERSBURG, FREE STATE

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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.

Gary Trower

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 the processes that threaten them. Identified heritage resources should be recorded through detailed documentation, and mitigation measures applied if resources are threatened, or collection and/or a rescue excavation carried out if necessary.

SANRAL proposes to upgrade the National Route 1 (N1) Section 16 between Winburg Station (km 89.8) and Ventersburg (km 133.53) by constructing a new carriageway that will have an increased road reserve width, going from 32m to 80m (Figure 1-3). The new road will run parallel to the existing road and will be approximately 44 km in length. It also proposes to lengthen and improve certain structures, and to build new bridges over certain rivers. Sections of the road will cross through parts of the landscape where the underlying geology could contain palaeontological material. According to the SAHRIS map summarised in Figure 5 (www.sahra.org.za/sahris/map/palaeo), portions of the property are given the highest ranking of red (highly sensitive), whereas other patches are green (moderate sensitivity), with dolerite intrusions allocated a grey ranking (zero/insignificant). Quaternary deposits can also contain fossils and artefacts from the Early to Later Stone Age, and coupled with the high palaeo-sensitivity of the Beaufort bedrock, a ground survey was conducted as part of a Phase 1 palaeontological impact assessment to locate and record any fossil material within the boundaries of the proposed development, as well as within a buffer zone surrounding the site footprint.

Figure 1: Sign showing the on-ramp onto the N1from Ventersburg, heading south

Figure 2: Photograph taken behind **N1Bloemfontein** sign shown in Figure 1, showing the bridge crossing the N1 highway on the left of the image. As can be seen in the road cutting, fine-grained sandstone is exposed to the east and west of the highway

Figure 3: Looking south from Ventersburg, showing the on-ramp heading out of town joining up with the N1 highway

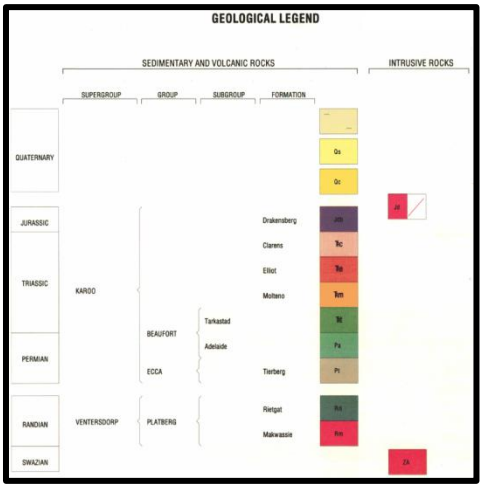
Geology

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, Quaternary deposits, and Late Permian deposits of the Beaufort Group, more specifically the Adelaide Formation. This latter sedimentary package accumulated as floodplain deposits within various drainage basins that flowed towards a giant inland sea and comprises of grey mudstone and dark grey shale, as well as siltsone and fine-grained sandstone (Figure 4). These deposits form an important component and subdivision of the stratigraphy of the Karoo Supergroup, an extensive inland basin which preserves a rich array of tetrapod fauna which

existed through the Permian and Triassic of southern Gondwana (Rubidge 2005, Smith *et al.* 1993). The existence of terrestrial, fresh water, brackish and marine 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). Known fossils in the area include *Zorillodontops* and a new Burnetiamorph near Verkeerdevlei (David Groenewald, pers. comm.)

Quaternary deposits are given a moderate palaeo-sensitivity rating as they can also contain fossils and artefacts from the Early to Later Stone Age, and alluvial deposits with an alkaline chemistry are the sediments most likely to yield fossil material.

Figure 4: Map showing the geology of the region, with the site footprint crossing over dolerite, 2 types of Quaternary deposits, and the Adelaide Formation of the Beaufort Group, a geological unit with high sensitivity. Modified from 2826 Winburg, 1:250 000 Geological Series, Geological Survey, 1981)



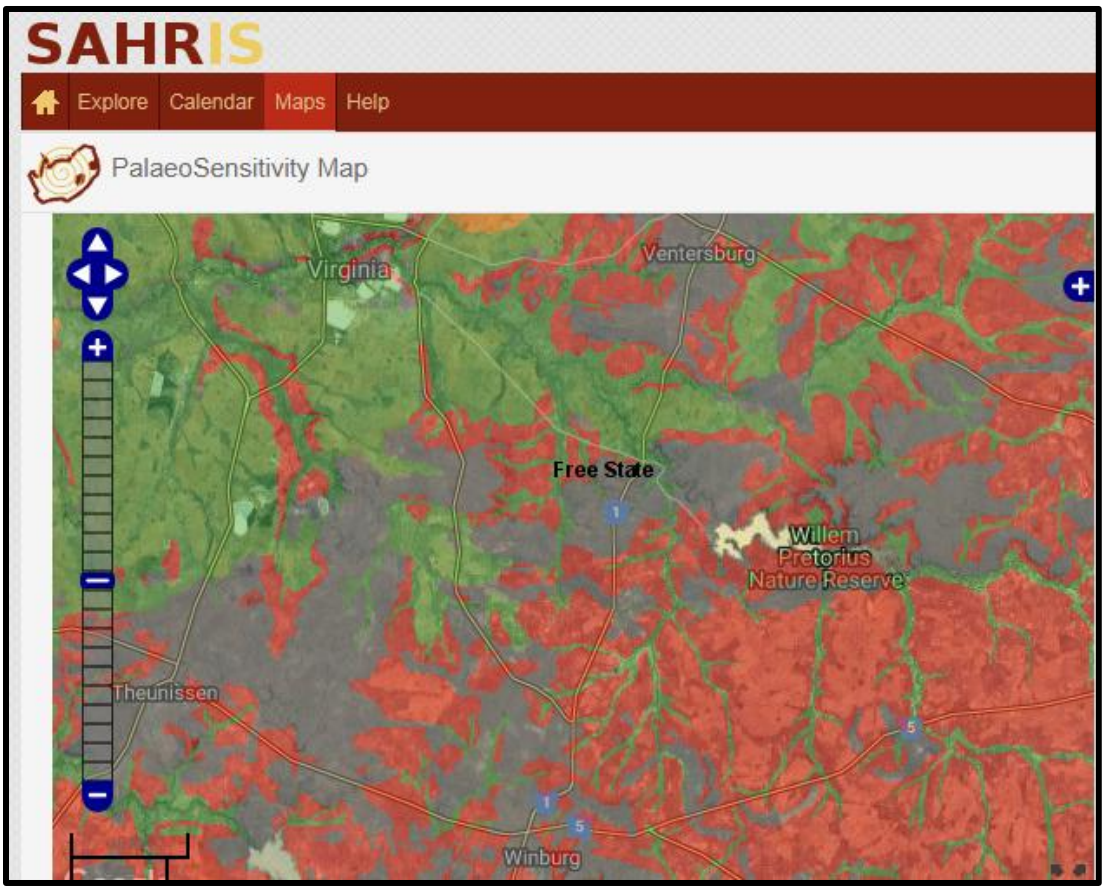


Figure 5: Map showing how the geology of the region translates into palaeo-sensitivity. The patches of red represent the Adelaide Formation of the Beaufort Group, a rock type with a high sensitivity for possible fossil occurrences. The green patches represent Quaternary deposits, whereas the grey areas represent dolerite outcrops which have a zero/insignificant palaeontology rating. Modified from the SAHRIS palaeosensitivity 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 and 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. The location of outcrops of Quaternary deposits along the route of the proposed upgrade, especially pockets of alluvium which could harbour archaeological and/or palaeontological material, were also noted so that those locations could receive more attention during the fieldwork survey.

The terrain along the site footprint has an aesthetic value including springs, streams, rocks and densely vegetated hills (Figure 6). Several stone-walled archaeological features occur on top of some of the hills in this area, and have been referred to as Goya sites (Figure 9-12). These are especially well-preserved in the hills of the nearby Willem Pretorius Game Reserve, but a huge settlement was also noted within the site footprint where the road cuts through one such occurrence at GPS coordinates 28° 15' 18.84" S 27° 04' 39.66" E, Figure 10. Grave sites were observed at two locations, with one site (GPS coordinates 28° 18' 20.65" S and 27° 03' 55.35" E) comprising of several heaps of rock in close proximity to each other but with no headstones, Figure 17-20. These features were located just a few hundred metres south of two rectangular bases made of stone slabs, which appeared to be the foundations of old houses or similar structures (GPS coordinates 28° 18' 03.06" S 27° 03' 53.14" E, Figure 13-16). The graves from the second site had headstones and were historical in age, and were located at the turn-off to Eittel, at road marker N1-16X, 103.2 (Figure 21-24). Both sets of graves are located less than 50m from the N1, and work activities are likely to come within metres of them, so extra caution will have to be exercised by site workers along these two sections of the road.

Where the road crosses palaeontologically sensitive areas, the terrain was surveyed on foot. In spite of examining several road cuttings (Figure 25-27) and patches of rock which were exposed at the surface (Figure 7-8), only one piece of petrified wood was recorded. This fossil fragment was out of context, found lying on the surface, and is of low significance as it has little information to offer scientists (GPS coordinates 28° 18' 09.73" S 27° 03' 53.64" E, Figure 28-29). Fossil wood of this kind is common and only helpful to palaeontologists when found *in situ*, where there is a good understanding of the age of the deposit it originated from, and when the specimen is more complete in nature. As the rocks of this region are highly

fossiliferous, it is probable that fossil material is located within the broader landscape but was not observed due to its hidden or buried nature.

Quaternary alluvial deposits were challenging to survey as they were almost entirely covered with well-established vegetation. It was therefore difficult to gauge the nature of these occurrences as there were no good exposures where it was possible to view what was present below the surface, therefore no fossil material could be seen at the points where the N1 crosses over the various drainage lines along the route.

Figure 6: The surrounding landscape has an aesthetic value, with streams and densely vegetated hills, so developers should make the effort to reduce scarring of the terrain by selecting appropriate well-hidden quarry sites, and to clean-up and rehabilitate stockpile and/or construction camps after completion of the project.

Figure 7: Outcrops of potentially fossiliferous bedrock exposed near the road and likely to be impacted by its upgrade were examined for any indication of palaeontological material but none was found

Figure 8: The bedrock depicted in Fig.7 looked very promising from a distance, but when examined close-up showed no signs of fossils in the exposed sandstone

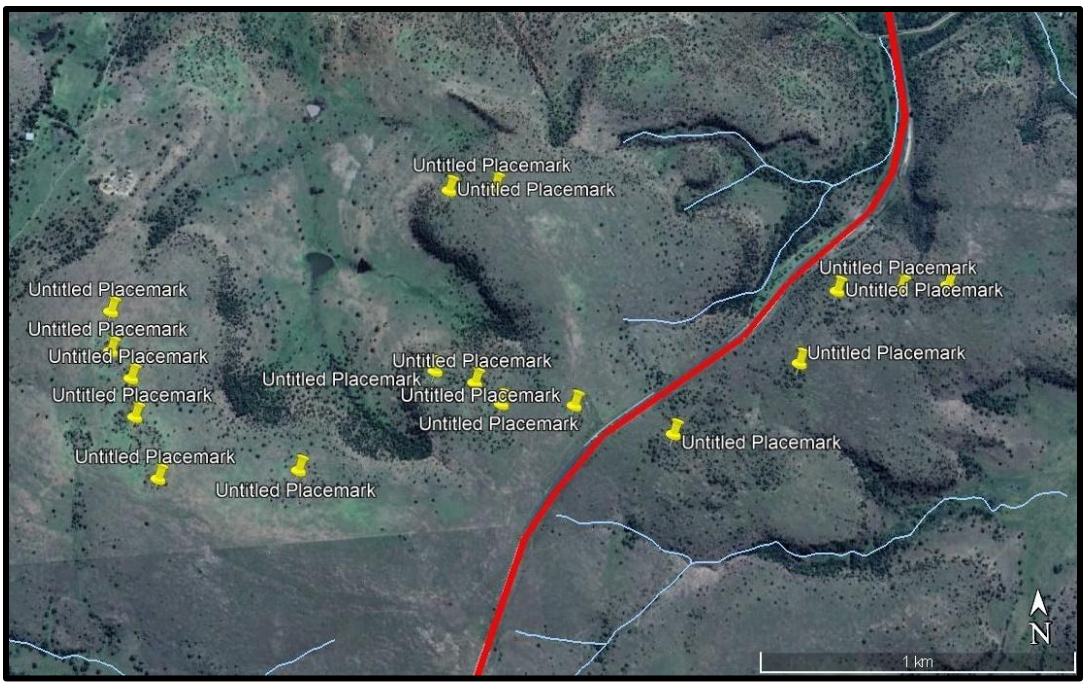
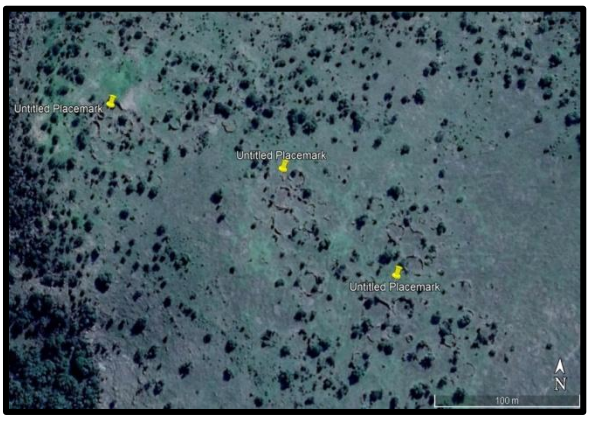


Figure 9: The yellow markers indicate all of the stone-walled features that occur in the hills adjacent to the road at GPS coordinates 28° 15' 18.84" S 27° 04' 39.66" E



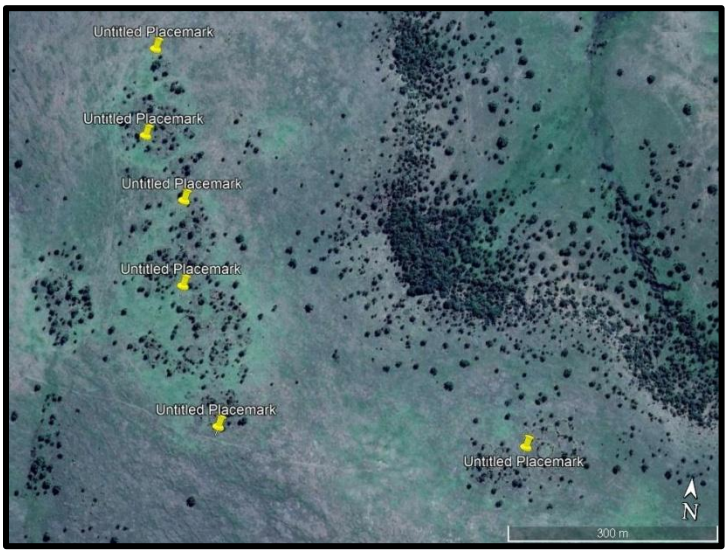


Figure 10-12: The circular stone-walled features represent an archaeological village comprising of houses with courtyards and probably livestock pens. The stone-walling occurs on tops of hills in the region and stretches over several kilometres

Figure 13-16: During the PIA survey two historical stone structures were observed on the western side of the highway, less than 50 m from the N1. They appeared to be foundations of some sort, although no walls were present so it difficult to determine their approximate age and what purpose they served. These structures were just a few hundred metres away from the possible graves in Fig.17-20

Figure 17-20: During the PIA survey possible graves were observed just a few hundred metres south of the stone foundations in Fig.13-16 on the western side of the highway. These graves do not have headstones but the shape of the stone piles suggests human burials. Furthermore, they resemble graves observed on previous surveys as this is a common form of burial in rural areas. The graves are less than 50 m from the N1, with some being only metres from the roadside

Figure 21-24: During the PIA survey graves were observed at the Eittel turn off, at road marker N1-16X, 103.2. When parked where the car is standing, the graves are on the left, on the eastern side of the highway. These graves are less than 50 m from the N1

Figure 25-27: During the survey several road cuttings were surveyed on the sides of the highway, but most of these comprised of dolerite. Depicted above is one such cutting, at road marker N1-16X, 109.6

Figure 28 & 29: Piece of petrified wood that was observed on the surface during the ground survey. The fossil was out of context and of little value to palaeontologists

Contingency plan for possible 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.

Furthermore, 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 cease all construction if any fossiliferous material is 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

During the ground survey only one fossil was located, which was out of context and of low significance and this undated fragmentary fossil therefore has little information to offer scientists. Other heritage-related resources were recorded within the site footprint, and planners will need to be cautious and sensitive to these occurrences, especially where the road gets to within 45 metres of a stone-walled archaeological feature at GPS coordinates 28° 15' 18.84" S 27° 04' 39.66" E, and where the road comes to within 50 metres of graves at the Eittel turn-off at road marker N1-16X, 103.2, and to within less than 50 metres of possible graves at GPS coordinates 28° 18' 20.65" S 27° 03' 55.35" E.

During the laying of the building foundations for the proposed project it is recommended that non-fossiliferous rocks are used (e.g. dolerite / berg-gruis etc.) as a foundation fill or

tar/concrete mix, and that if local rocks are being sourced for this purpose then it is suggested that the quarrying of fossiliferous bedrock be avoided if possible. If sandstone, mudstone or shale is locally quarried for use in the new development, it is very likely to contain fossil material. Developers should make the effort to take a greener, more holistic approach to building by considering what visual impact quarrying is having on the aesthetic value of the surrounding landscape by ensuring that quarried raw materials are (as far as possible) non-fossiliferous and are being harvested in a manner that reduces the scarring on the landscape. As the aesthetic beauty of the natural landscape also falls under heritage, developers should carefully plan the layout of new quarry sites in order to reduce their visibility, and where possible to select existing quarry sites. They should also ensure that quarrying activities do not interfere with the flow of water at spring eyes as dolerite is the suggested raw material for quarrying, but some dolerite dykes have springs associated with them. Springs are also very often sacred sites or places of significance in local lore and a source of water for birds and wildlife, and should be protected as best as possible.

In conclusion, during the site survey several heritage-related occurrences were recorded, including petrified wood, graves, stone-walled historical buildings and stone-walled archaeological settlements. As the road reserve width will be increased from 32 m to 80 m, engineers may need to make small adjustments to the proposed layout of the route in order to avoid some of these features, more especially the graves and stone-walled archaeological site. The fact that very little fossil material was found during the survey, as well as the fact that very little Adelaide Subgroup rock is exposed at the surface immediately adjacent to the road, and the fact that most of the road cuttings are into dolerite no further palaeontological assessment is required. If any palaeontological material were to be unearthed, developers are reminded that work should immediately cease and the chance find protocol outlined above should be followed to ensure that developments comply with the law, and to ensure that a

rare object stands a good chance of being recorded and/or relocated before destruction. The surrounding landscape also has heritage value, with springs, streams and densely vegetated hills, and several game reserves in the area, so developers should make the effort to reduce scarring of the terrain by selecting appropriate, well-hidden quarry sites, and to clean-up and rehabilitate stockpile and/or construction camps after completion of the project.

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